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Weed Control Guide for Ohio and Indiana

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Weed Control Principles

Importance of Weed Control

Weed control is an essential part of all crop production systems. Weeds reduce yields by competing with crops for water, nutrients, and sunlight, and may directly reduce profits by hindering harvest operations, lowering crop quality, and producing chemicals which are harmful to crop plants (allelopathy). Left uncontrolled, weeds may harbor insects and diseases and produce seed or rootstocks which infest the field and affect future crops. Despite large expenditures for weed control, it is estimated that losses in U.S. crops due to weeds left uncontrolled exceed $8 billion annually.

Years of research have shown that good weed control within the first 4 to 6 weeks after crops are planted is critical in order to avoid a yield reduction from weeds. The effectiveness of any weed control program depends largely upon one factor - timeliness**.** There are many cultural, mechanical, and chemical methods of weed control that are effective if applied at the correct time. Fields that are kept free of weeds for the first four to six weeks after planting give the crop a "head start" which enables it to shade out or otherwise out compete weeds that emerge later in the season.

Identify specific weed problems. Weed species vary greatly in their ability to compete with crops and reduce yields. Is 100% control of all weeds necessary? Perhaps this can be answered by stating that most successful producers design control programs to maximize profit, not just to control weeds. While it is true that crops are able to tolerate a certain threshold number of weeds without suffering a yield reduction, there are some weeds for which 100% control may be desirable because they are particularly competitive, persistent, or difficult to control.

Cultural And Mechanical (Nonchemical) Weed Control

Herbicide performance is strongly related to environmental conditions, so not even the best herbicides are equally effective from year to year. The most desirable weed control program is one that will economically control existing weeds and prevent a buildup of weed seed or tubers, rhizomes, etc. in the soil. Such a weed control program includes integrating several crop management practices in addition to use of herbicides.

Crop rotation is one of the most effective cultural practices for improving long-term weed control. Crop rotation aids in controlling weeds by: 1) allowing rotation of herbicides as well as crops, and 2) providing the opportunity to plant highly competitive crops that prevent weed establishment. Many herbicides available for use in corn are extremely effective at controlling weeds for which there are no adequate controls in soybeans or other crops. Rotation to a densely planted crop such as alfalfa or small grains helps control annual weeds with little, if any, chemical input. Rotating to small seeded legumes (e.g. alfalfa) or other densely grown perennial grass-legume forage mixtures is effective at reducing populations of some perennial weeds.

Any practice that promotes optimum early and vigorous crop growth helps give crops a competitive edge over weeds. The following are some of these practices:

- Narrow row spacings (15 inches or less) for soybeans
- Proper planting date and seeding rate
- Use of insect-,disease-, and nematode-resistant varieties
- Insect and disease control
- Adequate soil fertility
- Adequate drainage

The following are several other preventative cultural practices that help prevent weeds from becoming established and spreading:

- Control weeds in noncropland areas, including fencerows, drainage ditch banks, and rights-of-way
- Plant only high quality weed-free crop seed
- Do not spread manure, hay, or crop residues contaminated with weed seed on cropland
- Clean farm machinery between fields to avoid transport of weed seed, rhizomes, tubers, and rootstocks
- If "new" or unfamiliar weeds appear, have them identified quickly and take appropriate control measures

Mechanical weed control is still an important component of many weed control programs. Primary tillage involves moldboard plowing or some type of reduced tillage that destroys existing vegetation and allows adequate seedbed preparations. Secondary tillage is performed with a tandem disk, field cultivator, or similar implement for final seedbed preparation. Selective cultivation is performed with a rotary hoe, rolling cultivator, shovel (sweep) cultivator, or similar implement to control weeds after the crop has emerged from the soil.

If selective cultivation is used, it should be done early. Rotary hoes operated at a relatively high speed (7 to 10 mph) on fairly dry soil are effective for controlling small weeds (less than 1 inch tall). For maximum effectiveness, a rotary hoe should be used when weeds are in the "white stage", or just emerging from the soil. Cultivation with a shovel, sweep, or rolling cultivator is more effective than a rotary hoe on larger weeds, but should still be operated when weeds are very small. Cultivations should be shallow (1 to 2 inches deep) to prevent excessive root damage to the crop, depletion of soil moisture, or excessive ridging, which creates problems at harvest for some crops.

Conventional tillage systems involve primary and secondary tillage. These operations may be followed by selective cultivation, depending on the crop and its row spacing. Conventional tillage is effective for reducing populations of many biennial and perennial weeds that may may arise from rhizomes or rootstocks. Annual weeds that reproduce only from seed will most likely still be a problem and require additional controls.

Conservation or reduced tillage systems do not involve moldboard plowing, and maintain some previous crop residue on the soil surface. Tillage in a reduced tillage system consists of using a disk, field cultivator, or chisel plow and may be the last operation before planting. **No-till crop production** involves no primary or secondary tillage. The crop is planted directly into a sod or the previous year's crop residue. Conservation tillage systems generally rely more heavily on chemical weed control than conventional tillage systems. For additional details on reduced tillage systems, refer to other sections of this chapter.

Chemical Control of Weeds

When designing a weed control program based on herbicide use, consider soil type, tillage practices, crops (current and following), weed problems, and overall farming operations. It is important to select herbicides based on the weeds known to be present in a field. Herbicides are often combined to control a broader spectrum of weed species, reduce carryover, or reduce crop injury. Herbicide activity is affected by the weather, soil conditions, weed size, accuracy of application, and other factors.

While research has shown that weeds will not reduce crop yields if controlled within 4 to 6 weeks after emergence, preplant and preemergence herbicides have the advantage of eliminating weeds before they reach this threshold. Postemergence herbicides are comparable to soil-applied herbicides in effectiveness and economics if applied within the same threshold period. Some weeds are better controlled by soil-applied herbicides, while others are more susceptible to postemergence herbicides. Consider using a program consisting of preemergence and postemergence herbicides for maximum weed control and protection of crop yield.

Herbicide Nomenclature and Formulations

There is often more than one formulation of a particular herbicide. This can make selection and application of various products somewhat confusing. Each herbicide has at least one trade name, a common name, and a chemical name. For example, Lasso and Intrro are registered trade names, alachlor is the common name, and 2-chloro-N-(2,6-diethylphenyl)-N-(methoxymethyl)acetamide is the chemical name for a herbicide used in corn and soybeans.

Prepackaged mixtures contain two or more different herbicides. For example, Bicep II Magum/Cinch ATZ (trade names for the same product) is actually a mixture of s-metolachlor and atrazine. For this reason it is important to know common names of herbicides so that one knows exactly what a product contains.

Herbicides are sold in various liquid or solid formulations, depending upon (1) the solubility of the active ingredient in water, and (2) the manner in which the product is applied (i.e. dispersed in water or applied in the dry form). The formulation type is listed on the herbicide label and may be designated by a letter or letters following the trade name. A herbicide label must also give a list of all herbicideally active ingredients and the amount of active ingredient contained in the product. For liquid formulations, the amount of active ingredient is expressed both as a percentage of the total ingredients and as the amount of active ingredients ins in a gallon of product. Active ingredients contained in dry formulations are expressed only as a percentage by weight. Several formulations and abbreviations are listed below.

Emulsifiable concentrate (E or EC) - a liquid formulation containing various emulsifiers that aid in dispersing the active ingredient in water.

Water Soluble (S, AS, or WS) - usually a liquid formulation containing the active ingredient, water, and sometimes a surfactant and an antifreeze agent.

Oil Soluble (OS) - a liquid formulation containing the active ingredient dissolved in oil or some other organic solvent. These herbicides must be applied in an oil-based carrier such as diesel fuel or kerosene.

Liquid Flowable (F or LF) - a thick liquid with a slurry-like consistency containing the active ingredient, water, and stabilizers to help the active ingredient stay in suspension. Spray tank agitation is necessary to keep the product from settling out of the spray solution.

Suspension Concentrate (SC) - similar to Liquid Flowable.

Wettable Powder (W or WP) - a dry powder containing the active ingredient, a diluent or carrier (usually bentonite or attapulgite clay), and surfactants. Spray tank agitation is necessary to keep the product from settling out of the spray solution.

Dry Flowable (DF) - a dry herbicide-impregnated granules that easily disperses in water. Dry flowables are easier to handle and measure than wettable powders. Spray tank agitation is necessary to avoid settling.

Dispersible Granules (DG) or Water-Dispersible Granules (WDG) - a dry formulation similar to dry flowable formulations. The ingredients are in granules that easily disperse in water. Spray tank agitation is necessary to avoid settling.

Granules (G) - a dry formulation consisting of the active ingredient coating or adhered to some type of inert granule such as clay, vermiculite, or sand. These formulations are applied as a ready-to-use product. Granular application equipment is required.

Pellets (P) - a dry formulation of active ingredient coating or adhered to some type of inert pelleted material - similar to granules only much larger. Pellets are applied directly to the target area by hand or with spreaders.

Herbicide rates are sometimes expressed on an active ingredient basis in technical publications. To convert pounds of active material to pounds of a commercial dry formulation use:

$$\text{Pounds of commercial product/A} = \frac{\text{Pounds of active ingredient/A}}{\text{Percent Active Ingredient in Product}}$$

To convert pounds of active material to gallons of a commercial liquid formulation use:

$$\text{Gallons of commercial product/A} = \frac{\text{Pounds of Active Ingredient/A}}{\text{Pounds of Active Ingredient in Gallon}}$$

Soil-Applied Herbicides

Soil-applied herbicides can be applied preplant (or early preplant), preplant incorporated, or preemergence to the crop. The

activity of these herbicides is affected by soil texture, organic matter content, pH, moisture, and tillage. Soil-applied herbicides are more readily available for plant uptake in coarse-textured, low organic matter soils than in fine-textured, high organic matter soils. Selection of the appropriate herbicide rate is often important to avoid injury. Many herbicide labels specify application rates based on soil texture and organic matter content. Some herbicides are not labeled for use in sandy soils low in organic matter.

Soil pH can influence the activity of herbicides. Triazine herbicides are more available for plant uptake in soils with high pH, resulting in better weed control but increased risk of crop injury. The low pH resulting from continuous no-tillage or lack of lime application may reduce the availability of some herbicides, causing less effective weed control. In general, herbicides are most effective when soil pH is in the range recommended for optimum crop growth.

Soil-applied herbicides require adequate soil moisture for activity since uptake into germinating weeds occurs from the soil solution only. In the presence of adequate soil moisture, less herbicide is adsorbed onto the soil and more is available in the soil solution for weed control. Under dry conditions, herbicide is tightly adsorbed by soil colloids, and insufficient amounts may be available to provide acceptable weed control. Soil-applied herbicides require rainfall (usually 1/2 inch or more) to move them from the soil surface into the zone where weed seed germinate and emerge.

Early preplant herbicides are applied to the soil surface from a few weeks to more than a month prior to planting. Herbicides with a long residual soil activity can be applied early preplant. Herbicides with a shorter soil residual activity may not provide late season control when applied early. Early preplant herbicide programs frequently do not provide adequate season-long annual grass control in fields with moderate to high grass populations.

Advantages

- Allows more time for rainfall to move herbicides from the soil surface into the zone where weed seeds germinate.
- Herbicides can be applied with fertilizer, eliminating field trips.
- Reduces workload at planting time.
- Prevents the emergence of annual weeds and eliminates the need for a burndown herbicide application at the time of planting.
- Allows more time for herbicide degradation in the soil, reducing the risk of herbicide carryover problems.

Disadvantages

- Limits herbicide options since not all herbicides have sufficient soil residual for early application.
- May require higher rates, split applications, or subsequent postemergence applications for later season control.
- May cause soil compaction from operating application equipment when soils are wet.

Preplant incorporated herbicides are mixed into the soil prior to planting. Incorporation of some herbicides is necessary to prevent surface-loss from volatility or photodecomposition. Other herbicides are incorporated to reduce the dependence upon rainfall to move herbicide into the weed seed germination zone.

Advantages:

- Reduced dependence upon rainfall to position herbicides in the soil, providing more reliable weed control than pre-emergence applications.
- More effective control of yellow nutsedge than with pre-emergence applications.
- Herbicide may be applied with fertilizer.

Disadvantages

- Incorporation may result in added tillage and fuel costs.
- Incorporation can result in soil compaction and crusting.
- Weed control can be reduced if the herbicide is diluted by incorporation that is too deep.
- Streaking of herbicides due to improper incorporation can result in erratic weed control.
- Planting operations can be slowed due to the time required for herbicide application and incorporation.

The depth and thoroughness of incorporation depend upon the type of equipment used, the depth and speed of operation, soil texture, and the amount of soil moisture. Incorporation should place the herbicide uniformly throughout the upper 1 to 2 inches of soil for best control of small-seeded annual weeds. Slightly deeper placement may improve control of certain weeds from deep-germinating seeds, especially under dry conditions. The field cultivator and tandem disk place most of the herbicide at about one-half the depth of operation, so the suggested depth of operation for these implements is 3 to 4 inches.

Thorough and uniform incorporation, especially with a tandem disk or field cultivator, requires two passes at an angle to each other. However, some of the newer combination tools can provide uniform single-pass incorporation. The effectiveness of single-pass incorporation depends upon soil condition as much as the implement. One-pass incorporation is not a good approach with less than optimum soil tilth. Incorporation into soils that are too wet can result in streaked weed control; this may be increased with one-pass as compared to two pass incorporation. High crop residue levels make one-pass incorporation difficult to achieve.

Field cultivators are frequently used for herbicide incorporation. Two passes are recommended for uniform weed control, but field cultivators can give acceptable one-pass incorporation with proper set-up and operation. They should have 3 or more rows of shanks with an effective shank spacing of no more than 8 to 9 inches. Shanks can be equipped with points or sweeps. Sweeps usually provide better incorporation, especially when soil conditions are too wet or dry for optimum soil flow and mixing. Sweeps for "C" shank cultivators should be at least as wide as the effective shank spacing. For one-pass incorporation, wider sweeps or narrower spacing with a 3- to 5- bar harrow or rolling baskets will improve uniformity of incorporation and weed control.

The recommended operating depth for the field cultivator is 3 to 4 inches with a ground speed of at least 6 miles per hour. The

field cultivator must be operated in a level position. If the back shanks are lower than the front, untreated soil will be brought to the surface resulting in streaked weed control.

Tandem disk harrows invert the soil and usually place the herbicide deeper in the soil than most other incorporation tools. Tandem disks used for herbicide incorporation should have disk blade diameters of 20 inches or less and a blade spacing of 7 to 9 inches. Spherical disk blades provide better herbicide mixing than conical disk blades. The tandem disk should be operated at a depth of 3 to 4 inches with a ground speed between 4 and 6 miles per hour. The speed should be sufficient to move the soil the full width of the blade spacing. Two passes are recommended to obtain uniform incorporation with a tandem disk. A leveling device (harrow or rolling baskets) should be used behind the disk to obtain proper mixing.

Combination tools are tillage and incorporation tools that combine disk gangs, field cultivator shanks, and leveling devices. Many of these tools can handle large amounts of surface residue without clogging while still leaving considerable residue on the surface for erosion control. Combination tools may provide more uniform one-pass incorporation than a disk or field cultivator. Good soil tilth is still a prerequisite for effective one-pass incorporation. One-pass incorporation with these tools is generally no better than two passes with a disk or field cultivator.

Preemergence herbicides are applied to the soil surface after the crop is planted but before crop seedlings and weeds appear above the ground. For maximum preemergence activity, 1/2 to 1 inch of rainfall should occur within one week following application. Where this rain does not occur, a rotary hoe is recommended for control of weeds as they are emerging.

Advantages

- Planting and herbicide application may be done in one operation.
- When rainfall is adequate to move herbicide into the soil, preemergence applications can provide better weed control than preplant incorporated applications.
- Preemergence herbicides can be used in all tillage systems.
- Preemergence herbicides can be applied in liquid fertilizers.

Disadvantages

- Rainfall is required for herbicide activity
- On sandy soil, heavy rains may leach the herbicide down to the germinating crop seed and cause injury.
- Perennial and deep-germinating weeds are not as well-controlled compared to preplant incorporated applications.

Postemergence Herbicides

Postemergence herbicides are applied after the crop and weeds have emerged. Most postemergence herbicides have foliar activity only, while a few do provide foliar and soil activity.

Advantages

- Soil type does not affect herbicide activity.
- Herbicide decisions are based on a known weed species present at the time of application.
- Postemergence herbicides can be used in any tillage system.

Disadvantages

- Application timing is critical for good weed control and to avoid crop injury.
- Weed control can be reduced if environmental conditions cause weeds to be stressed at the time of application.
- Rain may prevent herbicide application at the proper crop or weed growth stage.

In order to achieve effective postemergence control, it is critical to follow label recommendations on rate and timing of applications, weed species controlled, and the use of spray additives. The rate and timing of application are based on weed size and climatic conditions. Weeds can usually be controlled with a lower application rate when they are small and tender. Larger weeds often require a higher rate or an additional herbicide or spray additive, especially if the weeds have developed under droughty conditions. Avoid applying postemergence herbicides during abnormally cool or dry weather, since weeds may not be actively growing under these conditions. Delaying application until weeds resume active growth will ensure better control. Herbicide penetration and activity are usually greater when the temperature and relative humidity are high, resulting in better weed control but possibly greater crop injury.

Many postemergence herbicides can cause crop injury. Crop size limitations are listed on product labels. Weed control can be reduced if rainfall occurs too soon after application. Postemergence herbicides labels specify an interval of anywhere between 1/2 and 8 hours between application and rainfall, depending upon the herbicide.

The use of an adjuvant such as surfactant, crop-oil concentrate, MSO, or fertilizer solution is often recommended to improve spray coverage and herbicide uptake. Weed control may be increased with the use of additives, but crop injury may be also increase. For this reason, follow label directions regarding the use of additives.

Other considerations for postemergence applications are spray volume, pressure, and nozzle selection. Translocated herbicides (those that move throughout plant) can be effective with partial foliar coverage, while contact herbicides (active only where they contact the plant) require more complete spray coverage. Foliar coverage increases as spray volume and pressure increase. For contact herbicides, 15 to 40 gallons per acre are often recommended for ground application. Translocated herbicides can often be applied in a minimum volume of 5 to 10 gallons per acre. Minimum spray pressures of 30 to 40 psi are recommended; this pressure range produces smaller droplets and improves penetration of dense canopies. Flat-fan nozzles are generally preferred for postemergence applications. Most labels do not recommend the use of low-pressure flooding nozzles for postemergence application.

Directed Postemergence Herbicides

Directed postemergence applications minimize crop injury because the herbicide is placed on the weeds rather than on the crop. Precise application and a height differential between the crop and the weeds are required for directed applications. If the weeds are smaller than the crop, the spray can be directed at the base of the crop so that little herbicide reaches the upper parts of the crop plant. Spray pressure should be set fairly low for this type of application to prevent fine spray particles or mist. Shielded nozzles can increase the safety of applications directed at the base of the crop plants.

"Wipers" (sponge or rope wick applicators) operate above the crop canopy to control weeds growing taller than the crop. This type of application works well for soybeans, since weeds must generally be at least a foot taller than the crop. Control of johnsongrass, hemp dogbane, and volunteer corn is often achieved using concentrated solutions of glyphosate or postemergence grass herbicides applied in this manner.

No-Tillage Weed Control

No-till production systems are more dependent upon herbicides for weed control than conventional or reduced-tillage systems. In no-till, those weeds that emerge from the previous fall through spring must be controlled with fall-applied residual herbicides, or with foliar-applied (e.g. glyphosate, Gramoxone, 2,4-D) and/or residual herbicides applied in the spring. Spring weed populations can consist of perennials (e.g. Canada thistle, dandelion), winter annuals (e.g. mustards, pennycress, chickweed), and early-emerging summer annuals (e.g. common lambsquarters, giant ragweed, Pennsylvania smartweed). If not killed at the time of planting, these weeds often become too large to be controlled by postemergence herbicides applied about three weeks after planting, and may reduce crop yield.

Broadleaf weeds emerge earlier in the spring than grasses, and application of 2,4-D with a preplant herbicide program may provide adequate burndown where grasses are not present. Several preplant herbicides have foliar activity in addition to soil activity, which can control or help control small broadleaf weeds. These herbicides include atrazine, mesotrione (Lumax, Lexar), chlorimuron (Canopy, Valor XLT, Envive), Hornet, Balance, cloransulam (FirstRate, Gangster, Sonic, Authority First), Python, and metribuzin. Where weeds are more than few inches tall, or annual grasses are present, a burndown herbicide program using paraquat or glyphosate should be considered. Glyphosate should be applied in the spring if perennial weed such as quackgrass are present. Combinations of glyphosate or paraquat plus 2,4-D will provide more complete control of a mixed population of weeds than either herbicide alone.

Applying preplant herbicides earlier in the spring when weeds have not emerged or are very small will minimize the need for glyphosate or paraquat. Early applications, compared to application at the time of planting, allow more opportunity for herbicides to receive adequate rain and move into the upper few inches of soil, However, early applications can result in poor late-season control of some weeds, especially giant foxtail, fall panicum, and waterhemp, especially when crop growth is slow and rain is abundant in the early part of the growing season. Moving herbicide application closer to the time of planting can prevent this problem to some extent. Preemergence herbicides applied at or after planting can provide acceptable control in no-till, but more rainfall will be needed for activity compred to a conventional tillage seedbed, since herbicide must move through crop residue to reach the soil surface.

Postemergence herbicide programs fit well into no-till production systems. There can be a reduction over time in the population of large-seeded annual broadleaf weeds in no-till, possibly reducing the need for a broad-spectrum preplant herbicide program. The application of postemergence herbicides on an as-needed basis may ultimately result in a reduction in herbicide inputs and costs in no-till. Giant foxtail and waterhemp populations often increase in no-till during the first several years, but effective control will eventually reduce the foxtail population, due to a lack of seed return to the soil surface. When planning a successful postemergence herbicide program for no-till, it is essential that the field is free of weeds at planting. Do not rely on postemergence herbicides to control weeds that have already emerged at planting.

A major challenge for weed management programs in no-till is increased populations of perennial weeds, which become more prevalent and difficult to control as tillage is reduced. These can include hemp dogbane, bindweeds, milkweeds, dandelion, and tree seedlings, to name a few. Most of these emerge fairly late in the season and cannot be killed by a glyphosate application at planting. Likewise, most postemergence herbicides only suppress perennials, which are more easily controlled in corn than in soybeans. The key to controlling perennial weeds is an application of glyphosate, dicamba, and/or 2,4-D when they are in the bud to bloom stage, or as late in the fall as possible before the weeds senesce or growth ceases due to frost or freeze. At this growth stage, the weeds will move herbicide throughout the plant and into the roots, resulting in maximum kill of the entire plant. The best opportunity for making this type of application is during the late-summer through fall after wheat harvest when plants have grown undisturbed for several months. Including wheat in a rotation to allow fall herbicide applications will aid greatly in the management of perennial weeds. Throughout the rest of the rotation, apply burndown or postemergence herbicides as necessary to at least suppress perennials, since this can keep infestations in check until a fall application can be made.

Pesticide Interactions in Crops and Weeds

When crop plants and weeds are exposed to more than one pesticide, the effects may be described as: a) additive - when no interaction occurs and effects on plants are independent and predictable, b) synergistic - when the biological activity of the pesticide mixture is greater than the sum activity of its individual components, or c) antagonistic - when the biological activity of the mixture is less than the sum activity of its individual components. Interactions of pesticide combinations in crops or weeds may be due to an alteration in the uptake, translocation, or metabolism of one or more of the active ingredients. The response of crops and weeds to pesticide mixtures is highly species-dependent. A given mixture might be synergistic in a weed while showing no adverse effects on the crop or vice-versa.

Herbicide Antagonism

When two or more herbicides are mixed together, the result can be a reduction in the activity of one of the herbicides on certain weeds. This is known as herbicide antagonism. The most common example of this is the reduction in grass control that can occur in soybeans when postemergence grass herbicides (Assure II, Fusion, etc) are mixed with postemergence broadleaf herbicides. The degree of antagonism is dependent upon the grass species as well as the herbicides applied. Antagonism rarely is a problem when volunteer corn or shattercane is the target grass, but tends to occur to some degree for giant foxtail, and can be a severe problem when the target grass is yellow foxtail or a perennial such as johnsongrass.

While all postemergence broadleaf herbicides are capable of causing antagonism to some degree in soybeans, those most likely to do so are Pursuit, Classic, Basagran, Raptor, Scepter, FirstRate, Synchrony, and HarmonyGT. Mixtures of postemergence grass herbicides with Pursuit are generally labeled for control of volunteer corn and shattercane only. Classic, Basagran, Synchrony, and HarmonyGT can be mixed with grass herbicides for control of certain grasses only (including giant foxtail), but an increased rate of the grass herbicide may be required. When grass plants are stressed and herbicide activity is reduced, the control of grass from Pursuit and Raptor can be reduced when mixed with Cobra and other contact herbicides. Herbicide labels generally indicate the grass herbicide rates required and grasses controlled when they are combined with other herbicides. Antagonism can sometimes be reduced by using different spray additives or including UAN or AMS in the spray mixture.

Antagonism between postemergence grass and broadleaf herbicides is most likely to occur when grasses are stressed due to cold or dry conditions and not actively growing. Antagonism will also tend to be more evident when grass size exceeds that indicated on the herbicide label. To minimize antagonism, apply the herbicides when grass size is well within label guidelines and make the application when conditions are favorable for active plant growth. Applying herbicides separately is the most effective method for avoiding problems with antagonism. However, antagonism may still occur when the grass herbicide is applied too soon after the broadleaf herbicide. In general, allow 7 days after the broadleaf herbicide application before applying the grass herbicide. Where the grass herbicide is applied first, the waiting period is usually only a day or so.

Herbicide - Insecticide Interactions

Herbicide-insecticide interactions are of special concern because they usually result in synergistic action and injury to crop plants. Crop injury results because some insecticides temporarily render crop plants unable to metabolize and detoxify herbicides that otherwise cause little or no injury. Application of some organophosphate corn rootworm insecticides (Thimet, Lorsban, etc) in combination with or followed by treatment with ALS inhibitor herbicides (Accent, Beacon, Lightning, Option, Steadfast, etc.) can injure corn. Symptoms of this injury include stunting, yellowing, and a failure of the corn leaves to properly unfurl.

The severity of injury is dependent upon environmental conditions, the insecticide used, and the method of insecticide application. Injury is most likely when insecticides are applied in-furrow, rather than T-banded. Thimet is the insecticide that tends to cause the most problems, especially when applied in-furrow. Some herbicide labels prohibit application where Thimet has been or will be applied to corn, while others prohibit in-furrow application.

Most research indicates that injury from a herbicide-insecticide interaction is likely to be most severe when rain is adequate to ensure effective insecticide and herbicide uptake and activity. Some studies have shown that significant rain during the week prior to the postemergence application of an ALS inhibitor increases the severity of injury. Injury may be more likely when the corn plant is under stress from weather or a previous herbicide application. However, conditions suitable for rapid crop growth following injury will provide an opportunity for the crop to outgrow injury.

To avoid problems with herbicide-insecticide interactions, make sure the use of an insecticide is warranted based on scouting or cropping history. Pyrethroid-type insecticides (Force, for example) do not increase the risk of injury from an herbicide, and can be substituted for organophosphate insecticides where use of an insecticide is warranted. Applying an organophosphate insecticide in a T-band rather than in-furrow can minimize the risk of injury. See Table 9 for a list of restrictions on insecticide use for ALS-inhibiting herbicides.

Herbicide Use Precautions

Herbicides, like all pesticides, should be handled with extreme care and respect in order to protect the applicator and others from poisoning, to protect the environment, and to avoid crop injury. Labels provide specific safety suggestions and requirements for handling particular products. The following are general guidelines to reduce the risks from herbicides.

- Apply herbicides only to those crops for which use has been approved.
- Clean tanks thoroughly when changing herbicides, especially when using a postemergence herbicide. Most postergence herbicide labels contain specific instructions for sprayer clean out.
- Correctly calibrate the sprayer and check the nozzle output before adding herbicide to a tank.
- Use recommended rates. Applying too much herbicide is costly, may damage crops, and is against the law. Using too little herbicide can result in poor weed control.
- Apply herbicides only as specified on the label. Observe the recommended intervals between application and livestock pasturing or crop harvesting. Observe the recommended interval between application and planting of follow crops
- Wear goggles, rubber gloves, and other protective clothing as suggested by the label.
- Guard against drift injury to nearby susceptible plants, such as ornamental, vegetables, or other agronomic crops.
- Apply herbicide only when all animals and persons not directly involved in the application have been removed from the area. Avoid unnecessary exposure.
- Check the label for the proper method of container disposal. Triple rinse, puncture, and haul metal containers to an approved sanitary landfill. Deposit paper containers in a sanitary landfill or burn them in an approved manner.

- Promptly return unused herbicides to a safe storage space. Store them in original containers away from unauthorized persons, especially children. Keep storage areas locked.
- Formulations and labels are frequently changed and government regulations modified, so always refer to the most recent product label.

Sprayer Calibration

Proper application of herbicides helps ensure crop safety, weed control performance, and cost efficiency. For these reasons, **calibration and maintenance of spray equipment are essential.** Over-application of herbicides is costly and may result in crop injury or carryover. Under-application may result in poor weed control. Similarly, sprayers that are not well-maintained may deliver an uneven spray pattern, resulting in weedy "streaks" throughout the field.

The procedures for maintaining and calibrating spray equipment are really quite simple and consist of two major steps: (1) selection of the proper nozzle tip, and (2) calibrating the equipment to deliver the correct amount of spray.

Selecting the Proper Nozzle Tip

Many different nozzle tips are available for applying herbicides, and a number of new tips have been introduced recently that can greatly reduce spray drift. With the exception of drift concerns, almost any nozzle can be used to apply preemergence herbicides to tilled soil when control of emerged weeds is not a concern. However, nozzle selection is more of a concern for application of postemergence herbicides to emerged weeds. Nozzles that result in relatively large droplets can work well for glyphosate and other translocated herbicides, but should generally be avoided with contact herbicides. For example, two nozzles that reduce drift, the Turbo Teejet and AI (air induction) Teejet nozzle, are rated excellent for translocated herbicides but only good for contact herbicides in the Spraying Systems nozzle selection guide.

Droplet size is an important consideration when applying herbicides alone or in combination with fungicides or insecticides. The recommended droplet size for fungicides is 150 – 250 microns: insecticides, 200-300 microns:;contact herbicides, 250-400 microns; and translocated herbicides, 400 microns or higher. Droplet size will influence herbicide efficacy, and the recommedned ranges should be used as a guide to select the appropriate nozzle and spray pressure to maximize performance. Consult technical information from nozzle manufacturers or a professional with knowledge of spray technology for more information on proper nozzle selection and use and appropriateness of herbicide mixtures with insecticides or fungicides.

Nozzles on the spray boom should be spaced according to the equiment manufacturers' recommendations, because the correct amount of spray overlap between adjacent nozzles is critical to achieve a uniform spray pattern. For the same reason, it is important that the height of the boom and pressure be adjusted according to the manufacturers' recommendations. The pressure and size of the nozzle tip orifice determine the spray output, so nozzle tip sizes should be matched with the desired spray application rate and ground speed. Nozzle tip manufacturers have selection guides that simplify this process.

Nozzle tips are available in a variety of materials, which vary considerably in price and wear life. The most common materials are hardened stainless steel, stainless steel, thermoplastics, and ceramics. Hardened stainless steel is the most wear-resistant material, but it is also the most expensive. Stainless steel, ceramic, and hardened stainless steel tips have excellent wear-resistance with abrasive or corrosive materials (e.g. wettable powders, liquid fertilizer solutions). Thermoplastic tips have shown good resistance to abrasion and corrosion, but may vary in wear life depending on the specific material used to mold the tips.

In general, flat fan or extended range flat fan nozzles give the most satisfactory performance over a wide variety of conditions. Nozzles placed on 15- to 30-inch spacings, with the height and angle adjusted to give 100% overlap, provide uniform coverage and some insurance against pattern skips in the event of a plugged nozzle or boom rocking in rough terrain. Do not angle tips more than 30 degrees from vertical as the drift potential greatly increases. For floaters and sprayers with boom heights greater than 3 feet, 80 degree flat fan tips are recommended. For lower boom heights, 100 degree tips are recommended. The 110 degree tips are needed to maintain 100% overlap at lower boom heights. For farmer application with lower boom heights and 110 degree tips, recommended nozzles types include extended range flat fan, Turbo TeeJet, air induction (AI), and Turbo Floodjet.

Formula for Nozzle Tip Selection and Calibration

A single formula may be used both for nozzle tip selection and sprayer calibration. The formula is:

$$\text{GPM (per nozzle)} = \frac{\text{GPA} \times \text{MPH} \times \text{W}}{5940}$$

Where:

GPM = required output per nozzle in gallons per minute

GPA = desired total carrier volume in gallons per acre

MPH = desired ground speed in miles per hour

W = space between nozzles in inches (or band width if making band applications)

A. Nozzle tip size (orifice) selection:

Select a nozzle that will give the required flow rate when the nozzle is operated within the recommended pressure range. Recommended carrier volumes (GPA) are specified on herbicide labels and typically range from 10 to 40 gallons per acre. Ground speed (MPH) should be accurately determined, since speedometers on many tractors are unreliable.

B. Measuring ground speed:

Mark off a distance of 200 feet in the field to be sprayed or in a field with similar surface conditions. At the engine throttle speed (rpm) and gear to be used for actual spraying, determine the time required to travel the 200 feet. Use the table below to determine actual speed in MPH.

Time (seconds) required to travel 200 feet	Speed in MPH
45	3.0
39	3.5
34	4.0
30	4.5
27	5.0
23.	6.0
19	7.0
18	7.5
17	8.0
15	9.0
14	10.0

C. Calibrating the sprayer

Install the selected nozzle tips in the sprayer. Using only water in the tank, turn the sprayer on and collect the output from a single nozzle for one minute in a container marked in ounces. The number of ounces collected in one minute can be converted to GPM by dividing by 128 (1 gallon = 128 ounces). If the GPM collected from the nozzle is below that required by the above formula, then increase the spray pressure. Decrease pressure if the output is too large. Check each nozzle separately for the correct output. Ideally, they should all be within 5% of the correct output.

Maintaining Spray Equipment

Check nozzle flow rates frequently and adjust the pressure to compensate for small changes in nozzle output resulting from normal wear. It is also important to recalibrate each time a different material is applied - for example, when changing from application of a wettable powder to a soluble liquid product, or from a water carrier to liquid fertilizer. Since each of these spray mixtures have different densities, actual flow rates can be quite different at a single pressure setting. Replace nozzle tips and recalibrate when output has changed 10% or more from that of new nozzle tips or when the spray pattern becomes uneven.

Cleaning Spray Equipment

Clean sprayers immediately after use. Most herbicides will injure crops other than those for which they are labeled, and small quantities of herbicides remaining in the sprayer from a previous application can cause extensive damage to the next field sprayed. The amount of these products in the spray lines, filters, sumps, tank, or screens can be sufficient to injure nonlabeled crops even when diluted by refilling the tank. Sprayer contamination can be more of a problem with plastic or poly spray tanks, compared to stainless steel, since small amounts of some herbicides can adhere to the plastic. These herbicides can then be released from the tank walls when UAN or solvent-based herbicides are used in subsequent applications.

Use of water alone is usually not sufficient to adequately clean spray tanks, especially for glyphosate, growth regulator herbicides, or many low-rate translocated herbicides. Labels for these products generally recommend use of household ammonia or a commercial tank cleaner. The labels of postemergence herbicides contain specific instructions on clean out procedures for a specific product. A publication titled "Cleaning Field Sprayers to Avoid Crop Injury" (Publication G4852) contains a concise summary of the cleanout procedures for most products, and is available on the web at http://muextension.missouri.edu/xplor/aguides/crops/g04852.htm.

The following is an example of a thorough sprayer cleanup procedure:

1. Drain sprayer and spray tank completely from the lowest point.

2. Thoroughly hose down the interior surfaces of the tank. Flush the tank, boom, and hoses with clean water for a minimum of 5 minutes.

3. Partially fill the tank with water and add household ammonia (one gallon per 100 gallons of water) or a commercial tank cleaner (follow label directions). Completely fill the tank with water, then flush the cleaning solution through the boom, hoses, and nozzles, and drain the system from the lowest point again. Then go to 4a or 4b.

4a. When spraying crops that are relatively tolerant to the product used in the previous load, add water to completely fill the tank again, and allow to agitate or recirculate for at least 15 minutes. Flush the boom, hoses, and nozzles again, and drain the system from the lowest point.

4b. If growth regulators were used and sensitive crops will be sprayed next, add more water and ammonia to the spray tank, agitate or recirculate, flush a portion of the solution through the booms, hoses and nozzles, and let the solution sit in the sprayer overnight.

5. Remove the nozzles and screen, and clean separately in a bucket containing water and the cleaning agent.

6. Thoroughly rinse the tank with clean water for a minimum of 5 minutes, flushing water through the boom and hoses. This procedure may need to be preceded by a pressure wash or steam cleaning of the tank to help remove caked deposits. To prepare spray equipment for storage over the winter, disconnect all hoses and allow the water to drain out. Coat bare metal parts with oil or a rust inhibitor. Disassemble metal nozzles and store in oil. Prepare the spray pump for storage based on the manufacturer's recommendations.

Compatibility of Herbicide-Fertilizer Combinations

Many soil-applied herbicides can be applied using fertilizer solution as the carrier. The compatibility of the components of these mixtures is critical, and should be tested prior to application even though product labels allow mixing. Most labels contain instructions for testing the compatibility of herbicides with fertilizer solution. Follow label directions closely when applying these combinations.

Testing for compatibility requires a glass jar and the herbicides and liquid fertilizer to be mixed. Place one pint of liquid fertilizer

in the jar and add two teaspoons of the liquid herbicide. If the herbicide is a dry formulation, mix two teaspoons of herbicide with sufficient water to form a slurry, and add the slurry to the fertilizer. Cover the jar, shake well, and observe the mixture for 30 seconds. Check the mixture again after 30 minutes. If the mixture does not separate, it is compatible. Each batch of liquid fertilizer should be checked, as they vary in mixing properties. The pH and mineral content of water will also influence compatibility.

If more than one herbicide is to be mixed with water or liquid fertilizer, the herbicides should be premixed in liquid fertilizer or water and tested for compatibility by mixing appropriate proportions of all components. The combination should be thoroughly agitated before each additional herbicide is added, and a specific mixing order followed. Unless label directions state otherwise, add the herbicide to water or fertilizer in the following order:

1) wettable powders or dispersible granules,
2) flowable or aqueous liquids (solutions),
3) emulsifiable concentrates,
4) COCs.

Spray tanks should be at least half filled with the carrier before the herbicides are added. Compatibility agents are available to improve compatibility. If the mixture foams excessively, separates, or becomes syrupy, do not apply. Even if all components appear compatible, the tank mixture will require constant agitation to prevent separation or poor distribution in the tank. Be sure the entire tank mixture is agitated before spraying. Do not store tank mixtures of herbicides for long periods or overnight without constant agitation. Best results will be obtained by applying tank mixtures promptly.

Off-Target Movement of Herbicides

Spray drift is the downwind movement of spray particles from the application site to non-target areas, some with sensitive plant species. The extent of spray drift increases as (1) the size of spray droplets decreases, (2) the height above the ground from which the droplets are released increases, and (3) wind speed increases. Drift can be minimized by following these guidelines.

- Spray when wind speed is low.
- Use the maximum nozzle orifice size without distorting spray pattern.
- Reduce spray pressure to the lowest setting without distorting spray pattern.
- Using nozzles that minimize drift, such as Air Induction, Turbo Teejet, or Flat Fan DriftGuard nozzles.
- Use drift control agents when permitted by the label.
- Follow label precautions for drift reduction measures.

Volatility and vapor drift is the tendency of an herbicide to vaporize and drift through the air as a gas. A herbicide with a high vapor pressure has a greater tendency to volatilize than one with a low vapor pressure. Application of Command is prohibited near sensitive plants because of the phytotoxicity of spray particles and vapors. Dicamba and the ester formulations of 2,4-D may vaporize at temperatures as low as 70°F and move with prevailing air currents to areas with sensitive plants, including ornamentals, soybeans, and vegetable crops. Amine formulations of 2,4-D are essentially nonvolatile. The volatility of dicamba varies with the formulation. Clarity and Distinct are less volatile than Banvel, but still have some potential to volatilize.

The rate of herbicide volatilization increases with increasing temperature. In the summer, temperatures at the soil surface may exceed 140°F on a clear day, greatly enhancing conditions for volatility. Vapors drift farther and over a longer period of time than do spray droplets. Changes in temperature and wind direction following application can move damaging vapors to sensitive plants. To avoid vapor drift, carefully observe label precautions when applying a volatile herbicide.

Herbicide Carryover

The length of time an herbicide remains active in the soil determines the period of weed control that can be expected through the current growing season and the potential for carryover to the following year. Although most herbicides dissipate within the same growing season in which they are applied, some herbicides persist longer than others and may be especially harmful to specific crops grown next in the rotation. The overall potential for carryover is a function of the herbicide, the accuracy of application, the rotational crop grown, and the environmental conditions following herbicide application.

Degradation of most soil-applied herbicides is the result of chemical and microbial breakdown processes. The rate of degradation increases with soil temperature, and degradation requires adequate soil moisture. Because a large portion of the herbicide is degraded in the summer and early fall following application, very dry conditions during this period will increase the potential for carryover of many herbicides.

The rotational crop is more likely to show injury symptoms from herbicide carryover if it is not tolerant to the herbicide or weakened by stress from adverse climate, disease, or nutritional deficiencies. Yield reduction from herbicide carryover injury is more likely to occur if adverse growing conditions continue throughout the growing season.

Herbicide carryover is also influenced by herbicide rate, distribution, soil type, soil pH, and timing of application. While most herbicides are safe to rotational crops when applied at normal use rates, higher rates in areas of fields where herbicides are not uniformly distributed may result in carryover problems. Poor distribution is generally the result of improper calibration, poor agitation, sprayer overlaps, or non-uniform incorporation.

Longer intervals between herbicide application and rotational crop planting allow the herbicide more time to degrade, thus reducing the risk of carryover. Delayed planting the year following application reduces the probability of injury from carryover. Where double cropping or intercropping practices are used, carryover problems may increase due to the number of crops planted within a fairly short period of time.

Herbicides are more persistent in fine-textured, high organic matter soils than in coarse-textured, low organic matter soils. The soil's absorptive capacity for herbicide increases as organic matter and clay content increases. Because microbial and chemical

degradation reactions occur mainly in the soil solution, absorption of herbicide on soil can "protect" the herbicide from breakdown. However, adsorption also reduces the availability of herbicide for plant uptake, so increased persistence may not always result in an increased carryover injury.

The persistence of some triazine (atrazine) and sulfonylurea (chlorimuron, prosulfuron) herbicides is longer at high soil pH than at low pH. The persistence of Scepter and Command is longest at low pH (<5.9). Follow label directions regarding the application of herbicides and soil pH.

The sensitivity of a crop to an herbicide affects the potential for carryover injury. Vegetable and ornamental crops are generally more sensitive to herbicide carryover than field crops. Within a specific crop, some varieties are more tolerant of a given herbicide than others. Herbicide labels contain restrictions regarding the interval that must occur between application of a herbicide and the planting of rotational crops.

Guidelines To Avoid Carryover Problems:

1) Select the appropriate herbicide rate based on soil type.
2) Calibrate the sprayer and apply herbicide accurately and uniformly.
3) If incorporating, make sure it is done thoroughly and uniformly.
4) Consider applying reduced rates of a persistent herbicide in combination with a less persistent herbicide.
5) Select herbicides based on rotation plans. Follow the recrop restrictions on herbicide labels.
6) Apply the herbicide as early as possible and delay planting of the rotational crop if carryover is suspected.

Testing for Herbicide Residues

In fields where a carryover problem is suspected, bioassays or soil tests may be performed to determine if unacceptable levels of herbicide residue are present. With a bioassay, one or more sensitive species are grown in the "suspect" soil and compared to the growth in "check" soil not treated with an herbicide. This comparison makes it possible to separate carryover injury from injury caused by plant disease, environmental stress, or lack of soil moisture. It may be necessary to bioassay soils with the plant species that will be planted in the "suspect" field. For suspected triazine carryover, a bioassay using oat plants is often effective. For sulfonylurea (e.g. Classic) and imidazolinone (e.g. Scepter), herbicides, corn can be an effective bioassay species. These classes of herbicide chemistry inhibit corn root growth, so it is important to observe root growth when conducting a bioassay.

Samples for bioassays should be taken from the field in early to mid-spring, leaving enough time to observe the effects before making a recrop decision. The method of sampling can be critical. A group of samples mixed together may not be accurate because the resulting average will not show whether "hot spots" of high herbicide concentration exist. Where soil has been moldboard plowed, sample to the depth of tillage (about 6 inches). In no-till or where soil has been chisel plowed, herbicides remain more concentrated in the upper few inches of the soil, and samples should be taken from fairly shallow depths (about 3 inches).

Commercial laboratories will test soil samples for herbicide residues, but the procedure can be expensive. The interpretation of test results is difficult since carryover potential depends upon both the actual herbicide concentration detected and the availability of the herbicide to plants. The availability of an herbicide varies with soil texture, organic matter content, and moisture. For the triazine herbicides and others that have been used for a number of years, it is possible to estimate carryover potential from test results. For some of the newer herbicides, a lack of information in general may preclude meaningful interpretation of test results.

The following table provides a rough guideline for planting various crops based on laboratory soil test results for triazine residues.

Triazine Residue Level		"Safe" to plant
3 inch sample (no-till)	6 inch sample (moldboard plow)	
less than 0.17 ppm	less than 0.08 ppm	oats, alfalfa
0.17 to 0.35 ppm	0.08 to 0.17 ppm	soybeans
greater than 0.35 ppm	greater than 0.17	corn

Avoiding Water Contamination

Surface Water

Traces of several common herbicides have been found in some municipal water sources in Ohio and Indiana. Herbicides and other pesticides can reach streams, lakes, and reservoirs from treated fields when dissolved in runoff water or adsorbed onto the surface of eroded soil particles. Runoff risk is greatest when heavy rains closely follow herbicide application to fields with steep slopes. Surface water quality can be protected by reducing water runoff and soil erosion from treated fields.

Conservation tillage systems generally reduce water runoff and soil erosion compared to conventional tillage due to the crop residue remaining on the soil surface. Incorporating herbicides may reduce runoff potential by reducing the concentration of herbicide on the soil surface. Grass strips are somewhat effective in reducing herbicide runoff because they trap sediment carrying herbicides and slow runoff water, allowing more herbicide to fall out of solution. Leaving untreated grass strips next to streams and ponds will help protect water quality. Never clean or dump sprayers or dispose of empty containers near streams, ponds, or lakes due to the risk of contamination.

Some herbicide labels contain a surface water advisory stamement, indicating they may have a potential for runoff into surface water under some conditions. All products containing sulfentrazone, atrazine, isoxaflutole, flufenacet, diflufenzopyr, terbacil, mesotrione, pyroxsulam, foramsulfuron, saflufenacil, terbacil, tembotrione, and cloransulam-methyl have this advisory.

Groundwater

In Oho and Indiana, the groundwater contamination from herbicides is minor compared to many other states. However, herbicide users should be aware that groundwater can become contaminated by herbicides. Most instances of groundwater contamination are due to leaching of herbicides from loading or

disposal sites. The potential for groundwater contamination can be reduced through careful application, handling, and storage of herbicides.

Leaching. While the majority of herbicide applied generally remains in the top few inches of soil and degrade, a small percentage of certain herbicides can leach below the root zone to possibly contaminate shallow groundwater. This is most likely to happen in sandy soils, which have a low capacity for absorbing herbicide. Herbicides are less likely to leach if they have low water solubility, are strongly absorbed on soil particles, or are fairly nonpersistent. Conversely, herbicides that are high in solubility, weakly absorbed on soil, and very persistent are most likely to leach.

The potential for groundwater contamination can be reduced by selecting and using herbicides with low leaching potential. This is especially important where soils are sandy. Applying lower herbicide rates and reducing the total amount applied, as in banding, can lower contamination potential.

Groundwater warning statements are required on the labels of herbicides that have been detected frequently in groundwater monitoring. Most groundwater statements have a similar wording: "This product is a chemical which can travel seep or leach) through the soil and can contaminate groundwater which may be used as drinking water. This product has been found in groundwater as a result of agricultural use. Users are advised not to apply this product where the water table (groundwater) is close to the surface and where soils are very permeable, i.e., well drained soils such as loamy sands. Your local agricultural agencies can provide further information on the type of soil in your area and the location of groundwater."

All products containing any of the following active ingredients are labeled with a groundwater advisory statement:

acetochlor	alachlor	isoxaflutole
atrazine	metolachlor	flufenacet
cyanazine	clopyralid	diflufenzopyr
metribuzin	flumetsulam	terbacil
simazine	dimethenamid	hexazinone
sulfentrazone	cloransulam-methyl	saflufenacil
tembotrione	sulfosulfuron	halosulfufon
lactofen	tebuthiuron	

Leaching from mixing or disposal areas. High soil herbicide concentrations occur through spillage or improper disposal of herbicides in small areas. These high concentrations can overload the ability of the soil to adsorb and degrade herbicides. Leaching of herbicides from these areas is much greater than in treated fields. If sprayers are drained or cleaned out in the same place over years, concentrated sources of herbicide are created. If this activity takes place near a well, contamination risks increase, especially if the well is not properly cased allowing surface runoff to enter the well. Herbicides should be stored and mixed away from a water well.

The best method to dispose of excess spray mixture and rinsate is to use them on a crop field. The excess can sometimes be applied at low rates on a portion of the field by increasing sprayer speed or diluting the mixture with additional water. Be careful not to exceed the total label rates for the crop, risking crop injury, carryover, or illegal applications.

Backsiphoning into wells can allow large quantities of herbicide to directly enter groundwater. This happens when the end of the water hose is allowed to extend into the spray solution when filling sprayers. If the water is shut off with the hose in the tank, the spray solution can backsiphon down the well or into the water system. To avoid backsiphoning, position the hose above the spray solution while filling and remove the hose prior to shutting off the water. Use an anti-backflow valve when drawing water from a well or pond. Inexpensive anti-backflow devices for hoses that are used to fill sprayers can be purchased from sprayer equipment dealers. A state regulation in Ohio requires an anti-backsiphoning device in certain sprayer systems.

Herbicide Resistance in Weeds

A number of crops and weeds exhibit tolerance to some herbicides by preventing their absorption and/or translocation, or by rapidly metabolizing the herbicide to a non-toxic form. These are the basic mechanisms of herbicide selectivity upon which modern herbicide use is based. Herbicide-resistant plants have biochemical differences in the site of action normally attacked by a herbicide in susceptible plants, thus leaving them unaffected by the herbicide. In weed populations throughout the world, large populations of single weed species can contain a relatively small number of biotypes that have slight genetic differences from the rest of the population. Experience since the herbicide revolution began in the 1940s indicates that some naturally occurring weed biotypes can be resistant to herbicides that are normally lethal to the majority of the population.

The phenomenon of resistance can be explained as follows. When the same herbicide or herbicides having the same site of action (for example, a photosynthesis inhibitor) are applied to an area repeatedly over time, the portion of a weed population susceptible to that herbicide is gradually depleted. This creates an opportunity for other weeds naturally resistant to that herbicide (including resistant biotypes of species normally susceptible to the herbicide) to become established. If the same herbicide or others with an identical mode of action are applied on a year-to-year basis, there is no interruption of the resistant weeds' yearly reproductive cycle, and the population will continue to expand rapidly over time.

Common lambsquarters and pigweed species are examples of weeds that have developed populations resistant to the triazine herbicides. In Ohio, triazine-resistant populations are most prevalent in areas where atrazine and/or simazine have been applied annually in continuous corn-growing areas. Some wild carrot populations have developed resistance to 2,4-D in Ohio. Elsewhere in the United States, there are reports of triazine-resistant velvetleaf, triazine-resistant giant foxtail, dinitroaniline-resistant goosegrass, and ACCase resistant giant and green foxtail and johnsongrass. More recently, there is growing concern because of reports that some weed biotypes are showing resistance to the newer herbicides, especially ALS inhibitors. The latter is of special concern because both classes of herbicides attack exactly the same site of action in plants, and evidence is growing that weeds resistant to imidazolinones may also be resistant to sulfonylureas and sulfonamides, a phenomenon known as cross-resistance. Populations of several weeds in Ohio and Indiana have developed resistance to ALS inhibitors, including:

giant and common ragweed, horseweed (marestail), waterhemp, cocklebur, Powell amaranth, smooth pigweed, and shattercane. More recently, populations of horseweed, and giant and common ragweed with resistance to glyphosate have been identified in Indiana and Ohio, and some populations are resistant to both glyphosate and ALS inhibitors.

Prevention is the key to avoiding development of herbicide-resistant weed populations in agricultural land. The following management techniques help keep resistant populations from developing:

Crop rotation - Some weed problems are more easily managed in some crops than others because different control options may be available. Crop rotation also helps disrupt weed life cycles and helps prevent any single weed species from becoming firmly established.

Herbicide rotation - Herbicide rotation is generally practiced along with crop rotation, and as long as herbicides used in one crop have a different mode of action from those used in other crops in the rotation, it will be more difficult for resistant populations to become established. Herbicides should also be rotated in a continuous monoculture system. Where two herbicide applications are made to a crop in the same year, avoid using herbicides with the same mode of action in both applications. Be sure to understand the components of premix herbicides when planning herbicide programs.

Timely postemergence practices - In general, triazine-resistant weed populations appear to develop more rapidly in no-till cropping systems. Timely cultivation and/or postemergence herbicide application are possible control options for conventional tillage. No-till growers have a number of postemergence herbicide options available for timely control of weed escapes. Control of escaped weeds is necessary to prevent reseeding and development of resistant weed populations.

The following two tables indicate the site of action for herbicides used in crop production in Ohio and Indiana. When rotating herbicide site of action to minimize resistance problems, it is essential to know the site(s) of action for herbicide products. Site of action definitions are as follows. The group number refers to the Weed Science Society of America approved codes for herbicide site of action/mode of action, which also appear on some herbicide labels.

Group 1. ACC-ase Inhibitors (ACC). The ACC-ase inhibitors block the activity of an enzyme (Acetyl-CoA Carboxylase) involved in fatty acid biosynthesis. Group 1 herbicides are applied postemergence, and translocate within the plant.

Group 2. ALS Inhibitors (ALS). ALS (acetolactate synthase) is an enzyme involved in the synthesis of several amino acids. This enzyme is also referred to as acetohydroxy acid synthase (AHAS). Group 2 herbicides are applied preemergence and postemergence, and translocate within the plant.

Group 3. Microtubule Assembly Inhibitors (MAI). The dinitroanilines and other herbicides in this class interfere with the organization of microtubules. They prevent polymerization of the protein tubulin into microtubules. Microtubules are involved in cell division and cell wall structure. Preemergence activity only. Uptake by roots only, not translocated.

Group 4. Synthetic Auxins (SA). The synthetic auxins interfere with plant growth by disrupting hormone balance and protein synthesis. The exact mode of action is unclear, and it is believed these herbicides have several sites of action. Applied preemergence and postemergence, but have primarily foliar activity. Group 4 herbicides translocate within the plant.

Group 5. Photosynthesis Inhibitors Binding Site A (PS2 - A). Several classes of herbicides disrupt photosynthesis by blocking electron transfer in Photosystem II (PSII). Herbicides in Classes PS2-A, PS2-B, and PS2-C bind to the same protein in PSII, but the herbicides exhibit different binding characteristics. For example, resistance to the triazine herbicides usually is due to a modification of the binding site. This modification usually provides resistance to herbicides in class PS2-A, but not for herbicides in classes PS2-B and PS2-C. Because of this, Basagran and Buctril will control triazine resistant weeds, even though the binding site for these herbicides has been modified. Applied preemergence and postemergence, but no translocation when applied postemergence.

Group 6. Photosynthesis Inhibitors Binding Site A (PS2 - B). See Photosynthesis Inhibitors Binding Site A.

Group 7. Photosynthesis Inhibitors Binding Site A (PS2 - C). See Photosynthesis Inhibitors Binding Site A.

Group 8. Lipid Synthesis Inhibitors (LSI). The thiocarbamate herbicides inhibit lipid synthesis, but the exact site and mode of action is unclear. These herbicides may have multiple sites of action. Premergence activity only.

Group 9. EPSP Inhibitors (EPSP). Glyphosate inhibits EPSP synthase (5-enolpyruvyl-shikimate-3 phosphate synthase), an enzyme involved in the production of several amino acids. Both ALS-inhibiting and EPSP-inhibiting herbicides inhibit amino acid synthesis, but their target sites affect different enzymes and they disrupt the synthesis of different amino acids. Foliar activity only, translocate within the plant.

Group 10. Glutamate Synthetase Inhibitors (GSI). Glufosinate inhibits glutamine synthetase, a key enzyme in incorporating ammonium into amino acids. Blockage of this enzyme allows a buildup of phytotoxic ammonia. Foliar activity only, not translocated.

Group 13. Carotenoid Biosynthesis Inhibitors (CBI). Clomazone inhibits the synthesis of carotenoids by possibly inhibiting production of all diterpenes, although the exact target site is unknown. A lack of diterpenes results in the loss of carotenoids and other compounds. A primary role of carotenoids is to protect chlorophyll from photo-oxidation. These herbicides are known as bleachers because sensitive plants turn white due to the loss of chlorophyll. Applied preemergence.

Group 14. PPO Inhibitors (PPO). These herbicides inhibit PPO (protoporphyrinogen oxidase). Inhibition of this enzyme results in the accumulation of Proto IX, a molecule that generates singlet oxygen. Singlet oxygen is highly reactive and disrupts membranes, resulting in rapid degeneration of plant tissues. Applied preemergence and postemergence, but not translocated (contact activity only).

Group 15. Cell Division Inhibitors (CDI). Herbicides inhibit proper cell division. The exact site of action for these herbicides is unknown, but they are believed to inhibit synthesis of very-long-chain fatty acids (VLCFAs) during cell division. There may be multiple sites of action. Applied preemergence.

Group 19. Auxin Transport Inhibitors (ATI). Herbicides inhibit the flow of natural and synthetic auxins, which are necessary for proper plant growth. The auxins become more concentrated in growing points, causing abnormal growth similar to synthetic auxin herbicides. Group 19. Applied postemergence, translocated within the plant.

Group 22. Photosytem I Inhibitors (PS1). These herbicides intercept electrons moving through Photosystem I (PSI). These electrons are then passed on to other compounds, resulting in the formation of hydrogen peroxide, which disrupts cellular integrity. Foliar activity only, not translocated (contact activity only).

Group 27/28. 4-HPPD Inhibitors (4-HPPD). Inhibit the enzyme 4-HPPD (4-hydroxyphenyl-pyruvate-dioxygenase), an enzyme involved in the synthesis of carotenoids (See Carotenoid Biosynthesis Inhibitors). Applied preemergence and postemergence, translocated within plant when applied postemergence.

Abbreviations in this guide

AMS = ammonium sulfate
COC = crop oil concentrate
MSO = methylated seed oil
NIS = nonionic surfactant
HSOC = high surfactant oil concentrate (specified as HSOB on some labels)
UAN - urea ammonium nitrate solution (28%, 32%)

Burndown Herbicide Programs for Corn and Soybeans

In no-till corn and soybean fields, it is essential to apply herbicides with foliar activity before crop emergence to control existing weeds. Depending upon the herbicide approach used in the field for that year, herbicides used to control weeds at planting may include glyphosate or Gramoxone Max, or it may be possible to rely solely on PRE herbicides with foliar activity (atrazine, Lexar/Lumax, Canopy, etc) in combination with 2,4-D. The latter approach will be most suitable when the field is only sparsely populated with small winter annual weeds, and herbicides are applied in late March or early April. Use of herbicide combinations in burndown treatments is justified in most no-till fields, due to the variety of winter weeds that are present. Consider fall herbicide treatments in fields that are heavily infested with winter weeds, such as chickweed, dandelions, wild carrot, and poison hemlock.

Glyphosate (Roundup, Touchdown, Cornerstone, etc)

Fields with quackgrass, Canada thistle, dandelion, and other cool-season perennial weeds will almost always require the use of glyphosate around the time of planting. This treatment can reduce the population of perennial weeds that reach an appropriate size by the time of application, such as quackgrass. For other perennials such as Canada thistle, the level of long-term control with glyphosate will be variable, since they may be small at the time of application. Application of glyphosate to small perennials often controls existing foliage, but regrowth occurs later in the growing crop. Cool-season perennials, legumes, and cool-season grasses are more effectively controlled with glyphosate the previous fall if crop rotation allows. Glyphosate is also effective on most annual broadleaf and grass weeds, although the addition of 2,4-D ester greatly improves control of marestail (horseweed), atriplex, giant ragweed, mustard species and some other key no-till weeds. Activity of glyphosate on established dandelion and some winter annuals can be extremely slow when applied in the spring under cool conditions, and use of fall application or alternative herbicides should be considered in fields where chickweed, purple deadnettle, and dandelion have been problematic (see later section on fall applications). Glyphosate is most effective when applied alone or with 2,4-D, in spray volumes of 10 gpa or less, and when AMS is included in the spray mix. AMS helps maintain glyphosate effectiveness in hard water, or when mixed with residual herbicides. Glyphosate activity can be reduced when mixed with certain residual herbicides (metribuzin, for example), and when applied using 28% nitrogen solution or a similar material as the spray carrier. For this reason, glyphosate labels often specify that these types of mixtures should be used only for control of small annual weeds.

2,4-D ester (Weedone, Salvo, etc)

In many no-till fields, vegetation up until early May consists primarily of broadleaf weeds, and 2,4-D ester is an economical and effective tool for control of these weeds. 2,4-D ester is most often used in combination with other herbicides to ensure that complete control of emerged weeds is achieved. Weeds not well-controlled by other herbicides that 2,4-D helps out on include marestail, prickly lettuce, mustards, giant ragweed, Pennsylvania smartweed, and dandelion. When applied too close to soybean or corn planting, 2,4-D can potentially reduce crop stands and cause injury to new seedlings. With regard to soybeans, restrictions are as follows for most products: rates up to 0.5 lb ai/A must be applied at least 7 days before planting; rates between 0.5 and 1 lb ai/A must be applied at least 30 days before planting. Several 2,4-D ester products, including Salvo, Weedone 650, and E-99, can be applied at a rate of 1 lb ai/A up to 15 days before planting. With regard to corn, some labels suggest that 2,4-D be applied at least 7 to 14 days before planting or 3 to 5 days after planting. Other labels allow application anytime after planting. The risk of corn injury seems to be primarily when 2,4-D is applied around the time of corn planting, and application is followed by enough rain to move 2,4-D into the soil where seeds are germinating. There is also risk of injury when seed furrows fail to close completely and rain washes herbicide into the seed furrow where direct contact with seed is possible. Injury may be more severe when 2,4-D is applied with chloroacetamide herbicides, especially to corn in the spike stage.

Ignite (glufosinate)

Ignite is a contact herbicide that can be applied preplant in ni-till to control small. emerged weeds. It is most effective when applied with metribuzin and 2,4-D ester, although 2,4-D ester is not needed for control of most anual weeds. This can be an effective alternative to combinations of glyphosate and 2,4-D ester where glyphosate-resistant marestail occurs, or when there is not enough time between application and planting to use 2,4-D ester. Ignite is most effective when applied under relatively warm, sunny conditions. It should be applied in a spray volume of at least 15 gpa, and this should be increased to 20 to 40 psi in dense weed canopies. Avoid use of nozzles that result in coarse spray droplets.

Paraquat (Gramoxone SL, Parazone)

Use of paraquat in no-till systems has declined greatly over the past decade due to reductions in the price of glyphosate and the greater versatility of glyphosate across a range of weed life cycles (perennial, biennial, etc) and sizes. Paraquat is most effective on small annual weeds, and when combined with photosynthetic inhibitor-type residual herbicides (atrazine, metribuzin). Mixing 2,4-D ester with paraquat also results in more complete control of broadleaf weeds. Paraquat is probably most useful when rapid dessication of weeds is essential, in order to allow tillage or planting. For example, a combination of paraquat plus atrazine or metribuzin will result in more rapid death and dessication of chickweed or purple deadnettle, compared to glyphosate, when applied in the spring under cool conditions. Paraquat should not be used for control of perennial or biennial weeds, legumes, or cool-

season grasses. Paraquat is most effective when applied with 2,4-D and COC in relatively high spray volumes (at least 15 gpa), and spray volume should be increased as weed density increases.

Residual herbicides with foliar activity (atrazine, Canopy, etc)

A number of residual herbicides also have foliar activity, and will control or help control small annual weeds. Herbicides in this category include atrazine, Callisto, Balance Flexx, Corvus, Verdict, metribuzin, Canopy/Cloak, Gangster, Envive, Valor XLT, Sonic, Authority First, and Hornet. These herbicides have activity primarily on small weeds, and the spectrum of control varies by herbicide. All have activity on broadleaf weeds, but most have little or no activity on emerged grasses. The most effective strategy when using one of these herbicides, in order to minimize the need for glyphosate or paraquat, is to apply prior to early April with 2,4-D ester. If emerged grasses are present, consult the product label to make sure it will provide adequate grass control, and supplement the spray mix with glyphosate or paraquat as needed. Mixtures of residual herbicides with 2,4-D and/or paraquat should generally be applied with COC. Mixtures with glyphosate should include only AMS and possibly NIS, depending upon the glyphosate product used.

Fall herbicide treatments for winter annuals and dandelions

Fall herbicide treatments have become a fairly common practice for some no-till producers, who recognize their value for managing certain tough winter weeds and providing a weedfree seedbed in the spring. The most effective treatments based on our research include:

Any crop next spring
Glyphosate + 2,4-D
Autumn/Autumn Super + glyphosate or 2,4-D
Metribuzin + 2,4-D (excluding dandelions)

Soybeans next spring
Canopy EX/Cloak EX/Fallout + 2,4-D
Canopy/Cloak DF + 2,4-D (excluding chickweed)
Basis + 2,4-D (lower rates of Basis and/or only in southern areas of OH and IN)

Corn next spring
Simazine + 2,4-D
Basis + 2,4-D

For control of winter annual weeds, apply herbicide anytime after early October. For the most effective dandelion control, delay application until after a frost. We have applied as late as early December for control of winter annual weeds, but we generally recommend application when dandelions are still mostly green, or by mid-November if possible. Apply glyphosate-containing treatments with AMS, and additional NIS if specified by the product label. Treatments that do not contain glyphosate should generally be applied with COC for best results.

The treatments listed should cost producers no more than about $8 to $15 per acre, excluding application costs. It is not necessary to use more expensive treatments, and we really question the value of treatments where the cost of the herbicide is more than about $12 per acre. One of the reasons for this is that the use of a fall treatment, even one with residual activity, does not guarantee that only one herbicide treatment will be required in Roundup Ready soybeans the following year. Excess money spent on fall treatments results in less money available for weed control in the crop, where it usually is greatly needed.

Our experience has been that the primary benefit of fall treatments is control of weeds that are present at the time of treatment, not residual control of weeds that emerge the following year. The primary exception to this is chlorimuron (Canopy/Cloak), which provides a longer period of residual control of more weed species than other fall-applied herbicides. An effective fall treatment usually results in a field that is mostly free of weeds until about late April, and this goes for treatments without residual as well as those with residual. In other words, in late April we cannot usually discern much difference between a fall treatment of glyphosate plus 2,4-D versus chlorimuron plus 2,4-D, even though the chlorimuron provides residual activity into the spring. However, the effect of the residual herbicide becomes much more apparent by the end of May, when its activity on summer annual weeds comes into play.

The issue here is not really control at the time of soybean planting, since any effective fall treatment results in a relatively weed-free field at the end of April. The issue is how well the residual herbicide controls weeds after planting, in order to build more flexibility into the postemergence application window. This flexibility can result in less risk of early-season yield loss from weed interference and result in a better chance of getting the postemergence herbicides applied to the right size weeds. We also look to the residual herbicide to help control several weeds that glyphosate can be somewhat variable on, such as giant ragweed and lambsquarters. It is our opinion that, if glyphosate is being managed properly, it is typically going to be extremely difficult to get by with one postemergence glyphosate application unless the residual herbicide applied in the fall provides substantial weed control into late May.

Herbicides other than chlorimuron can provide residual control of certain weeds when applied in the fall, but they tend to control fewer weed species and/or be generally less effective than chlorimuron. For example, Valor provides residual control of lambsquarters into early June, but is less effective than Canopy EX and provides very little control of giant ragweed. Scepter provides very little control of lambsquarters or giant ragweed when applied in the fall, whereas it can provide substantial residual control of these weeds when applied in the spring.

Table 1. Weed Response to "Burndown" Herbicides

This table gives a general comparative rating of "burndown" herbicides used in no-till corn and/or soybean production. Under unfavorable conditions, some herbicides may not perform as well as indicated below. Under very favorable conditions, control may be better than indicated. Herbicide rate, weed size and stage of growth, and environmental conditions interact to influence herbicide performance.

Weed control rating:
9 = 90% to 100%
8 = 80% to 90%
7 = 70% to 80%
6 = 60% to 70% control, and - = less than 60% control, not recommended.

Ratings are for control of existing vegetation only (not residual control). Treatments containing glyphosate should be applied with AMS (and surfactant if required by the glyphosate product label). Most other treatments should be applied with a COC or MSO (plus UAN if recommended by the label). Ratings for 2,4-D are based on a rate of 0.5 lb ai/A unless otherwise indicated - increasing the 2,4-D rate to 1.0 lb ai/A will improve control of legumes, dandelion, marestail, and some other weeds.

	Giant Foxtail	Lambsquarters	Common Ragweed	Giant Ragweed	Annual Smartweeds	Common chickweed	Mustards, Shepherd's-purse	Winter Wheat, Rye Cover	Orchardgrass/Fescue Sod	Canada Thistle	Red Clover	Alfalfa	Hairy Vetch	Marestail (glyphosate-resistant)[1]	Prickly Lettuce	Annual Bluegrass	Deadnettle, henbit	Carolina Foxtail	Dandelion	Cressleaf groundsel
Fall application																				
2,4-D (0.5 lb/1.0 lb)	-	-	-	-	-	-	9	-	-	-/6	6/8	-/7	6/8	8/9	8/9	-	-/8	-	6/7	9/9
2,4-D + dicamba	-	-	-	-	-	7	9	-	-	7	9	8	9	9	9	-	8	-	7	9
Autumn/Autumn Super + glyphosate	-	-	-	-	-	9	9	-	-	-	6	-	6	9	9	9	9	9	8	9
Basis + 2,4-D	-	-	-	-	-	9	9	-	-	6	6	-	6	9	9	9	8+	9	8	9
Chlorimuron[2] + 2,4-D	-	-	-	-	-	7	9	-	-	-	6	-	6	9	9	9	9	-	9	9
CanopyEX/CloakEX/Fallout + 2,4-D	-	-	-	-	-	9	9	-	-	-	6	-	6	9	9	9	9	-	9	9
Tribenuron + 2,4-D (1.0 lb)	-	-	-	-	-	9	9	-	-	6	6	-	6	9	9	-	8	-	7	9
Glyphosate	-	-	-	-	-	9	9	9	9	9	8	8	8	7	8	9	8	9	8	9
Glyphosate + 2,4-D	-	-	-	-	-	9	9	9	8	8	9	9	9	9	9	9	9	9	8	9
Metribuzin + 2,4-D	-	-	-	-	-	7+	9	-	-	-	-	-	6	9	9	-	9	7	7	9
Simazine + 2,4-D	-	-	-	-	-	9	9	-	-	-	-	-	6	9	9	8	8+	8	7	9
Spring application																				
2,4-D (0.5 lb/1.0 lb)	NR	9	9	9	7/8	-	8/9	-	-	-	7/8	7/8	8/9	7/8	8/9	-	-/7	-	6/7	7/8
2,4-D + dicamba	NR	9	9	9	9	6	9	-	-	6	9	8	9	9	9	-	-	-	8	9
Atrazine + 2,4-D	7	9	9	9	9	8+	9	-	-	-	8	7	8	9	9	8	9	9	6	8
Atrazine + paraquat	9	9	9	9	9	9	9	8	6	-	7	-	8	9	9	9	9	9	-	9
Atrazine + Hornet/SureStart	7	9	9	9	9	8	8	-	-	8	6	6	7	8	9	8	9	9	-	8
Balance/Corvus + atrazine + 2,4-D	8	9	9	9	9	9	9	-	-	-	6	-	8	9	9	8	9	9	6	9
Balance/Corvus+atrazine+glyphosate	9	9	9	9	9	9	9	8	-	6	7	6	7	8	9	9	9	9	7	9
Basis/Resolve/Prequel	9	9	9	9	9	9	9	-	-	-	7	7	8	9	9	8	9	9	8+	8
+ atrazine + 2,4-D																				
Chlorimuron[2] + glyphosate	9	8	9	9	9	7	8	9	-	6	7	6	6	8	8+	9	9	9	8+	9
Chlorimuron[2] + glyphosate + 2,4-D	9	9	9	9	9	7	9	9	-	6	8	8	8	9	9	9	9	9	8+	9
Cloransulam[2] + glyphosate + 2,4-D	9	9	9	9	9	7	9	9	-	6	8	8	8	9	9	9	8	9	8	9
Dicamba	NR	9	9	9	9	6	7	-	-	-	9	8	8	7	9	-	-	-	7	-
Expert	9	9	9	9	8	8	8	8	-	-	6	-	7	8	8	9	8	9	7	8
Expert + 2,4-D	9	9	9	9	9	8	9	8	-	6	7	7	8	9	9	9	9	9	8	9
Glyphosate	9	8	9	8	7	7	8	9	-	6	7	6	6	6	8	9	-	9	7	7
Glyphosate + 2,4-D	9	9	9	9	8	7	9	9	-	6	8	8	8	8+	9	9	7	9	8	9
Ignite + atrazine or metribuzin	9	9	9	9	9	9	9	-	-	6	-	-	6	8+	9	8	9	9	8	8
Lumax/Lexar	6	9	9	9	9	9	8	-	-	6	-	-	7	8	9	8	9	9	8+	8
Lumax/Lexar + 2,4-D	6	9	9	9	9	9	9	-	-	6	7	7	8	9	9	8	9	9	8+	9
Metribuzin + paraquat + 2,4-D	9	9	9	9	9	9	9	7	-	-	7	7	8	8+	9	9	9	9	6	9
Saflufenacil[2] + glyphosate or Ignite	9	9	9	9	9	8	9	8	-	6	7	6	6	9	9	9	8	9	8	8
Verdict + atrazine + glyphosate	9	9	9	9	9	9	9	9	-	6	7	6	8	9	9	9	9	9	8	8

[1]Ratings are for control of emerged marestail only. Marestail emerges in fall, spring, and early summer, and use of burndown plus residual herbicides in early spring results in most effective control. See "horseweed (marestail)" in the "Problem Weed" section for more information.

[2]Chlorimuron products: Canopy/Cloak DF and EX, Valor XLT, Envive, and Authority XL. Clorsansulam products: Authority First, Sonic, FirstRate, and Gangster. Saflufenacil products: Sharpen, Optill, Verdict.

Table 2. Application Intervals for Early Preplant Herbicides

This table gives the time interval, in days, that herbicides and herbicide combinations can be applied before planting corn or soybeans. Herbicide rates may increase when applied early preplant; consult labels for detailed information on application rates. Soil-applied herbicides not included in this table are not labeled for early application, and should be applied close to the time of planting or as directed by the label. Fall applications are usually targeted for control of emerged winter annuals, biennials, and dandelion, and herbicides applied in fall usually provide only limited control of weeds that emerge the following spring.

Corn	Single Preplant Application in Spring	Labeled for Fall Application
AAtrex, atrazine	up to 30 days	No
Acetochlor, acetochlor+atrazine	up to 30 days	No
Alachlor, alachlor+atrazine	up to 30 days	No
Authority MTZ	Not labeled in spring prior to corn	Yes (up to 14 oz)
Balance Flexx, Corvus, Prequel	up to 21 or 30 days[2]	No
Guardsman Max, Outlook	up to 30 days[1]	No
Hornet	up to 30 days	No
Lumax, Lexar	up to 14 days	No
metolachlor, metolachlor+atrazine	up to 30 days	No
s-metolachlor, s-metolachlor+atrazine, Expert	up to 30 days	No
Metribuzin	up to 14 days	Yes
Princep/simazine	up to 14 days	Yes
Python	up to 30 days	Yes
SureStart/TripleFlex	up to 30 days	Yes
Topnotch/FulTime	up to 40 days	No
Verdict, Sharpen (corn rates)	up to 30 days	No
Valor	7 to 30 days before planting	Yes

Soybeans	Single Preplant Application in spring	Labeled for Fall Application
Authority First, Authority MTZ, Authority Assist	up to 45 days, no later than 3 days after planting	Yes
Authority XL	up to 60 days	Yes
Canopy/Cloak DF	up to 45 days	Yes
Canopy EX/Cloak EX/Fallout	at least 7 to 14 days before planting[3]	Yes
Command3ME	up to 30 days	No
Envive	anytime, but no later than 3 days after planting	Yes
FirstRate	up to 28 days	No
Outlook	up to 30 days[1]	No
Gangster	up to 14 days	Yes
Metolachlor/s-metolachlor	up to 30 days	No
Metribuzin	up to 15 days	Yes
Optill, Sharpen	Up to 30 days	No
Pendimethalin	up to 45 days	Yes
Prefix	up to 15 days	No
Python	up to 30 days	Yes
Scepter	up to 45 days	Yes
Sharpen (burndown use)	anytime	Yes
Sonic	anytime	Yes
Spartan, Spartan Advance	anytime, but no later than 3 days after planting	Yes
Synchrony XP	up to 30 days	No
Valor	up to 14 days	Yes
Valor XLT	anytime, but no later than 3 days after planting	Yes

[1] Early application not recommended in areas where average annual rainfall exceeds 40 inches.

[2] Can be applied 30 days before planting if followed with planned postemergence treatments - otherwise it can be applied 21 days before planting.

[3] Canopy/Cloak EX rates of 2.2 oz or less should be applied at least 7 days before planting; rates of 2.2 to 3.3 oz should be applied at least 14 days before planting.

Burndown Herbicides in No-Tillage Corn and Soybeans

Herbicide	Formulation	Product Rate Range
2,4-D Amine	Various	0.5 - 1 lb ai/A
2,4-D Ester	Various	0.5 - 1 lb ai/A

- Apply in fall or spring for control of emerged annual broadleaf weeds, including ragweeds, lambsquarters, mustard species, marestail, prickly lettuce, and dandelion. Controls or suppresses perennial broadleaf weeds and legume sods (alfalfa, clover).
- Mode of action: group 4 (see pages 12-13).
- 2,4-D ester or amine can be applied preplant or preemergence to corn, but labels vary with regard to specific recommendations on timing of application. Labels for some products recommend application either 7 to 14 days before planting or 3 to 5 days after planting before the corn has emerged, while others specify application any time after planting.
- Applications of 2,4-D around the time of planting can injure corn. This is more likely to occur in coarse-textured soils with low organic matter content, and when above-average rainfall and prolonged soil moisture occur within a week after planting. When applied preemeergence, 2,4-D amine is more likely to injure corn than 2,4-D ester. Labels for some products do not allow preplant or preemergence use of 2,4-D on light, sandy soils. Injury may be more severe when 2,4-D is applied with chloracetamide herbicides.
- Many 2,4-D products are labeled for use in the spring prior to no-till soybean planting. OSU and Purdue University recommend the use of only 2,4-D low-volatile ester (LVE) or similar products for this application. 2,4-D amine products are more water soluble and may leach into the seed zone. For 2,4-D LVE, rates up to 0.5 lb active ingredient per acre must be applied at least 7 days before soybean planting. Application rates of more than 0.5 lb up to 1.0 lb active ingredient per acre generally must be applied at least 30 days before planting. Several 2,4- ester products, including E-99, Salvo, and Weedone 650, can be applied at a rate of 1.0 lb ai/A up to 15 days before planting. Do not apply more than 1 lb ai per acre. Only one spring application is allowed per year.
- 2,4-D is more effective than glyphosate for control of legume sods, marestail, dandelion, and prickly lettuce. For best control of alfalfa prior to corn planting, apply in combination with 1/2 pint of dicamba. If legume sods are cut prior to application of 2,4-D or 2,4-D plus dicamba, allow sufficient regrowth (4 to 6 inches) before herbicide application, or poor control may result.
- When applied at rate of 1 lb ai/A in the fall, 2,4-D will control mustards, marestail, purple deadnettle, and many other broadleaf weeds. Add glyphosate for effective control of common chickweed, wild carrot, poison hemlock, cressleaf groundsel, Canada thistle, dandelion, and grasses.

Herbicide	Formulation	Product Rate Range
Autumn	10 WDG	0.3 oz
Autumn Super	51 WDG	0.5 oz

- Autumn (iodosulfuron-methyl) can be applied in fall before corn or soybeans planting, or early spring up to 30 days before corn planting, for control of winter annual weeds and dandelion. Most effective control occurs when mixed with glyphosate or 2,4-D and applied in the fall. Apply with 2,4-D for control of ALS- or glyphosate-resistant marestail.
- Autumn Super is a premix of iodosulfuron and thiencarbazone, which adds control of emerged winter annual grasses and some residual control.
- Mode of action: group 2 (see pages 12-13).
- Apply Autumn with COC (1% v/v) plus UAN (1.5 - 2 qts/A) or AMS (1.5 - 3 lbs/A).
- Apply Autumn Super with COC, MSO or oil blend (1% v/v) plus UAN (1.5 - 2 qts/A) or AMS (1.5 - 3 lbs/A).
- Do not apply to frozen ground.

Herbicide	Formulation	Product Rate Range
Rimsulfuron + thifensulfuron (active ingredient)		
Basis Blend	30DF	0.825 - 2 oz
Thifensulfuron + tribenuron (active ingredient)		
Harmony Extra	50DF	0.75 - 0.9 oz
Nimble, TNT Broadleaf	75WDG	0.5 - 0.6 oz
Tribenuron (active ingredient)		
Express	50DF	0.25 - 0.5 oz
Nuance	75WDG	1/6 - 1/3 oz

Burndown Herbicides in No-Tillage Corn and Soybeans

- Tribenuron products can be applied in the fall and/or spring before planting corn or soybeans (at least 14 days before planting) for control of wild garlic and other broadleaf weeds.
- The premix of thifensulfuron and tribenuron-methyl controls wild garlic and annual broadleaf weeds, including lambsquarters, mustard species, Pennsylvania smartweed, field pennycress, and shepherd's purse. Tribenuron controls purple deadnettle, chickweed, and field pennycress, and provides partial control of shepherd's-purse and other mustard species. Apply with 2,4-D ester for best results.
- Basis Blend is a premix of rimsulfuron plus thifensulfuron that can be applied in the fall or spring before planting corn for control of winter annual weeds. When mixed with 2,4-D ester, fall-applied Basis controls chickweed, deadnettle, henbit, dandelion, mustards. and other winter weeds. Spring applications with other corn herbicides (2,4-D ester, atrazine) before corn planting can provide burndown of small annual grass and broadleaf weeds, and several weeks of residual control of foxtails, lambsquarters, and pigweeds. A mixture of Basis plus atrazine has been one of the most effective burndown treatments for no-till corn in OSU research. Apply with COC (1%, v/v) and ammonium nitrogen fertilizer. Can be mixed with other herbicides approved for these uses. The 0.825 oz rate can be applied up to 15 days before soybean planting. South of I-70, Basis can be applied at rates up to 1.25 oz/A in the fall prior to soybean planting.
- Mode of action: group 2 (see pages 12-13).
- To control wild garlic, apply the higher rates of thifensulfuron+tribenuron when garlic plants are less than 12 inches tall with 2 to 4 inches of new growth. Control will be better if applied during warm weather (60 F or more) to actively growing garlic plants. Thorough spray coverage of garlic plants is essential.
- Apply with COC (1% v/v) or NIS (0.25% v/v). Use flat fan or low-volume flood nozzles for best results.

Herbicide	Formulation	Product Rate Range
Chlorimuron (active ingredient)		
Canopy EX/Cloak EX/Fallout	29.5 DF	1.1 to 3.3 oz
Canopy/Cloak DF	75 DF	2.25 to 7 oz
Envive	41 DG	2.5 to 5 oz
Valor XLT	40 WDG	2.5 to 5 oz
Authority XL	70 DF	3 to 9.6 oz

- These products provide residual control of broadleaf weeds, and the chlorimuron component helps control many emerged no-till weeds in mixtures with 2,4-D and glyphosate in preplant burndown treatments.
- Mode of action: group 2 (Canopy/Cloak EX); group 2 and 5 (Canopy/Cloak DF); group 2 and 14 (Valor XLT, Envive, Authority XL). See pages 12-13.
- Canopy/Cloak EX can be applied in fall or spring, with following restriction: rates of 2.2 oz or less should be applied at least 7 days before planting; rates of 2.2 to 3.3 oz should be applied at least 14 days before planting. Canopy/Cloak DF can be applied in fall or spring (up to 45 days before planting). Envive and Valor XLT can be applied anytime in fall or spring, but must be applied before soybean emergence and no later than 3 days after planting. Authority XL can be applied in fall, or in spring from 60 days before through 3 days after soybean planting. Do not apply to frozen or snow-covered ground.
- Maximum rate on soils where the composite pH exceeds 7.0 (pH 6.8 for Valor XLT): Canopy/Cloak EX - 1.1 oz/A; Canopy/Cloak DF - 2.25 oz/A; Valor XLT and Envive - 2.5 oz/A. Authority XL cannot be applied on soils with pH greater than 7.6. Authority XL rates are not pH-dependent, but rotation intervals for most crops are extended to at least 18 months for soil pH between 7.2 and 7.6 regardless of rate.
- These products products can be applied to no-till or conservation tillage fields in the fall for burndown of existing vegetation and limited residual control into the following growing season. 2,4-D should be included with all fall-applied treatments. Do not apply to frozen ground.
- Canopy/Cloak EX controls common chickweed, but Canopy/Cloak DF, Envive, Valor XLT, and Authority XL require the addition of glyphosate or Express for chickweed control.
- Spring treatments should include 2,4-D ester and/or glyphosate for most effective control of emerged weeds. Glyphosate should be included if applied later than early April and where marestail, dandelion, and other perennials are present.
- Apply with COC (1 gallon/100 gallons spray) for best control of emerged weeds, unless glyphosate is included in the treatment.
- See descriptions of these products in "Soybean: Soil-Applied Herbicides" section for additional information.

Burndown Herbicides in No-Tillage Corn and Soybeans

Herbicide	Formulation
Corvus	2.63SC

- Corvus is a premix of isoxaflutole and cyprosulfamide (Balance Flexx) and thiencarbazone-methyl. See Corvus description in "Corn: Soil-applied Herbicides" section for more information.
- Preplant application of Corvus can control small, emerged annual weeds (6 inches or less) in no-till, especially when combined with atrazine. Apply with COC or MSO. Can be mixed with 2,4-D, Gramoxone, or glyphosate for improved burndown activity on larger weeds or weeds not controlled by Corvus and atrazine.
- See description of this product in "Corn Soil-Applied Herbicides" section for additional information.

Herbicide	Formulation	Product Rate Range
Dicamba	4L	1/2 - 1 pt
Distinct	76.4DF	2 - 3 oz

- Dicamba is sold under a number of trade names, including Banvel, Clarity, Sterling Blue, and Oracle. Dicamba is a translocated herbicide that can be applied before, during, or after no-till corn planting for control of emerged broadleaf weeds.
- Mode of action: group 4 (see pages 12-13).
- Use 1/2 pint on coarse-textured soils, and 1 pint on medium- or fine-textured soils containing at least 2 percent organic matter.
- Dicamba is more effective than glyphosate for control of legume sods, especially when applied in combination with 2,4-D. When planting into a legume sod, apply dicamba after regrowth of 4 to 6 inches has occurred.
- The addition of crop oil, surfactant, or fluid fertilizer may improve control of emerged weeds. Do not apply with crop oil when corn is more than 5 inches tall.
- Corn should be planted at least 1 1/2 inches deep with good-seed furrow closure. May injure corn if recommended rates are exceeded, application is not uniform, or corn is planted too shallow.
- The 1 pint rate provides limited residual control of small-seeded, annual broadleaf weeds.
- Some dicamba products are labeled for application in the spring prior to soybean planting. The Clarity label allows soybeans to be planted 14 days after application of 8 oz/A, and 28 days after application of 16 oz/A, as long as one inch of rainfall has occurred between application and planting.
- Distinct is a premix of dicamba and diflufenzopyr, and is more active that dicamba on a number of weeds. Distinct rates: cor n - 2 to 3 oz/A applied at least 14 days before planting; soybeans - 2 to 4 oz/A, at least 30 days and 1 inch of rain must occur between application and soybean planting.

Herbicide	Formulation	Product Rate Range
Dicamba + 2,4-D premix	3.87L	0.5 - 6 pts

- This product is available from various manufacturers, and product names and rates vary. It controls emerged weeds in the fall after corn or soybean harvest, or in the summer or fall after wheat harvest. Similar products are available from other manufacturers.
- Mode of action: group 4 (see pages 12-13).
- Controls mustards, marestail, cressleaf groundsel, dandelion and some other winter annual weeds, but is weak on purple deadnettle and common chickweed.
- Apply when annual weeds are less than 6 inches tall, when biennials are in the rosette stage, and when perennials are at least 6 inches tall or in the bud to bloom stage.
- Any crop can be planted 120 days after application of rates up to 6 pints per acre.
- Can be applied prior to wheat planting, but allow an additional 10 days between application and planting for each pint applied (e.g. for a 2 pint rate allow 20 days).
- The standard adjuvant recommendation is 2 to 4 pints of NIS per 100 gallons of spray solution.

Burndown Herbicides in No-Tillage Corn and Soybeans

Herbicide	Formulation	Product Rate Range
Dicamba + atrazine premix	3.2L	2 - 3 1/2 pt

- Dicamba plus atrazine is sold under a number of trade names, including Marksman, Sterling Plus, Banvel-K+atrazine, and Stratos. These products control most emerged annual broadleaf weeds, and suppress or control perennial broadleaf weeds, and provide some residual control of broadleaf weeds.
- Mode of action: group 5 (atrazine), group 4 (dicamba). See pages 12-13.
- Can be applied before, during, or after planting to emerged, actively growing weeds. Apply 2 pints on coarse soils with at least 2 percent organic matter, and 3 1/2 pints on medium- or fine-textured soils with at least 2 percent organic matter.
- The addition of crop oil, surfactant, or fluid fertilizer may improve control of emerged weeds. Do not apply with crop oil after corn is 5 inches tall.
- When planting into a legume sod, apply after regrowth of 4 to 6 inches has occurred.
- Corn should be planted at least 1 1/2 inches deep with good seed-furrow closure. May injure corn if recommended rates are exceeded, application is not uniform, or corn is planted too shallow.

Herbicide	Formulation
Expert	4.88L

- Expert is a premix of glyphosate, s-metolachlor (Dual II Magnum), and atrazine for burndown and residual control of grass and broadleaf weeds in no-till and conservation tillage corn. See descriptions of glyphosate and metolachlor/s-metolachlor plus atrazine for more information on these herbicides.
- Mode of action: group 9 (glyphosate), group 5 (atrazine), group 15 (s-metolachlor). See pages 12-13.
- Use rates provide the equivalent of 0.4 to 0.75 lbs of glyphosate acid and 1.75 to 2.6 quarts/A of Bicep II Magnum. Use rate ranges from 2.5 to 3.75 qts/A on coarse-textured soils with less than 3% organic matter, and from 3 to 3.75 on all other soils.
- Apply before, during, or after planting but before crop emergence.
- Can be applied postemergence to glyphosate-resistant corn. Use water as the spray carrier for postemergence applications.
- Can be applied in water or UAN (28% or 32% only). Control of emerged weeds, especially perennial and large annual weeds, may be reduced if fertilizer is used as the carrier.
- The addition of AMS (17 lbs/100 gallons) can improve control of emerged annual weeds under cool or dry conditions.

Herbicide	Formulation	Product Rate Range
Glyphosate	Various	0.75 - 1.5 lbs acid/A

- Do not apply broadcast after the crop has emerged, unless the crop has resistance to glyphosate (Roundup Ready, Agrisure GT, etc).
- To reduce the risk of developing glyphosate-resistant weed populations, OSU and Purdue University recommend application of glyphosate with 2,4-D ester wherever practical, including preplant applications to no-till corn and soybeans, in the summer/fall following wheat harvest, and in the fall for control of winter annuals and dandelion. An exception to this occurs when Canada thistle is the primary weed target for a fall application, in which case the 2,4-D ester should be omitted.
- Glyphosate is a nonselective, translocated herbicide that controls emerged annual and perennial grass and broadleaf weeds, volunteer cereals, and grass cover crops. Table 24 contains a list of some currently available glyphosate products. Application rates, adjuvant recommendations, and other guidelines for use vary among glyphosate products, and users should consult labels and local product use guides for more specific information. The following comments are meant as general guidelines for the use of glyphosate.
- Mode of action: group 9 (see pages 12-13).
- The minimum glyphosate rate for most situations where weeds are no more than about 6 inches tall should be 0.75 lbs of glyphosate acid/A. Rates should be increased accordingly as weeds become taller. Pennsylvania smartweed, atriplex, giant ragweed, crabgrass, fall panicum, barnyardgrass, marestail, dandelion, and a number of winter annual weeds can be difficult to control, and should be as small as possible at the time of application. A mixture of glyphosate plus 2,4-D ester (0.5 - 1 lb ai/A) will improve control of most broadleaf weeds.

Burndown Herbicides in No-Tillage Corn and Soybeans

- Glyphosate resistance has developed in populations of marestail and common and giant ragweed in Ohio and Indiana, and some lambsquarters populations appear to have become less sensitive to glyphosate. To improve control of these populations and reduce the risk of resistance, apply a mixture of glyphosate plus 2,4-D ester at least 7 days before soybean planting, and include preemergence herbicides that have residual activity on these weeds (e.g. Valor, metribuzin, Gangster). Avoid use of herbicide programs in glyphosate-resistant crops consisting solely of multiple glyphosate applications. See the "Problem Weeds" section of this guide for additional information on management of these weeds.
- For control of rye or overwintered wheat, apply in a spray volume of 10 gpa or less and use the appropriate rate for small grain size. Wheat should be treated before reaching a height of 18 inches.
- A number of glyphosate products can be applied immediately prior to alfalfa harvest in spring or fall, and the treated alfalfa then harvested and fed to livestock. This application is useful where corn will be planted immediately after alfalfa harvest, since it provides more effective alfalfa and perennial grass control, compared to application after harvest. Allow a minimum of 36 hours between application and harvest. Alfalfa should be harvested 3 to 7 days after application to avoid loss of quality and maximize perennial control. The preemergence herbicide program for corn should include atrazine at a rate of 1 1/4 to 1 1/2 quarts (or the equivalent amount in a premix).
- Glyphosate activity will be maximized when applied in water in a spray volume of 10 gpa or less. When mixing with residual herbicides, apply in 10 or more gallons of water or UAN per acre.
- Glyphosate activity on perennial and large annual weeds may be reduced when mixing with residual herbicides or applying in UAN. Residual herbicides most likely to reduce activity include Bullet and MicroTech, and herbicides with contact activity on emerged weeds (Valor, metribuzin, atrazine, etc). Consult labels for rates and precautions when mixing with residual herbicides.
- Recommendations for the use of AMS (17 lbs/100 gallons of water) with glyphosate vary among products. Addition of AMS may improve control, and is recommended under the following conditions: when mixing with residual corn or soybean herbicides, when air temperature is 55 degrees or less, or when hard or high pH water is used as the carrier.

Herbicide	Formulation	Product Rate Range
Gramoxone SL	2L	2 - 4 pts
Parazone	3SL	1.3 - 2.7 pts

- Do not apply broadcast after the crop has emerged.
- Gramoxone SL and Parazone contain paraquat, a nonselective contact herbicide that controls emerged annual grass and broadleaf weeds. Paraquat usually provides acceptable control of a rye cover, but is less effective than glyphosate for control of forage grasses such as orchardgrass and tall fescue. Paraquat is not effective for control of perennial broadleaf weeds, legume sods, perennial grass sods, or volunteer wheat although some suppression of these may occur.
- Mode of action: group 22 (see pages 12-13).
- May not control marestail and prickly lettuce. May not control smartweed, giant ragweed, and fall panicum that are more than 4 to 6 inches tall. Control of these and many other weeds will be improved when paraquat is mixed with photosynthetic inhibitor herbicides (atrazine, metribuzin, and Lorox). Paraquat should generally be applied with a metribuzin-containing product and 2,4-D ester in no-till soybeans.
- Application rates for Gramoxone SL: 2 to 2.5 pints for 1- to 3-inch weeds; 2.5 to 3 pints for 3- to 6-inch weeds; and 3 to 4 pints for weeds more than 6 inches tall. Application rates for Parazone: 1.3 to 1.7 pints for 1- to 3-inch weeds; 1.7 to 2 pints for 3- to 6-inch weeds; and 2 to 2.7 pints for weeds more than 6 inches tall
- Apply with COC (1 gallon/100 gallons spray) or NIS (1 quart/100 gallons). COC is the preferred spray adjuvant, especially when mixing with other herbicides.
- When using flat fan nozzles spaced at 20 inches or less, apply in a spray volume of at least 10 gpa with a pressure of at least 30 psi. Increase spray volume to at least 15 to 20 gpa if weeds are more than 3 inches tall. For large spray equipment with flood type nozzles, use a spray volume of at least 20 gpa with a pressure of at least 30 psi.
- Allow 30 minutes between application and rainfall.
- Do not apply with suspension or high-phosphate liquid fertilizers.

Burndown Herbicides in No-Tillage Corn and Soybeans

Herbicide	Formulation	Product Rate Range
Ignite 280 SL	2.34L	29 - 36 oz

- Ignite (glufosinate) is a contact herbicide that controls small, annual grass and broadleaf weeds, and suppresses some perennials.
- Mode of action: group 10 (see pages 12-13).
- Application of Ignite alone controls marestail and ragweeds, but may not provide adequate control of all of the weeds that can found in a typical no-till burndown situation in Ohio or Indiana. Apply in combination with 2,4-D ester and/or a metribuzin-containing herbicide (at least 0.2 lb ai metribuzin) for most effective control, especially where the field was not treated the previous fall.
- Maximum amounts of Ignite that can be applied per season (burndown + POST) in LibertyLink crops: corn - 44 oz; soybeans - 65 oz.
- Apply in a minimum spray volume of 15 gpa, and use 20 to 40 gpa in dense weed canopies. Apply using nozzles and spray pressures that result in medium-size spray droplets (250 to 350 microns). Control can be reduced when nozzles and pressure result in coarse droplets.
- Control can be reduced when applied to weeds under stress from drought or cold conditions.

Herbicide	Formulation
Lumax	4L
Lexar	3.7L

- Lumax and Lexar are premixes of atrazine plus s-metolachlor (Dual II Magnum) plus mesotrione (Callisto). A use rate of Lexar contains a higher amount of atrazine per acre, compared with Lumax, and a lower amount of s-metolachlor.
- Mode of action: group 5 (atrazine); group 15 (s-metolachlor); group 13 (mesotrione). See pages 12-13.
- Lexar and Lumax have been among the most effective preplant burndown treatments for no-till corn in OSU and Purdue University research, for control of dandelion and most winter annual weeds. These products also provide residual control of annual grass and broadleaf weeds. See descriptions of these products in the corn herbicide section for more information.
- Lexar use rates: soils with less than 3% organic matter - 3 qts/A; soils with more than 3% organic matter - 3.5 qts/A. Lumax use rates: soils with less than 3% organic matter - 2.5 qts/A; soils with more than 3% organic matter - 3.0 qts/A.
- See descriptions of these products in "Corn: Soil-Applied Herbicides" section for additional information.

Herbicide	Formulation	Product Rate
Prequel	45WDG	1.66 to 2.5 oz

- Prequel is premix of isoxaflutole (Balance Pro) and rimsulfuron that provides residual control of grass and broadleaf weeds, and also controls some small (less than 3 inches), emerged weeds in no-till burndown situations. See Prequel description in "Corn: Soil-applied Herbicides" section for more information.
- Control of emerged weeds can be improved with the addition of one or more of the following: 2,4-D, atrazine, glyphosate, or paraquat. Control of emerged weeds requires the addition of NIS or COC plus AMS or UAN. When mixed with Ignite or a glyphosate product that contains adjuvants, no additional NIS or COC is needed.
- See description of this product in "Corn: Soil-Applied Herbicides" section for additional information.

Herbicide	Formulation	Product Rate
Sharpen (corn)	2.85SC	2 to 3 oz
Sharpen (soybeans)		1 to 1.5 oz
Sharpen (wheat)		1 to 2 oz
Optill (soybeans)	68 WDG	2 oz
Verdict (corn)	5.57 EC	10 to 16 oz
Verdict (soybeans)		5 oz

- These products contain saflufenacil, which can help control emerged weeds, especially marestail, in preplant no-till burndown treatments. Sharpen and Optill (and Verdict used in soybeans) should be combined with glyphosate or Ignite for broad-spectrum burndown. The combination of Verdict and atrazine may provide adequate burndown of small weeds in no-till corn, but glyphosate should be added when weeds are more than about 4 inches tall, and for weeds Verdict does not control (see label). For more information on these products, see descriptions of Sharpen and Optill in "Soybeans: Soil-applied Herbicides" and description of Verdict in "Corn: Soil-applied Herbicides".
- Can be applied in the fall prior to soybeans. Sharpen must be applied at least 14 days before soybean planting when applied at rates greater than 1 oz/A. This extends to 44 days before planting on coarse-textured soils with less than 2% organic matter.
- Burndown activity requires the addition of MSO (1% v/v) plus either AMS (8.5 to 17 lbs/100 gallons) or UAN (1.25 to 2.5% v/v).
- Salfufenacil products used in soybeans cannot be mixed with or applied within 30 days of products containing flumioxazin (Valor products, Envive, and Gangster), sulfentrazone (Authority products and Sonic), or fomesafen (Prefix).

Corn Herbicide Management Strategies

Preemergence herbicide programs have long been the mainstay of weed management in corn, due in large part to the low cost of atrazine and its broad spectrum of control. A total preemergence approach can still be effective in fields with low to moderate populations of most annual weeds. The commonly used premix of atrazine plus an acetamide herbicide (Bicep II Magnum, Degree Xtra, Keystone, etc) can be supplemented as necessary with Balance, Python, Callisto (Lexar, Lumax), Hornet, or simazine to improve control of weeds such as fall panicum, triazine-resistant lambsquarters, giant ragweed, and velvetleaf. In fields with moderate to high weed populations, a preemergence plus postemergence approach will provide more consistent control with less risk of corn injury. A number of options are available for this type of program at a reasonable cost. A preemergence plus postemergence approach is especially effective in fields with giant ragweed, burcucumber, moderate to high annual populations of annual grasses and triazine-resistant lambsquarters, and perennial weeds. A number of effective total postemergence herbicide programs are also available. However, research indicates that total postemergence programs lacking residual activity should be used only in fields with low weed populations. A total postemergence herbicide program should be applied before most weeds in a field exceed 2 to 4 inches in height, and reinfestation with later-emerging weeds is likely if a herbicide with residual activity is not included.

Preemergence Corn Herbicide Programs

Total preemergence (PRE) herbicide programs fit fields with:

- low to moderate annual grass populations
- low giant ragweed populations
- any level of population of most annual broadleaf weeds

Total preemergence programs do not fit fields with:

- high grass populations
- moderate to high giant ragweed, cocklebur, velvetleaf, and annual morningglory populations
- perennial weeds
- burcucumber

Advantages of PRE programs:

- one-pass, can apply while planting
- with adequate rain, provides control through the first 6 weeks, and later-emerging weeds have little impact on corn yield
- effective on many annual grass and broadleaf weeds

Disadvantages of PRE programs:

- dependence upon adequate rain within narrow period of time
- not effective enough on tough broadleaf or perennial weeds or in high grass populations
- corn needs to be competitive with weeds earlier in season compared to PRE plus POST programs

Approaches:

Atrazine premix products (Lexar, Harness Xtra, etc) or similar mixes are effective broad-spectrum treatments for fields suited to total preemergence.

- can add simazine or Balance Flexx to improve grass control (or use a mixture of Radius + atrazine)
- can add Balance Flexx to improve consistency under low rainfall conditions
- can add Balance Flexx, Callisto, Python, or Hornet to improve triazine-resistant lambsquarters, giant ragweed, and velvetleaf control, or apply premix products that contain these herbicides.
- atrazine rates of 1.5 to 2 lb/A can improve control of velvetleaf and giant ragweed. Some premix products have less than 1.5 lbs/A

Preemergence plus Postemergence Corn Herbicide Programs

Preemergence (PRE) plus Postemergence (POST) herbicide programs fit any field, but are especially well-suited for fields with:

- moderate to high annual grass populations
- moderate to high giant ragweed, cocklebur, velvetleaf, and annual morningglory populations
- perennial weeds
- burcucumber

Advantages of PRE plus POST programs:

- very consistent, as long as some rain on PRE
- creates wider window for POST application, compared to total POST programs
- good on many tough weeds

Disdvantages of PRE plus POST programs:

- dependence upon rain for PRE activity (although have planned POST backup)
- two-pass
- cost

Approaches:

In fields with low to moderate grass populations, can take an approach of preemergence grass herbicide followed by postemergence broadleaf herbicide (without much grass activity). Examples:

- Outlook followed by dicamba + atrazine
- TopNotch followed by Hornet + Clarity

To provide postemergence control of a few grass escapes, can take an approach of a preemergence grass or grass and broadleaf herbicide followed by a postemergence broadleaf herbicide that also has activity on small grasses. Examples:

- Dual II Magnum followed by NorthStar
- Outlook followed by Distinct + atrazine
- Guardsman Max followed by Impact

In fields with moderate to high grass and/or problem broadleaf populations, can take an approach of preemergence grass or grass+broadleaf herbicide (full or reduced rate) followed by broad-spectrum postemergence herbicide with grass and broadleaf activity. Examples:

- Cinch ATZ followed by Steadfast ATZ
- atrazine + simazine followed by Lightning + Status (Clearfield corn)
- Corvus followed by Ignite (Liberty Link corn)
- Harness Xtra followed by glyphosate (RR corn)

Total Postemergence Corn Herbicide Programs (with residual)

Total postemergence (POST) herbicide programs that provide substantial residual control can be used in fields with:

- most annual weed populations

Avoid use in fields with:

- perennial broadleaf weeds (might emerge too late for control)
- high giant ragweed and annual grass populations

Advantages of total POST with residual:

- one-pass, can plant first and apply later
- not dependent upon rainfall for postemergence activity (although soil moisture status affects weed response to herbicides)
- consistent control of many annual weed populations

Disadvantages of total POST with residual:

- should be applied before weeds exceed 2 to 4 inches in height to avoid yield loss
- application too early for best perennial weed control
- need rain within 2 weeks of application for residual activity

Approaches:

Can make a single postemergence application before weeds exceed 4 inches in height with mix of postemergence herbicides with grass and broadleaf activity and residual herbicides with primarily broadleaf activity (if grass population not high). Examples:

- Ignite + atrazine (Liberty Link corn)
- glyphosate plus atrazine (glyphosate-resistant corn)
- Steadfast ATZ + Callisto
- Option + Marksman

In fields with moderate to high grass pressure, may need residual component with more activity on grasses than those listed above. Examples:

- Glyphosate + Degree Xtra (glyphosate-resistant corn)
- Halex GT (glyphosate-resistant corn)
- Ignite + atrazine/chloroacetamide premix (Liberty Link corn)

Table 3. Weed Response to Preplant/Preemergence Herbicides in Corn

This table compares the relative effectiveness of herbicides on individual weeds. Ratings are based on labeled application rate and weed size or growth stage. Performance may be better or worse than indicated in the table, due to weather or soil conditions or other variables. See pages 12-13 for additional information on mode of action classification.

Weed control rating:
9 = 90% to 100% control
8 = 80% to 90% control
7 = 70% to 80% control
6 = 60% to 70% control
- = less than 60% control, not recommended.

Crop tolerance rating:
0 = Excellent
1 = Good
2 = Fair
3 = Poor

Crop injury of 1 or less is rarely significant.

			Grasses											Broadleaf Weeds															
	Mode of Action	Crop Tolerance	Barnyardgrass	Crabgrass	Fall Panicum	Giant Foxtail	Yellow Foxtail	Shattercane	Rhizome Johnsongrass	Quackgrass	Yellow Nutsedge	Annual Morningglory	Black Nightshade	Burcucumber	Cocklebur	Common Ragweed	Common ragweed (ALS-resistant)	Giant Ragweed	Giant ragweed (ALS-resistant)	Jimsonweed	Lambsquarters	Lambsquarters (triazine-resistant)	Pigweed	Smartweed	Velvetleaf	Waterhemp
Preplant or Preemergence																													
Acetochlor[1]	15	1	9	9	8	9	9	-	-	-	8+	-	8+	-	-	7	7	-	-	-	7+	7+	8+	-	-	8
Acetochlor+atrazine[1]	5/15	1	9	9	8	9	9	-	-	6	8+	8	9	6	8	9	9	8	8	9	9	7+	9	9	8	9
Alachlor[1]	15	1	8	8+	8	8+	8+	-	-	-	8	-	8+	-	-	-	-	-	-	-	6	6	8	-	-	8
Alachlor + atrazine[1]	5/15	1	9	8+	8	8+	8+	-	-	6	8	8	9	6	8	9	9	8	8	9	9	6	9	9	8	9
Atrazine	5	0	8	-	-	7	7	-	-	8	7	8	9	6	8	9	9	8	8	9	9	-	9	9	8	9
Balance Flexx	28	1	8	7	8	8	6	6	6	-	-	-	9	7	-	9	9	6	6	9	9	9	9	8	9	8
Callisto	28	1	-	6	-	-	-	-	-	-	-	6	9	7	-	7	7	6	6	-	9	9	9	9	9	9
Corvus	2/28	1	8	8+	8+	8+	8+	7	7	-	7	7	9	7	8	9	9	8	8	8	9	9	9	9	9	9
Guardsman Max	5/15	1	9	8+	8	8+	8+	-	-	-	8	8	9	-	8	9	9	7	7	9	9	6	9	9	7+	9
Hornet	2/4	2	-	-	-	-	-	-	-	-	-	6	8+	-	8	8+	8+	7+	7+	8	9	9	9	8+	9	-
Lumax/Lexar	5/28/15	1	9	9	8+	9	9	-	-	6	8	8	9	7	8	9	9	8	8	9	9	9	9	9	9	9
Metolachlor[1]	15	1	8	9	8+	9	9	-	-	-	8+	-	8	-	-	-	-	-	-	-	6	6	8	-	-	8
s-Metolachlor[1]	15	1	8	9	8+	9	9	-	-	-	8+	-	8	-	-	-	-	-	-	-	6	6	8	-	-	8
Metolachlor + atrazine[1]	5/15	1	9	9	8	9	9	-	-	6	8	8	9	6	8	9	9	8	8	9	9	6	9	9	8	9
s-Metolachlor + atrazine[1]	5/15	1	9	9	8	9	9	-	-	6	8	8	9	6	8	9	9	8	8	9	9	6	9	9	8	9
Outlook	15	1	8	8+	8	8+	8+	-	-	-	8	-	8+	-	-	-	-	-	-	-	6	6	8	-	-	8
Prequel[2]	2/28	2	8	7	8	8	7	6	6	-	-	7	8	7	-	8	8	6	6	8	9	9	9	8	9	8
Python	2	2	-	-	-	-	-	-	-	-	-	-	8	-	7	7	-	-	-	7	9	9	9	8	8+	-
Resolve	2	1	7	6	6	7	7	-	-	-	-	7	-	-	-	7	-	-	-	7	7	7	7	7	6	-
Sharpen[2]	14	1	-	-	-	-	-	-	-	-	-	8	8	?	8	8	8	8	8	8	9	9	9	8	8	8
Simazine	5	0	8	7	7	8	8	-	-	6	-	7	9	6	7	9	9	7	7	8	9	-	9	8+	7	-
SureStart/TripleFlex[2]	2/4/15	2	8	8	8	8	8	-	-	-	7	6	8+	-	8	8+	8+	7+	7+	8	9	9	9	8+	8+	8
Valor[3]	14	1	-	-	-	-	-	-	-	-	-	7	9	-	-	7	7	-	-	-	9	9	9	7	7	7
Verdict[2]	14/15	1	8	8	8	8	8	-	-	-	-	8	9	?	8	9	9	8	8	8	9	9	9	9	8	9
Preemergence																													
Lorox/Linex	7	2	-	-	-	-	-	-	-	-	-	-	7	-	6	8	8	-	-	6	9	9	9	9	6	8
Pendimethalin	3	2	8	8	8	8	8	6	6	-	-	-	-	-	-	-	-	-	-	-	8	8	9	-	-	8

[1]Acetochlor, alachlor, metolachlor, and s-metolachlor, and premixes of these with atrazine are available from a number of manufacturers - see corn herbicide descriptions for more information. Grass weed control ratings presented here for acetochlor are for Degree products, which can provide a longer period of grass control compared to other acetochlor products. Broadleaf weed control ratings assume an atrazine rate of 1.5 lbs ai/A - the atrazine rate in some premix products may be lower.

[2]SureStart/TripleFlex, Verdict, Sharpen, and Prequel are intended for use in planned preemergence followed by postemergence programs, and ratings indicate early-season effectiveness, not full-season control. PRE application of these products should be followed with a POST application of Ignite, glyphosate, or other herbicides as necessary.

[3]Valor must be applied at least 7 days before corn planting. Use only in no-till fields.

Table 4. Weed Response to Postemergence Herbicides in Corn

			Grasses											Broadleaf Weeds																
	Mode of Action	Crop Tolerance	Barnyardgrass	Crabgrass	Fall Panicum	Giant Foxtail	Yellow Foxtail	Shattercane	Seedling Johnsongrass	Rhizome Johnsongrass	Quackgrass	Yellow Nutsedge	Annual Morningglory	Black Nightshade	Burcucumber	Cocklebur	Common Ragweed	Common ragweed (ALS-resistant)	Giant Ragweed	Giant ragweed (ALS-resistant)	Jimsonweed	Lambsquarters	Lambsquarters (triazine-resistant)	Pigweed	Smartweed	Velvetleaf	Waterhemp	Canada Thistle
Postemergence																														
2,4-D	4	2	-	-	-	-	-	-	-	-	-	-	9	7	-	9	9	9	9	9	7	9	9	9	6	8	8	6
Aim	14	2	-	-	-	-	-	-	-	-	-	-	8	8	-	-	6	6	-	-	-	7	7	8+	-	9	7	-
Atrazine	5	1	7	-	-	8	8	-	-	-	7	7	9	9	8	9	9	9	8	8	9	9	-	9	9	8	9	6
Basagran	6	0	-	-	-	-	-	-	-	-	-	8	-	-	-	9	7	7	6	6	9	6	6	-	9	8+	-	7
Beacon	2	2	-	-	8	7	7	9	9	7	8+	6	6	8	9	9	9	-	9	-	9	-	-	9	8	8	-	6
Bromoxynil	5	1	-	-	-	-	-	-	-	-	-	-	8	9	7	9	9	9	8	8	9	9	9	7	8	8	6	6
Bromoxynil+Atrazine	5/6	1	-	-	-	-	-	-	-	-	-	-	9	9	9	9	9	9	9	9	9	9	9	9	9	9	8	7+
Cadet	14	2	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	-	7	7	8	-	9	7	-
Callisto	28	1	-	7*	-	-	-	-	-	-	-	-	7	9	7+	7+	7+	7+	8	8	9	9	9	8	9	9	9	-
Callisto Xtra	5/28	1	-	7*	-	-	-	-	-	-	-	-	8	9	8	9	9	9	9	9	9	9	9	9	9	9	9	-
Capreno	2/27	1	8	8	8	8+	9	8	8	7	7	-	7	9	8	8	8	8	8	8	9	9	9	9	8	9	9	-
Dicamba	4	2	-	-	-	-	-	-	-	-	-	-	9	8	7	9	9	9	9	9	9	8	8	8	8	7+	8	7
Dicamba+atrazine	4/5	2	-	-	-	-	-	-	-	-	-	-	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	7+
Glyphosate[3]	9	0	8	8	8	9	9	9	9	9	9	7	6	8	8	9	8+	8+	8+	8+	9	8+	8+	9	8	8	8	9
Halex GT[3]	9/28/15	1	9	9	9	9	9	9	9	9	9	7	8	9	8	9	9	9	8+	8+	9	9	9	9	9	9	9	9
Hornet	2/4	1	-	-	-	-	-	-	-	-	-	-	7	7	6	9	9	9	9	9	7	7+	7+	7+	9	8+	-	8+
Ignite[2]	10	0	7	8	8	8+	7	8	8	7	6	-	8	9	8	9	9	9	9	9	9	8	8	8	9	8	8	6
Impact	28	0	7	7+	6	7+	7	6	7	-	-	-	7	9	7+	8	7	7	7	7	9	9	9	9	8	9	9	-
Impact + atrazine	5/28	0	8	8	6	8+	7+	6	7	-	-	-	8	9	8	9	9	9	9	9	9	9	9	9	9	9	9	-
Laudis	27	0	8	6	-	7	9	8	8	7	7	-	7	9	7	8	8	8	8	8	9	9	9	9	8	9	9	-
Laudis + atrazine	5/27	0	8	7	-	8	9	8	8	7	7	-	8	9	8	9	9	9	9	9	9	9	9	9	9	9	9	-
Laddok	5/6	1	-	-	-	-	-	-	-	-	-	8+	8	8	6	9	9	9	9	9	9	9	5	9	9	9	8	7+
Lightning[1]	2	1	7	7	7	8	8	8+	8+	7	-	-	7+	9	6	9	7	-	8	-	8+	8+	8+	9	9	9	-	6
Nicosulfuron	2	1	8+	4	8+	9	9	9	9	9	9	6	8	-	8	-	-	-	-	-	8	-	-	9	8	-	7	6
NorthStar	2/4	2	-	-	7	6	6	9	9	6	7	-	8	9	9	9	9	7	9	6	9	9	9	9	9	8+	8	7
Permit/Sandea/Halomax	2	1	-	-	-	-	-	-	-	-	-	9	6	-	-	9	8	-	8	-	8	-	-	9	7	8	-	6
Permit Plus	2	1	-	-	-	-	-	-	-	-	-	9	6	-	-	9	8	-	8	-	8	8	8	9	9	9	-	6
Resolve Q	2	1	7	-	7	7	7	7	7	-	-	-	-	-	-	6	6	-	-	-	-	7	7	8	6	7	-	-
Resource	14	2	-	-	-	-	-	-	-	-	-	-	-	-	-	7	7	7	-	-	7	7	7	9	-	9	7	-
Shotgun	4/5	2	-	-	-	6	6	-	-	-	-	-	9	9	7	9	9	9	9	9	9	9	9	9	9	8+	9	-
Spirit	2	2	-	-	7	6	6	9	9	6	7	-	7	8	9	9	9	-	9	-	9	6	6	9	8+	8+	-	6
Starane	4	1	-	-	-	-	-	-	-	-	-	-	9	7	7	8	9	9	-	-	7	-	-	-	7	8	-	-
Status	4/19	1	6	6	6	6	6	-	-	-	-	-	9	8	7	9	9	9	9	9	9	9	9	9	8+	8	8	9
Steadfast Q/Ironclad	2	1/2	8	-	8	9	9	9	9	8	8	-	6	-	7	6	-	-	-	-	6	-	-	9	7	-	-	6
Steadfast ATZ	2/5	2	8	7	8	9	9	9	9	8	8	7	8+	7	8	9	9	8	8	7	9	9	-	9	9	8	8	6
Stinger	4	0	-	-	-	-	-	-	-	-	-	-	-	8	-	9	9	9	9	9	8	-	-	-	-	-	-	9
WideMatch	4	1	-	-	-	-	-	-	-	-	-	-	9	7	7	9	9	9	9	9	8	-	-	-	7	8	-	8
Yukon	2/4	2	-	-	-	-	-	-	-	-	-	9	8	7	7	9	9	7	9	7	9	8	8	9	9	9	8	7

[1]Apply to Clearfield (imidazolinone-resistant or tolerant) corn only.
[2]Apply to Liberty Link (glufosinate-resistant) corn only.
[3]Apply to glyphosate-resistant (Roundup Ready, AgriSure GT, etc) corn only.
*Large crabgrass only

Corn: Soil-Applied Herbicides — Preplant or Preemergence

Herbicide	Formulation	Product Rate Range
AAtrex/atrazine	4L	2 - 4 pt
	90DF	1.1 - 2.2 lbs

- Mode of action: group 5 (see pages 12-13).
- Atrazine is generally applied at a rate of 1.4 to 2 pounds active ingredient per acre to control broadleaf weeds.
- Rates approaching 2 pounds active ingredient can improve control of velvetleaf, giant ragweed, cocklebur, and morningglory. Velvetleaf can be effectively controlled when atrazine is mixed with Balance, Callisto, or Hornet, but the latter three weeds are most effectively controlled with a combination of preemergence and postemergence herbicides. Atrazine will not control fall panicum, regardless of rate.
- Maximum soil-applied rate on soils not highly erodible is 2 pounds of active ingredient per acre. Maximum rate on highly erodible soils is 2 pounds active ingredient on fields with at least 30% crop residue, and 1.6 pounds active ingredient on fields with less than 30% crop residue. Soil applications may be followed with a postemergence application of atrazine, but total of all treatments cannot exceed 2.5 pounds active ingredient per acre per year.
- Preplant application of atrazine with COC and/or UAN can control small, emerged annual weeds.
- Plant only corn or sorghum the year (including fall) of atrazine application.
- Where oats, forage legumes, or forage grasses will be planted the following spring, do not apply more than 0.8 pounds active ingredient per acre.

Herbicide	Formulation
Acetochlor	various

- Acetochlor (plus safener) is sold under various trade names, including Harness, TopNotch, Surpass, Degree, Confidence, and Volley.
- Acetochlor controls annual grasses, pigweed, and black nightshade, and control or suppresses yellow nutsedge, lambsquarters, and common ragweed. Control of lambsquarters and common ragweed will generally be less effective compared to most broadleaf herbicides, but more effective than other acetamide herbicides.
- Mode of action: group 15 (see pages 12-13).
- Can be applied to field corn, popcorn, and production seed corn, but should generally not be used on corn seed stock. See labels for precautions. Acetochlor can be applied preplant or preemergence to sweet corn, but not postemergence.
- Degree and TopNotch are encapsulated products that can provide a longer period of annual grass control compared to other acetochlor products.
- Acetochlor products can be applied after planting but prior to weed emergence, and before corn height exceeds 11 inches. All acetochlor products except Degree must be applied using water as the spray carrier after the corn has emerged.
- Degree or Degree plus atrazine can be applied to emerged corn in water or UAN, but corn should not exceed 6 inches in height if fertilizer solution is used as the carrier. Do not apply in fertilizer solution when air temperatures exceed 85 degrees. Mixtures with products other than atrazine should be applied only in water if the corn has emerged. Leaf burn may occur when acetochlor is applied to emerged corn.

Degree 3.8L Use Rates (pts/A)[a]

Soil Texture Group	Less than 3% OM	3% or Greater OM
Coarse	2.25 to 1.75	1.75
Medium	1.75 to 2.25	1.75 to 2.25
Fine	1.75 to 4.25	2.25 to 2.75

a. On soils with 6 to 10% organic matter, use 4.25 to 6.25 pts/A.

Corn: Soil-Applied Herbicides — Preplant or Preemergence

Surpass/Volley 6.4EC Use Rates (pts/A) in Conventional Tillage Systems When Applied within 14 Days before Planting[a]		
Soil Texture Group	**Less than 3% OM**	**3% or Greater OM**
Coarse	1.5 to 2.25	1.5 to 2.5
Medium	1.5 to 2.5	1.5 to 2.5
Fine	1.5 to 2.75	2 to 3

a. Use higher end of rate range if OM content is at higher end of rate range or under anticipated heavy weed infestations.

Surpass/Volley 6.4EC Use Rates (pts/A) in Reduced or No-till System or Conventional System When Applied More than 14 Days Before Planting		
Soil Texture Group	**Less Than 3% OM**	**3% or More OM**
Coarse	2	2
Medium	2 to 2.5	2.25
Fine	3	3

TopNotch 3.2L Use Rate (qts/A)[a]				
	Time from Application to Planting			
Soil Texture Group	**Less than 10**	**10 to 30**	**30 to 40**	**After planting &/or Emergence**
Coarse	2	2 to 2.5	2.5	2
Medium	2 to 2.5	2.5	2.5 to 3	2 to 2.5
Fine	2.5 to 3	2.5 to 3	3 to 3.75	2.5 to 3

a. On coarse textured soils with less than 3% OM the maximum use rate is 2.25 qts/A.

Herbicide	Formulation	Product Rate Range
Acetochlor + atrazine	Various	

- Acetochlor plus atrazine (plus safener) is sold under various trade names, including Harness Xtra, Degree Xtra, Fultime, Keystone, Confidence Xtra, and Volley ATZ. These premix products control annual broadleaf and grass weeds in corn. The ratio of atrazine to acetochlor varies among products, and some products require the addition of atrazine or another broadleaf herbicide for effective control of broadleaf weeds.
- Degree Xtra and Fultime are encapsulated formulations that can provide a longer period of annual grass control compared to other acetochlor products.
- Mode of action: group 5 (atrazine), group 15 (acetochlor). See pages 12-13.
- Can be applied to field corn, popcorn, and production seed corn, but should generally not be used on corn seed stock. See labels for precautions. Can be applied preplant or preemergence to sweet corn, but not postemergence.
- Can be applied after planting and before corn height exceeds 11 inches and before weeds reach the 2-leaf stage. When mixing with postemergence herbicides to control larger weeds, follow the most restrictive label with regard to maximum corn size.
- All acetochlor products except Degree Xtra should be applied using water as the spray carrier after the corn has emerged.
- Degree Xtra can be applied in water or UAN, but corn should not exceed 6 inches in height if fertilizer solution is used as the carrier. Do not apply in fertilizer solution when air temperatures exceed 85 degrees. Mixtures with products other than atrazine should be applied only in water if the corn has emerged. Leaf burn may occur when applied to emerged corn.
- Can be mixed with Balance to improve control of velvetleaf, annual grasses, triazine-resistant lambsquarters, and burcucumber. See Balance description for precautions to avoid crop injury.

Corn: Soil-Applied Herbicides — Preplant or Preemergence

Degree Xtra 4L Use Rates (qts/A)	
Soil Texture Group	
Coarse	2.9
Medium[a]	2.9 to 3.7
Fine	3.2 to 3.7

a. In areas of heavy weed pressure rates can be increased to 4.3 qts/A.

FulTime 4L Use Rates (qts/A) in Conventional Tillage Systems When Applied within 14 Days Before Planting		
Soil Texture Group	**Less than 3% OM**	**3% or Greater OM**
Coarse	2.25 to 2.7	2.7 to 3
Medium	2.7 to 3.3	3 to 3.3
Fine	3 to 3.5	3 to 5

Harness Xtra/Confidence Xtra 5.6L Broadcast Rates (qts/A)[a]		
Soil Texture Group	**Less than 3% OM**	**3% or Greater OM**
Coarse	1.4	1.75
Medium	1.75 to 2.25	1.75 to 2.25
Fine	1.75 to 2.25	2.25 to 2.75

a. In areas of heavy infestations use up to 2.3 qts/A on coarse-textured soils and 2.3 to 3.0 qts/A on medium- and fine-textured soils, but do not exceed 2.4 qts/A on highly erodible soils with less than 30% plant residue.

Keystone/Volley ATZ 5.25L Use Rates in Conventional Tillage (qts/A)		
Soil Texture Group	**Less than 3% OM**	**3% or Greater OM**
Coarse	2.2 to 2.4	2.4 to 2.6
Medium	2.4 to 2.8	2.6 to 2.8
Fine	2.6 to 3	2.6 to 3.4

Herbicide	Formulation
Alachlor	Various

- Alachlor controls annual grasses and pigweed, and controls or suppresses yellow nutsedge and black nightshade. Product trade names include Lasso and Micro-Tech among others.
- Mode of action: group 15 (see pages 12-13).
- Micro-Tech can be applied after corn emergence until the corn is 5 inches tall, but should be applied before weeds have passed the 2-leaf stage in a mixture with atrazine. Can be applied to emerged corn in water or UAN. Do not apply in apply in fertilizer solution when air temperature exceeds 85 degrees. Other alachlor products and combinations should be applied in water after the corn has emerged. Leaf burn may occur when applied to emerged corn.
- Lasso 4EC use rates: coarse-textured soils - 2 to 2.25 qt/A; all medium-textured soils and fine-textured soils with less than 3% OM - 2 to 2.75 qt/A; fine-textured soils with greater than 3% OM - 2.5 to 3.25 qt/A.
- Incorporation to 2 inches will improve yellow nutsedge control and reduce dependence upon rainfall.

Corn: Soil-Applied Herbicides — Preplant or Preemergence

Herbicide	Formulation	Product Rate Range
Alachlor + atrazine	various	

- Alachlor + atrazine is available from various manufacturers, and includes products such as Lariat and Bullet . Bullet is a micro-encapsulated formulation, which may provide more effective control than Lariat and other non-encapsulated products in no-till situations.
- Mode of action: group 5 (atrazine), group 15 (alachlor). See pages 12-13.
- Lariat can be applied in water, and Bullet can be applied in water or 28% liquid nitrogen fertilizer, after planting until weeds reach the 2-leaf stage and when corn is no more than 5 inches tall. Application of Bullet in 28% should not be made if temperature exceeds 85 F. Leaf burn may occur when applied to emerged corn.

Bullet/Lariat Broadcast Rates (qts/A)[a]

Soil Texture Group	Less than 3% OM	3% or Greater OM
Coarse	2.5	3
Medium	3	3.75
Fine	3.75	3.75 to 4.5

a. In areas of heavy infestations use 4 to 5 qts/A, but do not exceed 4.25 qts/A on highly erodible soils with less than 30% plant residue.

Herbicide	Formulation
Balance Flexx	2L

- Balance Flexx (isoxaflutole + cyprosulfamide, a safener) can be applied preplant, preemergence, or early postmergence (up to V2 corn) for control of annual broadleaf weeds and early-season control of annual grasses. Balance Flexx can help control cocklebur, giant ragweed, and morningglory in mixtures with atrazine.
- Mode of action: group 28 (see pages 12-13).
- Can be applied up to 30 days prior to planting of LibertyLink, glyphosate-resistant, or Clearfield hybrids, where a postemergence treatment is planned.
- Preplant application of of Balance Flexx plus atrazine (1 lb ai/A) will control small, emerged annual weeds (3 inches or less) in no-till, including field pennycress, shepherd's-purse, chickweed, henbit, and marestail. Apply with COC or MSO. Can be mixed with 2,4-D, Gramoxone, or glyphosate for improved burndown activity on larger weeds.
- Postemergence application of Balance Flexx will not generally control weeds larger than the 1-leaf stage, but can be mixed with atrazine to improve control. Do not apply with adjuvants or other herbicides after corn has emerged.
- Isoxaflutole has occasionally injured corn, especially during extended periods of cold, wet conditions during corn seed germination and early crop development. The risk of injury is reduced with Balance Flexx due to the inclusion of a safener. To reduce the risk of injury, do not exceed recommended rate for soil type, plant corn at least 1 1/2 inches deep, and make sure seed is completely covered with soil and the seed furrow is firmed.
- Consult seed company for information on inbred tolerance to isoxaflutole before using Balance Flexx on seed corn inbreds.

Corn: Soil-Applied Herbicides — Preplant or Preemergence

Balance Flex Use Rates (floz/A)

	Soil Texture Group					
	Coarse		Medium		Fine	
	Organic matter					
Timing	Less than 1.5%	Greater than 1.5%	Less than 1.5%	Greater than 1.5%	Less than 1.5%	Greater than 1.5%
8 to 21 days before Planting	4.0	5.0	6.0	6.0	6.0	6.0
0 to 7 days before planting or early POST	3.0	4.0	5.0	5.0	6.0	6.0

Herbicide	Formulation	Product Rate Range
Callisto	4L	6 - 7.7 oz

- Callisto (mesotrione) can be applied preplant or preemergence for control of annual broadleaf weeds, including lambsquarters (including triazine-resistant), Pennsylvania smartweed, pigweeds, waterhemp, velvetleaf, and black nightshade. Callisto can help control giant ragweed, cocklebur, and morningglory in mixtures with atrazine.
- Mode of action: group 28 (see pages 12-13).
- Callisto does not control grass weeds, and should be applied in combination with Harness, Dual, TopNotch, or another acetamide grass herbicide, or an acetamide/atrazine premix (Bicep II, Magnum, Degree Xtra, etc.).
- Can be applied preplant, preemergence, or postemergence to field corn, seed corn, sweet corn, and yellow popcorn. Do not apply to white popcorn.
- Postemergence rate should not exceed 3 oz/A. To avoid crop injury, do not apply postemergence with emulsifiable concentrate herbicides or MSOs.

Herbicide	Formulation
Corvus	2.63SC

- Corvus is a premix of isoxaflutole and cyprosulfamide (Balance Flexx), and thiencarbazone-methyl that can be applied preplant, preemergence, or early postmergence (spike to V2 corn) for control of annual broadleaf and grass weeds. The addition of atrazine will improve control of large-seeded broadleaf weeds such as cocklebur, giant ragweed, and morningglory.
- Mode of action: group 28 (isoxaflutole); group 2 (thiencarbazone). See pages 12-13.
- Corvus rates: coarse-textured soils with less than 2% OM - 3.33 oz; medium- or fine-textured soils and coarse-textured soils with more than 2% OM - 5.6 oz.
- Can be applied up to 30 days prior to planting of LibertyLink, glyphosate-resistant, or Clearfield hybrids, where a postemergence treatment is planned.
- Preplant application of Corvus can control small, emerged annual weeds (6 inches or less) in no-till, especially when combined with atrazine. Apply with COC or MSO. Can be mixed with 2,4-D, Gramoxone, or glyphosate for improved burndown activity on larger weeds or weeds not controlled by Corvus and atrazine.
- Postemergence application of Corvus will control small-emerged weeds. Mixing with atrazine will improve control. Do not apply with adjuvants or other herbicides after corn has emerged
- Corvus should not be applied to corn that will receive soil or seed treatment with organophosphate or carbamate insecticides. See product label and Table 8 for additional information on herbicide-insecticide interactions.

Corn: Soil-Applied Herbicides — Preplant or Preemergence

- Isoxaflutole has occasionally injured corn, especially during extended periods of cold, wet conditions during corn seed germination and early crop development. The risk of injury is reduced with Corvus due to the inclusion of a safener. To reduce the risk of injury, do not exceed recommended rate for soil type, plant corn at least 1 1/2 inches deep, and make sure seed is completely covered with soil and the seed furrow is firmed.
- Consult seed company for information on inbred tolerance to isoxaflutole before using Corvus on seed corn inbreds.

Herbicide	Formulation
Guardsman Max	5L

- Guardsman Max is a premix of dimethenamid-P (Outlook) plus atrazine for control of annual grass and broadleaf weeds in corn.
- Mode of action: group 5 (atrazine), group 15 (dimethenamid). See pages 12-13.
- Can be applied early postemergence to corn that is up to 12 inches tall. Weeds should be less than 1 1/2 inches tall, unless other products are mixed with Guardsman Max to control larger emerged weeds.
- Can be applied to emerged corn with surfactant or low rates of liquid nitrogen fertilizer. Do not use liquid fertilizer as the spray carrier after the crop has emerged. COC may be included in postemergence applications only when Guardsman Max is applied alone or in combination with atrazine.

Guardsman Max Use Rate (pt/A)[a]

	Organic Matter	
Soil texture	**Less than 3%**	**3% or more**
Coarse	2.5 to 3	3 to 4
Medium or Fine	3 to 4	4 to 4.6

a. For all preplant applications, use 3.8 to 4.6 pt/A. Do not exceed 3.8 pt/A on highly erodible soils with less than 30% plant residue.

Herbicide	Formulation
Hornet	78.5WDG

- Hornet is a premix of flumetsulam (Python) plus clopyralid (Stinger). In addition to the broadleaf weeds controlled by Python, Hornet controls cocklebur and common ragweed. Expect partial control of giant ragweed.
- Mode of action: group 2 (flumetsulam), group 4 (clopyralid). See pages 12-13.
- Hornet can be mixed at a rate of 3 to 4 oz/A with atrazine premix products (Bicep, Harness Xtra, etc) to improve control of triazine-resistant lambsquarters, giant ragweed, and other broadleaf weeds.
- Apply preplant, preemergence, or at the spike stage. When using the rates shown here, apply before the corn is 2 inches tall. Preplant application with COC can control emerged Canada thistle and small annual broadleaf weeds, including mustards, shepherd's-purse, ragweeds, and Pennsylvania smartweed.
- Do not apply to sweet corn or popcorn. Corn inbred lines should be tested for crop tolerance before treating large acreages.
- Preemergence applications of Hornet can occasionally injure corn, primarily when growing conditions are unfavorable soon after application. This injury appears as stunting, temporary yellowing, and reduction in root growth. To avoid injury, plant at least 1 1/2 inches deep and do not use Hornet in soils with an average of less than 1 1/2 percent organic matter.
- Soil-applied organophosphate insecticides may increase the risk of crop injury, especially when applied in-furrow. See product label and Table 8 for more information on herbicide-insecticide interactions.
- Corn treated with Hornet that is stressed or damaged by herbicide or other factors should not be treated with Accent, Permit, Basis, Beacon, or other ALS-inhibiting herbicides.
- Do not apply where soil pH is greater than 7.8. Do not apply to soils with a combination of pH less than 5.9 and organic matter content greater than 5%.

Corn: Soil Applied Herbicides — Preplant or Preemergence

Hornet WDG Use Rates (oz/A)[a]		
Soil Texture Group	**Less than 3% OM**	**3% or Greater OM**
Coarse	4	4 to 5
Medium or Fine	4 to 5	5 to 6

a. Use higher rate in recommended range in areas of high weed infestations.

Herbicide	Formulation	Product Rate Range
Lorox	50DF	2/3 - 3 lb
Linex	4L	2/3 - 3 pts

- Lorox/Linex (linuron) controls broadleaf weeds. Linuron is generally applied at a rate of 3/4 to 1 lb/A in combination with other corn herbicides for control of triazine-resistant pigweed and lambsquarters.
- Mode of action: group 7 (see pages 12-13).
- Do not use on soils with more than 3 percent organic matter.
- Apply after corn planting, but before emergence.
- To avoid injury, corn should be planted at least 1 3/4 inches deep and adequately covered with soil.
- Do not apply to emerged corn.

Herbicide	Formulation
Lumax	4L
Lexar	3.7L

- Lumax and Lexar are premixes of atrazine, s-metolachlor (Dual II Magnum), and mesotrione (Callisto) for control of grass and broadleaf weeds in corn. A use rate of Lexar contains a higher amount of atrazine per acre, compared with Lumax, and a lower amount of s-metolachlor.
- Mode of action: group 5 (atrazine); group 15 (s-metolachlor); group 28 (mesotrione). See pages 12-13.
- Controls most annual broadleaf weeds, but expect partial control of giant ragweed, cocklebur, and annual morningglory.
- Lexar and Lumax have been among the most effective preplant burndown treatments for no-till corn in OSU and Purdue University research, for control of dandelion and most winter annual weeds.
- Lexar use rates: soils with less than 3% organic matter - 3 qts/A; soils with more than 3% organic matter - 3.5 qts/A. Lumax use rates: soils with less than 3% organic matter - 2.5 qts/A; soils with more than 3% organic matter - 3.0 qts/A.
- Lumax and Lexar can be applied preplant, preemergence, or postemergence before field and seed corn exceeds 12 inches in height. Broadleaf weeds should be less than 3 (Lumax) or 5 (Lexar) inches tall at the time of postemergence application. Control of emerged grasses (up to 1.5 inches tall) will require additional atrazine.
- Can be applied preplant or preemergence on yellow popcorn and sweet corn.
- NIS can be used when Lumax or Lexar is applied to emerged corn. AMS can be added when mixed with glyphosate or Liberty. Use of COC may result in temporary crop injury. Otherwise, do not apply with MSO or nitrogen based adjuvants (AMS, UAN, etc), or use fertilizer solution as the carrier after corn has emerged.
- Lumax/Lexar may be applied postemergence in a mixture with glyphosate on glyphosate-resistant corn at a rate as low as 2 qts/A (Lumax) or 2.25 qts/A (Lexar).
- Applying Lexar/Lumax postemergence to corn treated with Counter insecticide at planting may result in severe crop injury. See product label and Table 8 for more information on herbicide-insecticide interactions.
- If applied after June 1, rotating to crops other than corn or sorghum may result in crop injury.

Herbicide	Formulation
S-metolachlor	7.64E
Metolachlor	7.8E

- S-metolachlor (Dual II Magnum, Cinch) and metolachlor (Stalwart C, Parallel) control annual grasses and pigweed, and control or suppress waterhemp, black nightshade, and yellow nutsedge.
- Mode of action: group 15 (see pages 12-13).

Corn: Soil Applied Herbicides — Preplant or Preemergence

- Can be applied preplant or preemergence before the crop and weeds emerge. Can be applied broadcast with atrazine up to 5-inch corn or as a directed spray up to 12-inch corn, and before grass and broadleaf weeds exceed the 2-leaf stage. Do not apply using fertilizer solution as the spray carrier after the corn has emerged.
- May be applied up to 30 days before planting as a single application.
- Incorporation to a depth of 2 inches will improve yellow nutsedge control and reduce dependence upon rainfall.

Dual II Magnum, Cinch, Parallel, and Stalwart Use Rates (pts/A)

Soil Texture Group	Less than 3% OM	3% or Greater OM
Coarse	1 to 1.33	1.33
Medium	1.33 to 1.67	1.33 to 1.67
Fine	1.33 to 1.67	1.67 to 2

Herbicide	Formulation
S-metolachlor + atrazine	5.5L
Metolachlor + atrazine	5.5L

- S-metolachlor plus atrazine (Bicep II Magnum, Brawl II ATZ, Cinch ATZ) and metolachlor plus atrazine (Stalwart Xtra, Parallel Plus, Trizmet) control annual grass and broadleaf weeds in corn.
- Mode of action: group 5 (atrazine), group 15 (s-metolachlor/metolachlor). See pages 12-13.
- Can be applied preplant, preemergence, and after corn emergence until corn plants are 5 inches tall and before weeds exceed the 2-leaf stage. Do not apply using fertilizer solution as the spray carrier after the crop emerges.

Bicep II Magnum, Cinch ATZ, and Stalwart[a] Use Rates Up to 14 Days Before Planting (qts/A)

Soil Texture Group	Less than 3% OM	3% or Greater OM
Coarse	1.3	1.6
Medium	1.6	2.1
Fine	2.1	2.1[b] or 2.1 to 2.58

a. When using Stalwart, use 2.1 to 2.6 qts/A on fine-textured soils when applying on non-erodible land with 30% or more residue cover.
b. Do not exceed this rate on highly with less than 30% plant residue cover.

Herbicide	Formulation	Product Rate Range
Metribuzin	75DF	2 - 5 1/3 oz
	4L	3 - 8 oz

- Metribuzin (Dimetric, Tricor) is labeled in combination with other corn herbicides to improve residual control of broadleaf weeds, including lambsquarters, pigweed, common ragweed, Pennsylvania smartweed, and velvetleaf. In mixtures with 2,4-D, Gramoxone, and/or atrazine, metribuzin can also improve burndown of emerged weeds in no-till.
- Mode of action: group 15 (see pages 12-13).
- Apply before or after planting, but before corn emergence. Application rates increase when applied more than 10 days before planting.
- Observe the following precautions to avoid corn injury: Do not apply where soil pH is 7.0 or greater or on coarse-textured soils with less than 1 1/2% organic matter; do not apply more than 4 ounces/A of metribuzin 75DF on soils with less than 2% organic matter; plant corn seed at least 1 1/2 inches deep.
- Metribuzin can be used on field corn and in hybrid seed corn production fields. Both inbred lines should have known tolerance to metribuzin before using in seed production.

Corn: Soil Applied Herbicides — Preplant or Preemergence

Herbicide	Formulation
Outlook	6EC

- Outlook (dimethenamid-P) controls annual grasses and pigweed, and controls or suppresses yellow nutsedge and black nightshade.
- Mode of action: group 15 (see pages 12-13).
- Can be applied after crop emergence, but must be applied before weed emergence, or in a tank mixture with herbicides that control emerged weeds. Do not apply to corn that is more than 12 inches tall.
- May be applied after corn has emerged with surfactant or low rates of nitrogen fertilizer solution. Do not use fertilizer solution as the spray carrier after the crop has emerged. COC should not be added after the crop has emerged unless specified for a particular tank mixture.

Outlook Use Rates (floz/A)[a]

Soil Texture Group	Less than 3% OM	3% or Greater OM
Coarse	12 to 14	14 to 18
Medium and fine	14 to 18	18 to 21

a. When making applicaitons 15 to 45 days before planting or applying on muck soils, use 21 floz/A.

Herbicide	Formulation	Product Rate Range
Pendimethalin/Pendimax/Pendant/others	3.3EC	
Prowl H2O	3.8CS	

- The active ingredient in these products, pendimethalin, controls annual grasses, pigweed, and lambsquarters (including triazine-resistant biotypes), and helps control smartweed, velvetleaf, and seedling johnsongrass. Pendimethalin is often combined with atrazine for control of grass and broadleaf weeds where triazine-resistant pigweed and lambsquarters are a problem.
- Mode of action: group 3 (see pages 12-13).
- Can be applied postemergence until field corn is in the V8 stage or is 30 inches tall, and other types of corn are 20 to 24 inches tall. Where the corn canopy prevents spray particles from reaching the soil, use drop nozzles and apply as a directed spray. Postemergence applications provide residual control only, not control of emerged weeds.
- Apply only after planting. Do not incorporate or severe corn injury may result.
- To reduce the risk of corn injury, plant at least 1 1/2 inches deep and ensure good seed to soil contact. Combining pendimethalin with dicamba may increase the potential for crop injury, especially when corn is under stress from cool, wet conditions.

Prowl H2O Use Rates (pt/A)

Soil Texture	Soil Organic Matter Content [a]	
	Less than 3%	More than 3%
Coarse	2 to 3	3
Medium	3	4
Fine	3 to 4	4

Pendimethalin 3.3EC Use Rates (pt/A)

Soil Texture	Soil Organic Matter Content	
	Less than 3%	More than 3%
Coarse	1.8 to 3.6	3.6
Medium	2.4 to 3.6	3.6 to 4.8
Fine	2.4 to 4.8	3.6 to 4.8

The high rates for each soil texture above should be used if heavy weed populations are anticipated, extensive crop residues were present prior to seedbed preparation, or in no-till.

Corn: Soil Applied Herbicides — Preplant or Preemergence

Herbicide	Formulation	Product Rate
Prequel	45WDG	1.66 to 2.5 oz

- Prequel is premix of isoxaflutole (Balance Pro) and rimsulfuron that provides residual control of grass and broadleaf weeds, and also controls some small (less than 3 inches), emerged weeds in no-till burndown situations. Residual control can be improved with the addition of atrazine. Control of larger emerged weeds can be improved with the addition of one or more of the following: 2,4-D, atrazine, glyphosate, or paraquat.
- Mode of action: group 2 (flumetsulam); group 28 (isoxaflutole). See pages 12-13.
- This product is intended for use in a planned preemergence followed by postemergence program, and the product rates are not intended to provide full-season weed control. Preemergence or preplant application of Prequel should be followed by a postemergence application of glyphosate (glyphosate-resistant corn), Ignite (Liberty Link) corn, or conventional herbicides as needed.
- Use on field corn hybrids only.
- Control of emerged weeds requires the addition of NIS or COC, plus AMS or UAN. When mixed with Ignite or a glyphosate product that contains adjuvants, no additional NIS or COC is needed.
- Crop injury can increase and rate of crop recovery from injury can slow when corn is growing slowly under adverse environmental conditions, including extremely wet, cold, or dry soils, high pH, or low fertility. Do not use on coarse soils with less than 1% organic matter. Application to caorse soils with less than 1.5% organic matter or pH greater than 7.5 can cause adverse crop response. Plant corn at least 1 1/2 inches deep, and make sure that the seed furrow is firmed and seed is completely covered with soil.

Herbicide	Formulation
Princep/simazine	4L 90DF

- Simazine is often applied at reduced rates in combination with atrazine or atrazine premix products to improve or extend grass control.
- Mode of action: group 5 (see pages 12-13).
- Simazine rates will vary depending upon the herbicides in the mixture, but when used alone, rates are as follows (for simazine 4L): sand, silt, ot loam with low OM - 4 pts/A; soil with moderate amounts of clay and organic matter - 4.8 pts/A; loams high in OM and clay - 6 pts/A.
- Simazine is more effective than atrazine for control of fall panicum and crabgrass, but is less effective for control of cocklebur, quackgrass, yellow nutsedge, velvetleaf, and giant ragweed.
- Can be applied at a rate of 1 lb active ingredient/A in the fall prior to corn planting for control of winter annual weeds such as chickweed, mustards, and deadnettle. Apply with 2,4-D for best results. If weeds are more than an inch or two tall, apply with Gramoxone or glyphosate.

Herbicide	Formulation
Python	80WDG

- Python (flumetsulam) controls annual broadleaf weeds, including triazine-resistant lambsquarters and velvetleaf. Control of common ragweed and cocklebur is variable, and Python does not control giant ragweed or annual morningglory.
- Mode of action: group 2 (see pages 12-13).
- Python use rates range from 0.8 to 1 oz/A in coarse-textured soils, and 0.9 to 1.33 oz/A in medium or fine-textured soils. Reduced rates of Python can be mixed with atrazine premix products (Bicep, Harness Xtra, etc) to improve control of triazine-resistant lambsquarters.
- Can be applied postemergence, from spike stage to 20-inch or V6 stage, for residual control of pigweeds, lambsquarters, and velvetleaf.
- Do not apply to soils with a combination of pH less than 5.9 and organic matter content greater than 5%. Do not apply where soil pH is greater than 7.8.
- Python can occasionally injure corn, primarily when growing conditions are unfavorable soon after application. This injury appears as stunting, temporary yellowing, and reduction in root growth. To avoid injury, plant at least 1 1/2 inches deep and do not use Python in soils with an average of less than 1 1/2 percent organic matter.

Corn: Soil Applied Herbicides — Preplant or Preemergence

- Soil-applied organophosphate insecticides may increase the risk of crop injury, especially when applied in-furrow. See product label and Table 8 for more information on herbicide-insecticide interactions.
- Corn treated with Python that is stressed or damaged by herbicide or other factors should not be treated with Accent, Permit, Basis, Beacon, or other ALS-inhibiting herbicides.
- Do not apply to sweet corn or popcorn. Inbred lines should be tested for crop tolerance before treating large acreages.

Herbicide	Formulation	Product Rate Range
Resolve	25DF	0.5 - 2 oz

- Resolve (rimsulfuron) can provide residual control of annual grasses, pigweeds, and lambsquarters when applied at rates of 1 to 1.5 oz/A. Can be combined with atrazine for residual control of additional weeds. Preplant or preemergence application of Resolve or Resolve plus atrazine should be followed with a broad-spectrum postemergence herbicide program.
- Mode of action: group 2 (see pages 12-13).
- Preplant application of Resolve and atrazine can control small, emerged weeds in no-till corn, especially when mixed with 2,4-D.

Herbicide	Formulation
Sharpen	2.85SC

- Sharpen (saflufenacil) controls annual broadleaf weeds in field corn and popcorn. The addition of atrazine will improve control of large-seeded broadleaf weeds such as giant ragweed, morningglory, and cocklebur. Sharpen can also be added to other pre-emergence corn products to improve residual control of broadleaf weeds. Do not apply Sharpen after corn has emerged.
- Mode of action: group 14. See pages 12-13.
- This product is intended for use in a planned preemergence followed by postemergence program, and the product rates are not intended to provide full-season weed control. Preemergence or preplant application of Sharpen should be followed by a postemergence application of glyphosate (glyphosate-resistant corn), Ignite (Liberty Link) corn, or conventional herbicides as needed.
- Sharpen rates are based on soil texture as follows: coarse - 2 oz; medium - 2.5 oz; fine - 3 oz.
- Do not apply Sharpen where an at-planting application of an organophosphate or carbamate insecticide us planned or has occurred. See product label and Table 8 for more information on herbicide-insecticide interactions.
- Preplant application of Sharpen and atrazine can control small, emerged weeds in no-till, including marestail. Glyphosate should be added when weeds are more than about 4 inches tall and for weeds Sharpen does not control (see label). For control of emerged weeds, apply with MSO (1% v/v) and AMS (8.5 to 17 lbs/100 gallons) or UAN (1.25 to 2.5% v/v).

Herbicide	Formulation	Product Rate Range
SureStart/TripleFlex	4.25L	1.5 - 2 pts

- SureStart/TripleFlex is a premix of acetochlor, clopyralid (Stinger), and flumetsulam (Python) that provides residual control of grass and broadleaf weeds.
- Mode of action: group 2 (flumetsulam); group 4 (clopyralid); group 15 (acetochlor). See pages 12-13.
- This product is labeled for use only in glyphosate-resistant and Liberty Link corn, and is intended for use in a planned pre-emergence followed by postemergence program. Preemergence or preplant application of SureStart/TripleFlex should be followed by a postemergence application of glyphosate (glyphosate-resistant corn), Ignite (Liberty Link corn), or conventional herbicides as needed.
- Preplant/preemergence application rates: coarse texture - 1.5 pts; medium texture with less than 3% OM - 1.5 to 1.75 pts; medium texture with >3% OM - 1.75 pts; fine texture - 2 pts.
- SureStart/TripleFlex can also be applied early postemergence (up to 11-inch corn) in a mixture with glyphosate or Liberty, using the appropriate type of corn. This mixture will control emerged weeds and provide residual weed control after application.
- To reduce risk of crop injury, plant corn at least 1 1/2 inches deep, and make sure seed furrow is closed. Do not use where soil pH is greater than 7.8 or soil organic matter is less than 1.5%.
- Do not apply Counter insecticide to corn that has been or will be treated with SureStart/TripleFlex. See product label and Table 8 for more information on herbicide-insecticide interactions.

Corn: Soil Applied Herbicides — Preplant or Preemergence

Herbicide	Formulation	Product Rate Range
Valor SX	51WDG	2 oz

- Valor (flumioxazin) can be applied between 7 and 30 days prior to planting field corn. Valor controls lambsquarters (including triazine-resistant), black nightshade, and pigweeds. Valor suppresses or provides partial control of common ragweed, morningglory, velvetleaf, waterhemp, smartweed, and some annual grasses.
- Mode of action: group 14 (see page 12-13).
- Do not apply to popcorn, sweet corn, or corn grown for seed.
- Use only in no-till fields where last year's crop residue has not been incorporated into the soil. Do not conduct any tillage operations after the Valor has been applied.
- Do not apply in a mixture with any of the following herbicides unless following directions on a Valent supplemental label: flufenacet, metolachlor or s-metolachlor, alachlor, dimethenamid-p, or acetochlor.
- Valor should be applied with 2,4-D and glyphosate for most effective control of emerged weeds.

Herbicide	Formulation
Verdict	5.57EC

- Verdict is a premix of dimethenamid-P (Outlook) and saflufenacil (Sharpen) that controls annual grass and broadleaf weeds in field corn and popcorn. The addition of atrazine will improve control of large-seeded broadleaf weeds such as giant ragweed, morningglory, and cocklebur. Do not apply after corn has emerged.
- Mode of action: Group 15 (dimethenamid-P); group 14 (Saflufenacil). See pages 12-13.
- This product is intended for use in a planned preemergence followed by postemergence program, and the product rates are not intended to provide full-season weed control. Preemergence or preplant application of Verdict should be followed by a postemergence application of glyphosate (glyphosate-resistant corn), Ignite (Liberty Link) corn, or conventional herbicides as needed.
- Verdict rates are based on soil texture as follows: coarse - 10 to 12 oz; medium - 13 to 15 oz; fine - 16 to 18 oz.
- Do not apply Verdict where an at-planting application of an organophosphate or carbamate insecticide us planned or has occurred. See product label and Table 8 for more information on herbicide-insecticide interactions.
- Preplant application of Verdict and atrazine can control small, emerged weeds in no-till, including marestail. Glyphosate should be added when weeds are more than about 4 inches tall and for weeds Verdict does not control (see label). For control of emerged weeds, apply with MSO (1% v/v) and AMS (8.5 to 17 lbs/100 gallons) or UAN (1.25 to 2.5% v/v).

Corn: Postemergence Herbicides — Contact

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Aim	2EC	0.5 -1 oz	Not addressed on label

- Aim (carfentrazone-ethyl) is a contact herbicide that controls black nightshade, velvetleaf, redroot pigweed, and small annual morninglories and lambsquarters. Aim is often added to herbicide programs to improve control of velvetleaf.
- Mode of action: group 14 (see pages 12-13).
- Apply when weeds are 1 to 4 inches tall for best results. Velvetleaf can be controlled up to 36 inches tall. Apply broadcast before corn exceeds the 8-collar stage, and as a directed spray with drop nozzles up to the 14-collar stage.
- Apply with NIS (0.25% v/v). UAN (2 to 4 gallons/100 gallons) or AMS (2 to 4 lbs/A) can be added if recommended for use with other herbicides in a mix with Aim. The label does allow use of COC under dry conditions and in specific tank mixtures. Application with Buctril may cause unacceptable crop injury.
- Aim can be applied with drop nozzles to seed corn production fields. Avoid directing herbicide into the whorl.
- Aim can be applied to sweet corn, but the user assumes all responsibility for herbicide tolerance. Consult seed supplier about sweet corn tolerance to Aim prior to use.
- Apply in a spray volume of 10 to 20 gpa with a pressure of 20 to 40 psi. Flat fan nozzles are recommended for adequate spray coverage.
- Add Aim to the spray tank before adding other products.
- Aim usually causes leaf speckling and necrosis. The severity of injury varies with environmental conditions, adjuvants, and other herbicides in the mixture. To reduce injury, 1) do not apply within 6 to 8 hours of rain, 2) make sure spray nozzles are positioned at least 18 inches above the crop, and 3) avoid direction of excessive amounts of herbicide into corn whorls.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, or if mixing with Ignite, just add AMS.

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
AAtrex/atrazine	4L	1.5 - 2 qt	1 - 1.5 qt
	90DF	1.67 - 2.22 lb	1.1 - 1.7 lb

- Mode of action: group 5 (see pages 12-13).
- Maximum rate for postemergence application to fields without soil-applied atrazine in the same year is 2 pounds active ingredient/A. When applied postemergence to fields with soil-applied atrazine the same year, total amount of atrazine applied may not exceed 2.5 pounds active ingredient.
- For annual grass control, apply 2 lbs ai/A when grasses are no more than 1 1/2 inches tall. Atrazine will not control fall panicum.
- For control of broadleaf weeds, rates of 1.2 pounds active ingredient may be sufficient. Apply until broadleaf weeds are 4 inches tall.
- Apply with COC (1 qt/A) for best results. Mix atrazine with water first, and add oil last.
- Apply before the crop reaches 12 inches in height.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, or if mixing with Ignite, just add AMS.

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Basagran	4L	1.5 - 2 pt	1.5 - 2 pt

- Basagran (bentazon) is a contact herbicide that controls annual broadleaf weeds, including cocklebur, velvetleaf, and Pennsylvania smartweed. Basagran controls or suppresses Canada thistle and yellow nutsedge.
- Mode of action: group 6 (see pages 12-13).
- For best results, apply with COC when weeds are in the 2- to 6-leaf stage.
- Apply in combination with atrazine for control of pigweed, lambsquarters, and ragweeds.
- Add COC (1 qt/A) if mixing with glyphosate.

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Bromoxynil	2S	1 - 1.5 pt	Not labeled in Ohio or Indiana

- Bromoxynil is sold under various trade names, including Buctril, Moxy, and Broclean. Bromxynil is a contact herbicide that controls many annual broadleaf weeds, including black nightshade, cocklebur, ragweeds, lambsquarters, and smartweed, but is weak on pigweed and large velvetleaf.

Corn: Postemergence Herbicides — Contact

- Mode of action: group 6 (see pages 12-13).
- Apply at a rate of 1 pint per acre from corn emergence until tassel emergence. The 1 1/2-pint rate may be applied after corn reaches the 4-leaf stage and before tassel emergence. Maximum corn size at the time of application varies with the tank-mix partner.
- Do not apply to seed corn inbreds or popcorn prior to the 3-leaf stage.
- Do not use surfactant or crop oil when applying bromxynil alone or with most other herbicides. NIS and UAN are allowed in some mixtures.
- Apply in a minimum volume of 10 gpa at a minimum pressure of 30 psi using flat fan nozzles.
- May cause corn leaf burn, but effects are usually temporary.

Herbicide	Formulation	Product Rate Range
Bromoxynil + atrazine	3L	1 1/2 - 3 pt

- Bromoxynil plus atrazine is sold under various trade names. It controls most annual broadleaf weeds.
- Mode of action: group 5 (atrazine); group 6 (bromoxynil). See pages 12-13.
- Can be applied at a rate of 1 1/2 to 2 pints per acre after corn emergence and before corn is 12 inches tall. The 3-pint rate may be applied after corn reaches the 4-leaf stage and before corn is 12 inches tall.
- Do not use surfactant, crop oil, liquid fertilizers, or other additives when applying Buctril/atrazine or Moxy/atrazine alone or with most other herbicides. NIS and UAN are allowed in some mixtures.
- Apply in a volume of at least 10 gallons per acre at a minimum pressure of 30 psi using flat fan nozzles.

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Cadet	0.91EC	0.4 - 0.9 oz	0.4 - 0.6 oz

- Cadet (fluthiacet-methyl) is a contact herbicide that controls velvetleaf, and controls or suppresses small lambsquarters, pigweeds, black nightshade, and annual morningglory at the 0.9 oz rate.
- Mode of action: group 14 (see pages 12-13).
- Can be applied to field corn, popcorn, seed corn, and sweet corn from prior to planting up to 48 inches tall. Apply before tassel emergence.
- Apply with NIS (0.25% v/v), COC, or MSO (1 to 2 pts/A). UAN (1 to 2 qts/A) or AMS can be added. When combined with other herbicides, Cadet can generally be applied with any adjuvants required for those herbicides.
- Apply in a minimum spray volume of 15 gpa and pressure of 20-40 psi. Increase volume and pressure in dense crop and weed canopies.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, or if mixing with Ignite, just add AMS.

Herbicide	Formulation	Product Rate Range
Laddok S-12	5L	1 1/3 - 2 1/3 pt

- Laddok/Headline is a 1:1 premix of bentazon (Basagran) plus atrazine for control of most broadleaf weeds, and suppression or control of yellow nutsedge, Canada thistle, and some perennial vines.
- Mode of action: group 5 (atrazine); group 6 (bentazon). See pages 12-13.
- Application rate varies with weed species and size. Apply with UAN, AMS, or nonphytotoxic oil concentrate. The label allows combinations of spray additives, which vary with the weed species present. UAN or AMS should be added when velvetleaf is the target weed, and may also improve control of cocklebur and Pennsylvania smartweed. COC should also be added when common lambsquarters, common ragweed, Canada thistle, yellow nutsedge, or field bindweed is present.
- Apply in a spray volume of at least 10 gpa with a minimum pressure of 40 psi. Increasing the spray volume (up to 50 gpa) will improve control when the crop and weed foliage is dense.
- To suppress Canada thistle, apply 2 1/3 pints when thistle plants are 8 to 10 inches tall until the bud stage.
- A single application of 2 1/3 pints of Laddok can suppress yellow nutsedge that is 1 to 4 inches tall.
- Provides better control of velvetleaf, annual morningglory, lambsquarters, and pigweed than Basagran alone, but is no more effective on triazine-resistant lambsquarters.

Corn: Postemergence Herbicides — Contact

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Resource	0.86EC	4 to 6 oz (broadcast) 4 to 8 oz (directed)	Glyphosate: 2 - 4 oz Ignite: 2 oz

- Resource (flumiclorac) is a contact herbicide that controls velvetleaf (up to 10 inches tall) and pigweeds. Control of lambsquarters is variable, and some other broadleaf weeds will be suppressed.
- Mode of action: group 14 (see pages 12-13).
- Apply when corn is in the 2- to 10-leaf stage and broadleaf weeds are in the 2- to 3-leaf stage for best results. Use a directed spray if corn size prevents adequate spray coverage of weeds.
- COC should be included when Resource is applied alone. Use 1 pint/A for broadcast application and 1 quart/A for directed application. UAN or AMS can be added to improve control of large velvetleaf. Adjuvant recommendations vary with the other herbicides in the mixture. See the label for more information.
- Apply in a spray volume of at least 10 gpa with a spray pressure of 30 to 60 psi.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, or if mixing with Ignite, just add AMS.

Corn: Postemergence Herbicides — Systemic

Herbicide	Formulation	Product Rate Range	With Glyphosate
Beacon	75DF	3/8 - 3/4 oz	3/8 - 3/4 oz

- Beacon (primisulfuron) is a systemic sulfonylurea herbicide that controls or suppresses annual and perennial grasses and controls annual broadleaf weeds. Beacon provides only partial control of foxtail species and may be less effective than Accent for rhizome johnsongrass and quackgrass control, but is generally more effective than Accent for broadleaf weed control. Does not control ALS-resistant weeds.
- Mode of action: group 2 (see pages 12-13).
- Mixtures of Beacon plus dicamba or 2,4-D will suppress a number of perennial broadleaf weeds.
- Beacon is labeled for use on field corn, popcorn, and seed corn. Popcorn and inbred lines grown for seed may be severely injured by Beacon and should be thoroughly tested for potential sensitivity to Beacon before treating large acreage. Do not use Beacon on sweet corn.
- Apply broadcast or as a directed spray when field corn is between 4 and 20 inches tall, and as a directed spray after corn is 20 inches tall and before tassel emergence. All applications to inbred lines and popcorn should be made post-directed or semi-directed (nozzles positioned to avoid placing spray in whorl) after corn is 10 inches tall but before tassel emergence.
- Apply with NIS (0.25% v/v) or COC (1 to 4 pints per acre); COC is generally the preferred additive. Liquid nitrogen fertilizer (2 to 4 quarts/A) or AMS (2 to 4 lbs/A) may be added, but should not substitute for surfactant or oil concentrate. COC plus nitrogen fertilizer can be use when mixing with atrazine, Accent, or 2 oz/A or less of dicamba. Mixtures with most other herbicides should be applied with NIS. See label for detailed information on mixtures with other herbicides.
- Apply when grasses are at the following heights: shattercane and seedling johnsongrass — 4 to 12 inches; rhizome johnsongrass — 8 to 16 inches; quackgrass — 4 to 8 inches; fall panicum — less than 2 inches. Beacon will control common and giant ragweed that are 2 to 9 inches tall. Most other broadleaf weeds should be 1 to 4 inches tall when Beacon is applied.
- Do not make a foliar postemergence or a soil application of any organophosphate insecticide within 10 days before or 7 days after Beacon application.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, just add AMS.

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Callisto	4L	3 oz	3 oz

- Callisto (mesotrione) is a systemic herbicide that controls annual broadleaf weeds. The addition of atrazine (1/2 pint) improves control of a number of weeds, and is required for consistent control of common ragweed and morningglory. Where corn is more than 12 inches tall and atrazine cannot be used, a mixture of Callisto plus bromoxynil can improve control of ragweeds.
- Mode of action: group 28 (see pages 12-13).
- Apply when weeds are less than 5 inches tall for best results. Apply with atrazine (1/2 pint) if weeds are more than 5 inches tall.
- Callisto can be applied to field corn, seed corn, and yellow popcorn up to 30 inches tall or the 8-leaf stage. Callisto plus atrazine can be applied to corn up to 12 inches tall.
- Apply with COC (1% v/v) plus UAN (2.5% v/v) or AMS (8.5 lb/100 gallons). Do not use MSO (MSO) or MSO blend adjuvants. To avoid injury to yellow popcorn, apply with COC alone (do not add UAN or AMS) after crop emergence.
- Callisto can be applied at the rate of 2.5 oz/A when weeds are less than 5 inches tall and it is mixed with either atrazine (0.5 lbs ai/A) or glyphosate.
- Apply in a spray volume of 10 to 30 gpa, but use a volume of at least 20 gpa if weed foliage is dense.
- Severe crop injury may occur if Callisto is applied postemergence to corn that was previously treated with Counter or Lorsban, and this injury can result in yield loss. See product label and Table 8 for more information on herbicide-insecticide interactions.
- Do not apply Callisto postemergence in a mixture with emulsifiable concentrate grass herbicides, unless specifically addressed under one of the mixture sections of the label, or crop injury may occur.
- Do not use COC when mixing with Ignite. Do not use UAN, COC or MSO when mixing with glyphosate. If glyphosate has an adjuvant system, add AMS (8.5 - 17 lb/100 gal). If the glyphosate does not contain adjuvants, add NIS (0.25% v/v) and AMS.

Corn: Postemergence Herbicides — Systemic

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Callisto Xtra	3.7L	20 to 24 oz	20 to 24 oz

- Callisto Xtra is a premix of mesotrione (Callisto) and atrazine that controls annual broadleaf weeds.
- Mode of action: group 28 (mesotrione); group 5 (atrazine). See pages 12-13.
- Apply when weeds are less than 5 inches tall for best results. Can be applied to field corn, seed corn, and yellow popcorn from emergence up to 12 inches tall.
- Apply with COC (1% v/v) or NIS (0.25% v/v) plus UAN (2.5% v/v) or AMS (8.5 lb/100 gallons). COC is the preferred adjuvant to maximize activity. Do not use MSO (MSO) or MSO blend adjuvants. To avoid injury to yellow popcorn, apply with COC or NIS alone (do not add UAN or AMS) after crop emergence.
- Apply in a spray volume of 10 to 30 gpa, but use a volume of at least 15 gpa if weed foliage is dense.
- Severe crop injury may occur if Callisto Xtra is applied postemergence to corn that was previously treated with Counter or Lorsban, and this injury can result in yield loss. See product label and Table 8 for more information on herbicide-insecticide interactions.
- Do not apply Callisto Xtra postemergence in a mixture with emulsifiable concentrate grass herbicides, unless specifically addressed under one of the mixture sections of the label, or crop injury may occur.
- Do not use COC or UAN when mixing with Ignite. Do not use UAN, COC or MSO when mixing with glyphosate. If glyphosate has an adjuvant system, add AMS (8.5 - 17 lb/100 gal). If the glyphosate does not contain adjuvants, add NIS (0.25% v/v) and AMS.

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Capreno	3.45SC	3 oz	Glyphosate - 3 oz Ignite - 2 oz

- Capreno is a premix of tembotrione (Laudis) and thiencarbazone-methyl that controls annual grass and broadleaf weeds in field corn and seed corn. This product will provide residual control of grasses also. The addition of atrazine (0.5 lb/A) will generally improve the speed and effectiveness of control.
- Mode of action: group 28 (tembotrione), group 2 (thiencarbazone). See pages 12-13.
- Apply with COC (1% v/v, minimum of 1.25 pt/A) and 28% UAN (1.5 qts/A) or AMS (8.5 lbs/100 gallons, minimum of 1.5 lbs/A). High surfactant oil blends at their recommended rates can replace COC, but do not use NIS or MSO.
- Can be applied broadcast from the V1 to V6 stage of corn, and as a directed spray up to V7. Capreno is most effective when broadleaf weeds are less than 4 to 6 inches tall, and grasses are less than 3 inches tall and not tillering.
- Can also be applied preemergence where it will be followed by a postemergence herbicide treatment.
- Apply in a minimum spray volume of 10 gpa, but use a volume of 15 to 20 gpa if weed foliage is dense.
- Consult seed company for information on inbred tolerance before using Capreno on seed corn inbreds.
- Capreno should not be applied to corn that was treated with a soil-applied organophosphate insecticide. See product label and Table 8 for additional information on herbicide-insecticide interactions.
- Use 2 oz/A of Capreno and 22 oz/A of Ignite when mixing in Liberty Link corn. Do not use any adjuvants except AMS.
- Use 3 oz/A of Capreno when mixing with glyphosate in glyphosate-resistant corn. AMS should always be included with this combination. The addition of a glyphosate-compatible high surfactant oil blend is also recommended, and required if the glyphosate does not contain adjuvants.

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Dicamba	4L	1/2 - 1 pt	Not addressed on label

- Dicamba is sold under a number of trade names, including Banvel, Clarity, Sterling Blue, and Oracle. Dicamba is a translocated herbicide that controls many annual broadleaf weeds, including pigweeds, ragweeds, black nightshade, cocklebur, and Pennsylvania smartweed. Control of velvetleaf can be variable. Dicamba will control or suppress perennial broadleaf weeds, especially when applied with ALS inhibitor herbicides.
- Mode of action: group 4 (see pages 12-13).
- Apply 1/2 to 1 pint when corn is in the spike to five-leaf stage, or until corn is 8 inches tall, whichever occurs first. Do not apply more than 1/2 pint on coarse-textured soils. If the 6th true leaf is emerging from the whorl, or corn is more than 8 inches tall, a rate of 1/2 pint can be applied until corn is 36 inches tall, or until 15 days before tassel emergence. Apply as a directed spray when corn leaves prevent proper spray coverage, or sensitive crops are growing nearby.
- The 1 pint rate provides limited residual broadleaf weed control.

Corn: Postemergence Herbicides — Systemic

- Apply with 1/2 to 1 gallon per acre of UAN (28%) when velvetleaf is a target weed. Can be applied with surfactant or crop oil to improve control in dry growing conditions. Do not apply with crop oil when corn exceeds 5 inches in height.
- With any dicamba product, risk of corn injury increases when corn exceeds 8 to 10 inches in height. To reduce risk of injury, make sure nozzle spacing and spray boom height are set to minimize interception of spray by the corn plants.
- Soybeans and vegetables are extremely susceptible to dicamba drift and vapors. Apply in a spray volume of 20 gpa at a pressure of less than 20 psi to reduce drift. Do not apply where sensitive crops are growing nearby if winds over 5 MPH are moving in the direction of sensitive crops, corn is more than 24 inches tall, soybeans are more than 10 inches tall, or soybeans have begun to bloom. Most dicamba products should not be applied when air temperatures on the day of application will exceed 85 degrees.

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Dicamba + atrazine premix	3.2L	3 1/2 pt	Not addressed on label

- Dicamba plus atrazine is sold under a number of trade names, including Marksman, Sterling Plus, Banvel-K+atrazine, and Stratos. These products control most annual broadleaf weeds, and suppress or control perennial broadleaf weeds.
- Mode of action: group 5 (atrazine), group 4 (dicamba). See pages 12-13.
- Apply when corn is in the spike to five-leaf stage, or until corn is 8 inches tall, whichever comes first. The rate is 3 1/2 pints on medium- or fine-textured soils with at least 2 percent organic matter, and 2 pints on coarse-textured soils. Provides some residual broadleaf weed control.
- The addition of crop oil, surfactant, or liquid nitrogen fertilizer may improve control, especially when weeds are drought-stressed. Apply with UAN if velvetleaf is a target weed. Application with crop oils may cause crop injury. Do not apply with crop oil after corn exceeds 5 inches in height.
- Precautions on spray drift, volatility, and corn injury are the same as for dicamba. See dicamba description for more information.

Herbicide	Formulation	Product Rate Range	With Glyphosate
Hornet	78.5WDG	2 - 5 oz	2 - 4 oz

- Hornet is a premix of flumetsulam (Python) and clopyralid (Stinger) that controls annual broadleaf weeds, and suppresses certain perennial broadleaf weeds. Hornet controls ragweeds, velvetleaf, cocklebur, Pennsylvania smartweed, and small marestail, but is not effective for control of lambsquarters, pigweeds, black nightshade, and annual morningglory. The higher rates can suppress or control some perennial weeds, including dandelion and Jerusalem artichoke.
- Mode of action: group 2 (flumetsulam), group 4 (clopyralid). See pages 12-13.
- Hornet will control the above-ground growth of Canada thistle, but may be less effective than labeled rates of Stinger for long-term control of thistle. Mixing Hornet with Stinger will improve long-term control. Apply before thistle plants are in the bud stage for best results.
- Apply broadcast when weeds are 2 to 8 inches tall and field corn is up to 20 inches tall or at the 6-collar stage, whichever occurs first. Hornet can be applied as a directed postemergence application using drop nozzles to corn that is 20 to 36 inches tall.
- Apply with NIS (1 quart/100 gallons) or COC (1 gallon/100 gallons). Under dry conditions, the addition of UAN (2 1/2 gallons/100 gallons) may improve control.
- Apply in a spray volume of 10 to 40 gpa with a spray pressure of 20 to 40 psi.
- To avoid severe crop injury, do not apply to corn previously treated with Thimet. See product label and Table 8 for more information on herbicide-insecticide interactions.
- Do not apply to corn that shows symptoms of injury from previously applied herbicides.
- Do not apply to popcorn or sweet corn. Corn inbred lines may be injured by Hornet.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, just add AMS.

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Impact	2.8L	0.75 oz	0.5 - 0.75 oz

- Impact (topramezone) controls many broadleaf weeds, including biotypes resistant to ALS inhibitors, glyphosate, and triazines. Impact controls or suppress small annual grasses. Impact is most effective when applied in combination with 0.25 to 1.5 lbs ai/A of atrazine. The higher atrazine rates will provide residual weed control.
- Mode of action: group 28 (see pages 12-13).

Corn: Postemergence Herbicides — Systemic

- Can be applied to field corn, seed corn, popcorn, and sweet corn. Check with seed supplier for information on tolerance prior to use on inbreds grown for seed production.
- Apply when most broadleaf weeds are emerged and less than 6 inches tall.
- Impact can be applied postemergence up to 45 days before crop harvest. Apply with drop nozzles if the crop canopy prevents adequate spray coverage on weeds.
- For best results, apply with a MSO (1 to 1.5% v/v) plus either UAN (1.25 to 2.5% v/v) or AMS (8.5 to 17 lbs/100 gallons of water). NIS can be used instead of methylated seed soil if required in mixtures with other herbicides.
- Apply in a minimum spray volume of 10 gpa, and apply in 15 gpa when treating large weeds or high-density weed infestations.
- Impact should not be relied upon to provide complete control of grasses, but can control small (less than 3-inch) grasses that escape preemergence herbicides.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, or if mixing with Ignite, just add AMS.

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Laudis	3.5L	3 oz	glyphosate: 3 oz Ignite: 2 - 3 oz

- Laudis (tembotrione) controls many broadleaf weeds, including biotypes resistant to ALS inhibitors, glyphosate, and triazines. Laudis controls or suppress small annual grasses. Laudis is most effective when applied in combination with 0.5 lbs ai/A of atrazine.
- Mode of action: group 27 (see pages 12-13).
- Can be applied to field corn, seed corn, popcorn, and sweet corn. Check with seed supplier for information on tolerance prior to use on popcorn, sweet corn, or inbreds grown for seed production.
- Apply when broadleaf weeds are less than 6 inches tall. For most grass species, grasses should be less than 3 inches tall at time of application.
- Apply broadcast up to the V8 stage of field corn and popcorn, and V7 stage of sweet corn.
- Apply with a MSO (1% v/v, minimum of 1.25 pt/A) plus either UAN (1.5 qt/A) or AMS (1.5 lb/A). When mixing with atrazine, COC (1% v/v) should be used instead of MSO.
- Apply in a minimum spray volume of 10 gpa, and apply in 15 to 20 gpa in dense weed populations or under adverse environmental conditions. Use nozzles and pressure that result in medium spray droplets, and increase application volume when using nozzles that produce coarse spray droplets. Flat fan nozzles of 80 or 110 degrees will provide optimum postemergence spray coverage.
- Laudis should not be relied upon to provide complete control of grasses, but can control small (less than 3-inch) grasses that escape preemergence herbicides.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, or if mixing with Ignite, just add AMS.

Herbicide	Formulation	Product Rate Range
Nicosulfuron (active ingredient)		
Accent Q	54.5WDG	0.9 oz
NIC-IT	2L	2 oz

- These products contain nicosulfuron, a translocated sulfonylurea herbicide. Accent Q contains nicosulfuron plus isoxadifen, a safener to reduce the risk of corn injury. Nicosulfuron controls annual and perennial grasses and a few annual broadleaf weeds. Does not control crabgrass.
- Mode of action: group 2 (see pages 12-13).
- Accent Q and NIC-IT are labeled for use on field corn, popcorn, seed corn, and some sweet corn hybrids grown for processing and fresh market. Growers should contact seed suppliers for recommendations and information on crop tolerance, and use of soil-applied organophosphate insecticides, prior to application to popcorn or seed corn. Do not apply to any white popcorn inbred or hybrid unless approved by the seed supplier. Accent and NIC-IT can be used on High Lysine, Waxy, White or other Food Grade hybrids. A list of approved processing sweet corn hybrids is available from DuPont. With regard to use of Accent on fresh market sweet corn, the user assumes all risk based on recommendations from university or seed company personnel, or other experts.
- Can be applied broadcast or as a directed spray to field corn that is up to 20 inches tall or up to 6 collars (whichever occurs first). Apply as a directed spray when corn is 20 to 36 inches tall. Do not apply to corn that is at or past the 10-collar stage or more than 36 inches tall. Best results occur occur when corn is less than 12 inches tall and weeds are small.

Corn: Postemergence Herbicides — Systemic

- Can be applied broadcast to popcorn or seed corn that is less than 20 inches tall or up to 5 collars (whichever occurs first).
- OSU research has shown it can be difficult to achieve adequate season-long weed control with a single postemergence application of herbicides with limited residual activity (such as nicosulfuron). Applying a reduced rate of a preplant or preemergence herbicide prior to postemergence herbicide application will result in more consistent control of longer duration.
- For best results, apply with COC (1 gallon/100 gallons spray) plus UAN (2 to 4 quarts/A) or AMS (2 to 4 lbs/A). Substituting a MSO for COC can improve control under drought-stressed conditions. NIS (1 to 2 qts/100 gallons spray) can be used instead of crop oil if required in a mixture with another herbicide.
- Apply in a spray volume of at least 10 gpa with a pressure of 20 to 40 psi. Increase volume to at least 15 gpa in heavy weed pressure. Avoid spraying excessive amounts of herbicide directly into the corn whorl.
- Apply when grasses are at the following heights: foxtails and fall panicum — 2 to 4 inches; quackgrass — 4 to 10 inches; shattercane and seedling johnsongrass — 4 to 12 inches; rhizome johnsongrass — 8 to 18 inches.
- Control of yellow and green foxtail may be reduced in mixture with some broadleaf herbicides. Consult the label for spray additive recommendations when mixing with broadleaf herbicides, and follow the most restrictive label with regard to maximum corn size at the time of application.
- Control may be reduced if applied during conditions of drought stress, abnormally hot or cold weather, when daytime temperatures do not exceed 50 degrees, or following periods of large day/night temperature fluctuations.
- Where nicosulfuron is applied to corn previously treated with soil applications of organophosphate insecticides, temporary crop injury may occur. See product label and Table 8 for more information on herbicide-insecticide interactions.

Herbicide	Formulation	Product Rate Range	With Glyphosate
NorthStar	47DF	5 oz	2.5 - 5 oz

- NorthStar is a premix of primisulfuron (Beacon) plus dicamba (Banvel) for control of annual broadleaf weeds and suppression or control of annual and perennial grasses. NorthStar will suppress a number of perennial broadleaf weeds. See Beacon and dicamba descriptions for more information and precautions on use.
- Mode of action: group 2 (primisulfuron), group 4 (dicamba). See pages 12-13.
- Can be applied broadcast or directed to field corn that is between 4 and 20 inches tall. Apply using drop nozzles when corn is 20 inches (V6) up to 36 inches tall or 15 days before tassel emergence, whichever occurs first.
- For popcorn and seed corn inbreds, apply as a directed spray using drop nozzles when corn is between 10 and 36 inches tall or 15 days before tassel emergence, whichever occurs first. Inbred lines and popcorn hybrids should be thoroughly tested for sensitivity to NorthStar before treating large acreages.
- Apply with NIS (0.25% v/v) or COC (1 to 4 pints/A), but do not use COC if corn is more than 12 inches tall. UAN (2 to 4 qts/A) or AMS (2 to 4 lbs/A) may also be added.
- When mixing with glyphosate, add AMS if the glyphosate contains adjuvants. Otherwise, add adjuvants specified on the glyphosate product label.

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Peak	57DF	0.25 - 0.5 oz	0.25 - 0.5 oz

- Peak (prosulfuron) can be mixed with other broadleaf herbicides to improve control of emerged weeds and provide residual control of burcucumber and other weeds in field corn.
- Mode of action: group 2 (see page 12-13).
- Peak can be applied to corn up to 30 inches tall, but should be applied as a directed spray using drop nozzles when corn is past the 6-collar stage or more than 20 inches tall.
- When mixing Peak with a herbicide that contains a fully loaded adjuvant system (e.g. Touchdown Total), no additional adjuvant is needed. All other herbicide mixtures should be applied with COC (1% v/v).
- Check label for recrop information prior to use. Recrop to soybeans and other crops varies with rate applied, whether mixed with Spitit, area of the state, and soil pH. The recrop interval for soybeans can be 18 months for some rates and mixtures.
- See Table 8 for information on herbicide-insecticide interactions.

Corn: Postemergence Herbicides — Systemic

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Permit/Sandea/Halomax	75DF	2/3 to 1 1/3 oz	Not addressed on label

- These products contrin halosulfuron, is a translocated sulfonylurea herbicide that controls yellow nutsedge and annual broadleaf weeds, including velvetleaf, ragweeds, cocklebur, and redroot pigweed. Halosulfuron is weak on lambsquarters and annual morningglory. A combination of halosulfuron plus dicamba will improve control of these weeds and control or suppress perennial broadleaf weeds. Does not control ALS-resistant weeds.
- Mode of action: group 2 (see pages 12-13).
- Apply when field corn is in the spike through layby stage and most annual weeds are 1 to 6 inches tall for best results. When corn is more than 24 inches tall, mixtures of halosulfuron with other postemergence corn herbicides should be applied with drop nozzles to ensure weed coverage and avoid spraying directly into the whorl. Follow the most restrictive label with regard to maximum corn size when mixing with other herbicides.
- Can be applied broadcast (2/3 oz/A) to sweet corn and popcorn in the spike through layby stage. Two applications are allowed per year, but the second should be applied with drop nozzles. Sweet corn and popcorn hybrids should be thoroughly tested for sensitivity to halosulfuron before treating large acreages. Do not apply to the sweet corn variety 'Jubilee'. Do not apply when corn is under stress from environmental conditions.
- For control of yellow nutsedge, apply 1 to 1 1/3 ounces/A when nutsedge is 4 to 12 inches tall. Dense populations of nutsedge may require a second application.
- Apply in a minimum spray volume of 10 gpa with NIS (1 to 2 quarts/100 gallons) or COC (1 gallon/100 gallons). Include UAN (2 to 4 quarts/A) or AMS (2 to 4 lbs/A) when velvetleaf or redroot pigweed is present.
- Combinations with other herbicides can cause temporary crop injury, especially when the other herbicide in the mixture is Accent or Beacon. Do not apply in mixtures if the crop is under stress due to drought, water saturated soils, low fertility, hail, frost, insects, or when the maximum daytime temperature is above 92 degrees.

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Permit Plus	74DF	0.75 oz	Not addressed on label

- Permit Plus is a premix of halosulfuron (Permit) and thifensulfuron (Harmony GT) that controls yellow nutsedge and annual broadleaf weeds, including velvetleaf, ragweeds, lambsquarters, smartweed, cocklebur, and redroot pigweed. Does not control ALS-resistant weeds.
- Mode of action: group 2 (see pages 12-13).
- Apply broadcast or directed when field corn is in the one- to five-collar stage.
- Apply in a minimum spray volume of 10 gpa with NIS (1 to 2 quarts/100 gallons) or COC (1 gallon/100 gallons). Include UAN (2 to 4 quarts/A) or AMS (2 to 4 lbs/A).

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Resolve Q	22.4 WDG	1.25 oz	1.25 oz

- Resolve Q is a premix of rimsulfuron and thifensulfuron. It also contains a safener, isoxadifen, that reduces risk of corn injury and broadens the application window, compared with other rimsulfuron products.
- Resolve Q controls or suppresses small (1 to 2 inch) annual grass and broadleaf weeds, including foxtails, lambsquarters, and pigweed. When mixed with glyphosate in postemergence treatments to glyphosate-resistant corn, Resolve Q provides residual control of annual grasses and some small-seeded broadleaf weeds.
- Mode of action: group 2 (see pages 12-13).
- Can be applied broadcast to field corn with up to 6 collars, or up to 20 inches tall (whichever is more restrictive).
- No additional adjuvants are needed when applying with Ignite or a glyphosate product that contains surfactant. Otherwise, Resolve Q should be applied with NIS (0.25% v/v) plus UAN (2 qt/A) or AMS (2 lb/A).

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Shotgun	3.25L	2 - 3 pints	Not addressed on label

- Shotgun is a premix of atrazine plus 2,4-D for postemergence control of many broadleaf weeds in corn.
- Mode of action: group 5 (atrazine), group 4 (2,4-D). See pages 12-13.
- Apply broadcast in a minimum spray volume of 10 gpa when corn is spike to 8 inches tall, and as a directed spray when corn is 8 to 12 inches tall. Treated corn may be brittle and subject to breakage by wind during the 2 weeks following application.

Corn: Postemergence Herbicides — Systemic

- Allow 6 hours between application and rainfall.
- Follow precautions to prevent drift and volatility of 2,4-D, which will injure nearby broadleaf plants. Volatility is more likely at air temperatures greater than 85 degrees.

Herbicide	Formulation	Product Rate Range	With Glyphosate
Spirit	57DF	1 oz (1 packet per 4 acres)	0.75 - 1 oz

- Spirit is a premix of prosulfuron (Peak) plus primisulfuron (Beacon), translocated sulfonylurea herbicides. Broadleaf weed control is similar to Beacon, although Spirit is more effective on a few broadleaf weeds. Mixing with dicamba, 2,4-D, or bromoxynil will improve annual weed control. Most effective control/suppression of perennial broadleaf weeds will occur when mixed with 2,4-D or dicamba. Spirit is weak on annual morninglories and yellow nutsedge. Does not control ALS-resistant weeds.
- Mode of action: group 2 (see pages 12-13).
- Follow these guidelines to avoid carryover of Spirit to subsequent crops: 1) Avoid use where soil pH is greater than 7.8. If used where soil pH is greater than 7.8, plant only field corn or small grains the following year; 2) where less than one inch of rain occurs within one month of application, or less than 12 inches of rain occurs within 5 months after application, plant only corn, small grains, or STS soybeans the following year ; 2) north of Interstate 80, do not plant soybeans within 18 months of application; 3) south of I-80, soybeans can be planted 10 months after application where soil pH is less than 7.8; and 4) do not apply after June 30. See label for guidelines on rotation to other crops.
- Apply broadcast or directed when field corn is 4 to 24 inches tall. To avoid injury and improve spray coverage on weeds, apply as a directed spray using drop nozzles when corn is more than 20 inches tall.
- For popcorn, apply as a directed spray using drop nozzles when corn plants are 10 to 24 inches tall, and before tassel emergence. For seed corn inbreds, Spirit can be applied broadcast when corn is between 4 and 20 inches tall, or until the 6-collar stage, whichever occur first. Use drop nozzles when seed corn inbreds are 20 to 24 inches tall and before tassel emergence. Inbred lines and popcorn hybrids should be thoroughly tested for sensitivity to Spirit before treating large acreages. Do not apply to sweet corn.
- Apply in a minimum spray volume of 10 gpa. Increasing the volume to at least 20 gpa can improve control in dense weed infestations.
- Apply with COC (1 to 4 pints/A) or NIS (1 to 2 quarts/100 gallons). UAN (2 to 4 quarts/A) or AMS (2 lbs/A) may be added to improve control of velvetleaf and other weeds. COC is generally more effective than NIS. Use of a MSO (Meth Oil, Priority MSO, Sun-It II, for example) may improve control when weeds are large or drought-stressed.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, just add AMS.

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Starane	1.5L	2/3 pt	Not addressed on label

- Starane (fluroxypyr) is a translocated herbicide that controls hemp dogbane, common ragweed and a few other broadleaf weeds. Due to a relatively narrow spectrum of activity, Starane should be mixed with other herbicides to improve control of specific problem weeds.
- Mode of action: group 4 (see pages 12-13).
- Apply broadcast up to the V5 stage of field corn and when weeds are less than 8 inches tall. Applications when corn is past the V5 stage should be made as a directed spray using drop nozzles.
- Crop injury, including stem curvature, stunting, and brace root injury can occur with some corn hybrids when Starane is applied as a broadcast treatment. Hybrids susceptible to phenoxy injury may also be susceptible to injury from Starane.
- When mixing with other herbicides, use adjuvants specified on the label of the partner herbicides.

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Status	56 WDG	2.5 - 10 oz	2.5 - 5 oz

- Status is a premix of dicamba plus diflufenzopyr plus a safener, for control of most annual broadleaf weeds in corn. Addition of the safener results in reduced risk of injury to corn, compared with other dicamba products. Status can be weak on velvetleaf, although it is more effective than dicamba alone.
- Mode of action: group 4 (dicamba), group 19 (diflufenzopyr). See pages 12-13.

Corn: Postemergence Herbicides — Systemic

- Status can control or suppress small annual grasses that have escaped premergence herbicide treatments. Effectiveness on grasses is variable, and can be reduced under dry conditions.
- Status is generally more effective than other dicamba products on perennial broadleaf weeds, and has provided excellent control of Canada thistle and hedge bindweed in OSU research.
- Apply when corn is 4 to 36 inches tall, or from V2 to V10. The 5 oz rate should be used when Status is applied postemergence following preemergence herbicides. The 2.5 oz rate can be used to improve control in mixtures with glyphosate, Lightning, or Liberty, but rate should be increased to 5 oz where weeds are resistant to any of these herbicides.
- Status can be applied with NIS (0.25% v/v), COC (1 to 2 pt/A), or a methylated seed soil (1 to 2 pt/A) plus UAN (1.25% v/v) or AMS (5 to 17 lbs/100 gallons). To avoid mixing problems, add Status to spray tank first, and make sure it is fully suspended in water before adding AMS.
- Take precautions to avoid contact of Status with sensitive plants via drift or volatility. Exposure of soybeans to status via sprayer contamination or spray particle drift will result in more severe injury compared to other dicamba products. Thoroughly clean spray equipment, including tank, hoses, and screens, to make sure it is free of Status prior to using the same equipment in soybeans.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, or if mixing with Ignite, just add AMS.

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Steadfast Q	37.7 WDG	1.5 oz	Not addressed on label
Ironclad	75 DF	0.75 oz	Not addressed on label

- Steadfast Q and Ironclad are 2:1 premixes of nicosulfuron (Accent) and rimsulfuron , translocated sulfonylurea herbicides, that controls annual and perennial grasses, including foxtails, fall panicum, quackgrass, and shattercane. Will control large crabgrass up to one inch tall. Controls small annual morningglory, pigweed, Pennsylvania smartweed, and sunflower. Steadfast Q contains isoaxadifen, a safener that reduces the risk of crop injury.
- Mode of action: group 2 (see pages 12-13).
- Can be applied broadcast or as a directed spray to field corn that is up to 20 inches tall or up to 6 collars (whichever comes first). Best overall performance will occur when applied to corn less than 12 inches tall.
- Do not apply to popcorn, or sweet corn, or corn grown for seed (inbreds).
- OSU research has shown it can be difficult to achieve adequate season-long weed control with a single postemergence application of herbicides with limited residual activity (such as Steadfast/Ironclad). Applying a reduced rate of a preplant or preemergence herbicide prior to postemergence application of Steadfast/Ironclad will result in more consistent control of longer duration.
- For best results, apply with COC (1 gallon/100 gallons spray) plus UAN (28% - 2 quarts/A) or AMS (2 lbs/A). Substituting a MSO (Meth Oil, Priority MSO, Sun-It II, for example) for COC can improve control under drought-stressed conditions. NIS (1 to 2 qts/100 gallons spray) can be used instead of crop oil if required in a mixture with another herbicide, but grass control may be reduced.
- Apply in a spray volume of at least 15 gpa with a pressure of 20 to 40 psi. Avoid spraying excessive amounts of herbicide directly into the corn whorl.
- Apply when grasses are at the following heights: foxtails, fall panicum, and barnyardgrass — up to 4 inches; quackgrass — 4 to 8 inches; shattercane — up to 6 inches; seedling johnsongrass — up to 8 inches.
- Control may be reduced if applied during conditions of drought stress, abnormally hot or cold weather, when nighttime temperatures are less than 40 degrees, or following periods of large day/night temperature fluctuations.
- Where Steadfast/Ironclad is applied to corn previously treated with soil applications of organophosphate insecticides, temporary crop injury may occur. See product label and Table 8 for more information on herbicide-insecticide interactions.

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Steadfast ATZ	89.3DF	14 oz	Not addressed on label

- Steadfast ATZ is a premix of nicosulfuron, rimsulfuron, and atrazine for control of broadleaf and grass weeds.
- Mode of action: group 2 (nicosulfuron, rimsulfuron); group 5 (atrazine). See pages 12-13.
- Can be applied to field corn up to 12 inches tall or up to and including 6 collars (whichever occurs first).
- Do not apply to popcorn, sweet corn, or corn inbreds.
- Steadfast ATZ controls many annual broadleaf and grass weeds up to 4 inches tall. Mix with another herbicide for taller weeds or broader spectrum of control.
- See atrazine and Steadfast descriptions for other information and precautions.

Corn: Postemergence Herbicides — Systemic

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Stinger	3L	1/4 - 2/3 pt	Not addressed on label

- Stinger (clopyralid) is a translocated herbicide that controls ragweeds, cocklebur, jimsonweed, and Canada thistle. Controls or suppresses Jerusalem artichoke and suppresses sowthistle.
- Mode of action: group 4 (see pages 12-13).
- Apply after corn emergence until corn is 24 inches tall, and us a spray volume of at least 10 gallons per acre.
- For annual weed and Jerusalem artichoke control, apply 1/4 to 1/2 pint when weeds have 5 or fewer leaves.
- For Canada thistle control, apply 1/3 to 2/3 pint when thistles are at least 4 inches tall or across, but before the bud stage. The higher rate provides more complete plant kill and better control of dense patches. Do not cultivate prior to or for 14 to 20 days following application. Although control of thistle with Stinger during the season of application may appear similar to that from other corn herbicides, Stinger provides more complete kill of the entire plant (at a greater cost).

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
WideMatch	1.5L	1.3 pts	Not addressed on label

- WideMatch is a premix of clopyralid (Stinger) plus fluroxypyr (Starane) for control of broadleaf weeds in corn, including hemp dogbane, ragweeds, Canada thistle, marestail, and cocklebur. WideMatch is registered for use in Ohio, but not in Indiana.
- Mode of action: group 4 (see pages 12-13).
- Apply broadcast up to the V5 stage of field corn and when weeds are less than 8 inches tall. Applications when corn is past the V5 stage should be made as a directed spray using drop nozzles.
- Crop injury, including stem curvature, stunting, and brace root injury can occur with some corn hybrids when WideMatch is applied as a broadcast treatment. Hybrids susceptible to phenoxy injury may also be susceptible to injury from WideMatch.
- For most effective Canada thistle control, apply after the majority of the basal leaves have emerged and before bud stage.

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Yukon	67.5WG	4 - 8 oz	2 - 8 oz

- Yukon is a premix of halosulfuron (Permit) plus dicamba for control of most annual broadleaf weeds and yellow nutsedge. Yukon will also suppress/control some perennial broadleaf weeds, primarily during the growing season of application.
- Mode of action: group 2 (halosulfuron); group 4 (dicamba). See pages 12-13.
- Can be applied broadcast or with drop nozzles from the spike stage through 36 inch-tall corn. Weeds should generally be less than 6 inches tall for best results. Use a rate of 6 to 8 oz for yellow nutsedge control.
- Apply with NIS (1 to 2 quarts/100 gallons) or COC (1 gallon/100 gallons). COC may cause injury at the higher Yukon rates. UAN (28% UAN, etc - 2 to 4 quarts/A) or AMS (2 to 4 lbs/A) can be added to improve control of certain weeds or if required for another herbicide in the spray mix. Apply in a spray volume of at least 10 gpa.
- Most of the precautions and restrictions on use of Permit and dicamba apply to Yukon also. See Permit and dicamba descriptions for more information.
- When mixing with glyphosate, add NIS at 0.25% v/v if glyphosate product used does not contain adjuvants. Use of AMS at 8.5 - 17 lb/100 gal is required. When mixing with Ignite, the addition of AMS is required. (but not NIS).

Corn: Postemergence Herbicides — Systemic

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
2,4-D LV Ester	Various	0.17 - 0.25 lb ai/A	Not addressed on label
2,4-D Amine	Various	0.34 - 0.5 lb ai/A	

- Mode of action: group 4 (see pages 12-13).
- Controls many annual broadleaf weeds, including ragweeds, cocklebur, lambsquarters, and pigweed. Will control or suppress perennial broadleaf weeds, especially when applied with Beacon, Exceed, Spirit, or Permit.
- For best results, apply when weeds are small.
- If corn is more than 8 inches tall, use drop nozzles to reduce the risk of crop injury. Do not apply from the tasseling stage to the dough stage.
- Use precautions to prevent drift. The ester forms of 2,4-D can volatilize and injure nearby susceptible plants, including soybeans and vegetable crops. Amine formulations are less volatile than ester formulations, and should generally be used for postemergence applications in corn.
- Injury may result when applied to corn growing rapidly under high temperatures and high humidity. Corn may be brittle for 7 to 10 days after application, and is susceptible to stalk breakage from high winds or cultivation.

Clearfield Corn: Postemergence Herbicides

Herbicide	Formulation	Product Rate Range
Lightning	70DF	1.28 oz

- Lightning is a premix of imazethapyr (Pursuit) plus imazapyr for postemergence use on field corn hybrids that are tolerant to Pursuit and other imidazolinone herbicides. Use only on hybrids labeled as "Clearfield" or "imidazolinone-tolerant".
- Mode of action: group 2 (see pages 12-13).
- Lightning is similar to Pursuit in weed control spectrum, but has longer residual activity and is more effective on lambsquarters. Control of common and giant ragweed is variable. Mixing Lightning with Status will improve control of ragweeds, lambsquarters, and perennial broadleaf weeds. Lightning does not control ALS-resistant weeds when applied alone.
- OSU research has shown it can be difficult to achieve adequate season-long weed control with a single postemergence application of herbicides with limited residual activity. Applying Lightning with atrazine or following a reduced rate of a preplant or preemergence herbicide will result in more consistent control of longer duration. In fields with heavy grass pressure, use of a preemergence grass herbicide prior to postemergence use of Lightning is recommended.
- Apply before most annual weeds exceed 3 inches in height. Cocklebur, pigweed, shattercane, and seedling johnsongrass can be up to 8 inches tall. For control or suppression of Jerusalem artichoke, apply when plants are 6 to 10 inches tall.
- Apply with NIS (1 quart/100 gallons spray) plus UAN (1 to 2 quarts/acre) or AMS (2.5 lbs/A). Control of drought-stressed weeds will be maximized when the higher rates of fertilizer are used.
- Apply broadcast to corn up to 20 inches tall or the V6 stage, and as a directed spray until 45 days before harvest. Broadcast applications of Lightning when corn is more than 20 inches tall or past the V6 stage can result in poor kernel set and reduced yield. When mixing Lightning with other herbicides, always follow the more restrictive label with regard to spray additives, maximum crop size, and other precautions.
- Control may be reduced when weeds are growing slowly under cold or dry conditions. If possible, wait for rain and resumption of active weed growth before applying Lightning. If air temperatures reach or stay below 50 degrees F for 10 or more hours, delay application for 48 hours from the time temperatures increase above 50 degrees F.

Liberty Link Corn — Postemergence Herbicides

Herbicide	Formulation	Product Rate Range
Ignite 280SL	2.34L	22 oz

- Ignite (glufosinate) is a contact, broad-spectrum herbicide for postemergence use only on Liberty Link (glufosinate-resistant) corn.
- Mode of action: group 10 (see pages 12-13).
- Ignite controls many annual grass and broadleaf weeds up to 3 to 6 inches tall when applied at a rate of 22 oz per acre. Mixing with atrazine improves control of many weeds, including pigweeds, waterhemp, velvetleaf, annual morningglories, and lambsquarters, and provides several weeks of residual control. Maximum total amount of Ignite that can be applied per season (burndown = POST) is 44 oz.
- OSU and Purdue University research indicates that Ignite is most effective in a combined preemergence plus postemergence program, where the preemergence herbicide will provide control of grass and broadleaf weeds for several weeks to a month after corn planting. Postemergence applications of Liberty in this program should include atrazine, Capreno, or Laudis where possible. Ignite is weak on yellow foxtail, barnyardgrass, and lambsquarters, and the other PRE or POST herbicides used with Ignite should provide substantial control of these weeds.
- Maximum height for grass weeds at the 22 oz/A rate: barnyardgrass, crabgrass, yellow foxtail, fall panicum - 3 inches; woolly cupgrass, shattercane, and green, giant, and robust foxtails - 6 inches; volunteer corn - 10 inches. Yellow foxtail and crabgrass should be treated prior to tiller initiation for best results. Ignite is most effective on volunteer corn (including glyphosate-resistant) that is 6 to 12 inches tall.
- Maximum height for broadleaf weeds at the 22 oz/A rate: velvetleaf, pigweeds - 3 inches; lambsquarters, waterhemp - 4 inches; burcucumber, cocklebur, annual morningglories, black nightshade, ragweeds, and Pennsylvania smartweed - 6 inches.
- Ignite plus atrazine (1 lb ai/A) will control or suppress some perennial weeds, including dandelion, Canada thistle, Jerusalem artichoke, and wirestem muhly. Ignite has activity on above-ground growth only, so regrowth of perennials may occur and retreatment may be necessary.
- Apply with AMS at the rate of 3 lbs/A, or 17 lbs/100 gallons. When air temperatures are above 85 degrees, the rate can be reduced to 1.5 lbs/A, or 8.5 lbs/100 gallons, to reduce the risk of leaf burn. Applying with surfactants or crop oils may increase the risk of crop injury.
- Apply broadcast from corn emergence through the V7 stage (7 collars).
- Apply in a minimum spray volume of 15 gpa. Use a volume of 20 to 40 gpa in dense weed/crop canopies. Ignite should be applied with a nozzle type and spray pressure that results in medium spray droplets (250 to 350 microns).
- Ignite is most effective when applied under warm, sunny conditions. Effectiveness may be reduced if applied when heavy dew, fog and mist/rain are present, or if weeds are under stress due to drought, cool temperatures, or extended periods of cloudiness. To avoid reduced weed control, apply between dawn and two hours before sunset.

Glyphosate-Resistant Corn — Postemergence Herbicides

Herbicide	Formulation
Expert	4.88L

- Expert is a premix of glyphosate, s-metolachlor (Dual II Magnum), and atrazine that can be applied early postemergence to glyphosate-resistant corn. See descriptions of glyphosate and metolachlor/s-metolachlor plus atrazine for more information on these herbicides.
- Mode of action: group 9 (glyphosate), group 5 (atrazine), group 15 (s-metolaachlor). See pages 12-13.
- Use rates provide the equivalent of 0.4 to 0.75 lbs of glyphosate acid and 1.75 to 2.6 quarts/A of Bicep II Magnum. Use rate ranges from 2.5 to 3.75 qts/A on coarse-textured soils with less than 3% organic matter, and from 3 to 3.75 on all other soils.
- Apply before corn exceeds 12 inches in height.
- Use water as the spray carrier for postemergence applications. Do not mix other products with Expert when applying to emerged corn. Can cause minor corn leaf burn.

Herbicide	Formulation	Product Rate Range
Glyphosate	Various - see Table 24	0.56 - 1.12 lb ae/A

- Glyphosate is a translocated herbicide that controls emerged annual and perennial grass and broadleaf weeds. Table 24 contains a list of currently available glyphosate products. Variations in the formulation may result in differences in product rate and adjuvant recommendations, and specified rainfast intervals. Users should consult labels and local product use guides for more specific information.
- Apply postemergence only to glyphosate-resistant corn hybrids (Roundup Ready, Agrisure GT, etc).
- Mode of action: group 9 (see pages 12-13).
- The general recommendation on most labels for the initial postemergence glyphosate application is a rate of 0.56 to 0.75 lbs of glyphosate acid per acre (lbs ae/A) when weeds are less than 4 inches tall, or before weeds become competitive with the crop (see Table 24 for product rates). Rates should be increased to 1.1 lbs ae/A where weeds are more than 6 inches tall. Multiple postemergence applications of glyphosate are allowed. The maximim rate per application is 1.1 lbs ae/A of glyphosate and the total amount that can be applied postemergence in one season should not exceed 2.25 lbs ae/A. There are exceptions to this depending upon the glyphosate product used and the type of glyphosate-resistant corn planted, and in some situations the maximum rate and amount that can be applied may be lower. Consult seed supplier and glyphosate product label prior to use.
- University research has shown that postemergence glyphosate treatments should be applied when weeds are no more than 2 to 4 inches tall in order to avoid corn yield loss from early-season weed competition. Where preemergence herbicides are applied, there may be more flexibility in the timing of postemergence glyphosate treatments.
- The following management practices are most effective for minimizing the risk of glyphosate resistance in weeds, maintaining adequate weed control, and preserving maximum crop yield: 1) start weed free at planting through use of tillage or a preplant burndown herbicide application; 2) Apply preplant/preemergence herbicides at rates that provide 4 to 6 weeks of residual weed control; 3) make the first postemergence glyphosate application when weeds are less than about 4 inches tall; and 4) make a second postemergence glyphosate application about 3 weeks later as needed to control late-emerging weeds and weeds that were no completely killed by the initial application.
- A total postemergence approach can be effective in glyphosate-resistant corn, but only when: 1) the field is weed free at the time of crop planting through use of tillage or preplant burndown herbicides; 2) the postemergence treatment is applied soon enough after planting to small weeds (less than 2 to 4 inches tall), in order to avoid yield loss from weed interference; and 3) when the postemergence treatment includes not only glyphosate, but also residual herbicides that will control later-emerging weeds for several weeks to a month.
- For Roundup Ready Corn 2, most glyphosate products can be applied broadcast or as a directed spray using drop nozzles from corn emergence through the 8-collar stage or until corn is 30 inches tall, whichever occurs first. When corn is 24 to 30 inches tall, use of crop nozzles will generally improve spray coverage on weeds. Drop nozzles can be used to apply glyphosate to Roundup Ready Corn 2 up to 48 inches tall, but should be adjusted to keep spray out of corn whorls. Similar guidelines apply to the use of Touchdown on Agrisure GT corn. However, not all glyphosate products are labeled similarly with regard to use on Agrisure GT corn. Consult seed supplier and glyphosate product label prior to use.
- Glyphosate resistance has developed in populations of marestail and common and giant ragweed in Ohio and Indiana, and some lambsquarters populations appear to have become less sensitive to glyphosate. Consider use of a preemergence herbicide that provides residual control of these weeds, and avoid use of herbicide programs consisting solely of multiple glyphosate applications. In fields with a history of poor glyphosate performance on lambsquarters and giant and common ragweed, include another postemergence herbicide (Status, Callisto, etc) with the glyphosate to improve control.

Glyphosate-Resistant Corn — Postemergence Herbicides

- Control of perennial weeds will require higher rates than annual weeds. Application when perennials are in the bud to bloom stage (or boot to seedhead for grasses) will provide the most complete control of the entire plant. Minimum size of various perennial weeds for most effective control through the growing season: quackgrass, Canada thistle, wirestem muhly, and yellow nutsedge - 6 inches; field bindweed and common milkweed -12 inches; johnsongrass and hemp dogbane - 18 inches.
- Apply in a spray volume of 5 to 20 gpa. Take precautions to reduce spray drift, since corn, soybeans, and other sensitive crops are likely to be growing in areas surrounding treated fields. The risk of spray drift can be reduced by using a volume of 15 to 20 gpa, selecting the appropriate nozzles, and reducing spray pressure.

Herbicide	Formulation	Product Rate Range
Halex GT	4.38L	3.6 - 4 pts

- Halex GT is a premix of glyphosate, mesotrione (Callisto), and s-metolachlor (Dual II Magnum) for postemergence use in glyphosate-resistant corn (Agrisure GT, Roundup Ready 2, etc). This product controls emerged grass and broadleaf weeds, and provides approximately 4 weeks of residual weed control.
- Mode of action: group 9 (glyphosate); group 13 (mesotrione); group 15 (s-metolachlor). See pages 12-13.
- Weeds should be less than 2 to 4 inches tall at the time of application to minimize risk of yield loss from early-season weed interference. Apply with atrazine if weeds are more than 4 inches tall, or where weeds are resistant to glyphosate.
- Apply to glyphosate-resistant corn up to 30 inches tall or the 8-leaf stage, whichever occurs first. When mixed with atrazine, apply to corn up to 12 inches tall.
- Apply with NIS (1 to 2 qts/100 gallons) and AMS (8.5 to 17 lbs/100 gallons), using water as the spray carrier.

Corn: Harvest Aids

Herbicide	Formulation	Product Rate Range
Aim	2EC	1 - 2 oz

- Aim (carfentrazone) can be applied prior to harvest of corn for dessication of velvetleaf, morningglory, pigweeds, and other weeds. Apply at least 3 days before harvest when the crop is mature and grain has begun to dry down.
- Mode of action: group 14 (see page 12-13).
- The total amount of Aim that can be applied to small grains in one season, including postemergence and harvest aid treatments, cannot exceed 2 oz/A. UAN or AMS can be added.
- Use a spray volume that results in complete coverage of foliage. Apply with NIS (0.25% v/v) or a COC (1 to 2% v/v). UAN or AMS may also be added.

Herbicide	Formulation	Product Rate Range
Glyphosate	Various	See labels.

- Many glyphosate products can be applied as a preharvest treatment to control perennial and annual weeds in corn. Application rate varies with glyphosate product, type of application (ground vs aerial), type of corn (glyphosate-resistant corn vs other), and amount of glyphosate previously applied. Consult labels for specific recommendations.
- Preharvest applications of glyphosate may provide a good opportunity to control perennial weeds, such as pokeweed, because their growth is undisturbed compared to postharvest applications.
- Mode of action: group 9 (see pages 12-13).
- Apply when grain moisture is 35 percent or less. Corn should be physiologically mature (black layer formed) with maximum kernel fill complete. Apply at least 7 days before harvest.
- Depending upon the glyphosate product, the label prohibits or recommends avoiding preharvest application to corn grown for seed, due to the potential for a reduction in germination or vigor.

Herbicide	Formulation	Product Rate Range
Gramoxone SL	2L	1.2 - 2 pt
Parazone	3SL	0.8 - 1.3 pt

- Gramoxone and Parazone (paraquat) may be used for drying weeds in field corn, seed corn, and popcorn just before harvest. Apply when corn is mature - after the black layer has formed at the base of the kernels.
- Mode of action: group 22 (see pages 12-13).
- Mature cocklebur and lambsquarters are tolerant of paraquat and may not desiccate completely.
- For aerial application, use a spray volume of 5 gallons per acre; for ground application, use 20 gallons per acre. Add NIS (0.25% v/v) or COC (1% v/v).
- Apply at least 7 days before harvest.

Table 5. Grazing and Forage (Silage, Hay, etc.) Intervals for Herbicide-Treated Corn

This table is a guide for grazing and feeding herbicide-treated corn, and shows the time that should occur between herbicide application and grazing or harvest for silage. For premixes or combinations not listed below, the minimum interval equals the longer of the two intervals for each individual product in the mix. Always consult herbicide labels for specific limitations.

Herbicide	Grazing	Forage (silage, etc.)
2,4-D	7 days	7 days
Aim	none	none
Atrazine	60 days	60 days
Balance Flexx	none	none
Basagran	12 days	None
Beacon	30 days	45 days
Bicep II Magnum/Cinch ATZ	30 days	30 days
Bromoxynil	30 days	30 days
Cadet	90 days	30 days
Callisto	Do not graze	45 days
Callisto Xtra	Do not graze	60 days
Capreno	45 days	45 days
Corvus	45 days	45 days
Define	None	None
Degree	21 days	21 days
Degree Xtra	21 days	21 days
Dicamba	Past “milk” stage	Past “milk” stage
Dicamba+atrazine	Past “milk” stage	Past “milk” stage
Distinct	32 days	32 days
Dual II Magnum/Cinch	30 days	30 days
Expert	60 days	60 days
Field Master	56 days	56 days
FulTime	21 days	21 days
Gramoxone SL (at planting)	None	None
Guardsman Max	40 days	40 days
Harness	21 days	21 days
Harness Xtra	21 days	21 days
Hornet	85 days	45 days
Ignite	70 days	60 days
Keystone	21 days	21 days
Herbicide	Grazing	Forage (silage, etc.)
Impact	45 days	45 days
Laddok	21 days	21 days
Lariat/Bullet	21 days	21 days
Lasso/Micro-Tech	None	None
Laudis	45 days	45 days
Lightning/Pursuit	45 days	45 days
Lumax/Lexar	45 days	45 days
Metribuzin	60 days	60days

Table 5. (continued)

Nicosulfuron	30 days	30 days
Northstar	30 days	45 days
Outlook	60 days	60 days
Parallel	30 days	30 days
Peak	30 days	40 days
Pendimethalin	21 days	21 days
Permit/Sandea/Halomax/Permit Plus	30 days	30 days
Prequel	30 days	30 days
Princep/simazine	Do not graze	None
Python	85 days	85 days
Radius	None	None
Resolve/Resolve Q	30 days	30 days
Resource	28 days	28 days
Roundup WeatherMax, Glyphomax, other glyphosates	50 days	50 days
Sharpen	80 days	80 days
Shotgun	21 days	21 days
Spirit	30 days	40 days
Stalwart C, Stalwart Xtra	30 days	30 days
Starane	47 days	47 days
Status	32 days	32 days
Steadfast/Ironclad	30 days	30 day
Steadfast ATZ	60 days	60 days
SureStart/TripleFlex	45 days	45 days
Surpass/Topnotch	21 days	21 days
Stinger	40 days	40 days
Touchdown	50 days	50 days
Verdict	80 days	80 days
WideMatch	47 days	47 days
Yukon	30 days and past "milk" stage	30 days and past "milk" stage

Table 6. Rainfast Intervals, Spray Additives, and Maximum Crop Size for Postemergence Corn Herbicides

This table shows the required time interval between herbicide application and rainfall and summarizes label recommendations for spray additives and maximum crop stage. Check herbicide labels for additive rates. Information in this table applies to field corn only.

Herbicide	Rainfast Interval (hours)	Spray additives/Maximum Crop Size
2,4-D Amine	6-8	No additives. Broadcast up to 8-inch corn; directed spray before tassel stage.
2,4-D Ester	2-3	No additives. Broadcast up to 8-inch corn; directed spray before tassel stage.
Accent Q, NIC-IT	4	MSO, COC or SURF (Addition of UAN or AMS is recommended). Broadcast up to 6 collars or 20-inch corn; directed spray up to 10 collars or 36-inch field corn.
Aim	1	SURF. AMS or UAN may be added if required by tank-mix partner. Do not use COC or tank-mix with EC formulations of other crop protection chemicals except as specifically directed by label. Apply up to 8-collar corn.
Atrazine	2	MSO or COC. Apply before corn is 12 inches tall.
Basagran	8	COC, MSO, UAN, or AMS or COC or MSO + UAN or AMS, depending on weed species present.
Beacon	4	MSO, COC, or SURF (UAN or AMS may be added). Broadcast 4 to 20-inch corn; directed spray before tassel emergence.
Bromoxynil	1	No additives. Apply before tassel emergence.
Bromoxynil+atrazine	2	No additives. Apply before corn is 12 inches tall.
Cadet	4	NIC, COC, or MSO. UAN or AMS can be added. Preplant up to 48 inches tall, and before tas sel emergence.
Callisto	1	COC + UAN or AMS. Apply up to 30-inch or 8-leaf corn.
Callisto Xtra	-	COC or NIS + UAN or AMS. Apply up to 12-inch corn.
Capreno	1	COC + UAN or AMS. Apply broadcast from V1 to V6 corn; directed spray up to V7 corn.
Dicamba	6-8	Add UAN if velvetleaf is present. SURF, COC, or UAN may be added under dry conditions. Do not apply with COC when corn height exceeds 5 inches. Broadcast up to 5th-leaf stage or 8-inch corn; directed spray up to 36-inch corn.
Dicamba/atrazine	6-8	Add UAN if velvetleaf is present. SURF, COC, or UAN may be added under dry conditions. Do not apply with COC when corn height exceeds 5 inches. Apply broadcast up to 5-leaf stage or 8-inch corn.
Halex GT	2	SURF + AMS. Broadcast up to 30-inch or 8-leaf corn.
Hornet	2	SURF, COC, or MSO. UAN or AMS may be added under extremely dry conditions. Broadcast up to 20-inch corn or 6 collars; directed spray up to 36-inch corn.
Ignite	4	AMS. Broadcast up to 5-collar corn.
Impact	1	MSO or COC + UAN or AMS. SURF can be used in combinations with other broadleaf herbicides. Apply broadcast or directed up to 45 days before harvest.
Laddok	8	MSO, COC, UAN, AMS, DASH, or combinations of these. Apply before corn is 12 inches tall.
Laudis	1	MSO + UAN or AMS. Broadcast up to V8 corn.
Laudis + atrazine	2	COC + UAN or AMS. Broadcast up to 12-inch corn
Lightning	1	SURF + UAN, 10-34-0 or AMS. Broadcast up to V6 or 20-inch corn; directed spray up to 45 days before harvest.
Northstar	4	SURF, COC or MSO up to 12-inch corn. Only SURF between 12 and 36-inch corn. UAN or AMS may be added. Broadcast 4 to 20-inch corn; directed spray up to 36-inch corn.
Peak	4	COC unless mixed with glyphosate. Broadcast up to V6 or 20-inch corn; directed spray up to 30 inches.
Permit/Sandea/Halomax	4	SURF, MSO, or COC. UAN or AMS may be added. Apply through layby stage of corn.
Permit Plus	4	SURF or COC + UAN or AMS. Broadcast or directed from 1- to 5-collar stage.
Resolve	4	NIS + UAN or AMS, unless mixed with a glyphosate product or Ignite. Broadcast up to 12-inch or 6 collar corn.
Resolve Q	4	NIS + UAN or AMS, unless mixed with a glyphosate product or Ignite. Broadcast up to 20-inch or 6 collar corn.
Resource	1	COC. UAN or AMS may be added to improve control of certain species. Apply up to the 10-leaf stage.
Shotgun	6	No additives. Apply before 12-inch corn.
Spirit	4	COC, MSO or SURF.UAN or AMS may be added. Broadcast 4 to 20-inch corn; directed spray up to 24-inch corn or after 6 collar corn.
Starane	1	An adjuvant can be used if required by tank-mix partner. Broadcast up to the V5 stage; directed spray after the V5 stage.
Status	4	SURF, COC, or MSO + UAN or AMS. Broadcast from 4 to 36-inch corn (rates up to 5 oz/A)
Steadfast Q/Ironclad	4	COC, MSO, or SURF + UAN or AMS. COC or MSO is preferred over SURF. Broadcast up to and including 6 collars or 20-inch corn
Steadfast ATZ	4	COC, MSO, or SURF + UAN or AMS. COC or MSO is preferred over SURF. Broadcast up to and including 6 collars or 12-inch corn
Stinger	6-8	No additives. Up to 24-inch corn.
WideMatch	6	No additives. Broadcast up to the V5 stage; directed spray after the V5 stage.
Yukon	4	SURF or COC. UAN or AMS may be added. Apply broadcast or directed up to 36-inch corn.

Table 7. Herbicides Labeled for Use on Field Corn, Seed Corn, Popcorn, and Sweet Corn

	Field Corn	Field Corn Grown For Seed	Popcorn	Sweet Corn
2,4-D	Y	Y[5]	Y[5]	Y
Accent Q/NIC-IT	Y	Y[5, 8]	Y[1, 5, 8]	Y[5, 8]
Aim	Y	Y[9]	Y	Y[5]
Atrazine	Y	Y	Y	Y
Balance Flexx	Y	Y[5]	N	N
Basagran	Y	Y	Y	Y
Basis	Y	N	N	N
Beacon	Y[5]	Y[5, 7]	Y[5, 7]	N
Bicep II Magnum/Cinch ATZ	Y	Y	Y	Y
Bromoxynil	Y	Y[2, 5]	Y[2]	N
Cadet	Y	Y	Y	Y
Callisto, Callisto Xtra	Y	Y	Y[10]	Y
Capreno	Y	Y[5]	N	N
Corvus	Y	Y[5]	N	N
Degree	Y	Y	Y	Y
Degree Xtra	Y	Y	Y	Y
Dicamba	Y	Y[5]	Y[5]	N
Dicamba+atrazine	Y	Y[5]	Y[5]	N
Dual II Magnum/Cinch	Y	Y	Y	Y
Expert	Y	Y	Y	Y
Field Master	Y	Y	Y	N
FulTime	Y	Y	Y	Y
Guardsman Max	Y	Y	Y	Y[5]
Harness	Y	Y	Y	Y
Harness Xtra	Y	Y	Y	Y
Hornet	Y	Y[5]	N	N
Impact	Y	Y[5]	Y[5]	Y[5]
Keystone	Y	Y[3]	Y	Y
Laddok	Y	Y	Y	Y
Lariat/Bullet	Y	Y	Y	Y
Lasso/Micro-Tech	Y	Y	Y	Y[4]
Laudis	Y	Y[5]	Y[5]	Y[5]
Lumax/Lexar	Y	Y	Y[10]	Y
Metribuzin	Y	N	N	N
Northstar	Y[5]	Y[5, 7]	Y[5, 7]	N
Outlook	Y	Y	Y	Y[5]
Parallel/Parallel Plus	Y	Y	Y	N
Peak	Y	N	N	N
Pendimethalin	Y	Y	Y	Y
Permit/Sandea/Halomax	Y	Y	Y	Y[5]
Permit Plus	Y	N	N	N
Prequel	Y	N	N	N
Princep/simazine	Y	N	N	N
Python	Y	Y[5]	N	N
Resolve/Resolve Q	Y	N	N	N
Resource	Y	Y[5]	N	N
Sharpen	Y	Y	Y[5]	N
Shotgun	Y	N	N	N
Spirit	Y[5]	Y[5, 7]	Y[5, 7]	N
Stalwart C/Stalwart Xtra	Y	Y	Y	Y
Starane	Y	N	N	Y
Status	Y	Y	Y	N
Steadfast Q/Steadfast ATZ/Ironclad	Y	N	N	N
Stinger	Y	Y[5]	N	N
SureStart/TripleFlex	Y	N	N	N
Surpass/Topnotch	Y	Y	Y	Y
Valor	Y	N	N	N
Verdict	Y	N	Y[5]	N
WideMatch	Y	N	N	Y
Yukon	Y	Y	N	N

1 Do not apply to any white popcorn inbred or hybrid unless approved by seed supplier.
2 Do not apply prior to 3-leaf corn stage.
3 Do not use on corn seed stock such as “Breeders,” “Foundation,” or “Increase.”
4 Do not make postemergence application of Partner or Microtech to sweet corn.
5 Check with seed supplier or chemical representative for sensitivity of inbreds/hybrids prior to use.
6 Injury may occur on field corn hybrids with a Relative Maturity (RM) rating of less than 88 days or on waxy, Hi-Lysine, or food grade corn.
7 Can be used if spray is directed using drop nozzles when seed corn is between 4 and 20 and 4 and 30 inches tall for Spirit and Exceed, respectively, when popcorn is between10 and 24 and 10 and 30 inches tall for Spirit and Exceed respectively, and when seed corn and popcorn are between 10 and 36 and 10 and 48 inches tall for Northstar and Beacon, respectively. All products must be applied before tassel emergence.
8 Do not apply if corn is greater than 20 inches tall or exhibits 5 collars.
9 Apply as directed spray only. Avoid herbicide application into the corn whorl.
10 Yellow popcorn only.

Table 8. Herbicide and Organophosphate Insecticide Use Precautions

This table is a guide to using herbicides on field corn where an organophosphate (OP) insecticide is used at planting. Do not mix an OP insecticide with the herbicides shown below, as severe injury will occur. Read the herbicide label before applying OP insecticides postemergence when using any of these herbicides.
Definitions and Abbreviations:
Do not use = do not apply the herbicide if corn has been previously treated with soil insecticide.
NR = not recommended to apply the herbicide if corn has been previously treated with soil insecticide.
TI = Temporary injury may occur if the herbicide is applied to corn previously treated with soil insecticide.
Y = The herbicide can be used with nearly no risk of injury when applied to corn previously treated with soil insecticide.

	Soil-applied Organophosphate Insecticides					
Herbicide	**Counter 20CR (in furrow)**	**Counter 20CR (banded)**	**Thimet/ phorate**	**Lorsban**	**Aztec**	**Fortress**
Beacon	Do not use	NR	TI	TI	TI	TI
Callisto, Callisto Xtra (POST)	NR	NR	See label	NR	See label	See label
Capreno	Do not use	Do not use	Do not use	Do not use	Y	Do not use
Corvus	Do not use	Do not use	Do not use	Do not use	Y	Do not use
Halex GT	NR	NR	NR	NR	NR	NR
Hornet (PRE)	Do not use	Do not use	Do not use	TI[1]	TI[1]	TI[1]
Hornet (POST)	Do not use	Do not use	Do not use	TI	TI	TI
Lexar, Lumax (POST)	NR	NR	TI	TI	TI	TI
Nicosulfuron	Do not use	NR	TI	TI	Y	Y
NorthStar	Do not use	NR	TI	TI	TI	TI
Peak	Do not use	Do not use	TI	TI	TI	TI
Permit/Sandea/Halomax	Y	Y	Y	Y	Y	Y
Prequel	Do not use	TI	TI[2]	TI[2]	Y	Y
Python	Do not use	Do not use	Do not use	TI[1]	TI[1]	TI[1]
Resolve/Resolve Q	Do not use	NR	NR	NR	60 days[3]	60 days[3]
Spirit	Do not use	NR	TI	TI	TI	TI
Steadfast Q/Steadfast ATZ/Ironclad	Do not use	NR	NR	TI	Y	Y
SureStart	Do not use	Do not use	TI[1]	TI[1]	TI[1]	TI[1]
Verdict, Sharpen	Do not use	Do not use	Do not use	Do not use	Do not use	Do not use
Yukon	Y	Y	Y	Y	Y	Y
Clearfield CORN Only						
Lightning	Do not use	TI	Do not use[2]	TI	Y	Y

[1] Apply the soil insecticide in a T-band or a band to reduce risk of crop injury.
[2] Do not use herbicide if soil insecticide is applied in furrow. Herbicide may be used if soil insecticide is applied in a band, but temporary corn injury may still occur.
[3]Do not apply herbicide within 60 days of insecticide application.

Popcorn and Sweet Corn Weed Management

Weed management in popcorn and sweet corn is similar to field corn in many respects. However, there are a few important points to keep in mind when planning a weed management strategy for these specialty crops. First, not every product labeled in field corn is labeled in popcorn or sweet corn. Second, the sensitivity of popcorn and sweet corn inbreds and hybrids to herbicides varies. Popcorn and sweet corn inbreds and hybrids are generally selected based on their performance, but the selection can determine which herbicides can be used.

White popcorn lines are often more sensitive to herbicides than yellow corn lines. Tolerance of sweet corn to herbicides has been intensively studied, but the sensitivity of the many new varieties introduced every year is often uncertain. Labels for several new herbicides contain statements that limit the herbicide manufacturer's liability should sweet corn be damaged. Many sweet corn varieties are sensitive to mesotrione and sulfonyl urea herbicides. A few varieties are sensitive to Laudis while nearly all varieties tolerate Impact. For more information on sweet corn varietal response to herbicides visit the web sites listed below. It is always a good idea to address this issue with your seed supplier before selecting herbicides to use in popcorn or sweet corn. Finally, most popcorn and some sweet corn is grown under contract, and seed company contracts may specify herbicide programs to be used on their varieties.

- Ranking of sweet corn variety tolerance to nicosulfuron and Callisto:
  http://ipcm.wisc.edu/WCMNews/tabid/53/EntryId/656/Sweet-Corn-Tolerance-Results-from-2008.aspx
  http://ag.udel.edu/rec/WeedScience/Research_reports/Sweet%20Corn%20Hybrid%20Tolerance%20Rating%202007.pdf

- Response of sweet corn varieties to Impact and Laudis:
  http://ag.udel.edu/rec/WeedScience/Research_reports/Sweet_Corn_Tolerance_laudis_impact_07.pdf

The number of broad-spectrum postemergence herbicides labeled for popcorn and sweet corn is somewhat limited. Annual grasses should be controlled with preemergence herbicides, such as acetochlor (Degree, Harness, Surpass, and Topnotch), metolachlor, (Dual II Magnum), and dimethenamid-P (Outlook). Accent can be applied for postemergence grass control in popcorn, but it cannot be used on some hybrids and inbreds. Impact is much less likely to cause injury to popcorn than Accent, and it can be applied postemergence for control of small grasses and many broadleaf weeds. Shattercane, johnsongrass, and quackgrass can be particularly difficult to manage in these speciality crops. Fields infested with these weeds should probably not be planted to popcorn or sweet corn.

Many of the broadleaf herbicides labeled for field corn can also be used in popcorn and sweet corn. Atrazine is probably the most commonly used herbicide, and has activity on many broadleaf weeds such as black nightshade, common ragweed, and lambsquarters. It is somewhat less effective on giant ragweed, annual morningglories, and velvetleaf. Atrazine premix products, such as Degree Xtra, Bicep II Magnum, Keystone, Guardsman Max, are commonly used broad spectrum herbicides for popcorn and sweet corn, although not all premixes are labeled for both types of corn. Application of a three-way premix, such as Lumax or Lexar, will improve control of the broadleaf weeds that atrazine premix products fail to adequately control.

Table 9. Weed Response to Herbicides in Popcorn and Sweet Corn

This table compares the relative effectiveness of herbicides on individual weeds. Ratings are based on labeled application rate and weed size or growth stage. Performance may be better or worse than indicated in the table, due to weather or soil conditions or other variables. See pages 12-13 for additional information on mode of action classification.

Weed control rating:
9 = 90% to 100%
8 = 80% to 90%
7 = 70% to 80%
6 = 60% to 70%
- = less than 60% control, not recommended.

Crop tolerance rating:
0 = Excellent
1 = Good
2 = Fair
3 = Poor

Crop injury of 1 or less is rarely significant.

		Grasses										Broadleaf Weeds															
	Modeof action	Barnyardgrass	Crabgrass	Fall panicum	Giant foxtail	Yellow foxtail	Shattercane	Seedling johnsongrasss	Rhizome johnsongrass	Quackgrass	Yellow nutsedge	Annual morningglory	Black nighshade	Burcucumber	Cocklebur	Common ragweed	ALS-resistant common ragweed	Giant ragweed	ALS-resistant giant ragweed	Jimsonweed	Lambsquarter	Tri-resistant lambsquarter	Pigweed (redroot)	Smartweed	Velvetleaf	Waterhemp	Canada thistle
Preplant or Preemergence																											
Acetochlor	15	9	9	8	9	9	-	-	-	-	8+	-	8+	-	-	7	7	-	-	-	7+	7+	8+	-	-	8	-
Acetochlor+atrazine	5/15	9	9	8	9	9	-	-	-	6	8+	8	9	6	8	9	9	8	8	9	9	7+	9	9	8	9	-
Alachlor	15	8	8+	8	8+	8+	-	-	-	-	8	-	8+	-	-	-	-	-	-	-	6	6	8	-	-	8	-
Alachlor + atrazine	5/15	9	8	8	8	8	-	-	-	6	8	8	9	6	8	9	9	8	8	9	9	6	9	9	8	9	-
Atrazine	5	8	-	-	7	7	-	-	-	8	7	8	9	6	8	9	9	8	8	9	9	-	9	9	8	9	-
Callisto	28	-	6	-	-	-	-	-	-	-	-	6	9	7	-	7	7	6	6	-	9	9	9	9	9	9	-
Guardsman Max	5/15	9	8+	8	8+	8+	-	-	-	-	8	8	9	-	8	9	9	7	7	9	9	6	9	9	7+	9	-
Lumax / Lexar	5/28/15	9	9	8	9	9	-	-	-	6	8	8	9	7	8	9	9	8	8	9	9	9	9	9	9	9	-
Metolachlor	15	8	9	8+	9	9	-	-	-	-	8+	-	8	-	-	-	-	-	-	-	6	6	8	-	-	8	-
Metolachlor + atrazine	5/15	9	9	8	9	9	-	-	-	6	8	8	9	6	8	9	9	8	8	9	9	6	9	9	8	9	-
Outlook	15	8	8+	8	8+	8+	-	-	-	-	8	-	8+	-	-	-	-	-	-	-	6	6	8	-	-	8	-
Pendimethalin[1]	3	8	8	8	8	8	6	6	-	-	-	-	-	-	-	-	-	-	-	-	8	8	9	-	-	8	-
Sharpen	14	-	-	-	-	-	-	-	-	-	-	8	9	?	8	9	9	8	8	8	9	9	9	9	8	8	-
Verdict (popcorn only)	14/15	8	8	8	8	8	-	-	-	-	8	8	9	?	8	9	9	8	8	8	9	9	9	9	8	9	-
Postemergence																											
2,4-D (popcorn only)	4	-	-	-	-	-	-	-	-	-	-	9	7	-	9	9	9	9	9	7	9	9	9	6	8	8	6
Aim	14	-	-	-	-	-	-	-	-	-	-	8	8	-	-	6	6	-	-	-	7	7	8	-	9	7	-
Atrazine	5	7	-	-	8	8	-	-	-	7	7	9	9	8	9	9	9	8	8	9	9	-	9	9	8	9	6
Basagran	6	-	-	-	-	-	-	-	-	-	8	-	-	-	9	7	7	6	6	9	6	6	-	9	8+	-	7
Beacon (popcorn only)	2	-	-	8	7	7	9	9	7	8	6	6	8	9	9	9	-	9	-	9	-	-	9	8	8	-	6
Bromoxynil	6	-	-	-	-	-	-	-	-	-	-	8	9	7	9	9	9	8	8	9	9	9	7	8	8	6	6
Cadet	14	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	-	7	7	8	-	9	7	-
Callisto	28	-	7*	-	-	-	-	-	-	-	-	7	9	7+	7+	7+	7+	8	8	9	9	9	8	9	9	9	-
Callisto Xtra	5/28	-	7*	-	-	-	-	-	-	-	-	8	9	9	9	9	9	9	9	9	9	9	9	9	9	9	-
Dicamba (popcorn only)	4	-	-	-	-	-	-	-	-	-	-	9	8	7	9	9	9	9	9	9	9	9	9	8	7	8	7
Impact	28	7	7+	6	7+	7	6	7	-	-	-	7	9	7+	8	7	7	7	7	9	9	9	9	8	9	9	-
Impact + atrazine	5/28	8	8	6	8	7+	6	7	-	-	-	8	9	8	9	9	9	9	9	9	9	9	9	9	9	9	-
Laddok	5/6	-	-	-	-	-	-	-	-	-	8+	8	8	6	9	9	9	9	9	9	9	5	9	9	9	8	7
Laudis	28	8	6	-	7	9	8	8	7	7	-	7	9	7	8	8	8	8	8	9	9	9	9	8	9	9	-
Laudis + atrazine	5/28	8	7	-	8	9	8	8	7	7	-	8	9	8	9	9	9	9	9	9	9	9	9	9	9	9	-
Nicosulfuron	2	8	-	8	9	9	9	9	9	9	6	8	-	8	-	-	-	-	-	8	-	-	9	8	-	7	6
NorthStar (popcorn only)	2/4	-	-	7	6	6	9	9	6	7	-	8	9	9	9	9	7	9	6	9	9	9	9	9	8	8	7
Permit/Sandea/Halomax	2	-	-	-	-	-	-	-	-	-	9	6	-	-	9	8	-	8	-	8	-	-	9	7	8	-	6
Spirit (popcorn only)	2	-	-	7	6	6	9	9	6	7	-	7	8	9	9	9	-	9	-	9	6	6	9	8	8	-	6
Status (popcorn only)	4/19	6	6	6	6	6	-	-	-	-	-	9	8	7	9	9	9	9	9	9	9	9	9	8+	8	8	9
Stinger	4	-	-	-	-	-	-	-	-	-	-	-	8	-	9	9	9	9	9	8	-	-	-	-	-	-	9
Yukon (popcorn only)	2/4	-	-	-	-	-	-	-	-	-	9	8	7	7	9	9	7	9	7	9	8	8	9	9	9	8	7

[1] Popcorn - apply pendimethalin after planting or postemergence; sweet corn - apply pendimethalin postemergence only. Provides residual weed control only, not control of emerged weeds.

*Large crabgrass only.

Popcorn and Sweet corn: Soil-Applied Herbicides - Preplant or Preemergence

Herbicide	Formulation	Product Rate Range
AAtrex/atrazine	4L	2 - 4 pt
	90DF	1.1 - 2.2 lb

- Mode of Action: group 5 (see page 12-13).
- Atrazine is generally applied at a rate of 1.4 to 2 pounds active ingredient per acre to control broadleaf weeds.
- Rates approaching 2 pounds active ingredient will improve control of velvetleaf, cocklebur, giant ragweed, and morningglory. Atrazine will not control fall panicum, regardless of rate.
- Maximum soil-applied rate on soils not highly erodible is 2 pounds of active ingredient per acre. Maximum rate on highly erodible soils is 2 pounds active ingredient on fields with at least 30% crop residue, and 1.6 pounds active ingredient on fields with less than 30% crop residue. Soil applications may be followed with a postemergence application of atrazine, but total of all treatments cannot exceed 2.5 pounds active ingredient per acre per year.
- Plant only corn or sorghum the year of atrazine application.
- Where oats, forage legumes, or forage grasses will be planted the following spring, do not apply more than 0.8 pounds active ingredient per acre.

Herbicide	Formulation	Product Rate Range
Acetochlor	various	

- Acetochlor (plus safener) is sold under various trade names, including Harness, TopNotch, Surpass, Degree, Confidence, and Volley. Check label to make sure the product is labeled for sweet corn.
- Acetochlor controls annual grasses, pigweed, and black nightshade, and controls or suppresses yellow nutsedge, lambsquarters, and common ragweed. Control of lambsquarters and common ragweed will generally be less effective compared to most broadleaf herbicides, but more effective than other acetamide herbicides.
- Mode of action: group 15 (see page 12-13).
- Degree and TopNotch are encapsulated products that can provide a longer period of annual grass control compared to other acetochlor products.
- Acetochlor products can be applied after planting but prior to weed emergence, and before corn height exceeds 11 inches. All acetochlor products except Degree must be applied using water as the spray carrier after the corn has emerged.
- Degree and Degree plus atrazine can be applied to emerged popcorn in water or UAN, but popcorn should not exceed 6 inches in height if fertilizer solution is used as the carrier. Do not apply in fertilizer solution when air temperatures exceed 85 degrees. Mixtures with products other than atrazine should be applied only in water if corn has emerged. Leaf burn may occur when acetachlor is applied to emerged corn.
- Do not apply postemergence to sweet corn.

Degree 3.8L Use Rates (pts/A)

Soil Texture	Less than 3% OM	3% or more OM*
Coarse	2.25 to 3.25	3.25
Medium	3.25 to 4.25	3.25 to 4.25
Fine	3.25 to 4.25	4.25 to 5.0

*On soils with 6 to 10% organic matter (OM) use 4.25 to 6.25.

Harness/Confidence 7EC Use Rates (pts/A)[a]

Soil Texture	Less than 3% OM	3% or more OM[b]
Coarse	1.25 to 1.75	1.75
Medium	1.75 to 2.25	1.75 to 2.25
Fine	1.75 to 2.25	2.25 to 2.75

[a]Use higher rate in recommended rage in areas of high weed infestations.
[b]On soils with 6 to 10% OM use 2.5 to 3.4 pt/A.

Surpass/Volley 6.4EC Use Rates (pt/A) in Conventional Tillage Systems When Applied within 14 Days Before Planting[a]

Soil Texture	Less than 3% OM	3% or more OM[b]
Coarse	1.5 to 2.25	1.5 to 2.5
Medium	1.5 to 2.5	1.5 to 2.5
Fine	1.5 to 2.75	2 to 3

[a]Use higher rate in recommended range in areas of high weed infestations.

Popcorn and Sweet corn: Soil-Applied Herbicides - Preplant or Preemergence

Surpass/Volley 6.4EC Use Rates (pt/A) in Reduced or No-Till systems or Conventional Systems When Applied More Than 14 Days Before Planting

Soil Texture	Less than 3% OM	3% or more OM[b]
Coarse	2	2
Medium	2 to 2.5	2.5
Fine	3	3

TopNotch 3.2 L Use Rates (qt/A)

	Time from Application to Planting			
Soil Texture	Less than 10 days	10 to 30 days	30 to 40 days	After planting &/or emergence
Coarse	2	2 to 2.5[a]	2.5	2
Medium	2 to 2.5	2.5	2.5 to 3	2 to 2.5
Fine	2.5 to 3	2.5 to 3	3 to 3.75	2.5 to 3

[a] On coarse soil textures with less than 3% OM the maxium use rate is 2.25 qt/A

Herbicide	Formulation	Product Rate Range
Acetochlor + atrazine	Various	

- Acetochlor plus atrazine (plus safener) is sold under various trade names, including Harness Xtra, Degree Xtra, Fultime, Keystone, Confidence Xtra, and Volley ATZ. These premix products control annual broadleaves and grasses in popcorn. The ratio of atrazine to acetochlor varies with product, and some products require the addition of atrazine or another broadleaf herbicide for the effective control of some broadleaf weeds. Check label to make sure the product is labeled for sweet corn.
- Degree Xtra and Fultime are encapsulated formulations that can provide a longer period of annual grass control compared to other acetochlor products.
- Mode of action: group 5 (atrazine), group 15 (acetochlor). See page 12-13.
- Can be applied after planting and before corn height exceeds 11 inches and before weeds reach the 2 leaf-stage. When mixing with postemergence herbicides to control larger weeds, follow the most restrictive label with regard to maximum popcorn size.
- All acetochlor products except Degree Xtra should be applied using water as the spray carrier after the popcorn has emerged.
- Degree Xtra can be applied in water or UAN, but popcorn should not exceed 6 inches in height if fertilizer solution is the carrier. Do not apply in fertilizer solution when temperature exceeds 85 degrees. Mixtures with products other than atrazine should be applied only in water if the corn has emerged. Leaf burn may occur when applied to emerged corn.
- Do not apply postemergence to sweet corn.

Degree Xtra 4L Use Rates (qt/A)

Soil Texture	
Coarse	2.9
Medium*	2.9 to 3.7
Fine*	3.2 to 3.7

*In areas of heavy weed pressure rates can be increased to 4.3 qts/A.

FulTime 4L Use Rates (qt/A) in Conventional Tillage Systems When Applied Within 14 Days Before Planting

Soil Texture	Less than 3% OM	3% OM or more
Coarse	2.5 to 2.7	2.7 to 3
Medium	2.7 to 3.3	3 to 3.3
Fine	3 to 3.5	3 to 5

FulTime 4L Use Rates (qt/A) in Reduced or No-Till Systems or Conventional Systems When Applied More Than 14 Days Before Planting

	Time From Application		
Soil Texture	Greater than 10 days before planting	Less than 10 days before or after planting	After planting and/or emergence
Coarse	Do not apply more than 14 days before planting	2.5 to 3	2.5 to 3
Medium	2.7 to 4	2.7 to 3.3	2.7 to 3.3
Fine	3.3 to 5	3 to 5	3 to 4

Popcorn and Sweet corn: Soil-Applied Herbicides - Preplant or Preemergence

Harness Xtra/Confidence Xtra 5.6L Broadcast Rate (qt/A)*		
Soil Texture	**Less than 3% OM**	**3% or more OM**
Coarse	1.4	1.7
Medium	1.7 to 2.4	2.3 to 2.6
Fine	2.3 to 2.6	2.3 to 3.0

* In areas of heavy infestations use up to 2.3 qt/A on coarse-textured soils and 2.3 to 3.0 qt/A on medium- and fine-textured soils, but do not exceed 2.5 qt/A on highly erodible soils with less than 30% plant residue.

Keystone/Volley ATZ 5.25: Use Rate in Conventional Tillage (qt/A)		
Soil Texture	**Less than 3% OM**	**3% or more OM**
Coarse	2.2 to 2.4	2.4 to 2.6
Medium	2.4 to 2.8	2.6 to 2.8
Fine	2.6 to 3.0	2.6 to 3.4

Herbicide	Formulation	Product Rate Range
Alachlor	Various	

Lasso Use Rates (qt/A)*		
Soil Texture	**Less than 3% OM**	**Greater than 3% OM**
Coarse	2 to 2.25	2 to 2.25
Medium	2 to 2.75	2 to 2.75
Fine	2 to 2.75	2.5 to 3.25

* Use higher rate in the recommended range in areas of heavy weed pressure. Use a minimum of 2.5 qt/A on coarse-textured soils and 3 to 4 qt/A on medium or fine-textured soils to control black or hairy nightshade.

- Alachlor controls annual grasses and pigweed, and controls or suppresses yellow nutsedge and black nightshade. Product trade names include Lasso and Micro-Tech among others.
- Mode of Action: group 15 (see page 12-13).
- Micro-Tech can be applied after popcorn emergence until the corn is 5 inches tall, but should be applied before weeds have passed the 2-leaf stage in a mixture with atrazine. Can be applied to emerged corn in water or UAN. Do not apply in fertilizer solution when air temperatures exceeds 85 degrees. Other alachlor products and combinations should be applied in water after the corn has emerged. Leaf burn may occur when applied to emerged corn.
- Do not apply postemergence to sweet corn.
- Incorporation to 2 inches will improve yellow nutsedge control and reduce dependence upon rainfall.
- Allow 45 days between application and harvest of sweet corn. for forage.

Herbicide	Formulation	Product Rate Range
Alachlor + atrazine	Various	

Bullet Use Rates (qt/A)		
Soil Texture	**Less than 3% OM**	**Greater than 3% OM**
Coarse	2.5	3
Medium	3	3.75
Fine	3.75	3.75 to 4.5

Lariat Use Rates (qt/A)*		
Soil Texture	**Less than 3% OM**	**Greater than 3% OM**
Coarse	2 to 2.25	2 to 2.25
Medium	2 to 2.75	2 to 2.75
Fine	2 to 2.75	2.5 to 3.25

* In areas of heavy infestations use 4 to 5 qt/A, but do not exceed 4.25 qt/A on highly erodible soils with less than 30% plant residue.

- Alachlor + atrazine is available from various manufacturers, and include products such as Lariat and Bullet. Bullet is a microencapsulated formulation, which may provide more effective control than Lariat and other non-encapsulated products in no-till situations. Check labels to make sure the product is labeled for use in sweet corn.
- Mode of action: group 5 (atrazine), group 15 (alachlor). See page 12-13.
- Lariat can be applied in water, and Bullet can be applied in water or 28% liquid fertilizer, and after planting until weeds reach the 2-leaf stage and when corn is no more than 5 inches tall. Applications of Bullet in 28% should not be made if temperature exceeds 85 degrees F. Leaf burn may occur when applied to emerged corn.
- Do not apply postemergence to sweet corn.
- Do not make more than one application/year to sweet corn.

Popcorn and Sweet corn: Soil-Applied Herbicides - Preplant or Preemergence

Herbicide	Formulation	Product Rate Range
Callisto	4L	6 - 7.7 fl oz

- Yellow popcorn and sweet corn only. Do not apply to white popcorn.
- Callisto (mesotrione) can be applied preplant or preemergence for control of annual broadleaf weeds. Callisto can help control giant ragweed, cocklebur, and morningglory in mixtures with atrazine.
- Mode of action: group 28 (see page 12-13).
- Callisto does not control grass weeds, and should be applied in combination with Harness, Dual II Magnum, TopNotch, or another acetamide grass herbicide, or an acetamide/atrazine premix (Bicep II Magnum, Degree Xtra, etc.).

Herbicide	Formulation
Guardsman Max	5L

- Guardsman Max is a premix of dimethenamid-P (Outlook) plus atrazine for control of annual grass and broadleaf weeds.
- Mode of action: group 5 (atrazine), group 15 (dimethenamid). See page 12-13.
- Can be applied early postemergence to corn that is up to 12 inches tall. Weeds should be less than 1.5 inches tall, unless other products are mixed with Guardsman Max to control larger emerged weeds.
- Some popcorn and sweet corn hybrids may be sensitive to Guardsman Max. Consult your seed company for hybrid tolerance.
- Allow 45 days between application and harvest of sweet corn for forage.

Guardsman Max Use Rate (pt/A)[a]

	Organic Matter	
Soil texture	**Less than 3%**	**3% or more**
Coarse	2.5 to 3	3 to 4
Medium or Fine	3 to 4	4 to 4.6

a. For all preplant applications, use 3.8 to 4.6 pt/A. Do not exceed 3.8 pt/A on highly erodible soils with less than 30% plant residue cover.

Herbicide	Formulation	
Lumax	4L	2.5 - 3 qts
Lexar	3.7L	3 - 3.5 qts

- Yellow popcorn and sweet corn only. Do not apply to white popcorn.
- Lumax and Lexar are premixes of atrazine plus s-metolachlor (Dual II Magnum) plus mesotrione (Callisto) for control of grass and broadleaf weeds in corn. See descriptions for these products for more information.
- Mode of action: group 5 (atrazine); group 15 (s-metolachlor); group 28 (mesotrione).
- Control most annual broadleaf weeds, but expect partial control of giant ragweed, cocklebur, and annual morningglory.
- Can be applied preplant or preemergence. Do not apply postemergence to popcorn or sweet corn. Emerged broadleaf weeds should be less than 3 inches tall at the time of application. Control of emerged grasses (up to 1.5 inches tall) will require additional atrazine.

Popcorn and Sweet corn: Soil-Applied Herbicides - Preplant or Preemergence

Herbicide	Formulation	Product Rate Range
s-metolachlor	7.64E	
metolachlor	7.8E	

- S-metolachlor (Dual II Magnum, Cinch) and metolachlor (Stalwart C, Parallel) control annual grasses and pigweed, and control or suppress waterhemp, black nighshade, and yellow nutsedge.
- Mode of action: group 15 (see page 12-13).
- Can be applied preplant or preemergence before corn and weeds emerge. Can be applied postemergence with atrazine up to 5-inch corn or as a directed spray up to 12-inch corn, and before grass and broadleaf weeds exceed the 2-leaf stage. Do not apply using fertilizer solution as the spray carrier after the corn has emerged.
- May be applied up to 30 days before planting as a single application.
- Incorporation to a depth of 2 inches will improve yellow nutsedge cotnrol and reduce dependence on rainfall.
- Allow 30 days between application and harvest of sweet corn.

Use rates for Dual II Magnum, Cinch, Parallel, and Stalwart (pt/A)

Soil Texture	Less than 3% OM	3% or more OM
Coarse	1.0 to 1.33	1.33
Medium	1.33 to 1.67	1.33 to 1.67
Fine	1.33 to 1.67	1.67 to 2.0

Herbicide	Formulation	Product Rate Range
S-metolachlor + atrazine	5.5L	
metolachlor + atrazine	5.5L	

- S-metolachlor plus atrazine (Bicep II Magnum, Brawl II ATZ, Cinch ATZ) and metolachlor plus atrazine (Stalwart Xtra, Parallel Plus, Trizmet) control annual grass and broadleaf weeds in corn.
- Mode of action: group 5 (atrazine), group 15 (S-metolachlor/ metolachlor). See page 12-13.
- Can be applied preplant, preemergence, and after corn emergence until corn plants are 5 inches tall and before weeds exceed the 2-leaf stage. Do not apply using fertilizer solution as the spray carrier after crop emergence.
- Allow 30 days between application and harvest of sweet corn.

Bicep II Magnum/Cinch ATZ Use Rates (qt/A)

Soil Texture	Less than 3% OM	3% or more OM
Coarse	1.3	1.6
Medium	1.6	2.1
Fine	2.1	2.1[a]
		2.1 to 2.6[b]
Muck or Peat	Do not use	Do not use

[a] Do not exceed this rate on highly erodible land with less than 30% plant residue cover.

[b] For cocklebur, yellow nutsedge, and velvetleaf control on fine-textured soils above 3% OM, apply 3.0 qt/A Bicep II.

Stalwart Xtra Use Rates (qt/A)

Soil Texture	Less than 3% OM	3% or more OM
Coarse	1.3	1.6
Medium	1.6	2.1
Fine	2.1	2.1

Popcorn and Sweet corn: Soil-Applied Herbicides - Preplant or Preemergence

Herbicide	Formulation	Product Rate Range
Outlook	6EC	

Outlook Use Rates (fl oz/A)

Soil Texture	Less than 3% OM	3% or more OM
Coarse	10 to 14	14 to 18
Medium	14 to 16	16 to 20
Fine	16 to 18	18 to 21

- Outlook (dimethenamid-P) controls annual grasses and pigweed, and controls or suppresses yellow nutsedge and black nightshade.
- Mode of action: group 15 (see page 12-13).
- Can be applied preplant, preemergence, but must be applied before weed emergence, or in a mixture with herbicides that control emerged weeds. Do not apply to corn that is more than 12 inches tall.
- Can be applied after corn has emerged with surfactant or low rates of liquid fertilizer. Do not use fertilizer solution as the spray carrier after crop has emerged. COC should not be added after the crop has emerged unless specified for a particular tank mixture.
- Consult your seed company regarding hybrid tolerance to Outlook. Do not harvest sweet corn for 50 days after application. Do not make any layby applications to sweet corn.

Herbicide	Formulation	Product Rate Range
Pendimethalin/Pendimax/Pendant/etc	3.3EC	
Prowl H2O	3.8CS	

Prowl/Pendimax Use Rates (pt/A)

	Soil Organic Matter Content		
Soil Texture	Less than 1.5%	1.5 to 3%	More than 3%
Coarse	1.8 to 2.4	2.4 to 3.6	3.6
Medium	2.4 to 3.6	3.6	3.6 to 4.8
Fine	2.4 to 3.6	3.6 to 4.8	3.6 to 4.8

Prowl H2O Use Rates (pt/A)

	Soil Organic Matter Content		
Soil Texture	Less than 1.5%	1.5 to 3%	More than 3%
Coarse	2	3	3
Medium	3	3	4
Fine	3	4	4

- Apply in conventional systems only, do not apply in minimum or no-till systems. Apply only after planting. Do not incorporate or severe injury may result.
- The active ingredient in these products, pendimethalin controls annual grasses, pigweed, and lambsquarters (including triazine-resistant biotypes), and helps control smartweed, velvetleaf, and seedling johnsongrass. Pendimethalin is often combined with atrazine for control of grass and broadleaf weeds where triazine-resistant pigweed and lambsquarters are a problem.
- Mode of action: group 3 (see page 12-13).
- Do not apply preplant or preemergence on sweet corn.
- Can be applied postemergence until popcorn and sweet corn are 20 to 24 inches tall. Where the corn canopy prevents spray particles from reaching the soil, use drop nozzles and apply as a directed spray. Postemergence applications provide residual control only, not control of emerged weeds.
- To reduce the risk of corn injury, plant at least 1.5 inches deep and ensure seed to soil contact. Combining pendimethalin with dicamba may increase the potential for crop injury, especially when corn is under stress from cool, wet conditions.

Popcorn and Sweet corn: Soil-Applied Herbicides - Preplant or Preemergence

Herbicide	Formulation
Sharpen	2.85SC

- Sharpen (saflufenacil) controls or suppresses annual broadleaf weeds in popcorn. Check with seed supplier for information on varietal tolerance to Sharpen before using. Do not use on sweet corn.
- The addition of atrazine will improve control of large-seeded broadleaf weeds such as giant ragweed, morningglory, and cocklebur. Sharpen can also be added to other preemergence corn products to improve residual control of broadleaf weeds. Do not apply Sharpen after corn has emerged.
- Mode of action: group 14. See pages 12-13.
- This product is intended for use in a planned preemergence followed by postemergence program, and the product rates are not intended to provide full-season weed control. Preemergence or preplant application of Sharpen should be followed by application of postemergence herbicides as needed.
- Sharpen rates are based on soil texture as follows: coarse - 2 oz; medium - 2.5 oz; fine - 3 oz.
- Do not apply Sharpen where an at-planting application of an organophosphate or carbamate insecticide us planned or has occurred. See product label and Table 8 for more information on herbicide-insecticide interactions.
- Preplant application of Sharpen and atrazine can control small, emerged weeds in no-till, including marestail. Glyphosate should be added when weeds are more than about 4 inches tall and for weeds Sharpen does not control (see label). For control of emerged weeds, apply with MSO (1% v/v) and AMS (8.5 to 17 lbs/100 gallons) or UAN (1.25 to 2.5% v/v).

Herbicide	Formulation
Verdict	5.57EC

- Verdict is a premix of dimethenamid-P (Outlook) and saflufenacil (Sharpen) that controls annual grass and broadleaf weeds in popcorn. Check with seed supplier for information on varietal tolerance to Integrity before using.
- The addition of atrazine will improve control of large-seeded broadleaf weeds such as giant ragweed, morningglory, and cocklebur.
- Mode of action: Group 15 (dimethenamid-P); group 14 (Saflufenacil). See pages 12-13.
- This product is intended for use in a planned preemergence followed by postemergence program, and the product rates are not intended to provide full-season weed control. Preemergence or preplant application of Verdict should be followed by application of postemergence herbicides as needed.
- Verdict rates are based on soil texture as follows: coarse - 10 oz; medium - 13 oz; fine - 16 oz.
- Do not apply Verdict where an at-planting application of an organophosphate or carbamate insecticide us planned or has occurred. See product label and Table 8 for more information on herbicide-insecticide interactions.
- Preplant application of verdict can control small, emerged weeds in no-till, especially when combined with atrazine. Glyphosate should be added when weeds are more than about 4 inches tall, and for weeds Verdict does not control (see label). For control of emerged weeds, apply with MSO (1% v/v) and AMS (8.5 to 17 lbs/100 gallons) or UAN (1.25 to 2.5% v/v). Do not apply Verdict after corn has emerged.

Popcorn and Sweet Corn: Postemergence Herbicides—Contact

Herbicide	Formulation	Product Rate Range
Aim	2EC	0.5 -1 oz

- Aim (carfentrazone-ethyl) is a contact herbicide that controls black nightshade, velvetleaf, redroot pigweed, and small annual morningglories and lambsquarters. Aim is often mixed with other broadleaf herbicides to improve control of velvetleaf.
- Mode of action: group 14 (see page 12-13).
- Apply when weeds are 1 to 4 inches tall for best results. Velvetleaf can be controlled up to 36 inches tall. Apply before corn exceeds the 8-collar stage.
- Apply with NIS (0.25% v/v). UAN (2 to 4 gallons/100 gallons) or AMS (2 to 4 lbs/A) can be added if recommended for use with other herbicides in a mix with aim. In general, Aim should not be mixed with COC or EC formulations of other herbicides in order to avoid excessive crop injury. The label does allow use of COC under dry conditions and in specific mixtures.
- Apply in a spray volume of 10 to 20 gpa with a pressure of 20 to 40 psi. Flat fan nozzles are recommended for adequate spray coverage.
- Add Aim to the spray tank before adding other products.
- Aim usually causes leaf speckling and necrosis. The severity of injury varies with environmental conditions, adjuvants, tank-mix partner. To reduce injury, 1) do not apply within 6 to 8 hours of rain, 2) make sure spray nozzles are positioned at least 18 inches above the crop, and 3) avoid direction of excessive amounts of herbicide into the corn whorls.
- Not all sweet corn hybrids have been tested for their tolerance to Aim. The user assumes all liability for crop injury when Aim is applied to sweet corn.

Herbicide	Formulation	Product Rate Range
AAtrex / atrazine	4L 90DF	1.5 - 2 qt 1.67 - 2.22 lb

- Mode of action: group 5 (see page 12-13).
- Maximum rate for postemergence application to fields without soil-applied atrazine in the same year is 2 pounds active ingreadient/A. When applied postemergence to fields with soil-applied atrazine the same year, total amount of atrazine applied may not exceed 2.5 pounds of active ingredient.
- For annual grass control, apply 2 lba ai/A when grasses are no more than 1.5 inches tall. Atrazine will not control fall panicum.
- For control of broadleaf weeds, rates of 1.2 pounds of active ingredient may be sufficient. Apply until broadleaf weeds are 4 inches tall.
- Apply with COC (1% v/v) for best results. Mix atrazine with water first, and add oil last.
- Apply when popcorn or sweet corn is less then 12 inches tall.

Herbicide	Formulation	Product Rate Range
Basagran	4L	1.5 to 2 pt

- Basagran (bentazon) is a contact herbicide that controls many annual broadleaf weeds, including cocklebur, velvetleaf, and Pennsylvania smartweed. Basagran control or suppresses Canada thistle and yellow nutsedge.
- Mode of action: group 6 (see page 12-13).
- For best results, apply with COC when weeds are in the 2- to 6-leaf stage.
- Apply in combination with atrazine for control of pigweed, lambsquarters, and ragweed.
- Consult your seed company regarding sweet corn hybrid tolerance to Basagran.

Popcorn and Sweet corn: Postemergence Herbicides—Contact

Herbicide	Formulation	Product Rate Range
Bromoxynil	2S	1 - 1.5 pt

- Do not apply to popcorn prior to the 3-leaf stage. Not labeled for sweet corn.
- Bromoxynil is sold under various trade names, including Buctril, Moxy, and Broclean. Bromoxynil is a contact herbicide that controls annual broadleaf weeds, including black nightshade, cocklebur, ragweeds, lambsquarters, and smartweeds, but is weak on pigweed and large velvetleaf.
- Mode of action: group 6 (see page 12-13).
- Do not apply until the 3-leaf popcorn stage. Can be applied until tassel emergence. The 1.5-pint rate may be applied after corn reaches the 4-leaf stage and before tassel emergence. Maximum corn size at the time varies with tank-mix partner.
- Do not use surfactant or crop oil when applying bromxynil alone or with most other herbicides. NIS and fertilizer solution are allowed in some tank mixtures.
- Apply in a minimum volume of 10 gpa at a minimum pressure of 30 psi using flat fan nozzles. May cause leaf burn, but effect are usually temporary.

Herbicide	Formulation	Product Rate Range
Cadet	0.91EC	0.4 - 0.9 oz

- Cadet (fluthiacet-methyl) is a contact herbicide that controls velvetleaf, and controls or suppresses small lambsquarters, pigweeds, black nightshade, and annual morningglory at the 0.9 oz rate.
- Mode of action: group 14 (see pages 12-13).
- Can be applied to field corn, popcorn, seed corn, and sweet corn (processing only) from the 2-collar stage up to 48 inches tall. Apply before tassel emergence. Not labeled for freash market sweet corn.
- Apply with NIS (0.25% v/v), or a COC or MSO (1 to 2 pts/A). UAN (1 to 2 qts/A) or AMS can be added. When combined with other herbicides, Cadet can generally be applied with any adjuvants required for those herbicides.
- Apply in a minimum spray volume of 15 gpa and pressure of 20-40 psi. Increase volume and pressure in dense crop and weed canopies.
- Allow 40 days between application and harvest of sweet corn.

Herbicide	Formulation	Product Rate Range
Laddok S-12	5L	1.3 - 2.3 pt

- Do not apply to popcorn seed production fields.
- Laddok/Headline is a 1:1 premix of bentazon (Basagran) plus atrazine for control of most broadleaf weeds, and suppression or control of yellow nutsedge, Canada thistle, and some perennial vines.
- Mode of action: group 5 (atrazine); group 6 (bentazon). See page 12-13.
- Application rate with species and size. Apply with UAN solution, AMS, nonphytotoxic oil concentrate, or Dash. The label allows combinations of spray additives, which vary with the weed species present. UAN or AMS should be added when velvetleaf is the target weed, and may also increase control of cocklebur and Pennsylvania smartweed. COC should also be added when common lambsquarters, common ragweed, Canada thistle, yellow nutsedge, or field bindweed is present.
- Apply in a spray volume of at least 10 gpa with a minimum pressure of 40 psi. Increasing the spray volume (up to 50 gpa) will improve control when the crop and weed foliage is dense.
- To suppress Canada thistle, apply 2.3 pints when thistle plants are 8 to 10 inches tall until the bud stage.
- A single application of 2.3 pints of Laddok can suppress yellow nutsedge that is 1 to 4 inches tall.
- Provides more effective control of velvetleaf, annual morningglory, lambsquarters, and pigweed than Basagran alone, but is no more effective on triazine-resistant lambsquarters.

Popcorn and Sweet Corn: Postemergence Herbicides—Systemic

Herbicide	Formulation	Product Rate Range
Beacon	75DF	3/8 -3/4 oz

- Risk of severe injury - check with popcorn seed supplier or chemical representative for sensitivity of inbreds/hybrids. Not labeled for sweet corn.
- Can be used if spray is directed using drop nozzles when popcorn is between 10 and 48 inches tall. Nozzles should be positioned to avoid placing herbicide in whorl. Must be applied before tassel.
- Beacon (primsulfuron) is a translocated sulfonylurea that controls or suppresses annual and perennial grasses and controls annual broadleaf weeds. Beacon provides partial control of foxtail species and may be less effective than Accent for rhizome johnsongrass and quackgrass control, but is generally more effective than Accent on broadleaf weed control. Does not control ALS resistant weeds.
- Mode of action: group 2 (see page 12-13).
- Apply NIS (0.25% v/v) or COC (1 to 4 pints per acre); COC is generally the preferred additive. COC plus UAN or AMS can be used when tank-mixing with atrazine, Accent, or dicamba. Most other tank-mixures should be applied with NIS. See specific label for details.
- Do not make a foliar postemergence or a soil application of any organophosphate insecticide within 10 days before or 7 days after Beacon application.

Herbicide	Formulation	Product Rate Range
Callisto	4L	3 fl oz

- Apply only to yellow popcorn or sweet corn up to 30 inches tall or the 8-leaf stage. Apply when weeds are less than 5 inches tall for best results.
- Callisto (mesotrione) is a systemic herbicide that controls annual broadleaf weeds, including cocklebur, atriplex, lambsquarters (including triazine-resistant), giant ragweed, Pennsylvania smartweed, pigweeds, waterhemp, velvetleaf, and black nightshade. Callisto alone does not provide consistent control of common ragweed or morningglory, and can be variable on giant ragweed.
- Mode of action: group 28 (see page 12-13).
- Apply with COC (1% v/v). Do not use MSO (MSO), MSO blend adjuvants, AMS, or UAN.
- Do not apply if corn was previously treated with Lorsban. Do not tank mix Callisto with organophosphate or carbamate insecticides within 7 days before or after a postemergence Callisto application.
- To avoid crop injury, do not apply Callisto postemergence in a tank-mix with emulsifiable concentrate grass herbicides (Dual II Magnum, etc).
- Herbicide sensitivity in sweet corn and yellow popcorn varies widely, and not all sweet corn and yellow popcorn hybrids have been tested. Contact your sweet corn or popcorn company or agronomist about hybrid recommendations before making a postemergence application of Callisto to sweet corn or yellow popcorn.

Herbicide	Formulation	Product Rate Range
Callisto Xtra	3.7L	20 to 24 oz

- Callisto Xtra is a premix of mesotrione (Callisto) and atrazine that controls annual broadleaf weeds. See Callisto description for more information.
- Mode of action: group 28 (mesotrione); group 5 (atrazine). See pages 12-13.
- Apply when weeds are less than 5 inches tall for best results. Can be applied to sweet corn and yellow popcorn from emergence up to 12 inches tall.
- Apply with COC (1% v/v) or NIS (0.25% v/v). COC is the preferred adjuvant to maximize activity, but increases the risk of crop injury. Applying when weeds are less than 5 inches tall will minimize the need for COC. Do not use MSO (MSO) or MSO blend adjuvants, UAN or AMS.
- Apply in a spray volume of 10 to 30 gpa, but use a volume of at least 15 gpa if weed foliage is dense.
- Severe crop injury may occur if Callisto Xtra is applied postemergence to corn that was previously treated with Counter or Lorsban, and this injury can result in yield loss. See product label and Table 8 for more information on herbicide-insecticide interactions.
- Do not apply Callisto Xtra postemergence in a mixture with emulsifiable concentrate grass herbicides.

Popcorn and Sweet Corn: Postemergence Herbicides—Systemic

Herbicide	Formulation	Product Rate Range
Dicamba	4L	1/2 - 1 pt

- Risk of injury - check with popcorn seed supplier or chemical representative for sensitivity of selected inbreds/hybrids. Not labeled for sweet corn.
- Dicamba is sold under several trade names such as Banvel, Clarity, Sterling Blue, and Oracle. Dicamba is a translocated herbicide that controls many annual broadleaf weeds, including pigweed, black nightshade, cocklebur, and Pennsylvania smartweed. Control of velvetleaf can be variable. Dicamba will control or suppress perennial weeds, especially when mixed with an ALS herbicide.
- Mode of action: group 4 (see page 12-13).
- Apply 1/2 to 1 pint when corn is in the spike to 5-leaf stage, or until corn is 8 inches tall, whichever occurs first. Do not apply more than 1/2 to 1 pint on coarse-textured soils. If the 6th true leaf is emerging from the whorl, or corn is more than 8 inches tall, a rate of 1/2 pint can be applied until corn is 36 inches tall, or until 15 days before tassel emergence. Apply as a directed spray when corn leaves prevent proper spray coverage, or sensitive crops are growing nearby.
- The 1 pint rate provides limited residual broadleaf weed control.
- Apply with 1/2 to 1 gallon per acre of UAN (28%) when velvetleaf is a target weed. Can be applied with surfactant or crop oil to improve control in dry growing conditions. Do not apply with crop oil when corn exceeds 5 inches in height.
- With any dicamba product, risk of corn injury increases when corn exceeds 8 to 10 inches in height. To reduce risk of injury, make sure nozzle spacing and boom height are set to minimize interception of spray by the corn plants.
- Soybean and vegetables are extremely susceptible to dicamba drift and vapors. Apply in a spray volume of 20 gpa at a pressure of less than 20 psi to reduce drift. Do not apply where sensitive crops are present if winds over 5 MPH are moving in the direction of the sensitive crops, corn is more than 24 inches tall, soybeans are more than 10 inches tall, or soybeans have begun to bloom. Most dicamba products should not be applied when air temperatures on the day of application will exceed 85 degrees.

Herbicide	Formulation	Product Rate Range
Dicamba + atrazine	3.2L	3.5 pt

- Risk of injury - check with popcorn seed supplier or chemical representative for sensitivity of selected inbreds/hybrids. Not labeled for sweet corn.
- Dicamba + atrazine is sold under several trade names, including Marksman, Sterling Plus, Banvel-K + atrazine, and Stratos. These products control most annual broadleaf weeds, and suppress or control perennial broadleaf weeds.
- Mode of action: group 4 (dicamba), group 5 (atrazine). See page 12-13.
- Apply when corn is in the spike to five-leaf stage, or until corn is 8 inches tall, whichever comes first. The rate is 3.5 on medium- or fine textured soils with at least 2.5 percent organic matter, and 2 pints on coarse-textured soils. Provides some residual broadleaf weed control.
- The addition of crop oil, surfactant, or liquid nitrogen fertilizer may improve control, especially when weeds are drought-stressed. Apply with UAN if velvetleaf is a target weed. Application with crop oils may cause crop injury. Do not apply with crop oil after corn exceeds 5 inches in height.
- Precautions on spray drift, volatility, and corn injury are the same as for dicamba. See dicamba description above for more information.

Popcorn and Sweet Corn: Postemergence Herbicides—Systemic

Herbicide	Formulation	Product Rate Range
Impact	2.8L	0.75 oz

- Impact (topramezone) controls annual broadleaf weeds, including biotypes resistant to ALS inhibitors, glyphosate, and triazines. Impact controls or suppress small annual grasses. Impact is most effective when applied in combination with 0.25 to 1.5 lbs active ingredient /A of atrazine. The higher atrazine rates will provide residual weed control and more effective control of grasses.
- Mode of action: group 28 (see page 12-13).
- Popcorn inbreds and sweet corn hybrids vary in their tolerance to Impact. Users should check with seed supplier for information on tolerance prior to use in seed production fields.
- Apply when most broadleaf weeds are emerged and less than 6 inches tall.
- Impact can be applied postemergence up to 45 days before crop harvest. Apply with drop nozzles if the crop canopy prevents adequate spray coverage on weeds.
- For best results, apply with a MSO (1 to 1.5% v/v) plus either UAN (1.25 to 2.5% v/v) or AMS (8.5 to 17 lbs/100 gallons of water). NIS can be used instead of methylated seed soil if required in tank-mixes with other herbicides.
- Apply in a minimum spray volume of 10 gpa, and apply in 15 gpa when treating large weeds or high-density weed infestations.
- Impact should not be relied upon to provide complete control of grasses, but can control small grasses (less than 2 inches) that escape preemergence herbicides.

Herbicide	Formulation	Product Rate Range
Laudis	3.5L	3 oz

- Laudis (tembotrione) controls many broadleaf weeds, including biotypes resistant to ALS inhibitors, glyphosate, and triazines. Impact controls or suppress small annual grasses. Laudis is most effective when applied in combination with 0.5 lbs active ingredient /A of atrazine.
- Mode of action: group 27 (see pages 12-13).
- Check with seed supplier for information on hybrid tolerance prior to use on sweet corn or popcorn.
- Apply when broadleaf weeds are less than 6 inches tall. For most grass species, grasses should be less than 3 inches tall at time of application.
- Apply broadcast up to the V8 stage of popcorn and the V7 stage for sweet corn. Maximum of two applications on popcorn and one on sweet corn.
- Apply with a MSO (1% v/v, minimum of 1.25 pt/A) plus either UAN (1.5 qt/A) or AMS (1.5 lb/A). When mixing with atrazine, COC (1% v/v) should be used instead of MSO.
- Apply in a minimum spray volume of 10 gpa, and apply in 15 to 20 gpa in dense weed populations or under adverse environmental conditions. Use nozzles and pressure that result in medium spray droplets, and increase application volume when using nozzles that produce coarse spray droplets. Flat fan nozzles of 80 or 110 degrees will provide optimum postemergence spray coverage.
- Laudis should not be relied upon to provide complete control of grasses, but can control small (less than 2 inches) grasses that escape preemergence herbicides.

Popcorn and Sweet Corn: Postemergence Herbicides—Systemic

Herbicide	Formulation	Product Rate Range
Nicosulfuron (active ingredient)		
Accent Q	54.5DF	0.9 oz
NIC-IT	2L	2 oz

- Accent Q and NIC-IT are labeled for use on popcorn and some sweet corn hybrids grown for processing and fresh market. Growers should contact seed suppliers for recommendations and information on crop tolerance, and use of soil-applied organophosphate insecticides, prior to application. Do not apply to any white popcorn inbred or hybrid unless approved by the seed supplier. Accent and NIC-IT can be used on High Lysine, Waxy, White or other Food Grade hybrids. A list of approved processing sweet corn hybrids is available from DuPont. With regard to use of Accent on fresh market sweet corn, the user assumes all risk based on recommendations from university or seed company personnel, or other experts.
- Can be applied broadcast to popcorn that is less than 20 inches tall or has up to 5 collars (whichever occurs first). Do not apply broadcast to sweet corn more than 12 inches tall. Drop nozzles can be used up to 18 inches or V6 corn stage.
- Nicosulfuron is a translocated sulfonylurea herbicide that controls annual and perennial grasses and some annual broadleaf weeds, including Pennsylvania smartweed, pigweed, and annual morningglory. Does not control crabgrass.
- Mode of action: group 2 (see page 12-13).
- Accent Q contains nicosulfuron plus isoxadifen, a safener to reduce the risk of corn injury.
- Apply in a spray volume of at least 15 gpa with a spray pressure of 20 to 40 psi. Increase spray volume and pressure as weed density and size increase. Flat fan or Turbo Floodjet nozzles are recommended.
- To avoid a reduction in grass control or crop injury, do not mix with 2,4-D, Bassagran, Laddok, or organophosphate insecticides.
- Where nicosulfuron is applied to corn previously treated with soil applications of organophosphate insecticides, temporary crop injury may occur. Use on corn previously treated with Thimet may cause unacceptable crop injury.

Herbicide	Formulation	Product Rate Range
NorthStar	47DF	5 oz

- Not labeled for sweet corn.
- Risk of injury - check with your popcorn seed supplier or chemical representative for sensitivity of inbred/hybrid. Inbred lines and popcorn hybrids should be thoroughly tested for sensitivity to NorthStar before treating large acreages.
- Apply as a directed spray using drop nozzles when popcorn is between 10 and 30 inches tall. Must be applied before tassel emergence.
- NorthStar is a premix of primisulfuron (Beacon) plus dicamba (Banvel) for control of most annual broadleaf weeds and suppression or control of annual and perennial grasses. NorthStar will suppress a number of perennial broadleaf weeds. See Beacon and dicamba descriptions for more information and precautions on use.
- Mode of action: group 2 (primisulfuron), group 4 (dicamba). See page 12-13.
- Apply with NIS (0.25% v/v) or COC (1 to 4 pints/A), but do not use COC if corn is more than 12 inches tall. UAN (2 to 4 quarts/A) or AMS (2 to 4 lbs/A) may also be added.

Popcorn and Sweet Corn: Postemergence Herbicides—Systemic

Herbicide	Formulation	Product Rate Range
Permit/Sandea/Halomax	75DF	2/3 oz

- These products contain halosulfuron, a translocated sulfonylurea herbicide that controls yellow nutsedge and annual broadleaf weeds, including velvetleaf, ragweeds, cocklebur, and redroot pigweed. Halosulfuron is weak on lambsquarters and annual morninglories. Does not control ALS-resistant weeds.
- Mode of action: group 2 (see page 12-13).
- Can be applied broadcast to popcorn and sweet corn in the spike through layby stage. Two applications are allowed per year, but the second should be applied with drop nozzles. Popcorn and sweet corn hybrids should be thoroughly tested for sensitivity to halosulfuron before treating large acreages. Do not apply when corn is under stress from environmental conditions.
- For control of yellow nutsedge, apply 1 to 1 1/3 ounces/A when nutsedge is 4 to 12 inches tall. Dense populations of nutsedge may require a second application.
- Apply in a minimum spray volume of 10 gpa with NIS (1 to 2 quarts/100 gallons) or COC (1 gallon/ 100 gallons). Include UAN (2 to 4 quarts/A) or AMS (2 to 4 lbs/A) when velvetleaf or redroot pigweed is present.
- Tank mixtures may cause temporary crop injury, especially when the tank-mix partner is Accent or Beacon. Do not apply in a mixture if the crop is under stress due to drought, water saturated soils, low fertility, hail, frost, insects, or when the maximum daytime temperature is above 92 degrees.
- Allow 30 days after application before harvesting for forage or grazing.

Herbicide	Formulation	Product Rate Range
Spirit	57DF	1 oz (1 packet per 4 acres)

- Not labeled for sweet corn.
- Risk of injury - check with your seed supplier or chemical representative for sensitivity of popcorn inbred/hybrid.
- Apply as a directed spray using drop nozzles when popcorn is between 10 and 30 inches tall. Must be applied before tassel emergence.
- Spirit is a premix of prosulfuron (Peak) plus primisulfuron (Beacon). Mixing with dicamba, 2,4-D, or Buctril/Moxy will improve lambsquarters control. Most effective control/suppression of perennial broadleaf weeds will occur when mixed with 2,4-D or dicamba. Spirit is weak on annual morninglories and yellow nutsedge. Does not control ALS-resistant weeds.
- Mode of action: group 2 (see page 12-13).
- Follow these guidelines to avoid carryover of Spirit to subsequent crops: 1) Avoid use where soil pH is greater than 7.8. If used where soil pH is greater than 7.8, plant only field corn or small grains the following year; 2) where less than one inch of rain occurs within one month of application, or less than 12 inches of rain occurs within 5 months after application, plant only corn, small grains, or STS soybean the following year; 2) north of Interstate 80, do not plant soybeans within 18 months of application; 3) south of interstate 80, soybean can be planted 10 months after application where soil pH is less than 7.8; and 4) do not apply after June 30. See label for guidelines on rotation to other crops.
- Apply in a minimum spray volume of 10 gpa. Increasing the volume to at least 20 gpa can improve control in dense weed infestations.
- Apply with COC (1 to 4 pints/A) or NIS (1 to 2 quarts/100 gallons). UAN (2 to 4 quarts/A) or AMS (2 lbs/A) may be added to improve control of velvetleaf and other weeds. COC is generally more effective than NIS. Use of a MSO (Meth Oil, Priority MSO, Sun-It II, for example) may improve control when weeds are large or drought-stressed.

Popcorn and Sweet Corn: Postemergence Herbicides—Systemic

Herbicide	Formulation	Product Rate Range
Status	56WDG	5 - 10 oz

- Risk of injury - check with your popcorn seed supplier for sensitivity of inbred/hybrid. Not labeled for use on sweet corn.
- Status is a premix of dicamba plus diflufenzopyr plus a safener, for control of most annual broadleaf weeds. Status can be weak on velvetleaf, although it is more effective than dicamba alone.
- Mode of action: group 4 (dicamba), group 19 (diflufenzopyr). See page 12-13.
- Status can suppress small annual grasses that have escaped preemergence herbicide treatments. Effectiveness on grasses is variable, and can be reduced under dry conditions.
- Status is generally more effective than other dicamba products on perennial broadleaf weeds, and has provided excellent control of Canada thistle and hedge bindweed in OSU research.
- Apply 5 oz/A when corn is 4 to 36 inches tall, or from V2 to V10. As with any dicamba product, risk of corn injury increases when corn exceeds 8 to 10 inches in height. To reduce risk of injury, make sure nozzle spacing and spray boom height are set to minimize interception of spray by the corn plants.
- Apply with NIS (0.25% v/v), COC (1 to 2 pts/A), or MSO (1 to 2 pts/A), plus UAN (at least 1.25% v/v) or AMS (5 -17 lb/100 gallons). To avoid mixing problems, add Status to spray tank before adding AMS.
- Volatility of Status is similar to Clarity. Take precautions to avoid contact of herbicide with sensitive plants via drift or volatility. Exposure of soybeans to Status via sprayer contamination of spray particle drift with result in more severe injury compared to other dicamba products.

Herbicide	Formulation	Product Rate Range
Stinger	3L	1/4 - 2/3 pt

- Stinger (clopyralid) is a translocated herbicide that controls ragweeds, cocklebur, jimsonweed, and Canada thistle. Controls or suppresses Jerusalem artichoke and suppresses sowthistle.
- Mode of action: group 4 (see pages 12-13).
- Apply after corn emergence until popcorn is 24 inches tall or sweet corn is 18 inches tall. Use a spray volume of at least 10 gallons per acre.
- For annual weed and Jerusalem artichoke control, apply 1/4 to 1/2 pint when weeds have 5 or fewer leaves.
- For Canada thistle control, apply 1/3 to 2/3 pint when thistles are at least 4 inches tall or across, but before the bud stage. The higher rate provides more complete plant kill and better control of dense patches. Do not cultivate prior to or for 14 to 20 days following application.

Popcorn: Harvest Aids

Herbicide	Formulation	Product Rate Range
Aim	2EC	1 - 2 oz

- Aim (carfentrazone) can be applied prior to harvest of corn for dessication of velvetleaf, morningglory, pigweeds, and other weeds. Apply at least 3 days before harvest when the crop is mature and grain has begun to dry down.
- Mode of action: group 14 (see page 12-13).
- Use a spray volume that results in complete coverage of foliage. Apply with NIS (0.25% v/v) or COC (1 to 2% v/v). UAN or AMS may also be added.

Grain Sorghum Herbicide Management Strategies

Preemergence herbicide programs have been the mainstay of weed management in grain sorghum, due in large part to the low cost of atrazine, its broad spectrum of control, and lack of postemergence herbicides for grass control. Acetamide herbicides (metolachlor, Outlook, alachlor) are commonly used with atrazine in grain sorghum either as mixtures or premixes (Bicep II Magnum, Guardsman Max, Bullet/Lariat). If acetamide herbicides are used, grain sorghum seed must be pre-treated with a safener that protects it from injury caused by the acetamide herbicides. Common seed safeners include Screen and Concep. Always check with your seed company representative to determine if the seed has been treated with these safeners.

Common weed management issues

If shattercane or johnsongrass is present, it is advisable to plant something other than sorghum because there are no selective herbicides to control these weeds in sorghum. In addition, because there are no highly effective postemergence grass herbicides for sorghum, fields with heavy grass pressure should be avoided for similar reasons.

Table 10. Weed response to herbicides in grain sorghum.

Herbicide	Mode of action	Barnyardgrass	Crabgrass	Fall panicum	Foxtail	Goosegrass	Seedling johnsongrass	Rhizome johsongrass	Shattercane	Yellow nutsedge	Eastern black nightshade	Cocklebur	Jimsonweed	Common lambsquarters	Entire/lvyleaf morningglory	Pitted morningglory	Redroot and smooth pigweed	Common ragweed	Giant ragweed	Annual smartweed	Velvetleaf	Common / tall waterhemp	Crop response
Alachlor[1]	15	8	9	9	9	7	-	-	-	7	9	-	-	6	-	-	9	-	-	-	-	9	1
Atrazine	5	7	-	-	7	6	-	-	-	7	9	8	9	9	9	9	9	9	8	9	8	9	1
Callisto	28	-	6	-	-	-	-	-	-	-	9	7	-	9	6	6	9	7	6	9	9	9	2
Guardsman Max[1]	5/15	8	9	9	9	9	-	-	-	8	9	8	9	9	9	9	9	9	8	9	8	9	1
Lariat/Bullet[1]	5/15	8	9	9	9	9	-	-	-	8	9	8	9	9	9	9	9	9	8	9	8	9	1
Lexar/Lumax[1]		8	9	9	9	9	-	-	-	8	9	8	9	9	8	8	9	9	8	9	9	9	2
Metolachlor[1]	15	8	9	9	9	9	-	-	-	8	9	-	-	6	-	-	9	-	-	-	-	9	1
Metolachlor + atrazine[1]	5/15	8	9	9	9	9	-	-	-	8	9	8	9	9	9	9	9	9	8	9	8	9	1
Outlook1	15	8	9	8	8	9	-	-	-	7	8	-	-	7	-	-	9	-	-	-	-	9	1
Preemergence only																							
Ramrod	15	7	8	7	9	-	-	-	-	-	-	-	-	6	-	-	7	-	-	-	-	6	0
Ramrod/Atrazine	5/15	7	8	7	9	6	-	-	-	7	9	8	9	9	9	9	9	9	8	9	8	9	1
Postplant incorporated																							
Pendimethalin	3	9	9	8	9	9	7	-	7	-	-	-	-	7	-	-	8	-	-	-	-	7	1
Trifluralin	3	8	8	7	8	8	7	-	7	-	-	-	-	8	-	-	8	-	-	-	-	7	1
Postemergence																							
2,4-D	4	-	-	-	-	-	-	-	-	-	7	9	8	9	9	10	9	9	8	7	8	8	2
Aim	14	-	-	-	-	-	-	-	-	-	10	6	9	9	7	7	9	7	6	9	9	8	1
Atrazine	5	8	7	-	7	6	-	-	-	6	9	9	9	9	9	9	9	9	8	9	9	9	1
Basagran	6	-	-	-	-	-	-	-	-	7	-	9	9	6	-	7	-	8	8	9	8	-	0
Bromoxynil	6	-	-	-	-	-	-	-	-	-	9	9	10	9	8	8	7	9	9	9	8	6	1
Bromoxynil + atrazine	5/6	8	7	-	7	6	-	-	-	6	9	9	9	10	9	9	9	9	8	9	9	9	1
Dicamba	4	-	-	-	-	-	-	-	-	-	9	9	9	9	9	10	9	10	9	9	9	8	1
Dicamba + atrazine	4/5	8	7	-	7	6	-	-	-	6	9	9	9	9	9	9	9	9	8	9	8	9	1
Laddok	5/6	8	7	-	7	6	-	-	-	8	9	9	9	9	9	9	9	9	8	9	9	8	1
Peak	2	-	-	-	-	-	-	-	-	-	-	8	8	7	8	8	9	7	8	8	8	5	1
Permit	2	-	-	-	-	-	-	-	-	9	6	9	8	6	6	6	9	8	8	7	9	5	0
Shotgun	4/5	8	7	-	7	6	-	-	-	6	9	9	8	9	9	10	9	9	8	9	8	9	1
Post** directed **or hooded																							
Glyphosate	9	9	9	8	10	8		9		8	9	10	9	8	8	8	9	9	8	8	8	9	3
Gramoxone	22	9	9	8	8	8	8	-	6	-	-	-	7	9	-	-	9	8	-	-	6	-	1
Lorox/Linex	7	7	8	8	8	-	7	-	-	-	-	8	-	9	8	8	9	8	-	8	9	-	1

1Use chloroacetamide safened (examples are Screen or Concep) seed to avoid crop injury from these herbicides.
Mode of action: see pages 12-13 for more information on mode of action classification.

Grain Sorghum: Soil Applied Herbicides – Preplant or Preemergence

Herbicide	Formulation	Product Rate Range
Aatrex/Atrazine	4L	Highly erodible soils with less than 30% resi due cover – 3.2 pts/A Highly erodible soils with greater than 30% residue cover – 4 pts/A Soils not highly erodible – 4 pts/A 90DF Highly erodible soils with less than 30% residue cover – 1.8 lbs/A Highly erodible soils with greater than 30% residue cover – 2.2 lbs/A Soils not highly erodible – 2.2 lbs/A

- Mode of action: group 5 (see page 12-13).
- Apply up to 45 days before planting.
- Do not use on light, sandy soils.
- Do not use on loam or clay soils with less than 1% organic matter.

Herbicide	Formulation
Alachlor/Lasso/MicroTech/Intrro	4L or 4EC

- Mode of action: group 15 (see page 12-13).
- Apply only to sorghum with safened seed.
- May be applied up to 7 days before planting as a single application.

Intrro Use Rates (qts/A)

	Soil Texture Group		
Applications	**Coarse**	**Medium**	**Fine**
Preplant incorporated alone[a]	2 to 2.5	2.5 to 2.75	2.5 to 3
Preplant surface application alone[b]	1.5 to 2	2 to 2.25	2 to 2.5

a. Rates may be increased to a maximum of 4 qts/A on any soil type when heavy infestation of yellow nutsedge is present.
b. Rates may be increased to a maximum of 3 qts/A on any soil type when heavy infestation of yellow nutsedge is present

Grain Sorghum: Soil Applied Herbicides – Preplant or Preemergence

Intrro + Atrazine Use Rates (qts/A)[a]

		Soil Texture Group		
	Organic Matter	**Coarse**	**Medium**	**Fine**
Preplant incorporated alone	Less than 1.5%	Not recommended	1.5 to 2	1.75 ot 2
	1.5% or Greater	Not recommended	1.5 to 2	2 to 2.5
Preplant surface application alone	Less than 1.5%	1.5 (not recommended on sand)	1.5 to 1.75	1.5 to 2
	1.5% or Greater	1.5 to 1.75	1.5 to 2	1.75 to 2.25

a. See label for atrazine rates.

Herbicide	**Formulation**
Bicep II Magnum s-metolachlor + atrazine	5.5L

- Mode of action: group 15 (s-metolachlor); group 5 (atrazine). See page 12-13.
- Do not use on light, sandy soils.
- Do not use on loam or clay soils with less than 1% organic matter.
- Apply only to sorghum with safened seed.
- May be applied up to 30 days before planting as a single application.
- Incorporation to a depth of 2 inches will improve yellow nutsedge control and reduce dependence on rainfall for activation.

Bicep II Magnum Use Rates (qts/A)

Soil Texture Group	**Organic Matter**	
Coarse	Any level	Do not use
Medium	Less than 1%	Do not use
	1% or greater and less than 30% residue cover	2.1
	1% or greater and more than 30% residue cover	2.1 to 2.33
Fime	Less than 1% and less than 30% residue cover	2.1
	1% to 1.5% and more than 30% residue cover	2.1 to 2.33
	1.5% or greater and more than 30% residue cover	2.33 to 2.6

Grain Sorghum: Soil Applied Herbicides – Preplant or Preemergence

Herbicide	Formulation
Bicep Lite II Magnum s-metolachlor + atrazine (low atrazine)	6L

- Mode of action: group 15 (s-metolachlor); group 5 (atrazine). See page 12-13.
- Do not use on light, sandy soils.
- Do not use on loam or clay soils with less than 1% organic matter.
- Apply only to sorghum with safened seed.
- May be applied up to 30 days before planting as a single application.

Bicep Lite II Magnum Use Rates (qts/A)

Soil Texture Group	Organic Matter	
Coarse	Any level	Do not use
Medium	Less than 1%	Do not use
	1% or greater	1.5 to 1.7
Fine	Less than 1%	1.5 to 1.7
	1% or greater	1.7 to 1.9

Herbicide	Formulation	Product Rate Range
Callisto	4L	6 - 6.4 oz

- Callisto (mesotrione) controls annual broadleaf weeds. Callisto has limited activity on giant ragweed, cocklebur, and morningglory, but may help control these weeds in mixtures with atrazine.
- Mode of action: group 28 (see pages 12-13).
- Callisto does not control grass weeds, and should be applied in combination with Harness, Dual, TopNotch, or another acetamide grass herbicide, or an acetamide/atrazine premix (Bicep II, Magnum, Degree Xtra, etc.).
- Callisto can be applied preplant up to 21 days before planting or preemergence. The risk of injury can be reduced by applying at least 7 days before planting. Do not incorporate after application or apply to emerged sorghum.
- Do not apply on sandy soils.

Herbicide	Formulation
Guardsman Max	5L

- Mode of action: group 15 (dimethenamid); group 5 (atrazine). See page 12-13.
- Do not use on light, sandy soils.
- Do not use on loam or clay soils with less than 1% organic matter.
- Apply only to sorghum with safened seed.
- May be applied up to 30 days before planting as a single application.
- Incorporation to a depth of 2 inches will improve yellow nutsedge control and reduce dependence on rainfall for activation.

Guardsman Max Use Rate (pts/A)

Soil Texture Group	Less than 3% OM	3% or Greater OM
Coarse	2.5 to 3	3 to 4
Medium or fine	3 to 4	4 to 4.6

Grain Sorghum: Soil Applied Herbicides – Preplant or Preemergence

Herbicide	Formulation
Lariat	4F

- Mode of action: group 15 (alachlor); group 5 (atrazine). See page 12-13.
- Do not use on light, sandy soils.
- Do not use on loam or clay soils with less than 1% organic matter.
- Apply only to sorghum with safened seed.
- May be applied up to 7 days before planting as a single application.
- Incorporation to a depth of 2 inches will improve yellow nutsedge control and reduce dependence on rainfall for activation.

Lariat Use Rates (qts/A)

Soil Texture Group	Less than 1.5% OM	1.5% or Greater OM
Coarse	2.5	2.75
Medium	2.75	2.75 to 3.75
Fine	3	3 to 4

Herbicide	Formulation	Product Rate Range
Lumax	4L	2.5 qts
Lexar	3.7L	3.0 qts

- Lumax and Lexar are premixes of atrazine plus s-metolachlor (Dual II Magnum) plus mesotrione (Callisto) for control of grass and broadleaf weeds in corn. A use rate of Lexar contains a higher amount of atrazine per acre, compared with Lumax, and a lower amount of s-metolachlor.
- Sorghum seed lmust be treated with Concep III herbicide safener prior to planting or severe crop injury may occur.
- Mode of action: group 5 (atrazine); group 15 (s-metolachlor); group 28 (mesotrione). See pages 12-13.
- Can be applied preplant up to 21 days before planting or preemergence. The risk of injury can be reduced by applying at least 7 days before planting. Do not incorporate after application or apply to emerged sorghum. DO not apply on sandy soils.
- If applied after June 1, rotating to crops other than corn or sorghum may result in crop injury.

Herbicide	Formulation
Metolachlor/s-metolachlor	Various

- Mode of action: group 15 (see page 12-13).
- Metolachlor and s-metolachor are available from several manufacturers under various trade names.
- Apply only to sorghum with safened seed.
- May be applied up to 30 days before planting as a single application preplant incorporated or preemergence.
- Do not use on coarse soils with less than 1.5% organic matter.
- Incorporation to a depth of 2 inches will improve yellow nutsedge control and reduce dependence on rainfall for activation.

Dual II and Stalwart/Parallel + atrazine Use Rates (qts/A)

Soil Texture Group	Dual II	Stalwart/Parallel
Coarse	2.5	2.75
Medium	2.75	2.75 to 3.75
Fine	3	3 to 4

Grain Sorghum: Soil Applied Herbicides – Preplant or Preemergence

Herbicide	Formulation
Outlook	6EC

- Mode of action: group 15 (see page 12-13).
- Apply only to sorghum with safened seed.
- May be applied up to 30 days before planting as a single application and postemergence on grain sorghum up to 12 inches tall.
- Incorporation to a depth of 2 inches will improve yellow nutsedge control and reduce dependence on rainfall for activation.

Outlook Use Rates (oz/A)

Soil Texture Group	Less than 3% OM	3% or Greater OM
Coarse	12 to 14	14 to 18
Medium and Fine	14 tp 18	18 to 21

Grain Sorghum: Postemergence Incorporated (Preemergence to Weeds) and Layby

Herbicide	Formulation	Product Rate Range
Pendimethalin/Prowl/Pendimax	3.3 EC	1.5 to 3.6 pt/A
Prowl H2O	3.8 CS	2 to 3 pt/A

- Active ingredient: pendimethalin.
- Mode of action: group 3 (see page 12-13).
- Apply to cultivated or otherwise weed-free soil after grain sorghum is 4 inches tall and up to the last cultivation. If mixed with atrazine, apply after grain sorghum has reached the 2-leaf stage and weeds are no more than 1 inch tall, but before the sorghum is 12 inches tall. Can be applied postemergence without cultivation at 2 pt/A on medium- and fine-textured soils.
- Use drop nozzles if foliage prevents coverage of soil.
- Incorporate 1 inch deep with a cultivator or rain/irrigation within 7 days after application.
- Do not use on sand or loamy sand soils unless culti-sprayed.
- Do not apply using fertilizer solution as the spray carrier.
- Do not replant grain sorghum in the event of crop loss.
- Do not apply more than once per season.
- Do not apply as postemergence incorporated treatment where sorghum is planted in double row beds.
- Do not allow grazing or feed forage to livestock until 21 days after application.

Herbicide	Formulation	Product Rate Range
Trifluralin/Treflan	4EC	0.6 to 1.6 pt/A

- Mode of action: group 3 (see page 12-13).
- Apply to cultivated or otherwise weed-free soil after grain sorghum is 8 inches tall and up to the last cultivation. If mixed with atrazine, do not apply after grain sorghum is 12 inches tall.
- Use drop nozzles if foliage prevents coverage of soil.
- Incorporate 1 inch deep with a cultivator or rain/irrigation immediately after application.
- Do not use on sand or loamy sand soils.
- Do not allow grazing or feed forage to livestock until 21 days after application.

Grain Sorghum: Postemergence

Herbicide	Formulation	Product Rate Range
2,4-D amine	4 lb/gal	1 pt/A
2,4-D ester	4 lb/gal	0.5 pt/A

- Mode of action: group 4 (see page 12-13).
- Numerous formulations are available. Application rates, spray volumes, and timings vary with company and formulation.
- Apply when grain sorghum is at least 6 inches tall and before it is 15 inches tall. If it is over 8 inches tall use drop nozzles to direct spray between rows.
- Most hybrids are injured by 2,4-D. Injury symptoms include rolled leaves, and brittle, spreading stems and tillers. High humidity and temperatures increase potential for injury.

Herbicide	Formulation	Product Rate Range
Aim	1.9EC	0.5 oz/A

- Mode of action: group 14 (see page 12-13).
- Aim is a contact herbicide that controls black nightshade, velvetleaf, and pigweeds, and possibly small morningglory and lambsquarters. Aim is often mixed with other herbicides to improve control of these weeds.
- Add NIS at 1 qt/100 gallons or 0.25% v/v. Do not mix with COC or MSOs or EC formulations of other herbicides because of crop injury. UAN (2 to 4 gallons/100 gallons) or AMS (2 to 4 lbs/A) can be added if recommended for use with other herbicides.
- Leaf speckling is likely. Severity of injury varies with environmental conditions, adjuvants, and other herbicides in the mixture. To reduce risk of injury, 1) do not apply within 6 to 8 hrs of rain, and 2) make sure spray nozzles are positioned 18 inches above crop and avoid applications directly into crop whorls.
- Apply in a spray volume of 10 to 20 gpa with a pressure of 20 to 40 psi. Flat fan nozzles are recommended for adequate coverage.
- Add Aim to the tank before adding other herbicides.

Herbicide	Formulation	Product Rate Range
Atrazine	4L	1 qt/A
	90DF	1.1 lb/A

- Mode of action: group 5 (see page 12-13).
- Atrazine can injure grain sorghum on high pH soils.
- Do not use on sandy/sandy loam soils.
- Add COC at 1 qt/A or NIS at 1 qt/A or 0.25% v/v.
- Apply after sorghum reaches 3-leaf stage but before 12 inches tall.
- Apply before weeds exceed 1.5 inches in height.

Herbicide	Formulation	Product Rate
Basagran	4L	1 to 2 pt/A

- Mode of action: group 6 (see page 12-13).
- Broadcast applications can be made to sorghum until heading.
- Add COC at 1 to 2 pt/A. Add a nitrogen fertilizer source if velvetleaf is present.
- Apply no more than 2 pints per growing season.

Herbicide	Formulation	Product Rate
Bromoxynil	2E	1 to 1.5 pt/A

- Bromoxynil is sold under the trade names Buctril, Moxy, and Broclean.
- Mode of action: group 6 (see page 12-13).
- This is a contact herbicide and thorough coverage is required.
- Safer to sorghum than 2,4-D or dicamba, but somewhat weaker on pigweed species.
- Broadcast applications can be made to sorghum from the 3- to 4-leaf stage until the pre-boot stage.
- Do not graze or cut forage for feed within 30 days after application.

Grain Sorghum: Postemergence

Herbicide	Formulation	Product Rate
Bromoxynil+atrazine	3F	1.5 to 3 pt/A

- Mode of action: group 5 (atrazine); group 6 (bromoxynil). See page 12-13.
- Apply from the 2 to 4 leaf stage up to 10 inches tall. See label for more detail on rates and growth stages.
- Can be mixed with dicamba to improve control of pigweeds and bindweed.
- Do not graze or cut forage for feed within 30 days after application.

Herbicide	Formulation	Product Rate
Dicamba	4L	0.5 pt/A

- Dicamba is sold under a variety of trade names, including Banvel, Clarity, Sterling Blue, Oracle, and Banvel-K.
- Mode of action: group 4 (see page 12-13).
- Broadcast applications can be made to sorghum up to 8 inches tall. Directed applications can be made to sorghum 8 to 15 inches tall to keep product out of whorls. Failure to follow these height restrictions can result in damage seed heads.
- Do not apply to sorghum grown for seed.
- Do not allow grazing or feed treated forage before mature grain stage.
- Do not apply when temperature on day of application is expected to exceed 85 F.
- Expect some crop response in the form of rolled up leaves.

Herbicide	Formulation	Product Rate Range
Dicamba+atrazine	3.2L	1.5 to 2 pt/A

- Dicamba plus atrazine is sold under various trade names, including Marksman, Sterling Plus, Banvel-K+atrazine, and Stratos.
- Mode of action: group 4 (dicamba); group 5 (atrazine). See page 12-13.
- Apply from 2 to 5 leaf stage of grain sorghum and weeds less than 6 inches tall.
- The 1.5 pt rate is only for pigweed control.

Herbicide	Formulation	Product Rate
Laddok S-12	5L	2 to 3.5 pt/A

- Mode of action: group 5 (atrazine); group 6 (bentazon). See page 12-13.
- Apply from emergence up to 12 inches tall
- Add COC or Dash at 1 qt/A or UAN at 2 to4 qt/A or AMS at 2to4 lb/A. Add UAN or AMS if velvetleaf is a target.
- Do not graze or cut forage for feed within 21 days after application.

Herbicide	Formulation	Product Rate
Peak	57DG	0.5 to 1 oz/A

- Mode of action: group 2 (see page 12-13).
- Apply to grain sorghum from 5 to 30 inches tall.
- If applied alone or mixed with atrazine, add COC at 1 qt/A. Add UAN at 2to4 qt/A if velvetleaf is targeted.
- If mixed with 2,4-D, dicamba or bromoxynil, use NIS rather than COC.
- No restrictions on rotation to wheat.
- Soybean is very sensitive to Peak residues and rotational intervals will vary by region, rate used, and soil pH.

Grain Sorghum: Postemergence

Herbicide	Formulation	Product Rate
Permit/Sandea	75DF	0.67 oz/A

- Mode of action: group 2 (see page 12-13).
- Apply to grain sorghum in the 2-leaf stage to layby (before head emergence).
- Add dicamba or 2,4-D to improve control of pigweeds and morninglories.
- Always apply with NIS at 1 to 2 qt/100 gallons (0.25 to 0.5% v/v). Add UAN at 4 gal/100 gal for control of velvetleaf.
- Do not apply to sorghum treated with an organophosphate insecticide.

Herbicide	Formulation	Product Rate Range
Shotgun	3.25L	2 pt/A

- Mode of action: group 4 (2,4-D); group 5 (atrazine). See page 12-13.
- Apply from spike to 8 inches tall or 4 leaf stage as a broadcast spray. Directed applications can be used on 8 to 12 inch tall grain sorghum.
- Do not use with liquid fertilizer.
- Addition of adjuvants is not recommended because of crop injury concerns.

Grain Sorghum: Postemergence Directed or Hooded Sprayer

Herbicide	Formulation	Product Rate
Glyphosate	3 lb ae/gal	1 to 2 pt

- Mode of action: group 9 (see page 12-13).
- Hooded application only.
- Glyphosate will cause severe injury to grain sorghum, so avoid drift and use hoods that are shielded on all four sides.
- Weeds in the row (outside of the hood) will not be controlled.

Herbicide	Formulation	Product Rate
Gramoxone SL	2L	2 to 3.75 pt/A
Parazone	3SL	0.7 to 1.3 pt

- Mode of action: group 22 (see page 12-13).
- Apply after grain sorghum is over 12 inches tall, but before weeds are 3 inches tall.
- Directed application - keep spray off all but lower 3 inches of sorghum.
- Use NIS at 0.5 pt/100 gallons (0.125% v/v).

Herbicide	Formulation	Product Rate
Linex	4L	1 to 2 pt/A

- Mode of action: group 7 (see page 12-13).
- Directed application - Keep spray off all but lower 3 inches of sorghum.
- Use a NIS at 1 qt/100 gallon.

Grain Sorghum: Special Problems Postemergence – Johnsongrass and Shattercane

Herbicide	Formulation	Product Rate
Glyphosate	3 lb ae/gal	2.5 oz/gallon (2% solution)

- Mode of action: group 9 (see page 12-13).
- Spot application – sorghum plants will be injured or killed if treated.
- Add NIS (see label).
- Add AMS at 8.5 to 17 lbs/100 gallons.

Herbicide	Formulation	Product Rate
Glyphosate	3 lb ae/gal	10% solution (roller) 33% solution (rope wick or wiper)

- Mode of action: group 9 (see page 12-13).
- Spot application – sorghum plants will be injured or killed if treated.
- Add NIS (see label).
- Add AMS at 8.5 to 17 lbs/100 gallons.

Grain Sorghum: Special Problems Postemergence – Annual and Perennial Vines

Herbicide	Formulation	Product Rate
2,4-D amine	4 lb/gal	1.5 to 2 pt/A
2,4-D ester	4 lb/gal	0.75 to 1 pt/A

- Mode of action: group 4 (see page 12-13).
- Apply after grain sorghum is over 6 inches but before it is 15 inches tall. If sorghum is more than 8 inches tall use drop nozzles to keep spray off leaves.
- For control of annual morningglories, honeyvine milkweed, field bindweed, trumpetcreeper.

Herbicide	Formulation	Product Rate
Dicamba	4 lb/gal	2 to 4 pt/A

- Mode of action: group 4 (see page 12-13).
- Fall treatment only, Apply after crop harvest, but before a killing frost. Avoid disturbing area for at least 7 days after application.
- Delay planting wheat 45 days for each pint of Banvel/Clarity applied.
- For control of annual morningglories, honeyvine milkweed, field bindweed, trumpetcreeper.

Herbicide	Formulation	Product Rate
Glyphosate	3 lb ae/gal	2 to 4 pt/A

- Mode of action: group 9 (see page 12-13).
- Fall treatment only, Apply after crop harvest, but before a killing frost. Avoid disturbing area for at least 7 days after application.
- Delay planting wheat 45 days for each pint of Banvel/Clarity applied.
- For control of annual morningglories, honeyvine milkweed, field bindweed, trumpetcreeper.

Grain Sorghum: Harvest Aid

Herbicide	Formulation	Product Rate Range
AimEW	1.9L	1 oz

- Aim (carfentrazone) can be applied prior to harvest of mature sorghum for dessication of velvetleaf, morningglory, pigweeds, and other weeds. Apply at least 3 days before harvest.
- The total amount of Aim that can be applied to small grains in one season, including postemergence and harvest aid treatments, cannot exceed 1 oz/A.
- Use a spray volume that results in complete coverage of foliage. Apply with NIS (0.25% v/v) or a COC or MSO (1 to 2% v/v). UAN or AMS may also be added.

Herbicide	Formulation	Product Rate
Glyphosate	3 lb ae/gal	2 to 4 pt/A

- Mode of action: group 9 (see page 12-13).
- Apply at least 7 days before harvest, make applications at 30% grain moisture or less. A 14 day delay is recommended to give the product time to kill the weeds and weed growth to dessicate.
- Do not apply to grain sorghum grown for seed.

Herbicide	Formulation	Product Rate
Reglone	2 lb/gal	1.5 to 2 pt/A

- Apply 1 to 2 weeks before harvest make applications at 30% grain moisture or less.
- Do not use seed from treated plants for food, feed or oil purposes.

Herbicide	Formulation	Product Rate
Sodium chlorate	Many	4 to 6 lb/A

- Apply 7 to 10 days before harvest.
- Use spray adjuvants as recommended by the label.
- Can be applied in 28% UAN solutions to enhance foliar activity.
- Do not graze treated fields or feed treated fodder, forage, or seed within 14 days of application.

Table 11. Grazing and forage (silage, hay, etc.) intervals for herbicide-treated grain sorghum.

This table is a guide for grazing and feeding herbicide-treated grain sorghum, and shows the time that should occur between herbicide application and grazing or harvest for silage. For premixes or combinations not listed below, the minimum time interval should be the longer of the two intervals for each individual active ingredient in the mix. Consult herbicide labels for specific limitations.

Herbicide	Grazing	Forage (silage, etc)
2,4-D	7 days	7 days
Aim	No restriction	No restriction
Alachlor	None	None
Alachlor + atrazine	21 days	21 days
Atrazine	21 days	21 days
Basagran	21 days	none
Bromoxynil	45 days	45 days
Bromoxynil + atrazine	45 days	45 days
Callisto	Do not graze	Do not feed
Dicamba	past milk stage	past milk stage
Dicamba + atrazine	21 days	37 days
Expert	60 days	60 days
Glyphosate	Do not graze	Do not feed
Guardsman Max	40 days	40 days
Laddok	21 days	21 days
Lexar/Lumax	Do not graze	Do not feed
Lorox/Linex	Do not graze	Do not feed
Metolachlor/s-metolachlor	30 days	30 days
Metolachlor/s-metolachlor + atrazine	30 days	30 days
Outlook	60 days	60 days
Paraquat (at planting)	No restriction	No restriction
Paraquat (post-directed)	Do not graze	Do not feed
Peak	30 days	40 days
Permit/Sandea	30 days	30 days
Pendimethalin	21 days	21 days
Sharpen	70 days	70 days
Shotgun	21 days	21 days
Treflan/trifuralin	No restrictions on label	No restrictions on label

Table 12. Rainfast intervals, spray additives, and maximum crop sizes for postemergence grain sorghum herbicides.

This table shows the required time interval between herbicide application and rainfall and summarizes label recommendations for spray additives and maximum crop stage. Check herbicide labels for additive rates. Information in this table applies to field corn only.

Herbicide	Rainfast interval (hours)	Spray additives/Maximum crop size
2,4-D amine	6-8	No additives. Broadcast on 6- to 8-inch tall sorghum. Use drop nozzles on 8- to 15-inch tall sorghum.
2,4-D ester	2-3	No additives. Broadcast on 6- to 8-inch tall sorghum. Use drop nozzles on 8- to 15-inch tall sorghum.
Aim	1	SURF. UAN or AMS can be added if recommended with tank mix partners.Broadcast up to 6 leaf growth stage.
Atrazine	1-2	COC or NIS. Broadcast from 3-leaf stage up to 12 inches tall.
Basagran	8	COC. Add UAN or AMS if velvetleaf is present. Broadcast up to just before heading.
Bromoxynil	2	No additives. Broadcast applications until pre-boot stage.
Bromoxynil+atrazine	1	No additives. Broadcast applications from 2 to 4 lf stage until 10 inches tall.
Dicamba	6-8	No additives. Broadcast on 6- to 8-inch tall sorghum. Use drop nozzles on 8- to 15-inch tall sorghum.
Dicamba+ atrazine	6-8	SURF only if crop injury can be tolerated. Apply from 2 to 5 leaf stage.
Glyphosate	1-2 see label of specific product	AMS. See label of specific product regarding NIS.
Gramoxone	0.5	SURF. Directed or hooded application - apply after grain sorghum is 12 inches tall.
Laddok	8	COC or DASH or UAN. Add UAN or AMS if velvetleaf is present. Broadcast from emergence to 12 inches tall.
Lorox/Linex	No information on label	SURF. Directed or hooded applications – apply after grain sorghum is 12 inches tall.
Peak	4	SURF or COC; Add UAN if velvetleaf is targeted. Broadcast from 5 to 30 inches tall.
Permit/Sandea	4	SURF; add UAN if velvetleaf is targeted. Broadcast from 2 leaf until layby (before head emergence).
Shotgun	6	No additives recommended because of crop injury concerns. Apply from spike to 8 inches tall or 4 leaf stage as a broadcast spray. Directed applications can be used on 8 to 12 inch tall grain sorghum.

Soybean Herbicide Management Strategies

A number of broad-spectrum preemergence (PRE) and postemergence (POST) herbicides are available for use in soybeans. In OSU research, almost any type of approach to herbicide management can be used in fields with low weed pressure with little risk of crop yield loss. These approaches include: total PRE, PRE followed by POST, and total POST. However, the biology of some weeds that occur in soybean fields, in addition to the slow early development of no-till soybeans, can make it difficult to achieve effective weed control with a single application of PRE or POST herbicides. For this reason, a PRE followed by POST program or a two-pass POST program often provides the most consistent control.

Weeds that are especially problematic in a total PRE herbicide program, depending upon their population, include annual grasses, giant ragweed, ALS-resistant common ragweed, marestail, annual morningglory, cocklebur, waterhemp, and most perennial weeds. Another major drawback to PRE herbicides applied at planting is the narrow window of time in which at least 0.5 to 1 inch of rain must occur to move herbicide into the soil. In early May when soybeans are often planted, weeds will typically start to emerge within 8 to 10 days after tillage or an application of glyphosate or paraquat. Rain is needed before these weeds emerge in order for PRE herbicides to be effective. Applying herbicides several weeks or more before planting of no-till soybeans often results in more consistent weed control initially, although herbicide activity may not last as long after planting, compared to application at the time of planting.

Weeds that can be problematic in a one-pass, total POST herbicide program, depending upon their population, include annual grasses, giant ragweed, waterhemp, lambsquarters, marestail, and some perennials (because they may be too small at the time of an early POST application). Most POST soybean herbicides should be applied before weeds exceed 3 to 6 inches in height for consistent control and to avoid crop yield loss. Glyphosate application can be timed for weed heights of 4 to 8 inches, although velvetleaf, lambsquarters and some other weeds are more easily controlled when less than 6 inches tall. Problems with proper timing of a single postemergence application include: 1) giant ragweed grows at approximately twice the rate of most annual weeds, and is likely to be 8 to 12 inches tall when other weeds are 3 to 6 inches tall; 2) wet and/or cold weather can prevent timely application and result in the need to treat many acres within a short period of time once favorable weather returns, and 3) when weed populations continue to emerge after the POST application and are not suppressed by the soybean leaf canopy, a second POST application may be needed.

A planned PRE plus POST approach will provide more consistent weed control than any one-pass approach in many fields, and help solve some of the problems in management of glyphosate and other POST herbicides. The most complete PRE plus POST program includes use of a PRE herbicide with activity on key broadleaf weeds that also provides at least some early-season control of grasses, followed by glyphosate in Rounudp Ready soybeans, or another POST treatment with activity on grass and broadleaf weeds in non-Roundup Ready soybeans. The PRE herbicide can control or reduce the population of some problem broadleaf weeds, such as lambsquarters, waterhemp, and giant ragweed, making it relatively easy to control any later-emerging weeds with the POST treatment. A major advantage of the PRE plus POST approach, compared to total POST, is that the PRE herbicide will often provide enough weed control to prevent major problems if weather delays the POST application. The PRE plus POST approach can allow for a slightly delayed POST application, resulting in more consistent control of late-emerging weeds such as foxtails, giant ragweed, black nightshade, waterhemp, and perennials.

Preemergence (PRE) Soybean Herbicide Programs

Total PRE herbicide programs fit fields with:

- low annual grass populations
- low to moderate populations of annual broadleaf weeds, including common ragweed, smartweed, pigweed, and velvetleaf
- most populations of lambsquarters

Total PRE programs do not fit fields with:

- moderate to high annual grass populations
- giant ragweed, cocklebur, burcucumber, annual morningglory, or waterhemp
- biennial and perennial weeds

Advantages:

- one-pass, can apply while planting
- with adequate rain, provides control through the first 6 weeks, and later-emerging weeds have much reduced impact on soybean yields

Disadvantages:

- dependence upon adequate rain within narrow period of time
- not effective enough on tough broadleaf or perennial weeds or in moderate to high grass populations
- soybeans need to be competitive earlier in season compared to PRE plus POST programs

Approaches:
The most broad-spectrum programs include mixtures of a grass herbicide (Command, metolachlor, Outlook, pendimethalin, etc) with Canopy, Gangster, Envive, Valor XLT, Scepter, Sonic, or Authority First. Python, Valor, and metribuzin have less activity on giant ragweed and other tough broadleaf weeds compared to the previously listed products.

Preemergence (PRE) plus Postemergence (POST) Soybean Herbicide Programs

PRE plus POST herbicide programs fit any field, but are especially well-suited for fields with:

- moderate to high annual grass populations
- moderate to high giant ragweed, cocklebur, and annual morningglory populations
- waterhemp
- biennial and perennial weeds
- burcucumber
- no-tillage

Advantages:

- very consistent, as long as some rain on PRE
- creates wider window for POST application, compared to total POST programs
- good on many tough weeds
- best approach to control of herbicide-resistant weeds

Disadvantages:

- dependence upon rain for PRE activity (although have planned POST backup)
- two-pass

Approaches:
In fields with low grass populations, using PRE grass or grass plus broadleaf herbicides followed by POST broadleaf herbicide is one approach. Examples:

- Dual II Magnum followed by Flexstar + thifensulfuron
- Prowl followed by Pursuit + Cobra

In fields with moderate to high grass populations, using a PRE broadleaf herbicide that also has some grass activity followed by a POST grass or grass plus broadleaf herbicide treatment is another approach. Choice of PRE herbicide would vary with type of broadleaf weeds present – problem weeds such as giant ragweed require PRE use of Canopy EX, Synchrony XP, FirstRate, Gangster, or Scepter. Examples:

- Canopy followed by Flexstar + Fusion
- Valor XLT followed by glyphosate (RR soybeans)

Total Postemergence (POST) Soybean Herbicide Programs

Total POST herbicide programs (one application) can be used in fields with:

- low to moderate populations of most annual weeds
- low populations of giant ragweed

Avoid use in fields with:

- moderate to high lambsquarters or grass populations
- high giant ragweed populations
- marestail
- late-season perennials such as hemp dogbane

Advantages:

- one-pass, can plant first and apply later (except for burndown in no-till soybeans)
- not dependent upon rainfall for postemergence activity (although soil moisture status affects weed response to herbicides)
- consistent control of low to moderate annual weed populations

Disadvantages:

- narrow window of application depending upon weather should be applied before weeds exceed about 6 inches in height to avoid yield loss
- a second POST application may be needed for late-emerging weeds that are not suppressed by the soybean leaf canopy
- application may be too early for best perennial weed control
- Difficult to control herbicide-resistant weeds without the use of PRE herbicides

Approaches:

Apply a POST herbicide treatment with activity on grass and broadleaf weeds before weeds exceed 3 to 6 inches in height (4 to 8 inches for Roundup Ready soybean program). Make a second POST application as necessary for late-emerging weeds. Examples:

Glyphosate (Roundup Ready soybeans)
Flexstar + Harmony GT + Fusion
Raptor

Table 13. Weed Response to Preplant/Preemergence Herbicides in Soybeans

This table compares the relative effectiveness of herbicides on individual weeds. Ratings are based on labeled application rate and weed size or growth stage. Performance may be better or worse than indicated in the table, due to weather or soil conditions or other variables. See pages 12-13 for more information on herbicide mode of action classification and description of mode of action groups.

Weed control rating:
9 = 90% to 100% control
8 = 80% to 90% control
7 = 70% to 80% control
6 = 60% to 70% control
- = less thn 60% control, not recommended.

Crop tolerance rating:
0 = Excellent
1 = Good
2 = Fair
3 = Poor

Crop injury of 1 or less is rarely significant.

			Grasses									Broadleaf Weeds																	
	Mode of Action	Crop Tolerance	Barnyardgrass	Crabgrass	Fall Panicum	Giant Foxtail	Yellow Foxtail	Shattercane	Seedling Johnsongrass	Yellow Nutsedge	Annual Morningglory	Black Nightshade	Burcucumber	Cocklebur	Common Ragweed	Common ragweed (ALS-resistant)	Com ragweed (ALS- + PPO-resis)	Giant Ragweed	Giant ragweed (ALS-resistant)	Jimsonweed	Lambsquarters	Lambsquarters (triazine-resistant)	Marestail (glyphosate-resistant)[2]	Marestail (ALS + glyphosate-resis)[2]	Pigweed	Smartweed	Velvetleaf	Waterhemp
Preplant Incorporated Only																													
Trifluralin	3	1	9	9	9	9	9	7	7	-	-	-	-	-	-	-	-	-	-	-	8+	8+	-	-	9	-	-	8
Preplant or Preemergence																													
Alachlor[1]	15	1	8	9	8	8	8	-	-	8	-	8	-	-	-	-	-	-	-	-	6	6	-	-	8	-	-	7
Authority Assist	2/15	2	6	7	7	7	7	6	6	8	8+	9	-	7	6	-	-	-	-	8	9	9	8	8	9	9	8	8
Authority First/Sonic	2/14	2	-	7	-	-	-	-	-	-	8+	8	-	8	9	-	-	7	-	8	9	9	9	8	9	9	8	8
Authority MTZ	5/14	2	-	-	-	-	-	-	-	6	7	8	-	-	-	-	-	-	-	6	9	8	8	8	9	9	7	8
Authority XL	2/14	2	-	-	-	-	-	-	-	8	8+	8	-	8	9	-	-	7	-	9	9	9	9	8	9	9	8+	8
Boundary	5/15	1	8	9	8+	8+	8+	-	-	8+	3	8	-	-	6	6	6	-	-	6	8	6	6	6	9	8	6	8
Canopy DF/Cloak DF	2/5	2	-	-	-	-	-	-	-	-	7+	-	6	8	9	-	-	7	-	9	9	9	9	6	9	9	8+	6
Canopy EX/Cloak EX/Fallout	2	2	-	-	-	-	-	-	-	-	7+	-	6	8	9	-	-	7	-	9	9	9	9	-	9	9	8+	-
Command	13	0	9	9	9	9	9	6	6	-	-	6	-	6	7	7	-	-	-	8	9	9	-	-	-	8	9	-
Envive	2/14	2	-	-	-	-	-	-	-	-	8	9	6	8	9	7	-	7	-	9	9	9	9	8	9	9	8+	8
FirstRate	2	0	-	-	-	-	-	-	-	-	7+	-	-	8	9	-	-	7	-	-	9	9	9	-	9	8	8+	-
Gangster	2/14	2	-	-	-	-	-	-	-	-	8	9	-	8	9	7	-	7	-	9	9	9	9	8	9	9	8+	8
Lorox	7	2	-	-	-	-	-	-	-	-	-	7	-	6	8	8	8	-	-	6	9	9	-	-	9	9	6	8
Metolachlor[1]	15	1	8	9	8+	8+	8+	-	-	8+	-	8	-	-	-	-	-	-	-	-	6	6	-	-	8	-	-	7
s-Metolachlor[1]	15	1	8	9	8+	8+	8+	-	-	8+	-	8	-	-	-	-	-	-	-	-	6	6	-	-	8	-	-	7
Metribuzin	5	2	6	5	6	6	6	-	-	-	-	-	-	-	7	7	7	-	-	7	9	-	8	8	9	9	7	7
Optill	2/14	2	6	7	7	7	7	6	6	-	7	9	-	7	7	-	-	-	-	8	9	9	7	7	9	9	9	-
Outlook	15	1	8	9	8	8	8	-	-	8	-	8	-	-	-	-	-	-	-	-	6	6	-	-	8	-	-	7
Pendimethalin	3	2	8	9	9	8	8	7	7	-	-	-	-	-	-	-	-	-	-	-	8+	8+	-	-	9	-	-	7
Prefix[3]	14/15	1	7	7	7	7	7	-	-	-	-	8	-	-	8	8	-	-	-	-	7	7	-	-	8	-	-	8
Pursuit	2	1	6	7	7	7	7	6	6	-	7	9	-	7	6	-	-	-	-	8	9	9	-	-	9	9	8	-
Python	2	1	-	-	-	-	-	-	-	-	-	8	-	7	7	-	-	-	-	7	9	9	9	-	8	8+	-	
Scepter	2	1	-	-	-	-	-	-	-	6	7	9	6	8	8	-	-	7	-	9	9	9	6	-	9	9	7	-
Spartan	14	2	7	7	7	7	7	-	-	8	8	9	-	-	-	-	-	-	-	-	9	9	8	8	9	8	7	8
Valor/Encompass	14	2	-	-	-	-	-	-	-	-	7+	9	-	-	7	7	-	-	-	-	9	9	8	8	9	7	7	8
Valor XLT	2/14	2	-	-	-	-	-	-	-	-	8	9	6	8	9	7	-	7	-	9	9	9	9	8	9	9	8+	8
Warrant[1]	15	1	8	8	8	8	8	-	-	7	-	8	-	-	-	-	-	-	-	-	8	8	-	-	8	6	-	8

[1]Warrant is labeled only for POST use in soybeans, and provides residual weed control only (does not control emerged weeds)..
[2]Marestail ratings are for residual control only (not burndown), and are based on a weedfree start at planting through use of an effective burndown treatment.
[3]Prefix rates are not intended to provide season-long control. Prefix should be used only where it will be followed with a broad-spectrum POST herbicide treatment (such as glyphosate in Roundup Ready soybeans or Ignite on Liberty Link soybeans).

Table 14. Broadleaf Weed Response to Herbicides in Roundup Ready Soybeans

This table compares the relative effectiveness of herbicide programs on individual weeds in Roundup Ready soybeans. Ratings are based on: 1) a weedfree start at planting using tillage or an effective burndown herbicide treatment; 3) an initial postemergence application of glyphosate to 6-inch weeds (6 to 12 inches for giant ragweed). Performance may be better or worse than indicated in the table, due to weather or soil conditions or other variables.

Weed control rating:
9 = 90% to 100% control
8 = 80% to 90% control
7 = 70% to 80% control
6 = 60% to 70% control

Crop tolerance rating:
0 = Excellent
1 = Good
2 = Fair
3 = Poor

Crop injury of 1 or less is rarely significant.

	Mode of Action	Crop Tolerance	Annual Morningglory	Black Nightshade	Burcucumber	Cocklebur	Common Ragweed[1]	Common ragweed (ALS-resistant)	Common ragweed (ALS- + PPO-resis)	Giant Ragweed[1]	Giant ragweed (ALS-resistant)	Jimsonweed	Lambsquarters	Lambsquarters (triazine-resistant)	Marestail (glyphosate-resistant)[2]	Marestail (ALS- + glyphosate-resistant)[2]	Pigweed	Smartweed	Velvetleaf	Waterhemp
Postemergence																				
Glyphosate 0.75 lb ae/A	9	0	6	8	8	9	8+	8+	8+	8	8	9	8	8	-	-	9	8	8	8
Glyphosate 1.5 lb	9	0	7	9	8	9	9	9	9	8+	8+	9	8+	8+	-	-	9	9	9	8+
Preemergence followed by (fb) Postemergence																				
Authority MTZ (10 oz)																				
fb glyphosate 0.75 lb	5/14/9	2	7+	9	8	9	8+	8+	8+	8	8	9	9	9	8	8	9	9	9	9
fb glyphosate 1.5 lb		2	7+	9	8	9	9	9	9	8+	8+	9	9	9	8	8	9	9	9	9
Canopy/Cloak DF (4 oz)																				
fb glyphosate 0.75 lb	2/5/9	2	8	8	8	9	9	8+	8+	9	8	9	9	9	9	6	9	9	9	9
fb glyphosate 1.5 lb		2	8+	9	8	9	9	9	9	9	8+	9	9	9	9	6	9	9	9	9
Gangster (2.4 oz)																				
fb glyphosate 0.75 lb	2/14/9	2	8+	9	8	9	9	9	8+	9	8	9	9	9	9	8	9	9	9	9
fb glyphosate 1.5 lb		2	8+	9	8	9	9	9	9	9	8+	9	9	9	9	8	9	9	9	9
Metribuzin (8 oz)																				
fb glyphosate 0.75 lb	5/9	1	6	8	8	9	9	9	9	8	8	9	9	8	8	8	9	9	9	9
fb glyphosate 1.5 lb		1	7	9	8	9	9	9	9	8+	8+	9	9	8+	8	8	9	9	9	9
Optill (2 oz)																				
fb glyphosate 0.75 lb	2/14/9	2	8	9	8	9	9	8+	8+	8	8	9	9	9	7	6	9	9	9	8
fb glyphosate 1.5 lb		2	8	9	8	9	9	9	9	8+	8+	9	9	9	7	6	9	9	9	8+
Pendimethalin (1.2 lb ai)																				
fb glyphosate 0.75 lb	3/9	2	6	8	8	9	8+	8+	8+	8	8	9	9	9	-	-	9	8	8	9
fb glyphosate 1.5 lb		2	7	9	8	9	9	9	9	8+	8+	9	9	9	-	-	9	9	9	9
Prefix (2 pts)																				
fb glyphosate 0.75 lb	14/15/9	2	6	9	8	9	9	9	9	8	8	9	9	9	-	-	9	8	8	9
fb glyphosate 1.5 lb		2	7	9	8	9	9	9	9	8+	8+	9	9	8+	-	-	9	9	9	9
Python (1 oz)																				
fb glyphosate 0.75 lb	2/9	1	6	9	8	9	9	8+	8+	8	8	9	9	9	9	-	9	9	9	8
fb glyphosate 1.5 lb		1	7	9	8	9	9	9	9	8+	8+	9	9	9	9	-	9	9	9	9
Scepter (2.8 oz)																				
fb glyphosate 0.75 lb	2/9	1	8	9	8	9	9	8+	8+	9	8	9	9	9	6	-	9	9	9	8
fb glyphosate 1.5 lb		1	8+	9	8	9	9	9	9	9	8+	9	9	9	6	-	9	9	9	8+
Sonic/Authority First/Authority XL																				
fb glyphosate 0.75 lb	2/14/9	2	8	9	8	9	9	8+	8+	9	8	9	9	9	9	7	9	9	9	8+
fb glyphosate 1.5 lb		2	8+	9	8	9	9	9	9	9	8+	9	9	9	9	7	9	9	9	8+
Valor/Encompass (2 oz)																				
fb glyphosate 0.75 lb	14/9	2	8+	9	8	9	9	9	8+	8	8	9	9	9	8	8	9	9	9	9
fb glyphosate 1.5 lb		2	8+	9	8	9	9	9	9	8+	8+	9	9	9	8	8	9	9	9	9
Valor XLT or Envive (3 oz)																				
fb glyphosate 0.75 lb	2/14/9	2	8+	9	8	9	9	9	8+	9	8	9	9	9	9	8	9	9	9	9
fb glyphosate 1.5 lb		2	8+	9	8	9	9	9	9	9	8+	9	9	9	9	8	9	9	9	9

[1]Some giant and common ragweed populations in Ohio and Indiana have become resistant to glyphosate, and some have resistance to both glyphosate and ALS inhibitors. These populations will require the use of other postemergence herbicides in addition to glyphosate. See the following page and the "giant ragweed" and "common ragweed (herbicide-resistant)" descriptions in the "Problem Weed" section for more information.

[2]Marestail ratings are for in-crop control only (not burndown), and are based on a weedfree start at planting through use of an effective burndown treatment.

Table 15. Grasses and Nutsedge - Response to Postemergence Herbicides in Soybeans

This table compares the relative effectiveness of herbicides on individual weeds. Ratings indicate the level of control of weeds present at the time of application, and are based on labeled rate and weed size or growth stage. Performance may be better or worse than indicated in the table, due to weather or soil conditions or other variables.

Weed control rating:
9 = 90% to 100% control
8 = 80% to 90% control
7 = 70% to 80% control
6 = 60% to 70% control
- = less than 60% control, not recommended.

Crop tolerance rating:
0 = Excellent
1 = Good
2 = Fair
3 = Poor

Crop injury of 1 or less is rarely significant.

	Mode of Action	Crop Tolerance	Barnyardgrass	Crabgrass	Fall Panicum	Giant Foxtail	Yellow Foxtail	Shattercane	Seedling Johnsongrass	Rhizome Johnsongrass	Quackgrass	Volunteer Corn	Vol Corn (glyphosate-resistant)	Wirestem muhly	Yellow nutsedge
Postemergence															
Basagran	6	1	-	-	-	-	-	-	-	-	-	-	-	-	8+
Cadet	14	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Classic	2	2	-	-	-	-	-	-	-	-	-	-	-	-	8
Cobra/Phoenix	14	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Extreme/Tackle[2]	2/9	1	9	8+	9	9	9	9	9	8+	8+	9	-	8	7
FirstRate	2	1	-	-	-	-	-	-	-	-	-	-	-	-	6
Flexstar/Rhythm	14	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Flexstar GT[2]	9/14	2	9	9	9	9	9	8	9	9	9	9	-	8+	8
Glyphosate 0.75 lb ae/A[2]	9	0	8+	8+	8+	9	9	8	9	9	9	9	-	8+	7
Glyphosate 1.5 lb[2]	9	0	9	9	9	9	9	8	9	9	9	9	-	9	8
Ignite[3]	10	0	6	8	8	8+	6	8	8	7	6	7	7	6	-
Pursuit	2	1	6	7	7	8	7	8	8	-	-	-	-	-	-
Raptor	2	2	6	7	7	8+	7	-	-	-	-	8	8	-	-
Reflex/Dawn	14	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Resource	14	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Storm	6/14	2	-	-	-	-	-	-	-	-	-	-	-	-	7
Synchrony XP[1]	2	0	-	-	-	-	-	-	-	-	-	-	-	-	8
Thifensulfuron	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Ultra Blazer	14	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Assure II/Targa	1	0	8+	8+	9	9	8	9	9	9	9	9	9	6	-
Clethodim	1	0	9	8+	9	9	9	9	9	9	9	9	9	8+	-
Fusilade DX	1	0	8	8	8	8	8	9	9	9	9	9	9	8+	-
Fusion	1	0	9	8+	9	9	9	9	9	9	9	9	9	8+	-
Poast/Poast Plus	1	0	9	8	9	9	9	8	8	7	7+	8	8	-	-

[1] Ratings are for 0.75 oz/A applied to STS soybeans.
[2] Apply to Roundup Ready soybeans only.
[3] Apply to Liberty Link soybeans only

Table 16. Broadleaf Weeds - Response to Postemergence Herbicides in Soybeans

This table compares the relative effectiveness of herbicides on individual weeds. Ratings indicate the level of control of weeds present at the time of application, and are based on labeled rate and weed size or growth stage. Performance may be better or worse than indicated in the table, due to weather or soil conditions or other variables.

Weed control rating:
9 = 90% to 100% control
8 = 80% to 90% control
7 = 70% to 80% control
6 = 60% to 70% control
- = less than 60% control, not recommended.

Crop tolerance rating:
0 = Excellent
1 = Good
2 = Fair
3 = Poor

Crop injury of 1 or less is rarely significant.

	Mode of Action	Crop Tolerance	Annual Morningglory	Black Nightshade	Burcucumber	Cocklebur	Common Ragweed	Common ragweed (ALS-resistant)	Common ragweed (glyphosate-resistant)	Com ragweed (ALS- + glyphosate-resistant)	Common ragweed (ALS- + PPO-resistant)	Giant Ragweed	Giant ragweed (ALS-resistant)	Giant ragweed (glyphosate-resistant)	Giant ragweed (ALS- + glyphosate-resis)	Jimsonweed	Lambsquarters	Lambsquarters (triazine-resistant)	Pigweed	Marestial (glyphosate-resistant)	Mareastail (ALS- + glyphosate-resis)	Smartweed	Velvetleaf	Waterhemp
Postemergence																								
Basagran	6	1	-	-	-	9	7	7	7	7	7	6	6	6	6	9	7	7	-	-	-	9	8+	-
Cadet	14	2	7	-	-	-	-	-	-	-	-	-	-	-	-	-	7	7	8	-	-	-	9	7
Classic	2	2	7	-	8+	9	8	-	8	-	-	7+	-	7+	-	8+	-	-	9	8	-	8	8	-
Cobra/Phoenix	14	3	7	8+	7	8	9	9	9	9	-	8	8	8	8	9	-		9	-	-	6	7	9
Extreme/Tackle[2]	2/9	1	8	9	8	9	8+	8+	7	-	8+	8+	8+	6	-	9	8+	8+	9	-	-	9	9	8
FirstRate	2	1	8	-	8+	9	9	-	9	-	-	9	-	9	-	8	-	-	-	8	-	8	9	-
Flexstar/Rhythm	14	2	8	9	7	8+	9	9	9	9	-	8	8	8	8	9	7	7	9	-	-	9	8	9
Flexstar GT[2]	9/14	2	9	9	8	9	9	9	9	9	9	9	9	8	8	9	8+	8+	9	-	-	9	9	9
Glyphosate 0.75 lb ae/A[2]	9	0	6	8	8	9	8+	8+	-	-	8+	8	8	-	-	9	8	8	9	-	-	8	8	8
Glyphosate 1.5 lb[2]	9	0	7	9	8	9	9	9	-	-	9	8+	8+	-	-	9	8+	8+	9	-	-	9	9	8+
Ignite[3]	10	0	8	9	8	9	9	9	9	9	9	8+	8+	8+	8+	9	8	8	8	8	8	9	8	8
Pursuit	2	1	7	9	6	9	6	-	6	-	-	7	-	7	-	8+	6	6	9	-	-	9	9	-
Raptor	2	2	7	9	6	8	7	-	7	-	-	8	-	8	-	8	8	8	9	-	-	8	9	-
Reflex/Dawn	14	2	8	8	6	7	8+	8+	8+	8+	-	8	8	8	8	9	-	-	9	-	-	7	6	9
Resource	14	2	6	-	6	7	7	7	7	7	-	-	-	-	-	7	7	7	7	-	-	-	9	7
Storm	6/14	2	8+	7	6	8+	9	9	9	9	5	7+	7+	7+	7+	9	6	6	9	-	-	9	8	8+
Synchrony XP[1]	2	0	8	-	8+	9	8	-	8	-	-	7+	-	7+	-	9	8	8	9	8	-	9	9	-
Thifensulfuron	2	2+	-	-	-	6	-	-	-	-	-	-	-	-	-	-	8	8	9	-	-	8	9	-
Ultra Blazer	14	2	8	8	6	7	9	9	9	9	-	7	7	7	7	9	-	-	9	-	-	9	6	9

[1] Ratings are for 0.75 oz/A applied to STS soybeans.
[2] Apply to Roundup Ready soybeans only.
[3] Apply to Liberty Link soybeans only

Soybeans: Soil-Applied Herbicides — Preplant or Preemergence

Herbicide	Formulation	Product Rate Range
Alachlor	Various	1.75 to 3 qts

- Alachlor is sold under various trade names, including Lasso, Intrro, and Micro-Tech.
- Alachlor controls annual grasses and pigweed, and helps control yellow nutsedge and black nightshade. Use the higher rates for control of yellow nutsedge and black nightshade.
- Mode of action: group 15 (see page 12-13).
- Intrro use rates, when applied alone: coarse-textured soils - 2.5 qt/A; medium- and fine-textured soils - 3 qt/A. Rates when mixed with broadleaf herbicides: coarse-textured soils - 1.75 to 2.25 qt/A; medium-textured soils - 2 to 2.5 qt/A; fine-textured soils - 2.5 to 3 qt/A.
- Incorporate (no deeper than 2 inches) to improve yellow nutsedge control and to reduce dependence upon rainfall.

Herbicide	Formulation	Product Rate Range
Authority Assist	4L	4 to 12 oz

- Authority Assist is a premix of imazethapyr (Pursuit) and sulfentrazone (Spartan) for control or suppression of broadleaf weeds, including lambsquarters, pigweeds, black nightshade, Pennsylvania smartweed, velvetleaf, annual morningglory, and waterhemp. Provides partial control of annual grasses, but a follow up postemergence application will be necessary for complete grass control. This product does not control common or giant ragweed.
- Mode of action: group 14 (sulfentrazone); group 2 (imazethapyr). See page 12-13.
- Application rates when used in standard PRE or PRE + POST programs, on soils with 2 to 4% OM: coarse-textured - 8 to 10 oz; medium-textured - 10 to 12 oz; fine-textured - 12 oz. Application rate when followed by a POST application of glyphosate in Roundup Ready soybeans, on soils with 2 to 4% OM: coarse-textured - 4 to 5 oz; medium-textured - 5 to 6 oz; fine-textured - 6 oz. Within a rate range, use higher rates where soil pH is less than 7, and lower rates where soil pH is greater than 7.
- Can be applied from 45 days before planting through 3 days after planting. Apply prior to soybean seed germination to prevent injury to emerging soybean seedlings.
- Do not use on coarse soils with less than 1% organic matter, or to soils with pH greater than 7.5. Do not incorporate deeper than 2 inches.

Herbicide	Formulation	Product Rate Range
Authority MTZ	45DG	8 to 20 oz

- Authority MTZ is a premix of metribuzin and sulfentrazone (Spartan) for control or suppression of broadleaf weeds, including lambsquarters, pigweeds, black nightshade, Pennsylvania smartweed, velvetleaf, and waterhemp. This product does not control giant or common ragweed or cocklebur.
- Mode of action: group 14 (sulfentrazone); group 5 (metribuzin). See page 12-13.
- Application rates when used in standard PRE or PRE + POST programs, on soils with 2 to 4% OM: coarse-textured - 14 to 16 oz; medium-textured - 16 to 18 oz; fine-textured - 18 to 20 oz. Application rate when followed by a POST application of glyphosate in Roundup Ready soybeans, on soils with 2 to 4% OM: coarse-textured - 8 to 10 oz; medium-textured - 10 to 12 oz; fine-textured - 12 to 14 oz.
- Can be applied from 30 days before planting through 3 days after planting. Apply prior to soybean seed germination to prevent injury to emerging soybean seedlings.
- Do not apply to sandy soils with less than 1% organic matter, or to soils with pH greater than 7.5. Do not apply to frozen soil or incorporate deeper than 2 inches.

Soybeans: Soil-Applied Herbicides — Preplant or Preemergence

Herbicide	Formulation	Product Rate Range
Authority XL	70DF	3 - 9.6 oz

- Authority XL is a premix of chlorimuron (Classic) and sulfentrazone (Spartan) for control or suppression of most annual broadleaf weeds. This product does not control ALS-resistant ragweeds, but does provide residual control of ALS-resistant marestail and waterhemp.
- Mode of action: group 14 (sulfentrazone); group 2 (chlorimuron). See pages 12-13.
- Can be applied in fall, or in spring from 60 days before through 3 days after soybean planting, but before emergence. The chlorimuron component helps control many emerged no-till weeds in mixtures with 2,4-D and glyphosate in spring preplant burndown treatments.
- Application rates when used in standard PRE or PRE + POST programs, on soils with 2 to 4% OM: coarse-textured - 6 to 7 oz; medium-textured - 7 to 8 oz; fine-textured - 8 to 9.6 oz. Application rate when followed by a POST application of glyphosate in Roundup Ready soybeans or Ignite in LibertyLink soybeans, on soils with 2 to 4% OM: coarse-textured - 3.2 to 4 oz; medium-textured - 3.2 to 4.8 oz; fine-textured - 4 to 5 oz.
- Do not apply on soils with pH greater than 7.6. Authority XL rates are not pH-dependent, but rotation intervals for all crops except small grains are extended to at least 18 months for soil pH between 7.2 and 7.6, regardless of rate.

Herbicide	Formulation	Product Rate Range
Boundary	6.5E	1.5 to 3 pts

- Boundary is a premix of s-metolachlor plus metribuzin for annual grass and broadleaf control in soybeans. Weeds controlled include most annual grasses, lambsquarters, pigweeds, waterhemp, black nightshade, and Pennsylvania smartweed. See metribuzin and s-metolachlor descriptions for guidelines on use.
- Mode of action: group 5 (metribuzin), group 15 (s-metolachlor). See page 12-13.
- Application rates can be reduced to 1.5 to 1.8 pts/A when part of a planned preemergence followed by postemergence program.

Herbicide	Formulation	Product Rate Range
Canopy EX/Cloak EX/Fallout	29.5DF	1.1 to 3.3 oz
Synchrony XP	28.4WDG	1 to 3 oz
Canopy/Cloak DF	75DF	2.25 to 7 oz

- Canopy EX is a premix of chlorimuron (Classic) plus tribenuron (Express), also available as Cloak EX and Fallout; Synchrony XP is a premix of chlorimuron plus thifensulfuron (Harmony GT); and Canopy/Cloak DF is a premix of chlorimuron plus metribuzin. These herbicides provide residual control of ragweeds, annual morningglory, cocklebur, velvetleaf, Pennsylvania smartweed, pigweeds, and lambsquarters. Control of cocklebur, morningglory, and giant ragweed varies with rainfall and population. Early preplant application will provide most effective control of giant ragweed.
- Canopy EX and Synchrony XP do not control ALS-resistant weeds. High rates of Canopy/Cloak DF can provide limited residual control of ALS-resistant waterhemp, pigweed, and marestail, but additional metribuzin will usually be needed for acceptable control of these weeds.
- Mode of action: group 5 (chlorimuron, tribenuron, thifensulfuron); group 5 (metribuzin). See page 12-13.
- Canopy EX can be applied in fall or spring, with following restriction: rates of 2.2 oz or less should be applied at least 7 days before planting; rates of 2.2 to 3.3 oz should be applied at least 14 days before planting. Canopy/Cloak DF can be applied in fall or spring (no more than 45 days before planting). Synchrony can be applied preplant or preemergence in the spring, no more than 45 days before planting.
- Maximum rate on soils where the composite pH exceeds 7.0: Canopy EX - 1.1 oz/A; Canopy/Cloak DF - 2.25 oz/A; Synchrony XP - 1 oz/A.
- The chlorimuron component helps control many emerged no-till weeds in mixtures with 2,4-D and glyphosate in spring preplant burndown treatments.
- Apply with COC (1 gallon/100 gallons spray) for best control of emerged weeds, unless glyphosate is included in the treatment.
- Canopy/Cloak products can be applied to no-till or conservation tillage fields in the fall for burndown of existing vegetation and limited residual control into the following growing season. 2,4-D should be included with all fall-applied treatments. Do not apply to frozen ground.
- Soybean stunting may occur when rainfall results in prolonged wet soil conditions following application.

Soybeans: Soil-Applied Herbicides — Preplant or Preemergence

Herbicide	Formulation	Product Rate Range
Command	3ME	1 1/3 - 2 2/3 pt

- Command (clomazone) controls annual grasses, velvetleaf, lambsquarters, and smartweed, and controls or suppresses jimsonweed and common ragweed. The lower rates control velvetleaf and suppress grasses and some broadleaf weeds.
- Mode of action: group 13 (see pages 12-13).
- Many ornamental, vegetable, and agronomic crops are sensitive to Command spray drift and vapors moving outside the target area. Chlorosis or bleaching of sensitive plants may occur. Do not apply within 1200 feet of the following areas: towns and housing developments, commercial fruit or vegetable production, commercial greenhouses or nurseries. Do not apply within 300 feet of other desirable plants. Do not apply in winds above 10 mph, do not exceed a spray pressure of 30 psi, and do not rinse spray equipment near desirable plants. Do not apply to fence rows, waterways, ditches and roadsides.

Herbicide	Formulation	Product Rate Range
Envive	41.3 DG	2.5 - 5.3 oz

- Envive is premix of chlorimuron (Classic) plus thifensulfuron (Harmony GT) plus flumioxazin (Valor) for residual control of most annual broadleaf weeds. Control of cocklebur, morningglory, and giant ragweed varies with rainfall and population. Early preplant application will provide most effective control of giant ragweed.
- Envive will not control ALS-resistant giant ragweed, but will provide partial control of ALS-resistant common ragweed. The 5 oz rate will provide the most effective control of ALS-resistant pigweed, waterhemp, and common ragweed.
- Mode of action: group 2 (chlorimuron, thifensulfuron); group 14 (flumioxazin). See pages 12-13.
- Envive can be applied anytime in fall or spring, but must be applied before soybean emergence and no later than 3 days after planting. Do not apply to frozen or snow-covered ground.
- Rates of 3 to 3.5 oz/A can be used when followed by postemergence application of glyphosate in Roundup Ready soybeans. Maximum rate on soils where the composite pH exceeds 7.0 is 2.5 oz.
- Preplant applications of Envive can control small, emerged annual weeds up to 3 inches tall, including prickly lettuce, wild garlic, common ragweed, and mustard species. Control of common chickweed requires the addition of Express or glyphosate. Spring treatments should include 2,4-D ester and/or glyphosate for most effective control of emerged weeds. Glyphosate should be included in applications later than early April and where dandelion and other perennials are present. Mixtures of Envive with glyphosate or glyphosate plus 2,4-D have been among the most effective spring treatments for dandelion control in OSU and Purdue University research.
- Apply with COC or modified seed oil (1% v/v) or NIS (0.25% v/v) for control of emerged weeds.
- Soybean stunting may occur when rainfall results in prolonged wet soil conditions following application. Excessive rainfall shortly after soybean emergence can result in minor leaf necrosis or crinkling, or loss of lower leaves. Risk of injury can be minimized by not using this product on poorly-drained soils, planting seeds at least 1.5 inches deep, and ensuring that seeds are completely covered with soil.
- To avoid severe soybean injury, do not mix Envive with or apply Envive in fields where products containing any of the following have been used: s-metolachlor, metolachlor, alachlor, or Outlook.

Herbicide	Formulation
FirstRate	84DF

- FirstRate (cloransulam-methyl) controls many annual broadleaf weeds, including ragweeds, velvetleaf, lambsquarters, pigweed, and cocklebur. Control of waterhemp is usually inadequate. Does not control ALS-resistant weeds.
- Control of giant ragweed, morningglory, and cocklebur varies with rainfall, population, and application method. Moderate to high population densities of giant ragweed will require an additional application of a postemergence herbicide.
- Mode of action: group 2 (see page 12-13).
- Application rates in Ohio and south of I-64 in Indiana: 3% or less soil organic matter - 0.6 oz; greater than 3% organic matter - 0.75 oz. The rate is 0.75 oz south of I-64 in Indiana.
- For best results, apply within 2 weeks before planting. Do not apply earlier than 4 weeks before planting.
- Preplant applications with COC plus UAN or AMS can control small emerged annual broadleaf weeds, including ragweeds and annual smartweeds. Mixing with 2,4-D ester or other burndown herbicides will improve control of most annual weeds.

Soybeans: Soil-Applied Herbicides — Preplant or Preemergence

Herbicide	Formulation	Product Rate Range
Gangster	Co-pack	1.8 - 3.6 oz

- Gangster is a co-pack of flumioxazin (Valor) plus cloransulam (FirstRate) for annual broadleaf weed control and limited grass suppression in soybeans. Does not control ALS-resistant giant ragweed, and provides partial control of ALS-resistant common ragweed. See Valor and FirstRate descriptions for guidelines and precautions on use.
- Mode of action: group 14 (flumioxazin), group 2 (cloransulam). See page 12-13.
- Lower labeled rates (1.8 to 2.4 oz) can be used when followed with a postemergence glyphosate application in Roundup Ready soybeans. Rates of 2.4 to 3 oz should be used in non-Roundup Ready soybeans.
- Do not apply Gangster after soybean emergence.

Herbicide	Formulation	Product Rate Range
Lorox	50DF 4L	2/3 - 1 2/3 lb 2/3 -1 2/3 pt

- Lorox (linuron) controls many annual broadleaf weeds, including Pennsylvania smartweed, pigweeds, lambsquarters, and common ragweed. Helps suppress black nightshade and cocklebur, but does not control giant ragweed or annual morningglory.
- Mode of action: group 7 (see pages 12-13).
- Best-suited for use on medium-textured soils with 1 percent to 3 percent organic matter. Do not use on very sandy soils.
- Can provide burndown of small, emerged annual weeds present at application when mixed with 2,4-D ester.
- Apply to the soil surface only. Do not incorporate following application. May occasionally injure soybeans. Accurate application of the correct rate based on soil type is important to reduce the risk of injury.

Herbicide	Formulation
s-Metolachlor	7.64E
Metolachlor	7.8E

- S-metolachlor (Dual II Magnum/Cinch) and metolachlor (Parallel/Stalwart) control annual grasses and pigweed, and control or suppress yellow nutsedge and black nightshade.
- Mode of action: group 15 (see page 12-13).
- Use rates for most products are similar: coarse-textured soils - 1 to 1.33 pt/A; all medium-textured soils, and fine-textured soils with less than 3% OM - 1.33 to 1.67 pt/A; fine-textured soils, less than 3% - 1.67 to 2 pt/A.
- May be applied up to 30 days before planting as a single application.
- Incorporation to a depth of 2 inches will improve yellow nutsedge control and reduce dependence upon rainfall.

Dual II Magnum, Parallel, and Stalwart Use Rates (pts/A)

Soil Texture Group	Less than 3% OM	3% or Greater OM
Coarse	1 to 1.33	1.33
Medium	1.33 to 1.67	1.33 to 1.67
Fine	1.33 to 1.67	1.67 to 2

Herbicide	Formulation
Metribuzin	4F 75DF

- Metribuzin (Dimetric, Tricor, Metri DF) controls annual broadleaf weeds, including Pennsylvania smartweed, pigweeds, waterhemp, lambsquarters, and marestail (emerging from seed). Control of common ragweed and velvetleaf is variable. Metribuzin does not adequately control annual morningglory, giant ragweed, cocklebur, or black nightshade.

Soybeans: Soil-Applied Herbicides — Preplant or Preemergence

- Mode of action: group 5 (see page 12-13).
- Preplant applications of metribuzin, paraquat, and 2,4-D ester can provide effective burndown in many no-till situations.
- May injure soybeans when applied at high rates. Injury may be greater where soil pH is over 7.5, and where seedling diseases, weather stress, or atrazine carryover occur. Soybean varieties vary in tolerance to metribuzin. Selection of a variety with above-normal tolerance to metribuzin will reduce the risk of crop injury.
- To avoid soybean injury, accurately apply the correct rate based on soil type. Do not use on sandy soil that is low in organic matter.
- Can be applied in the fall with 2,4-D ester for control of winter annual weeds, including marestail, mustards, purple deadnettle, and common chickweed.

Metribuzin 75 DF Use Rates (lb/A)

	Soil Organice Matter Content		
Soil Texture Group	**Less than 2%**	**2% to 4%**	**More than 4%**
Coarse	Do not use	0.5	0.75
Medium	0.5 to 0.75	0.75 to 0.83	0.83 to 1
Fine	0.75 to 0.83	0.83 to 1	1 to 1.17

Herbicide	Formulation	Product Rate Range
Optill	68WDG	2 oz

- Optill is a premix of saflufenacil (Sharpen) and imazethapyr (Pursuit) that provides residual control of grass and broadleaf weeds, and can help burndown emerged weeds in no-till, especially marestail. It should generally be combined with glyphosate or Ignite for burndown.
- Mode of action: group 14 (saflufenacil); group 2 (imazethapyr). See pages 12-13.
- Apply prior to crop emergence. On coarse-textured soils with 2% organic matter or less, apply at least 30 days before planting.
- Do not apply Optill with products containing sulfentrazone (Authority) or flumioxazin (Valor) as a mixture, or within 30 days of each other, or crop injury may result. Do not mix Sharpen with herbicides that contain clomazone (Command).
- Burndown activity requires the addition of MSO (1% v/v) plus either AMS (8.5 to 17 lbs/100 gallons) or UAN (1.25 to 2.5% v/v).
- Ensure that the seed furrow is closed and seed row sufficiently covered with soil to avoid washing and concentration of saflufenacil in the seed zone.

Herbicide	Formulation
Outlook	6EC

- Outlook (dimethenamid-P) controls annual grasses and pigweed, and control or suppress yellow nutsedge and black nightshade.
- Mode of action: group 15 (see page 12-13).
- Application rates vary with soil texture, organic matter content, and CEC. Can be applied early postemergence on soybeans up to the third trifoliate stage, but will not control emerged grasses.
- Can be incorporated into the upper 1 to 2 inches of soil up to 2 weeks before planting. Incorporation will improve yellow nutsedge control.
- Can be applied up to 30 days before planting as a single application.

Outlook Use Rates (floz/A)[a]

Soil Texture Group	Less than 3% OM	3% or Greater OM
Coarse	12 to 14	14 to 18
Medium and Fine	14 to 18	18 to 21

a. Not recommended on soils with CEC values less than 5 or coarse soils with less than 1.5% organic matter.

Soybeans: Soil-Applied Herbicides — Preplant or Preemergence

Herbicide	Formulation	Product Rate Range
Prefix	5.29L	2 - 3 pts

- Prefix is a premix of s-metolachlor (Dual II Magnum) plus fomesafen (Reflex) that provides early-season control of annual grasses and small-seeded broadleaf weeds, including black nightshade, pigweeds, common ragweed, and waterhemp. This product is intended for use in a planned preemergence followed by postemergence herbicide program.
- Mode of action: group 15 (s-metolachlor), group 14 (fomesafen). See page 12-13.
- Maximum use rates: north of I-70 - 2.5 pts; south of I-70 - 3 pts.
- Do not apply postmergence products containing fomesafen (Flexstar/Rhythm, Reflex/Dawn, Flexstar GT) to fields treated with Prefix.

Herbicide	Formulation
Pendimethalin/Pendimax/Pendant/etc	3.3EC
Prowl H2O	3.8CS

- The active ingredient in these products, pendimethalin, controls annual grasses, pigweed, and lambsquarters and helps control smartweed and velvetleaf.
- Mode of action: group 3 (see page 12-13).
- Preplant applications should be incorporated within 7 days of application. Incorporation may not be necessary if sufficient rainfall occurs.
- When applied without incorporation, apply from 15 days before planting through 2 days after planting.
- Application close to or after planting may result in soybean injury, including stem swelling and brittleness. To reduce the risk of injury, apply early preplant or incorporate prior to planting.

Prowl H2O Use Rates (pt/A)

Soil Texture	Soil Organic Matter Content [a]	
	Less than 3%	More than 3%
Coarse	1.5	1.5 to 2
Medium	2 to 2.5	2 to 3
Fine	2 to 3	2.5 to 3

Pendimethalin 3.3EC Use Rates (pt/A)

Soil Texture	Soil Organic Matter Content	
	Less than 3%	More than 3%
Coarse	1.8	1.8 to 2.4
Medium	2.4 to 3	2.4 to 3.6
Fine	2.4 to 3.6	3 to 3.6

The high rates for each soil texture above should be used if heavy weed populations are anticipated, extensive crop residues were present prior to seedbed preparation, or in no-till.

Herbicide	Formulation	Product Rate Range
Pursuit	2S	4 oz

- Pursuit (imazethapyr) controls annual broadleaf weeds and controls or suppresses annual grasses. Pursuit is weak on common and giant ragweed. Does not control ALS-resistant weeds.
- Mode of action: group 2 (see page 12-13).
- Pursuit may be applied preplant (up to 45 days before planting), preplant incorporated, preemergence, or postemergence. Postemergence applications provide more consistent control than soil-applied treatments.

Soybeans: Soil-Applied Herbicides — Preplant or Preemergence

Herbicide	Formulation	Product Rate Range
Python	80WDG	0.8-1.33 oz.

- Python (flumetsulam) controls annual broadleaf weeds, including velvetleaf, lambsquarters (including triazine-resistant), and pigweeds. Control of common ragweed is variable. Python does not adequately control cocklebur, giant ragweed, or annual morningglory. Does not control ALS-resistant weeds.
- Mode of action: group 2 (see page 12-13).
- Python use rates range from 0.8 to 1 oz/A on coarse-textured soils, and 0.9 to 1.33 oz/A in medium or fine-textured soils.
- May by applied up to 30 days before planting. Rates increase when applied early, compared to application at planting. Preplant application of Python will control small mustards and field pennycress when applied with COC and 2,4-D.
- Do not apply to soils with the combination of pH less than 5.9 and organic matter content greater than 5%. Do not apply where soil pH is greater than 7.8.

Herbicide	Formulation	Product Rate Range
Scepter	70DG	2.8 oz

- Scepter (imazaquin) controls many annual broadleaf weeds, including lambsquarters, Pennsylvania smartweed, pigweeds, black nightshade, ragweeds, and cocklebur. Does not control ALS-resistant weeds.
- Mode of action: group 2 (see page 12-13).
- Residual control of large-seeded broadleaf weeds (cocklebur, giant and common ragweed) varies with rainfall, population, and application method; early preplant application will provide most effective control of these weeds.
- Imazaquin may persist for long periods in soil, especially where excessive rates occur from misapplication or streaked incorporation. Accurate application and uniform incorporation are important for follow-crop safety. Carryover is more likely in soils high in organic matter and clay, especially where soil pH is less than 6, and when droughty conditions occur during the season of application.
- Corn may be planted 9 1/2 months after application if at least 15 inches of rain is received between 2 weeks before application and November 15 of the same year. If this condition is not met, plant only imidazolinone-tolerant (Clearfield) corn the next year.

Herbicide	Formulation
Sequence	5.25L

- Sequence is a premix of glyphosate plus s-metolachlor (Dual II Magnum) for preplant or preemergence application. See glyphosate and s-metolachlor descriptions for more information.
- Can be applied at reduced rates when followed by a postmergence herbicide treatment.
- Can be applied postemergence to Roundup Ready soybeans to provide control of emerged weeds and residual control of annual grasses, black nightshade, pigweeds, and waterhemp. Apply between cracking and the 3rd trifoliate soybean stage.

Sequence Use Rates (pt/A)

Soil Texture Group	Less than 3% OM	3% or Greater OM
Coarse	2.5 to 3.5	3.5
Medium	3.5 to 4	3.5 to 4
Fine	3.5 to 4	4

Soybeans: Soil-Applied Herbicides — Preplant or Preemergence

Herbicide	Formulation	Product Rate Range
Sharpen	2.85SC	1 to 1.5 oz
Verdict	5.57EC	5 oz

- Sharpen (saflufenacil) can help burndown emerged weeds in no-till, especially marestail, and provides a low level (40 to 60%) of residual control of broadleaf weeds. It should be combined with glyphosate or Ignite for burndown, and with other residual herbicide(s) for broad-spectrum residual control.
- Verdict is a premix of salflufenacil and dimethenamid-p (Outlook), which has improved residual control of grasses and a few small-seeded broadleaf weeds, compared with Sharpen. The 5 oz rate of Verdict provides the equivalent amount of saflufenacil in 1 oz/A of Sharpen.
- Mode of action: Sharpen - group 14; Verdict - group 14 (saflufenacil) and group 15 (dimethenamid-p). See pages 12-13.
- Apply prior to crop emergence. On coarse-textured soils with 2% organic matter or less, apply at least 30 (1 oz) or 44 (1.5 oz) days before planting. Sharpen must be applied at least 14 days before soybean planting when applied at rates greater than 1 oz/A.
- Do not apply Sharpen or Verdict with products containing sulfentrazone (Authority) or flumioxazin (Valor) as a mixture, or within 30 days of each other, or crop injury may result.
- Burndown activity requires the addition of MSO (1% v/v) plus either AMS (8.5 to 17 lbs/100 gallons) or UAN (1.25 to 2.5% v/v).
- Ensure that the seed furrow is closed and seed row sufficiently covered with soil to avoid washing and concentration of saflufenacil in the seed zone.

Herbicide	Formulation	Product Rate Range
Sonic/Authority First	70 WDG	3 - 8 oz

- Sonic/Authority First is a premix of sulfentrazone (Spartan) and cloransulam (FirstRate) that controls many broadleaf weeds.
- Mode of action: group 14 (sulfentrazone); group 2 (cloransulam). See page 12-13.
- Can be applied at rates as low as 3 oz/A in Roundup Ready soybeans, when followed with a postemergence glyphosate application. Use rates in non-Roundup Ready soybeans: 3% or less OM - 6.5 oz; greater than 3% OM - 8 oz.
- Apply preplant or preemergence, up to 3 days after soybean planting.
- In preplant burndown applications, apply with NIS (1 to 2 pts/100 gallon) or COC (1.2 gallon/100 gallons), plus AMS (17 lb/100 gallon). Mix with glyphosate and 2,4-D for most effective control of emerged weeds in no-till.

Herbicide	Formulation
Spartan	4F
Spartan Advance	4.6L

- Spartan (sulfentrazone) controls black nightshade, marestail (emerging from seed), pigweeds, lambsquarters, kochia, and waterhemp, and can suppress annual grasses and annual morningglory. Spartan Advance is a premix of sulfentrazone and glyphosate.
- Mode of action: group 14 (see page 12-13).
- May cause stunting of soybeans if excessive rain occurs between application and soybeans emergence. Soybeans generally outgrow this injury, but some soybean varieties are more sensitive to this herbicide and can be severely injured. Check with seed supplier for varietal tolerance information prior to use.

Spartan use rates (oz/A)

% organic matter	Soil texture		
	Coarse	Medium	Fine
< 1.0%	4.5 to 6	6 to 8	8
1 to 3%	6 to 8	8 to 10.1	10.1
> 3%	8 to 10.1	10.1 to 12	12

Soybeans: Soil-Applied Herbicides — Preplant or Preemergence

Herbicide	Formulation
Treflan/Trifluralin	4EC, HFP, HF 10G

- Treflan (trifluralin) controls annual grasses, pigweed, waterhemp, and lambsquarters and helps control smartweed, morningglory, and johnsongrass.
- Mode of action: group 3 (see page 12-13).
- Treflan HFP rates: coarse-textured soils, less than 2% OM - 1 pt/A; coarse-textured soils with 2 to 5% OM and medium-textured soils - 1.5 pts/A; fine-textured soils - 2 pts/A.
- Must be incorporated into the soil (depth of 2 to 3 inches) within 24 hours after application. For best results, make two incorporation passes in different directions.

Herbicide	Formulation
Valor/Encompass	51WDG

- Valor/Encompass (flumioxazin) can be applied preplant or preemergence for control of lambsquarters (including triazine-resistant), black nightshade, pigweeds, waterhemp, and marestail (emerging from seed). Valor suppresses or provides partial control of common ragweed, morningglory, velvetleaf, smartweed, and some annual grasses.
- Mode of action: group 14 (see page 12-13).
- Use rates: all coarse or medium-textured soils, and fine-textured soils with less than 3% OM - 2 to 2.5 oz; fine-textured soils with greater than 3% OM - 2 to 3 oz.
- Do not incorporate Valor/Encompass into the soil following application.
- In OSU research, Valor has occasionally stunted and slowed the growth of soybeans when high rainfall conditions occur following soybean planting. The label states that risk of crop injury can be minimized by avoiding use on poorly drained soils, planting at least 1 1/2 inches deep, and completely covering seeds with soil. To avoid severe injury, do not mix Valor/Encompass with alachlor, metolachlor, s-metolachlor, or Outlook, unless otherwise directed by state labeling.
- Valor has limited foliar activity on emerged weeds, and should be applied with 2,4-D and glyphosate for most effective control of emerged weeds in no-till.

Herbicide	Formulation	Product Rate Range
Valor XLT	40 WDG	2.5 to 5 oz

- Valor XLT is premix of chlorimuron (Classic) plus flumioxazin (Valor) for residual control of most annual broadleaf weeds. Control of cocklebur, morningglory, and giant ragweed varies with rainfall and population. Early preplant application will provide most effective control of giant ragweed.
- Valor XLT will not control ALS-resistant giant ragweed, but will provide partial control of ALS-resistant common ragweed. The 5 oz rate will provide the most effective control of ALS-resistant pigweed, waterhemp, and common ragweed.
- Mode of action: group 2 (chlorimuron); group 14 (flumioxazin). See page 12-13.
- Valor XLT can be applied in fall or spring, but must be applied before soybean emergence and no later than 3 days after planting. Do not apply to frozen or snow-covered ground. Fall applications should be made after October 15, or when soil temperature is below 50 F.
- Apply 3 to 4 oz to soils with 0.5 to 3% OM, and 3 to 5 oz to soils with 3 to 5% OM. Rates of 3 to 3.5 oz/A can be used when followed by postemergence application of glyphosate in Roundup Ready soybeans. Maximum rate on soils where the composite pH exceeds 6.8 is 2.5 oz.
- Preplant application of Valor XLT can control small, emerged annual weeds up to 3 inches tall, including prickly lettuce, wild garlic, common ragweed, and mustard species. Control of common chickweed requires the addition of Express or glyphosate. Fall applications of Valor XLT should include 2,4-D and Express. Spring burndown applications should include glyphosate or glyphosate plus 2,4-D ester. Mixtures of Valor XLT with glyphosate or glyphosate plus 2,4-D have been among the most effective spring treatments for dandelion control in OSU and Purdue University research.
- Soybean stunting may occur when rainfall results in prolonged wet soil conditions following application. Risk of injury can be minimized by not using this product on poorly-drained soils, planting seeds at least 1.5 inches deep, and ensuring that seeds are completely covered with soil.
- To avoid severe injury, do not mix Valor with alachlor, metolachlor, s-metlachlor, or Outlook, unless otherwise directed by state labeling.

Soybeans: Postemergence Herbicides — Contact

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Aim	2EC	0.25 oz	Not addressed on label

- Aim (carfentrazone) is a contact herbicide that controls primarily velvetleaf at 0.25 oz rate.
- Mode of action: group 14 (see page 12-13).
- Apply when soybeans are in the V3 to V10 stage. Do not use on soybeans with maturity less than 2.0. Maximum broadcast rate: 0.25 oz/A for 2.1 to 3.4 maturity; 0.5 oz for maturity of 3.5 or higher.
- Apply with NIS (0.25% v/v) in a spray volume of 10 to 20 gpa.
- Always add Aim to the spray tank first when mixing with other herbicides.
- Application of Aim is likely to cause soybean leaf burn.

Herbicide	Formulation	Product Rate Range	With Glyphosate or Ignite
Basagran	4L	1 - 2 pt	1 - 2 pt

- Basagran (bentazon) is a contact herbicide that controls many annual broadleaf weeds, but is weak on pigweed, ragweeds, and annual morningglories. At higher rates, controls or suppresses yellow nutsedge and Canada thistle.
- Mode of action: group 6 (see page 12-13).
- Basagran should be applied with COC (1.25% v/v) and/or nitrogen fertilizer (UAN or AMS). The label suggests the use of UAN (1/2 to 1 gallon/A) or AMS (2.5 pound/A) in place of COC where velvetleaf is the primary target weed. COC must also be used if common ragweed and lambsquarters are present. Additive recommendations vary when mixing with other herbicides; see the label for additional information.
- Apply in a spray volume of at least 20 gpa with a minimum pressure of 40 psi. Increasing spray volume (up to 50 gpa) will improve control when crop and weed foliage is dense.
- Application with Flexstar will improve control of morningglory, giant ragweed, and pigweed.
- The addition of 2 fluid ounces of 2,4-DB will improve morningglory control. Do not add crop oil or UAN when applying with 2,4-DB.
- May cause temporary soybean leaf burn, but is less injurious to soybeans than most other postemergence herbicides.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, or if mixing with Ignite, just add AMS.

Herbicide	Formulation	Product Rate Range	With Glyphosate
Cadet	0.91EC	0.4 - 0.9 oz	0.4 - 0.6 oz

- Cadet (fluthiacet-methyl) is a contact herbicide that controls velvetleaf, and controls or suppresses small lambsquarters, pigweeds, black nightshade, and annual morningglory at the 0.9 oz rate.
- Mode of action: group 14 (see pages 12-13).
- Apply from first trifoliate stage through flowering, but at least 60 days before harvest.
- Apply with NIS (0.25% v/v), or a COC or MSO (1 to 2 pts/A). UAN (1 to 2 qts/A) or AMS can be added. When combined with other herbicides, Cadet can generally be applied with any adjuvants required for those herbicides.
- Apply in a minimum spray volume of 15 gpa and pressure of 20-40 psi. Increase volume and pressure in dense crop and weed canopies.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, just add AMS.

Soybeans: Postemergence Herbicides — Contact

Herbicide	Formulation	Product Rate Range	With Glyphosate
Cobra/Phoenix	2L	8 - 12.5 oz	6 - 8 fl oz

- Cobra/Phoenix (lactofen) is a contact herbicide that is similar to Flexstar in weeds controlled. In OSU research, Flexstar has been more consistently effective than Cobra on giant and common ragweed and annual morningglory. Cobra can suppress some perennial vines, including climbing milkweed and bigroot morningglory.
- Mode of action: group 14 (see page 12-13).
- For best results, apply with COC (0.25 to 1%, v/v) up to the 4- to 6-leaf stage of weeds. Surfactant, UAN, or AMS may be substituted for COC when weeds are actively growing under high temperature, high humidity, and high soil moisture conditions. Do not use surfactant when relative humidity is less than 80 percent.
- Cobra can be applied late in the season for suppression of tall weeds, including black nightshade (up to 16 inches), velvetleaf and ragweeds (up to 36 inches), and pigweed (up to 24 inches). Use a rate of 12.5 ounces/A plus 1 quart/A of COC for this type of application. Apply at least 45 days prior to harvest.
- Apply in a spray volume of 20 to 30 gallons per acre at a spray pressure of 40 to 60 psi using flat fan or hollow cone nozzles.
- Cobra causes more severe soybean leaf burn than other postemergence herbicides. Phoenix causes less injury to soybeans than Cobra.
- When mixing with glyphosate, add AMS (2.5 to 4.5 lb/A).

Herbicide	Formulation	Product Rate Range	With Glyphosate
Flexstar/Rhythm	1.88L	1 - 1.6 pints	6 - 12 oz

- Flexstar/Rhythm (fomesafen) controls annual broadleaf weeds, including ragweeds, cocklebur, pigweeds, waterhemp, annual morninglories, velvetleaf, Pennsylvania smartweed, and black nightshade. Can suppress Canada thistle, bindweeds, and climbing milkweed, but does not control lambsquarters.
- Mode of action: group 14 (see page 12-13).
- Maximum rates: north of I-70 - 1.3 pints; south of I-70 - 1.6 pints.
- Apply in a spray volume of 15 to 20 gpa (use 20 gpa in dense foliage) with a spray pressure of 30 to 60 psi.
- Apply with COC or MSO (0.5 to 1% v/v) or NIS (0.25 to 0.5%), plus UAN (minimum of 1% v/v) or AMS (minimum of 4 lbs/100 gallons). MSO is the preferred adjuvant for effectiveness on weeds, but can cause more soybean leaf burn than COC.
- Flexstar/Rhythm can reduce the activity of postemergence grass herbicides mixtures, especially under drought-stress conditions. To avoid a reduction in grass control, apply Flexstar/Rhythm 2 to 3 days after the postemergence grass herbicide is applied, or wait about 7 days after Flexstar/Rhythm is applied before applying the grass herbicide. See label for more information.
- Often causes temporary soybean leaf burn.
- Do not apply more than once every two years.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, just add AMS.

Herbicide	Formulation	Product Rate Range	With Glyphosate
Reflex/Dawn	2LC	1 - 1 1/2 pt	6 - 12 oz

- Reflex/Dawn (fomesafen) is similar to Flexstar in weed control spectrum but is less effective on cocklebur and velvetleaf.
- Mode of action: group 14 (see page 12-13).
- Maximum rate: north of I-70 - 1 1/4 pints; south of I-70 - 1 1/2 pints.
- Apply when weeds are less than 4 inches tall and actively growing. Do not apply to weeds growing under drought stress or when maximum daytime temperatures are less than 70 degrees..
- Apply with COC (0.5 percent to 1 percent v/v) or NIS (0.25 percent to 0.5 percent v/v). UAN can be added to the spray mixture along with COC or NIS, which may improve control of velvetleaf and other weeds. Do not substitute UAN for COC or NIS.
- Apply in a spray volume of at least 10 gpa with a pressure of 40 to 60 psi. When weed foliage is dense use a spray volume of at least 20 gpa with a pressure of 60 psi.
- Application in combination with Basagran will improve control of velvetleaf, cocklebur, giant ragweed, and some other weeds.

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- The addition of 2 to 3 fluid ounces of 2,4-DB will improve morningglory, giant ragweed, and cocklebur control.
- Often causes temporary soybean leaf burn.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, just add AMS.

Herbicide	Formulation	Product Rate Range	With Glyphosate
Resource	0.86EC	4 - 12 oz	2 - 4 fl oz

- Resource (flumiclorac) is a contact herbicide that controls velvetleaf and pigweeds. Control of lambsquarters is variable, and some other broadleaf weeds will be suppressed.
- Mode of action: group 14 (see page 12-13).
- Apply 4 to 8 ounces/A when broadleaf weeds are in the 2- to 3-leaf stage for best results. The 8 ounce rate will control velvetleaf up to 24 inches tall. Use 12 ounces /A for velvetleaf up to 30 inches tall.
- Apply in a spray volume of at least 10 gpa with a spray pressure of 30 to 60 psi.
- Resource applied alone and in mixtures with most other herbicides requires the use of COC (1 quart/A) . The addition of liquid nitrogen fertilizer may enhance control of tall velvetleaf and is required in some mixtures. See the label for more information.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, just add AMS.

Herbicide	Formulation	Product Rate Range	With Glyphosate
Rezult	Co-pack	3.25 pts	Not addressed on label

- Rezult is a co-pack of Poast Plus (premix of sethoxydim plus Dash) plus Basagran (bentazon). The use rate contains the equivalent of 1.6 pints of Poast Plus and 1.6 pints of Basagran. See Poast Plus and Basagran descriptions and product labels for more information.
- Mode of action: group 6 (bentazon), group 1 (sethoxydim). See page 12-13.
- Apply when most weeds are 2 to 4 inches tall in a spray volume of 10 to 20 gpa with a spray pressure of at least 40 psi (60 psi where foliage is dense).
- Include UAN (28, 30, or 32% - 2 quarts/A) in the spray mix when applied alone or in combination with Classic. Apply with a silicon adjuvant (1 to 2 pints/100 gallons spray) when applied with Blazer or Reflex.

Herbicide	Formulation	Product Rate Range	With Glyphosate
Storm	4S	1.5 pt	1.5 pt

- Storm is a 2:1 premix of bentazon (Basagran) plus acifluorfen (Ultra Blazer) for control of broadleaf weeds. The recommended rate of Storm (1 1/2 pt) is equivalent to 1 pint of Basagran and 1 pint of Ultra Blazer.
- Mode of action: group 14 (acifluorfen), group 6 (bentazon). See page 12-13.
- Apply Storm in a spray volume of 10 to 20 gpa. Use a minimum pressure of 40 psi. Increasing the spray volume (up to 50 gpa) will improve control when crop and weed foliage is dense.
- Apply Storm with COC (1 to 2 pints/A), UAN (1/2 to 1 gallon/A), or NIS (1 to 2 pints/100 gallons), depending upon weed species present and other herbicide in the mixture. See label for specific directions.
- Apply early when weeds are small (2 to 4 inches) for best results. Control is reduced when weeds exceed maximum size stated on the label.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, just add AMS.

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Herbicide	Formulation	Product Rate Range	With Glyphosate
Ultra Blazer	2L	0.5 - 1.5 pt	0.5 - 1.5 pt

- Ultra Blazer (acifluorfen) is a contact herbicide that controls many annual broadleaf weeds, including pigweed, waterhemp, annual morningglory, common ragweed, and black nightshade. Control of giant ragweed is variable. Cocklebur, velvetleaf, and lambsquarters are not adequately controlled.
- Mode of action: group 14 (see page 12-13).
- Apply when weeds are in the 2- to 4-inch stage and actively growing.
- Standard adjuvant recommendation is NIS (1 to 2 pints per 100 gallons spray). Various rates and combinations of surfactant or COC and UAN are allowed depending upon weed species and environmental conditions. Application with COC will increase crop injury.
- Apply in a spray volume of at least 20 gpa with a minimum pressure of 40 psi. Increasing spray volume (up to 50 gpa) will improve control when crop and weed foliage is dense.
- Application in combination with Basagran will improve control of velvetleaf, cocklebur, giant ragweed and some other weeds.
- The addition of 2 fluid ounces of 2,4-DB will improve morningglory, giant ragweed, and cocklebur control.
- Often causes soybean leaf burn. Soybeans usually recover within a few weeks.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, just add AMS.

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Herbicide	Formulation	Product Rate Range	With Glyphosate
Assure II/Targa	0.88EC	5 - 10 oz	5 - 10 oz

- Assure II/Targa (quizalifop) is a translocated herbicide that controls many annual and perennial grasses, including giant foxtail, johnsongrass, shattercane, quackgrass, and volunteer corn. Quizalifop is often less effective than other postemergence grass herbicides for control of yellow foxtail, barnyardgrass, and crabgrass, especially in mixtures with broadleaf herbicides.
- Mode of action: group 1 (see page 12-13).
- Apply 7 to 8 ounces per acre for control of foxtails (2 to 8 inches tall), and fall panicum, barnyardgrass, and crabgrass (2 to 6 inches tall). Lower rates may be used for control of shattercane, seedling johnsongrass, and small giant foxtail.
- For perennial grass control, application is delayed until grass reaches a height of at least 4 to 10 inches, depending upon the target weed. Two applications may be needed for perennial grass control.
- Apply with COC (1 to 2 gallons/100 gallons spray) for best results. NIS (2 pints/100 gallons spray) may be used instead of crop oil if required in a mixture with other herbicides. Petroleum-based COCs are preferred over MSOs.
- For control of volunteer glyphosate-resistant corn in Roundup Ready soybeans in mixtures with glyphosate, apply the following rates based on corn size: up to 12 inches - 4 oz; 12-18 inches - 5 oz; 18 to 30 inches - 8 oz. The addition of NIS at the rate of 2 pints per 100 gallons spray is recommended in this mixture. If the glyphosate product contains a surfactant package, add NIS at the rate of 1 pint per 100 gallons.
- Apply in a spray volume of 10 to 40 gpa with a pressure of 25 to 60 psi.
- A reduction in the control of grasses may occur when quizalifop is applied to moisture-stressed plants or mixed with Classic, Harmony GT, or Basagran. The reduction due to mixing is not usually observed for volunteer corn, giant foxtail, shattercane, and johnsongrass control, and no increase in Assure II/Targa rate is required for control of these grasses in mixtures. To maintain control of other grasses, increase the Assure II/Targa rate by 2 ounces in mixtures. Do not mix Assure II/Targa with Basagran, Classic, or Harmony GT when the target grass is barnyardgrass, quackgrass, crabgrass, yellow foxtail, or wirestem muhly.
- For sequential applications of Assure II/Targa and broadleaf herbicides, wait at least 24 hours after Assure II/Targa application before applying the broadleaf herbicide. If the broadleaf herbicide is applied first, do not apply Assure II/Targa until grass plants begin to develop new leaves.
- When mixing with glyphosate products without an adjuvant, use NIS or COC at above rates. If glyphosate product has an adjuvant, use NIS (1 pint/100 gallons). If conditions are dry, use COC (1 gallon/100 gallons).

Herbicide	Formulation	Product Rate Range	With Glyphosate
Classic	25DF	0.25 - 0.75 oz	0.25 - 0.33 oz

- Classic (chlorimuron) is a translocated sulfonylurea herbicide that controls many annual broadleaf weeds, including velvetleaf, annual morningglory, burcucumber, pigweed, cocklebur, Pennsylvania smartweed, yellow nutsedge, and ragweeds. Classic does not control lambsquarters or black nightshade, and control of giant ragweed that are 4 to 8 inches tall is variable. Does not control ALS-resistant weeds.
- Mode of action: group 2 (see page 12-13).
- Apply with NIS (0.125% v/v or greater) or COC (1% v/v) plus UAN (2 - 4 quarts/A) or AMS (2 - 4 lbs/A).. COC provides better control than surfactant under hot, dry conditions and is suggested for control of pigweed and giant ragweed.
- Most weeds up to 2 inches tall can be controlled with a rate of 1/2 ounce per acre. Rate increases with weed size and leaf stage. Velvetleaf and common ragweed control require a minimum rate of 2/3 ounce per acre, and the minimum rate for large giant ragweed and Jerusalem artichoke is 3/4 ounce per acre. Classic will control cocklebur up to 12 inches tall at the rate of 3/4 ounce per acre.
- May be applied with 1 to 2 fluid ounces of 2,4-DB for improved morningglory control. Soybean must be at least 8 inches tall before this mixture is applied.
- Split applications of Classic 14 to 21 days apart will improve control of morningglory, giant ragweed, burcucumber, and Jerusalem artichoke.
- Apply in a minimum spray volume of 10 gallons per acre at a minimum pressure of 25 psi.
- May cause temporary yellowing and stunting of soybeans, especially when applied with COC.
- Apply any time after the first trifoliate has opened, but no later than 60 days before soybean maturity.
- Treating weeds under stress from abnormally cold or hot weather or dry soil conditions may result in only partial control. To maintain effective control, delay application until stress passes and weeds resume active growth.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (4.25 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, just add AMS.

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Herbicide	Formulation	Product Rate Range	With Glyphosate
Clethodim	Various	See labels.	Select Max 6 - 12 fl oz Arrow 6 - 8 fl oz Section 6 - 8 fl oz

- Clethodim is a translocated herbicide for control of annual and perennial grasses, including foxtails, barnyardgrass, fall panicum, johnsongrass, shattercane, quackgrass, and volunteer corn.
- Clethodim is sold under various trade names, including Select, Arrow, Section, and Select Max.
- Mode of action: group 1 (see page 12-13).
- Most clethodim products are 2 lb/gal formulations, and the rates are as follows: 6 oz/A when giant foxtail is 2 to 12 inches tall, shattercane and seedling johnsongrass are 4 to 10 inches tall, volunteer corn is 12 to 18 inches tall, and most other annual grasses are 2 to 6 inches tall. A rate of 4 ounces per acre may be used to control volunteer corn that is 4 to 12 inches tall. Lower rates may be used for control of small giant foxtail that are actively growing under favorable environmental conditions.
- Select Max should be applied at a rate of 9 to 12 oz/A for control of annual grasses less then 6 inches tall. Rate should be increased to 14 to 16 oz/A for annual grasses more than 6 inches tall and perennial grasses.
- Control of volunteer corn with Select Max when mixed with glyphosate: 6 oz/A for volunteer corn that is less than 12 inches tall, and 9 oz/A for corn that is 12 to 24 inches tall. Apply with AMS (8.5 to 17 lbs/100 gallons). Add surfactant if required by the glyphosate product label. Other clethodim products will not usually adequately control volunteer corn when mixed with glyphosate unless applied with COC or MSO. Consult labels and local use guides for more information on adjuvant types and rates.
- Control of perennial grasses requires higher rates and possibly sequential applications. Application should be delayed until perennial grasses are at least 4 to 12 inches tall, depending upon the target weed.
- Labels for most clethodim products (excluding Select Max) specify application with COC or MSO (1% v/v and not less than 1 pint/A) in a spray volume of 10 to 40 gpa at a pressure of 30 to 60 psi. Do not apply with flood nozzles. UAN or AMS can be added, and may improve control of some grasses.
- When applied alone, the preferred adjuvants for Select Max are NIS (0.25%) and AMS (2.5 lbs/A). COC (1% v/v or 1 qt/A) can be substituted for NIS if required for other herbicides mixed with Select Max.
- Mixing clethodim with broadleaf herbicides may reduce grass control, especially under dry conditions. Increasing the clethodim rate can help maintain grass control in mixtures with broadleaf herbicides. When making separate applications of grass and broadleaf herbicides, allow at least one day between applications if the grass herbicide is applied first.
- When mixing with glyphosate, adjuvants are handled differently on different labels. Add AMS (2.5 to 4 lb/A) when using any clethodim product and glyphosate. Select Max - add NIS (0.25% v/v). Arrow or Section - add NIS (0.125% v/v) or COC (0.5 - 1% v/v). If mixing with a loaded glyphosate product, see glyphosate label also.

Herbicide	Formulation	Product Rate Range	With Glyphosate
FirstRate	84DF	0.3 - 0.6 oz	0.3 - 0.6 oz

- FirstRate (cloransulam-methyl) is a translocated sulfonamide herbicide than controls ragweeds, velvetleaf, annual morningglory, and cocklebur. Does not control ALS-resistant weeds.
- Mode of action: group 2 (see page 12-13).
- Apply with NIS (0.125 to 0.25% v/v) plus 28% UAN (2.5% v/v) or AMS (2 lbs/A); or with COC or MSO (1.2% v/v). COC or MSO plus UAN or AMS can increase crop injury and should only be used under adverse weed control conditions. The spray mix should include UAN or AMS if velvetleaf is a target weed.
- Control of giant ragweed may be reduced when air temperature remains below 55 degrees for significant periods within 2 days before or after application.
- Apply in a spray volume of 10 to 40 gpa with a pressure of 20 to 40 psi.
- Mixing FirstRate with a grass herbicide, especially Assure II or Fusion, may result in reduced grass control. Increase the grass herbicide rate or apply separately to avoid this problem.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, just add AMS.

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Herbicide	Formulation	Product Rate Range	With Glyphosate
Fusilade DX	2E	6 - 12 oz	4 - 6 oz

- Fusilade DX (fluazifop) is a translocated herbicide that controls annual and perennial grasses.
- Mode of action: group 1 (see page 12-13).
- Mixtures with Pursuit and Classic are labeled for control of volunteer corn and shattercane only.
- For sequential applications of Fusilade and broadleaf herbicides, the minimum time interval that must occur between applications varies with the herbicides sprayed and the order of application. See the label for additional information.
- Apply 12 oz per acre to actively growing giant foxtail (2 to 6 inches tall) or other annual grasses (2 to 4 inches tall) before grass has tillered. The rate for shattercane is 6 to 8 ounces per acre, and the rate is 4 to 6 oz/A for volunteer corn. Apply with COC (0.5 - 1.0% v/v) or NIS (0.25 - 0.5% v/v) in a minimum spray volume of 5 gallons per acre. UAN can also be added.
- The Fusilade rate is 4 to 6 oz/A for control of volunteer glyphosate-resistant corn in Roundup Ready soybeans in mixtures with glyphosate. The 4 oz rate can be used only under the following conditions: favorable soil moisture and humidity; volunteer corn is less than 12 inches tall; and COC (0.25% v/v) is used as the spray adjuvant. In mixtures with glyphosate products that are formulated with a surfactant package, where COC is not used, apply the 6 oz Fusion rate.
- For perennial grass control, use 12 oz and delay application until grass reaches a height of at least 4 to 8 inches, depending upon the target weed. A second application of 8 ounces/A may be needed for complete control.

Herbicide	Formulation	Product Rate Range	With Glyphosate
Fusion	2.66E	6 - 14 oz	6 - 12 oz

- Fusion is a premix of fluazifop-P (Fusilade) plus fenoxaprop-ethyl, translocated herbicides that control annual and perennial grasses, including foxtails, barnyardgrass, johnsongrass, shattercane, volunteer corn, and quackgrass.
- Mode of action: group 1 (see page 12-13).
- Mixtures with Pursuit are labeled for control of volunteer corn and shattercane only.
- When applied alone, the rate is 6 to 8 ounces per acre for control of foxtails, fall panicum, and many other annual grasses, 6 ounces per acre for control of seedling johnsongrass and shattercane, and 4 to 6 ounces for volunteer corn. The lower rates may be used when grasses are actively growing and are at the earliest growth stages indicated on the label, soybeans are planted in narrow rows or cultivation is planned, weed densities are light to moderate, and COC is used. The Fusion rate may need to be increased to 12 ounces when mixed with broadleaf herbicides, depending upon grass size and environmental conditions at the time of application.
- The Fusion rate is 4 to 6 oz/A for control of volunteer glyphosate-resistant corn in Roundup Ready soybeans in mixtures with glyphosate. The 4 oz rate can be used only under the following conditions: favorable soil moisture and humidity; volunteer corn is less than 12 inches tall; and COC (0.25% v/v) is used as the spray adjuvant. In mixtures with glyphosate products that are formulated with a surfactant package, where COC is not used, apply the 6 oz Fusion rate.
- Can be applied at 8 to 14 ounces/A as a rescue treatment for control of giant foxtail up to 16 inches tall. Use 12 to 14 ounces/A if grass is drought-or temperature-stressed. Do not mix with broadleaf herbicides when applying rescue treatments.
- Do not mix with Classic, Harmony GT, or Synchrony STS if conditions are dry and target grasses include yellow foxtail, barnyardgrass, or crabgrass.
- For perennial grass control, application is delayed until grass reaches a height of at least 4 to 6 inches, depending upon the target weed. Two applications may be needed for perennial grass control.
- For sequential applications of Fusion and broadleaf herbicides, the minimum time interval that must occur between applications varies with the herbicides sprayed and the order of application. See the label for additional information on sequential applications.
- Apply with COC (2 to 4 quarts/100 gallons spray) for best results. NIS (1 to 2 quarts/100 gallons spray) may be used instead of crop oil if required in a mixture with other herbicides. Liquid nitrogen fertilizer can be added to the spray mixture, but should not be used as a substitute for COC or surfactant.
- Apply in 5 to 40 gpa at a spray pressure of 40 to 60 psi. Use 60 psi and a minimum volume of 20 gpa where grass foliage is dense.

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Herbicide	Formulation	Product Rate Range	With Glyphosate
Poast	1.5E	12 - 24 oz	12 - 24 oz
Poast Plus	1E	12 - 36 oz	12 - 36 oz

- Poast (sethoxydim) controls annual grasses and controls or suppresses perennial grasses. Poast Plus is a premix of sethoxydim plus Dash.
- Mode of action: group 1 (see page 12-13).
- For control of most annual grasses, apply 16 ounces of Poast or 24 ounces of Poast plus before weeds are 8 inches tall. Control of volunteer cereals (prior to overwintering) requires higher rates. The label allows for reductions in rate when applied to small actively growing grass. Reduced-rate recommendations apply only to barnyardgrass, fall panicum, giant and green foxtails, and volunteer corn. See label for more information.
- Apply with 2 pints of oil concentrate or 1 pint of Dash per acre. Include UAN (1/2 to 1 gallon/A) or AMS (2 1/2 lb/A) for control of crabgrass, volunteer corn, or volunteer wheat. When mixing with Basagran, include UAN or AMS in the spray mix. Rates and additive recommendations vary when mixing with Basagran, depending upon the target grasses. See label for more information.
- Use a rate of 24 oz/A (Poast) or 36 oz/A (Poast Plus) as a rescue treatment for control of foxtails up to 16 inches tall, barnyardgrass and fall panicum up to 12 inches tall, and crabgrass up to 8 inches tall. Add UAN or AMS for control of crabgrass.
- Poast and Poast Plus are generally less effective than other postemergence grass herbicides for perennial grass control. Two applications may be necessary for perennial grass control.
- Optimum spray volume is 10 gallons per acre, but spray volumes of 5 to 20 gallons per acre may be used. Apply with a spray pressure of 40 to 60 psi.
- Poor control may result when applied to weeds under stress from hot,dry conditions or herbicide injury.
- When applied in mixture with a glyphosate product not loaded with an adjuvant system follow recomendations above, but do not use MSO. If glyphosate product is loaded with an adjuvant system, see glyphosate label for adjuvant recommendations.

Herbicide	Formulation	Product Rate Range	With Glyphosate
Pursuit	2S	4 oz	4 oz

- Pursuit (imazethapyr) is a translocated imidazolinone herbicide that controls annual broadleaf weeds and controls or suppresses grasses. Pursuit also provides some residual control of grass and broadleaf weeds. Control of common and giant ragweeds and lambsquarters is variable. Mixtures with reduced rates of Flexstar or Cobra will improve control of ragweeds. Pursuit does not control ALS-resistant weeds.
- Mode of action: group 2 (see page 12-13).
- Apply with NIS (2 pints/100 gallons spray) or a COC (1 1/2 to 2 pints/A) plus UAN (1 to 2 quarts per acre). AMS (2 1/2 pounds/A) may be substituted for liquid fertilizer in the spray mix. Control of large or drought-stressed weeds will be maximized when the higher rates of fertilizer are used in combination with a seed oil-based COC (Meth Oil or Sun-It II, for example).
- For control of most annual grass and broadleaf weeds, apply before weeds are 3 inches tall and before soybeans bloom. Pursuit should be applied before lambsquarters and morningglory are 2 inches tall. Cocklebur, pigweed, shattercane, and seedling johnsongrass can be controlled up to 8 inches tall. For control or suppression of Jerusalem artichoke, apply when artichokes are 6 to 10 inches tall.
- Control may be reduced when weeds are growing slowly under cold or dry conditions. If possible, wait for rain and resumption of active weed growth before applying Pursuit. If air temperatures reach or stay below 50 F for 10 or more hours, delay application for 48 hours from the time temperatures increase above 50 F.
- Combinations of Pursuit plus thifensulfuron can cause severe injury and yield loss under environmental conditions that predispose soybeans to herbicide injury.
- Apply in a spray volume of at least 10 gallons per acre with a spray pressure of 20 to 40 psi. Flat fan spray nozzles are recommended for adequate plant coverage. Allow 1 hour between application and rainfall.
- Mixtures of Pursuit with postemergence grass herbicides are generally labeled for control of volunteer corn and shattercane only.
- When mixing with glyphosate, add NIS (0.25% v/v) and AMS (8.5 to 17 lb/100 gallons) if the glyphosate is not formulated with its own adjuvant. If the glyphosate has its own adjuvant system, just add AMS.

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Herbicide	Formulation	Product Rate Range	With Glyphosate
Raptor	1AS	4 - 5 oz	4 - 5 oz

- Raptor (imazamox) is a translocated imidazolinone herbicide that controls annual broadleaf and grass weeds. Raptor generally provides better control of lambsquarters and annual grasses than Pursuit. Control of common and giant ragweeds and waterhemp is variable. Raptor provides a shorter period of residual control compared to Pursuit. Raptor does not control ALS-resistant weeds.
- Mode of action: group 2 (see page 12-13).
- Apply with NIS (2 pints/100 gallons spray) or a COC (1% v/v) plus UAN (1 to 2 quarts per acre) or AMS (2 1/2 pounds/A). AMS is generally the preferred nitrogen source over UAN or 10-34-0. Control of large or drought- or temperature-stressed weeds will be maximized when the higher rates of fertilizer are used in combination with a seed oil-based COC (Meth Oil or Sun-It II, for example).
- For control of most annual grass and broadleaf weeds, apply before weeds are 4 to 5 inches tall and before soybeans bloom.
- Control may be reduced when weeds are growing slowly under cold or dry conditions. If possible, wait for rain and resumption of active weed growth before applying Raptor. If air temperatures reach or stay below 50 F for 10 or more hours, delay application for 48 hours from the time temperatures increase above 50 F.
- Raptor is more injurious to soybeans than Pursuit. Internode shortening and/or temporary yellowing of plants may occur following application, especially when applied with a COC or MSO.
- Apply in a spray volume of at least 10 gallons per acre with a spray pressure of 20 to 40 psi. Flat fan spray nozzles are recommended for adequate plant coverage.
- When applied in mixture with glyphosate, always include AMS (4.5 - 17 lb/100 gal). Include NIS (0.25% v/v) if glyphosate product does not contain an adjuvant.

Herbicide	Formulation	Product Rate Range	With Glyphosate
Synchrony XP	28.4%WDG	0.375 - 0.75 oz	0.375 oz

- Synchrony XP is a premix of chlorimuron (Classic) plus thifensulfuron (Harmony GT). Rates higher than 0.375 oz/A should be applied only on STS soybeans (sulfonylurea tolerant soybeans).
- Mode of action: group 2 (see page 12-13).
- Synchrony applied at 0.75 oz/A controls many annual broadleaf weeds, including lambsquarters, velvetleaf, cocklebur, morningglory, burcucumber, pigweed, Pennsylvania smartweed, yellow nutsedge, and ragweeds. Control of giant ragweed that are 4 to 8 inches tall is variable. Black nightshade is not controlled. Synchrony will suppress or control small perennial sowthistle, dandelion, common milkweed, pokeweed, and Jerusalem artichoke. Does not control ALS-resistant weeds.
- Mixing with Cobra, Flexstar, or Reflex will improve control of giant ragweed, common ragweed, black nightshade, and waterhemp.
- Apply after the first trifoliate soybean leaves have opened but no later than 60 days before soybean maturity. Weeds should be 2 to 4 inches tall and actively growing for best results. Cocklebur, pigweed, velvetleaf, and smartweed can be controlled up to 8 inches tall.
- Apply with COC (1% v/v) plus an ammonium nitrogen fertilizer at the following rates: 28% - 2 to 4 quarts/A; 10-34-0 - 1 to 2 quarts/A; or ammonum sulfate - 2 to 4 pounds/A. Use the lower fertilizer rates for spray volumes of less than 15 gpa.
- At a reduced rate of 0.375 oz/A, Synchrony STS can be applied to non-STS soybeans for control of small cocklebur, pigweed, and sunflower and suppression of other weeds. Use NIS instead of COC on non-STS soybeans. This Synchrony rate can be used on mixtures with Flexstar, FirstRate, or Harmony GT.
- Apply in a minimum spray volume of 10 gpa at a pressure of at least 25 psi using flat fan nozzles.
- Synchrony STS may reduce the activity of a grass herbicide in mixtures. Increase the rate of the grass herbicide or apply separately to maintain effective control.
- When mixing with glyphosate, add AMS (4.25 - 17 lb/100 gal). If allowed by the glyphosate label, the use of NIS (0.25% v/v) may improve efficacy.

Soybeans: Postemergence Herbicides — Systemic

Herbicide	Formulation	Product Rate Range	With Glyphosate
Thifensulfuron (active ingredient)			
Harmony SG	50DF	0.12 oz	Not labeled
Harass, Unity, Treaty	75DF	0.08 oz	

- Thifensulfuron is a translocated sulfonylurea herbicide that controls velvetleaf, pigweed, lambsquarters, and Pennsylvania smartweed. Thifensulfuron is often included in mixtures with other broadleaf herbicides to improve lambsquarter and velvetleaf control. Does not control ALS-resistant weeds.
- Mode of action: group 2 (see page 12-13).
- Treating weeds under stress from abnormally cold or hot weather or dry soil conditions may result in only partial control. To maintain effective control, delay application until stress passes and weeds resume active growth.
- Apply with 0.125 to 0.25 percent NIS (v/v) when weeds are less than 4 inches tall and actively growing. Liquid nitrogen fertilizer or AMS should also be included in the spray mix at the following rates: 28% - 2 to 4 quarts/A; 10-34-0 - 2 to 4 pints/A; or AMS - 2 to 4 pounds/A. Under dry conditions, thifensulfuron can be applied with COC, but soybean injury is likely to be more severe. To avoid injury when mixing with other products, follow label directions closely regarding spray additives.
- Apply with flat fan nozzles in a spray volume of 10 to 25 gpa at a pressure of 25 to 60 psi.
- Apply after the first trifoliate soybean leaf has fully expanded up to 60 days before harvest.
- Application of thifensulfuron may cause temporary wilting, leaf yellowing, and/or growth retardation (shortened internode spacing). These symptoms are most likely to occur when applied during periods of hot and humid weather.

Liberty Link Soybeans — Postemergence Herbicides

Herbicide	Formulation	Product Rate Range
Ignite 280 SL	2.34L	22 - 36 oz

- Ignite (glufosinate) is a contact, broad-spectrum herbicide for postemergence use only on Liberty Link (glufosinate-resistant) soybeans.
- Mode of action: group 10 (see pages 12-13).
- Ignite controls many annual grass and broadleaf weeds up to 3 to 6 inches tall when applied at a rate of 22 oz/A. Two postemergence applications are allowed, but the total amount of Ignite per season (burndown + POST) should not exceed 65 oz/A.
- OSU and Purdue University research indicates that Ignite is most effective in a combined preemergence plus postemergence program, where the preemergence herbicide will provide control of grass and broadleaf weeds for several weeks to a month after soybean planting. The preemergence herbicide should have substantial activity on lambsquarters, giant ragweed, waterhemp, marestail, and velvetleaf. Ignite is weak on barnyardgrass and yellow foxtail, and these weeds should be controlled by the PRE herbicides or with the addition of a POST grass herbicide (clethodim, Fusion, etc).
- Maximum height for grass weeds at the 22 oz/A rate: barnyardgrass, crabgrass, yellow foxtail, fall panicum - 3 inches; woolly cupgrass, shattercane, and green, giant, and robust foxtails - 6 inches; volunteer corn - 10 inches. Yellow foxtail and crabgrass should be treated prior to tiller initiation for best results.
- Maximum height for broadleaf weeds at the 22 oz/A rate: velvetleaf, pigweeds - 3 inches; lambsquarters, waterhemp - 4 inches; burcucumber, cocklebur, annual morningglories, black nightshade, ragweeds, and Pennsylvania smartweed - 6 inches.
- Ignite will control glyphosate- and ALS-resistant ragweeds and marestail. For most effective control, apply when weeds are 4 to 6 inches tall. A second application of Ignite (approximately 3 weeks later) will be necessary in dense giant ragweed infestations, where the preemergence herbicide fails to substantially reduce the weed population, or for control of large marestail that were present at the time of soybean planting and escaped prior herbicide treatment.
- Ignite can suppress some perennial weeds, but has activity on above-ground growth only. Regrowth of perennials may require a second application of Ignite.
- Glufosinate activity on certain weeds is enhanced by the addition of AMS. The Ignite label does not mention AMS with regard to Liberty Link soybeans, but specifies the use of AMS (3 lbs/A, or 17 lbs/100 gallons) in postemergence applications to Liberty Link corn. Ignite has typically been applied with AMS (8.5 lbs/100 gallons) in OSU and Purdue University research.
- Apply after soybean emergence and prior to soybean bloom.
- Apply in a minimum spray volume of 15 gpa. Use a volume of 20 to 40 gpa in dense weed/crop canopies. Ignite should be applied with a nozzle type and spray pressure that results in medium spray droplets (250 to 350 microns).
- Ignite is most effective when applied under warm, sunny conditions. Effectiveness may be reduced if applied when heavy dew, fog and mist/rain are present, or if weeds are under stress due to drought, cool temperatures, or extended periods of cloudiness. To avoid reduced weed control, apply between dawn and two hours before sunset.

Roundup Ready Soybeans: Postemergence Herbicides

Herbicide	Formulation	Product Rate Range
Extreme/Thunder Master	2.17L	3 pints
Tackle	4.128SL	1 quart

- These products are premixes of imazethapyr (Pursuit) and glyphosate for postemergence plus residual grass and broadleaf weed control in Roundup Ready soybeans. They do not provide residual control of ALS-resistant weeds. See Pursuit and glyphosate description for guidelines and restrictions on use.
- Mode of action: group 2 (imazethapyr); group 9 (glyphosate). (see page 12-13).
- Can be more effective than glyphosate on black nightshade, due to the residual control of later-emerging nightshade plants.
- Apply when weeds are less than 8 inches in height, with NIS (1 pint/100 gallons) plus AMS (2.5 lbs/A) or UAN (1 to 2 qts/A).
- This herbicide mixture occasionally causes unacceptable crop injury. Do not apply more than once per growing season.

Herbicide	Formulation	Product Rate Range
Flexstar GT	3.29L	3 - 4.5 pts/A

- Flexstar GT is a premix of glyphosate and fomesafen (Flexstar) for postemergence application to Roundup Ready soybeans. Can also be applied prior to soybean emergence for no-till burndown.
- Mode of action: group 9/14 (see page 12-13).
- Use rates: north of I-70 - 3 to 3.75 pts/A; south of I-70 - 3 to 4.5 pts. Rates of 3.75 to 4.5 pints will provide the most consistent control of glyphosate-resistant common or giant ragweed. The label allows a reduction of rate to 2.375 pts/A in fields without glyphosate-resistant weeds, as long as weeds are less than 4 inches tall.
- Flexstar GT contains adjuvants, and requires only the addition of AMS (8.5 to 17 lbs/100 gallons) in areas where weeds are not resistant to glyphosate. The addition of COC or MSO (0.5 - 1% v/v) can improve control but also increases leaf burn and other injury symptoms. Based on OSU research, the addition of COC or MSO is required for effective control of glyphosate-resistant ragweeds or in other situations where it is necessary to maximize the activity of fomesafen.
- Apply in a spray volume of 15 to 20 gpa with a pressure of 30 to 60 psi. Flat fan nozzles will result in the most effective control. Do not use air induction of other nozzles that deliver large spray droplets.

Herbicide	Formulation	Product Rate Range
Glyphosate	Various	0.56 - 1.5 lbs acid/A

- Glyphosate is a nonselective, translocated herbicide that controls emerged annual and perennial grass and broadleaf weeds. Table 24 contains a list of currently available glyphosate products. Application rates, adjuvant recommendations, rainfast intervals, and other guidelines for use vary among glyphosate products, and users should consult labels and local product use guides for more specific information.
- Mode of action: group 9 (see page 12-13).
- Glyphosate can be applied broadcast to Roundup Ready soybeans before, during, or after planting and crop emergence. The postemergence application window, per most glyphosate labels, is from emergence (cracking) through flowering, or the R2 stage of soybean development. Soybean development exceeds the R2 stage, or begins the R3 stage, when a pod at least 3/16 inch long appears at one of the four uppermost nodes on the main stem with a fully-developed leaf. Crop injury and reduced pod formation has been observed where glyphosate was applied in late summer to soybeans that were past the R2 stage of growth.
- The following management practices are most effective for minimizing the risk of glyphosate resistance in weeds, maintaining adequate weed control, and preserving maximum crop yield: 1) start weed free at planting through use of tillage or a preplant burndown herbicide application, which should include 2,4-D ester; 2) include residual herbicides in the preplant application to reduce weed populations and help control tough weeds; 3) make the first postemergence glyphosate application when weeds are less than about 6 inches tall; and 4) make a second postemergence glyphosate application about 3 weeks later as needed to control late-emerging weeds and weeds that were not completely killed by the initial application.

Roundup Ready Soybeans: Postemergence Herbicides

- The general recommendation on most labels for the initial postemergence application is a rate of 0.75 lbs of glyphosate acid per acre (lbs a.e./A) when weeds are less than 4 to 8 inches tall (see Table 24 for product rates). University research indicates that weeds should be no larger than 6 to 8 inches tall at the time of postemergence glyphosate application to avoid yield loss from weed interference. Rate should be increased to 1.1 to 1.5 lbs ae/A for larger weeds or in fields with a history of poor glyphosate performance. Additional postemergence applications are permitted, but the total glyphosate in all postemergence applications should not exceed 2.25 lbs ae/A.
- For control of volunteer glyphosate-resistant corn in Roundup Ready soybeans, apply glyphosate with Assure II, Targa, Fusion, Fusilade DX, or Select Max. Do not use other clethodim formulations (Select, Arrow, etc) or Poast products in mixtures with glyphosate for control of glyphosate-resistant volunteer corn. Consult labels and local recommendation guides for information on adjuvants and rates when mixing glyphosate with postemergence grass herbicides.
- Glyphosate resistance has developed in populations of marestail and common and giant ragweed in Ohio and Indiana, and some lambsquarters populations appear to have become less sensitive to glyphosate. Consider use of a preemergence herbicide that provides residual control of these weeds, in order to avoid use of herbicide programs consisting solely of multiple glyphosate applications. Applying a glyphosate rate of 1.5 lbs a.e./A when plants are small (less than 6 inches tall) can result in more consistently effective control of populations that have developed a low level of resistance, especially when followed by anoth application of glyphosate 3 weeks later. Alternative approaches will be necessary where the population has a higher level of glyphsoate resistance, and in populations with resistance to both glyphosate and ALS inhibitors (FirstRate, Classic, etc). For more detailed recommendations for control of these weeds, see the "Control of Problem Weeds" section in this guide.
- In OSU and Purdue University research, use of all of the following strategies has resulted in most effective control of dense giant ragweed populations: (1) apply a preplant herbicide treatment that includes 2,4-D ester, glyphosate, and a residual herbicide with activity on giant ragweed; (2) make the first postmergence application of glyphosate at 1.5 lbs ae/A when giant ragweed are not more than 10 inches tall, and (3) follow with a second application of glyphosate at 0.75 lb ae/A approximately 3 weeks later.
- Application of a combination of glyphosate plus FirstRate can improve control of marestail and giant ragweed. However, university research indicates that many marestail populations in Ohio and Indiana are ALS-resistant, and FirstRate will not improve control of ALS-resistant populations.
- Annual morningglory, groundcherry, ladysthumb, velvetleaf, marestail, and Pennsylvania smartweed should be less than 6 inches tall at the time of application.
- Best control of perennials will occur at higher labeled rates. Application when perennials are in the bud to bloom stage (or boot to seedhead for grasses) will provide the most complete control of the entire plant. Minimum size of various perennial weeds for most effective control through the growing season: quackgrass, Canada thistle, wirestem muhly, and yellow nutsedge - 6 inches; field bindweed and common milkweed - 12 inches; johnsongrass and hemp dogbane - 18 inches.
- Apply in a spray volume of 5 to 20 gpa. Take precautions to reduce spray drift. Corn, soybeans, and other sensitive crops are likely to be growing in areas surrounding treated fields. Using 15 to 20 gpa and flat fan or drift-control nozzles at low pressure will reduce the potential for spray drift.
- The addition of AMS will improve control of velvetleaf and some other weeds. AMS will also improve control when using hard water or when daytime air temperatures are 55 degrees or less.

Roundup Ready Soybeans: Postemergence Herbicides

Herbicide	Formulation
Sequence	5.25L

- Sequence is a premix of glyphosate plus s-metolachlor (Dual II Magnum) that can be applied postemergence to Roundup Ready soybeans to provide control of emerged weeds and residual control of annual grasses, black nightshade, pigweeds, and waterhemp.
- Apply between cracking and the 3rd trifoliate soybean stage.

Herbicide	Formulation
Warrant	3L

- Warrant (acetochlor) can be applied early postemergence to soybeans for residual control of annual grasses, lambsquarters, pigweed, waterhemp, and black nightshade. Warrant applied alone does not control emerged weeds, but a mixture of glyphosate and Warrant will control emerged weeds and provide residual control.
- Mode of action: group 15 (see pages12-13).
- Apply after the soybeans have emerged and prior to the R2 stage, and prior to weed emergence or in combination with glyphosate to control emerged weeds.
- Optimum timing and rate of application (when applied with glyphosate) is 1.5 qts/A when weeds are 2 to 4 inches tall, and soybeans are at V2 to V3. Labeled rates range from 1.25 to 2 qts/A depending upon soil texture and organic matter content.

Soybeans: Selective Application of Glyphosate

Herbicide	Formulation	Product Rate Range
Glyphosate	Various	See comments

- Glyphosate can be applied to weeds growing above the soybean canopy through selective applicators such as rope-wicks or sponge wipers. This application is useful for control of volunteer corn, shattercane, johnsongrass, hemp dogbane, and common milkweed. Table 24 contains a list of currently available glyphosate products.
- Mode of action: group 9 (see page 12-13).
- Weeds should be at least 6 inches taller than the soybeans. Avoid contact of herbicide with the crop. Adjust equipment so that the lowest wiper contact is at least 2 inches above the soybeans.
- For mixing instructions and equipment calibration, refer to directions on labels.

Soybeans: Harvest Aid

Herbicide	Formulation	Product Rate Range
Aim	2EC	1 - 1.5 oz

- Aim (carfentrazone) can be applied prior to harvest of mature soybeans for dessication of velvetleaf, morningglory, pigweeds, and other weeds. Apply at least 3 days before harvest.
- Mode of action: group 14 (see page 12-13).
- The total amount of Aim that can be applied to soybeans in one season, including preplant, postemergence, and harvest aid treatments, cannot exceed 1.5 oz/A.
- Use a spray volume that results in complete coverage of foliage. Apply with NIS (0.25% v/v) or a COC (1 to 2% v/v). UAN or AMS may also be added.

Herbicide	Formulation	Product Rate Range
Gramoxone SL	2L	8 to 16 oz
Parazone	3SL	5.4 to 10.7 oz

- Gramoxone and Parazone (paraquat) may be used for drying weeds in soybeans just before harvest. For indeterminate soybean varieties, apply when 65 percent of the seed pods have reached a mature brown color or when seed moisture is 30 percent or less. For determinate varieties, apply when at least one-half of the leaves have dropped and the rest of the leaves are turning yellow.
- Mode of action: group 22 (see page 12-13).
- Mature cocklebur and lambsquarters are tolerant of paraquat and may not desiccate completely.
- For aerial application, use a spray volume of 5 gallons per acre; for ground application, use 20 gallons per acre. Add NIS (0.25% v/v) or COC (1% v/v).
- Apply at least 15 days before harvest. Do not graze or harvest for forage or hay.

Herbicide	Formulation	Product Rate Range
Glyphosate	Various	0.75 lb acid/A (aerial application) up to 4.5 lbs acid/A (ground application)

- Table 24 contains a list of currently available glyphosate products. Application rates, adjuvant recommendations, rainfast intervals, application parameters, and other guidelines for use vary among glyphosate products, and users should consult labels and local product use guides for more specific information. The following comments are meant as general guidelines for the use of glyphosate except where a product name is listed.
- Can be applied as a preharvest treatment to control perennial and annual weeds in soybeans. Dessication from glyphosate application is less rapid than that from Gramoxone. Preharvest applications of glyphosate may provide a good opportunity to control perennial weeds because their growth is undisturbed compared to postharvest applications.
- Mode of action: group 9 (see page 12-13).
- Apply after pods have set and lost all green color, and at least 7 or 14 days before harvest, depending upon the product used. Do not graze or harvest the treated crop for livestock feed (Roundup brand labels allow use of soybeans for livestock feed when harvested at least 25 days after the last preharvest application).
- Do not use a preharvest glyphosate application in soybeans grown for seed, due to the potential for a reduction in viability or vigor.

Table 17. Rainfast Intervals and Spray Additive Recommendations for Postemergence Soybean Herbicides

This table shows the required time interval between herbicide application and rainfall and summarizes label recommendations for spray additives. Check herbicide labels for additive rates. Use the following key for spray additives:

Herbicide	Rainfast Interval (hours)	Spray additives
Aim	1	SURF
Assure II/Targa	1	SURF, COC, OR MSO. COC is preferred.
Basagran	8	MSO, COC, UAN or AMS; or COC or MSO + UAN or AMS
Cadet	4	SURF, COC, or MSO. UAN or AMS can be added.
Classic	1	SURF, COC, MSO or SURF + UAN or 10-34-0
Clethodim	1	COC or MSO. UAN, AMS, or 10-34-0 may be added.
Cobra	1/2	MSO, COC or UAN. SURF may be used under conditions of high humidity.
Cobra + Classic	1	SURF
Extreme/Tackle/Thunder Master	1	SURF + UAN, 10-34-0 or AMS.
FirstRate	2	SURF, COC, or MSO, + UAN or AMS, or COC or MSO alone.
Flexstar/Rhythm	1	MSO, COC, or SURF + UAN or AMS
Fusilade DX	1	MSO, SURF or COC. UAN or 10-34-0 may be added.
Fusion	1	MSO, SURF or COC. UAN or AMS may be added.
Ignite	4	None specified on label.
Poast/Poast Plus	1	MSO, COC or Dash. UAN or AMS may be added.
Pursuit	1	MSO, SURF or COC, + UAN, 10-34-0, or AMS.
Raptor	1	COC, MSO, or SURF + UAN, 10-34-0, or AMS
Reflex/Dawn	1	MSO, SURF or COC. UAN or 10-34-0 may be added.
Resource	1	MSO or COC. UAN OR AMS may be added to improve control of certain weeds.
Select Max	1	SURF + AMS. COC can be used instead of SURF in mixtures with broadleaf herbicides.
Storm	8	MSO, SURF, COC, or UAN.
Synchrony XP	1	MSO or COC + UAN, 10-34-0, or AMS.
Synchrony XP + Cobra	1	COC or MSO + UAN, 10-34-0, or AMS.
Thifensulfuron	1	SURF + UAN, 10-34-0, or AMS. COC may be used instead of SURF under dry conditions.
Ultra Blazer	4	SURF or COC. UAN or 10-34-0 may be added to improve control of certain weeds.

Table 18. Harvest and Feeding Intervals for Soybean Herbicides

Soybean Herbicides	Days to Harvest	
	Grain	Forage
Aim	Apply up to third trifoliate	Do not feed
Assure II/Targa	80	Do not feed
Basagran	30	30
Basagran + 2,4-DB	60	60
Basagran + thifensulfuron	60	Do not feed
Basagran + Reflex	Apply prior to bloom	Do not feed
Basagran + Cobra	90	Do not feed
Cadet	60	Do not feed
Classic	Apply 60 days before maturity	Do not feed
Clethodim	60	Do not feed
Cobra	45	Do not feed
Extreme/Tackle/Thunder Master	Apply prior to bloom and 85 days before harvest	Do not feed
FirstRate	65	14
Flexstar/Rhythm/Flexstar GT	45	Do not feed
Fusilade DX	Apply prior to bloom	Do not feed
Fusion	Apply prior to bloom	Do not feed
Ignite	Apply prior to bloom.	Do not feed
Optill	85	Do not feed
Poast	75	Do not feed[1]
Poast/Poast Plus	75	Do not feed[1]
Pursuit	85	Do not feed
Raptor	85 and apply prior to bloom	Do not feed
Reflex/Dawn	45	Do not feed
Reflex + 2,4-DB	Apply prior to bloom	Do not feed
Resource	60	Do not feed
Sharpen	?	65
Storm	50	Do not feed
Synchrony XP	Apply 60 days before maturity	Do not feed
Thifensulfuron	60	Do not feed
Ultra Blazer	50	Do not feed

[1] Soybean hay may be fed.

Weed Management Strategies for Wheat

A healthy wheat crop competes well with weeds, especially when production techniques result in an initial uniform stand and when loss of stand due to winter injury is minimal. Effective weed control and prevention of weed seed production in prior crops will reduce the risk of weed problems in wheat. Some wheat fields can benefit greatly from herbicide application, and failure to scout fields and take the appropriate measure can result in yield loss and harvesting problems in these fields. The weeds that appear above the wheat canopy late in the season, such as ragweeds and Canada thistle, can often be easily controlled with a spring herbicide treatment. The most common weed problems in wheat include:

- winter annual weeds, such as common chickweed, purple deadnettle, shepherd's-purse, and field pennycress. These weeds become established in the fall along with the wheat, and can interfere with the early development of wheat in spring. Dense populations of winter annual weeds should be controlled in late fall or early spring to minimize interference with wheat growth. Many of these weeds have emerged by the time of no-till wheat planting, and can be controlled with glyphosate before wheat emerges.

- wild garlic, due to the contamination of harvested grain with its bulblets. Several herbicides are effective if applied in the spring after garlic has several inches of new growth.

- Canada thistle, which can greatly suppress wheat growth due to its tendency to occur in dense patches. many wheat herbicides have some activity on thistle, and can suppress it adequately through harvest if not applied too early in spring.

- dandelion, which can interfere with wheat establishment in the fall and wheat growth in the spring. Emerged dandelion should be controlled prior to wheat planting with tillage or glyphosate.

- summer annual broadleaf weeds, such as common and giant ragweed, which can begin to emerge in late March. A healthy wheat crop can adequately suppress these weeds but herbicide application is occasionally warranted.

It is essential to apply herbicides at the correct stage of wheat growth to avoid crop injury. When wheat has not yet reached the jointing stage, any herbicide labeled can be safely applied. As wheat growth stage advances past jointing and approaches the boot stage, herbicide choices become much more limited. Most herbicides can be applied in UAN when the wheat is top-dressed. This may increase crop injury somewhat, and some labels recommend adjusting surfactant rates to minimize injury.

Table 19. Weed Response to Postemergence Herbicides in Small Grains

This table compares the relative effectiveness of herbicides on individual weeds. Ratings are based on labeled application rate and weed size or growth stage. Performance may vary due to weather and soil conditions, or other variables. See pages 12-13 for more information on herbicide site of action and a description of site of action groups.

Weed control rating:

9 = 90% to 100%; 8 = 80% to 90%; 7 = 70% to 80%; 6 = 60% to70%; - = less than 60% control.

	Winter annual															Summer annual							Perennial	
	Site of action	Bluegrass, annual	Cheat	Brome, downy	Ryegrass, annual	Chickweed, common	Deadnettle, purple	Henbit	Lettuce, wild or prickly	Marestail (horseweed)	Marestail (ALS-resis)	Mustard species	Pennycress, field	Shepherdspurse		Buckwehat, wild	Lambsquarters, common	Pigweed	Ragweed, common	Ragweed, giant	Smartweed, ladysthumb		Garlic, wild	Thistle, Canada
Aim	14	-	-	-	-	-	-	-	-	-	-	6	7	6		6	7	8	6	-	-		-	-
Axial Star	2/4	-	-	-	9	-	-	-	6	-	-	7	-	-		6	-	-	8	8	6		-	-
Axial TBC	1/2	-	-	-	9	9	-	-	6	-	-	9	6	9		6	-	6	-	-	-		-	-
Axial XL	2	-	-	-	9	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-		-	-
Bromoxynil	6	-	-	-	-	6	-	8	6	6	6	9	8	8		9	9	7	9	8	9		-	6
Cleansweep D or M	4/6	-	-	-	-	6	6	8	7	8	8	9	9	9		9	9	9	9	9	9		-	8
Curtail	4	-	-	-	-	-	-	-	9	8	8	9	9	9		9	9	9	9	9	8		-	9
Dicamba	4	-	-	-	-	6	-	6	8	8	8	6	6	8		9	9	9	9	9	9		-	6
Finesse/ Report Extra	4	9	-	-	-	9	9	9	8	8	-	9	9	9		8	9	9	8	-	7		6	7
Huskie	6/27	-	-	-	-	8	9	9	9	9	9	9	9	9		8+	9	9	9	9	8+		-	6
Maverick	2	-	8	8	-	-	7	7	8	7	-	8	8	8		-	6	8	-	-	-		7	-
MCPA	4	-	-	-	-	-	-	-	9	8	8	9	9	9		8	9	9	9	9	7		-	-
Olympus	2	-	9	8	-	9	9	9	-	8	-	9	8	9		6	-	6	-	-	-		-	-
Olympus Flex	2	8	8	8	9	9	8	8	-	8	-	8	8	8		6	-	7	-	-	-		-	-
Orion	2/4	-	-	-	-	9	-	-	9	-	-	9	9	9		8	9	9	9	8	9		-	6
Peak	2	-	-	-	-	7	7	7	8	-	-	9	9	8		8	7	9	9	7	7		8	6
PowerFlex	2	-	9	8	9	9	7	7	6	6	-	9	9	8		7	8	9	-	-	7		-	-
Pulsar + MCPA	4	-	-	-	-	8	8	8	9	8	8	9	9	9		9	9	9	9	9	8		-	-
Starane	4	-	-	-	-	-	-	-	6	-	-	7	-	-		7	-	-	9	9	7		-	-
Stinger	4	-	-	-	-	-	-	-	8	9	9	-	-	-		9	-	-	9	9	8		-	9
Tribenuron	2	-	-	-	-	9	9	9	9	-	-	9	9	8		8	9	9	-	-	8		6	8
Tribenuron + thifensulfuron	2	-	-	-	-	9	8	9	8	7	-	9	9	9		8	9	9	-	-	9		9	7
WideMatch	4	-	-	-	-	-	-	-	8	9	9	7	-	-		9	-	-	9	9	7		-	8
2,4-D	4	-	-	-	-	-	-	-	9	8	8	9	9	9		-	9	9	9	9	6		7	7

Small Grains: Wheat Only

Herbicide	Formulation	Product Rate Range
Axial Star	1.15L	16.4 oz

- Axial Star is a premix of pinoxaden (Axial) and fluroxypyr (Starane) that controls annual ryegrass, foxtails, and barnyardgrass, and a few broadleaf weeds in wheat. Mix with other broadleaf herbicides to expand the spectrum of broadleaf weed control.
- Mode of action: group 1 - pinoxaden); group 4 - fluroxypyr (see page 12-13).
- Apply when wheat is in the 2-leaf to pre-boot stage, and when grass weeds have 1 to 5 leaves and less than 3 tillers.
- Do not plant soybeans and other crops within 4 months after application.
- Can be mixed with most other broadleaf herbicides used in wheat. See label for more information.

Herbicide	Formulation	Product Rate Range
Axial XL	0.42L	16.4 oz

- Axial XL (pinoxaden) controls annual ryegrass, foxtails, and barnyardgrass in wheat.
- Mode of action: group 1 (see page 12-13).
- Apply when wheat is in the 2-leaf to pre-boot stage, and when grass weeds have 1 to 5 leaves and less than 3 tillers.
- Do not plant soybeans and most other crops for 120 days after application.
- Can be mixed with most other broadleaf herbicides used in wheat. See label for more information.

Herbicide	Formulation	Product Rate Range
Axial TBC	0.84L	8.85 oz

- Axial TBC is a premix of florasulam and pinoxaden that controls annual ryegrass, foxtails, barnyardgrass, and some broadleaf weeds in wheat and barley. The label specifies the addition of MCPA or other herbicide to improve broadleaf weed control.
- Mode of action: group 1 (pinoxaden); group 2 (florasulam)
- Apply when wheat is in the 3-leaf to boot stage, and when grass weeds have 1 to 5 leaves and less than 3 tillers.
- Apply with Adigor Adjuvant at the rate of 9.6 oz/A. Can be applied in a spray solution containing up to 50% UAN or other nitrogen fertilizer.
- Allow 9 months between application and soybean planting.

Herbicide	Formulation	Product Rate Range
Axiom	68DF	4 - 10 oz

- Axiom is a premix of metribuzin and flufenacet that can be applied early postemergence in wheat to control small winter annual grass and broadleaf weeds. Axiom provides limited residual weed control also.
- Mode of action: group 5/15 (see pages 12-13).
- Apply in the fall from spike to 3-leaf stage of wheat, and prior to the 1-leaf stage of weeds. For best results, use tillage or burn-down herbicides to ensure that wheat is weedfree at the time of planting.
- Some wheat varieties are sensitive to Axiom. Check the label and with seed supplier for information on tolerance prior to using.

Herbicide	Formulation	Product Rate Range
Curtail	2.38L	1 - 2 2/3 pts

- Curtail is a premix of clopyralid (Stinger) plus 2,4-D amine that controls many annual weeds in wheat, including ragweeds, lambsquarters, mustard species, field pennycress, and shepherd's-purse.
- Curtail controls Canada thistle, but will be less effective than Stinger for long-term thistle control. For best thistle control, apply after the majority of the weed's basal leaves have emerged from the soil, but before bud stage. Other perennials controlled or suppressed include sowthistle, dandelion, and curly dock.
- Mode of action: group 4 (see page 12-13).
- Apply in the spring to actively growing wheat after 4 leaves have unfolded on the main stem. Maximum rates based on wheat growth stage and weed size are as follows: 2 2/3 pints - before jointing, weeds up to 12 inches tall; 1.5 pints - before boot stage,

weeds up to 10 inches tall; and 1 pint - before boot stage, weeds less than 6 inches tall.
- Apply in a spray volume of at least 10 gpa and increase volume where the weed/crop canopy is dense.
- Curtail can be applied in UAN.
- Allow 6 to 8 hours between application and rainfall.
- Do not apply Curtail where double-crop soybeans will be planted after wheat harvest or a legume will be seeded into standing wheat.
- Do not harvest hay from treated fields.
- Crop rotation restrictions: grasses - 30 days after application; alfalfa, soybeans - 10 1/2 months; clovers - 18 months.

Herbicide	Formulation	Product Rate Range
Dicamba + 2,4-D premix	3.87L	0.5 - 1 pt

- This product is available from various manufacturers, and product names and rates vary. Controls broadleaf weeds in wheat.
- Mode of action: group 4 (see page 12-13).
- Apply 0.5 to 1 pint per acre in the spring after tillering and prior to the joint stage.
- Rates up to 1 1/3 pints per acre can be applied in the fall after wheat begins to tiller for suppression of perennial weeds such as dandelion. Apply following a frost but before a killing freeze. Periods of extended stress such as cold and wet weather may increase the risk of crop injury. Do not apply in the fall unless the user is willing to accept the risk of of crop injury.
- Apply in a spray volume of at least 5 gpa, and increase spray volume in dense or tall vegetation.

Herbicide	Formulation	Product Rate Range
Maverick	75DF	2/3 oz

- Maverick (sulfosulfuron) can be applied in the fall to emerged wheat to suppress or control grass weeds.
- Mode of action: group 2 (see page 12-13).
- Maverick will suppress or control downy bromegrass and cheat, which are winter annual grasses. Most effective application timing is postemergence in the fall when these grasses are in the 2 to 3-leaf stage. This treatment will also suppress quackgrass. Maverick provides residual control of some winter annual broadleaf weeds, but may not adequately control emerged broadleaf weeds.
- Apply with NIS (2 qts/100 gallons).
- The optimum pH of the spray solution is 6.0 to 8.0 when using Maverick.
- OSU recommends the use of an STS soybean variety where double-crop soybeans will be planted after wheat harvest. The label specifies the following with regard to rotation to soybean: 1) STS soybeans can be planted 3 months after application where soil pH is less than 6.5 and at least 30 inches of rain has occurred between application and soybean planting; 2) non-STS soybeans can be planted 5 months after application where soil pH is less than 6.5 and at least 30 inches of rain has occurred; and 3) non-STS soybeans can be planted 12 months after application where soil pH is less than 7.5 and at least 24 inches of rain has occurred.
- Any crop other than soybeans or wheat should be planted no sooner than 3 months after Maverick application and only after the completion of a successful field bioassay.

Herbicide	Formulation	Product Rate Range
Metribuzin	75DF	0.75 - 2 oz

- Metribuzin (Dimetric, Metri DF) can be applied in the fall to emerged wheat to help control winter annual weeds.
- Mode of action: group 5 (see page 12-13).
- Wheat should be in the 2-leaf to 2-tiller stage and actively growing at the time of application. Rate varies with soil type.
- Wheat varieties vary in their tolerance to metribuzin. Consult the label for a list of varieties that are approved for use with metribuzin.
- Can be applied with other herbicides labeled for fall application, including Harmony Extra. Consult labels for all precautions before application of any herbicide combination.
- Do not apply with fertilizer solution.
- Crop injury may occur if metribuzin is applied: 1)when the crop is under stress from frost damage, drought, or excessive moisture; 2) to soils with pH greater than 7.7, or 3) to fields where wheat is planted less than 1 inch deep.

Small Grains: Wheat Only

Herbicide	Formulation	Product Rate Range
Olympus	70WDG	0.6 - 0.9 oz

- Olympus (propoxycarbazone-sodium) controls downy brome, cheat, and mustard species. Olympus should be mixed with other herbicide(s) to control a broader spectrum of broadleaf weeds.
- Mode of action: group 2 (see page 12-13).
- Apply in the fall after the majority of the wheat plants have emerged, or in the spring before jointing.
- Apply with NIS (0.25 to 0.5% v/v). When applied using UAN as the carrier, the NIS rate is 0.25% v/v. Temporary crop injury, including reduced growth, discoloration, and leaf burn, may occur when fertilizer is the carrier. Do not use adjuvants that result in a spray solution pH of less than 5.
- Can be mixed with Harmony GT, Harmony Extra, dicamba, or bromoxynil.
- Do not plant crops other than wheat within 4 months after application. Conduct field bioassay before rotating to any other crop - see label for guidelines.

Herbicide	Formulation	Product Rate Range
Olympus Flex	4.5WDG	3 - 3.5 oz

- Olympus Flex is a premix of mesosulfuron-methyl and propoxycarbazone-sodium that controls winter annual grasses in wheat, including annual bluegrass, annual ryegrass, downy brome, and cheat. Olympus Flex should generally be mixed with other herbicide(s) to control broadleaf weeds.
- Mode of action: group 2 (see page 12-13).
- Apply in the fall or spring, from when the first fully expanded true leaf of wheat is visible, through jointing. Application in the fall will result in most effective winter annual grass control.
- Apply with NIS (0.5% v/v) plus AMS (1.5 - 3 lbs/A) or 28% UAN (1 - 2 qts/A). MSO (1.3 to 1.5 pt/A)can be substituted for surfactant (without the addition of AMS or UAN), but the risk of crop injury increases. Up to 15% of the spray solution can be UAN or other nitrogen solution, and NIS is still required.
- Can be mixed with Harmony GT, Harmony Extra, Widematch, MCPA, bromoxynil, and generic equivalents of these herbicides.
- Soybeans can be planted when both these conditions have been met: 5 months has elapsed and 18 inches of precipitation has occurred since application.

Herbicide	Formulation	Product Rate Range
PowerFlex	7.5DF	3.5 oz

- PowerFlex (pyroxsulam) controls downy brome, cheat, and Italian ryegrass, and some winter annual broadleaf weeds.
- Mode of action: group 2 (see page 12-13).
- Apply in the fall or spring, when wheat is in the 3-leaf to jointing stage. Most effective control results from treatment of winter annual grasses in the fall at the 2-leaf to 2-tiller stage of growth, and when broadleaf weeds are no more than 2 inches tall or in diameter.
- Apply with NIS (0.25% to 0.50% v/v) or COC (1 to 1.25% v/v). When using NIS, UAN (1-2 qt/A) or AMS (3 lbs/acre) may be added to enhance control. Potential for crop injury is increased with the use COC. Do not use additives that lower the spray solution below a pH of 6.0.
- PowerFlex may be applied in spray solutions containing nitrogen fertilizer solution (UAN). The spray solution should not consist of more than 50% UAN and should not exceed 30 pounds of actual nitrogen per acre. When PowerFlex is applied in spray solutions containing UAN, use NIS at a maximum of 0.25% v/v, instead of COC or MSO. Temporary crop injury may result when liquid nitrogen is used as the spray carrier.
- A separate application of nitrogen fertilizer solution made 7 days before or after a PowerFlex application may result in transient leaf burn or stunting. Do not make a liquid fertilizer application during this period unless the risk of crop response is acceptable.
- Grass control can be reduced if PowerFlex is mixed with dicamba or amine formulations of 2,4-D or MCPA.
- Allow 3 months between application and soybean planting. Where Powerflex is applied in fall or anytime prior to February, do not plant soybeans until after April 30.

Small Grains: Wheat Only

Herbicide	Formulation	Product Rate Range
Pulsar	1.67L	8.3 - 12.5 oz

- Pulsar is a premix of fluroxypyr (Starane) and dicamba for control of broadleaf weeds in wheat and barley. Pulsar applied alone has a fairly narrow spectrum of control, and should generally be mixed with MCPA ester or another broadleaf herbicide.
- Mode of action: group 4 (see page 12-13).
- Apply before the jointing stage of wheat (label does not specify whether fall application is allowed).
- Pulsar can be applied with NIS (0.125% to 0.25% v/v) to improve control under less than optimum environmental conditions. Can be applied in a spray solution containing up to 50% nitrogen fertilizer solution.
- Allow 9 months between application and soybean planting.

Herbicide	Formulation	Product Rate Range
Tribenuron methyl (active ingredient)		
Express TotalSol	50DF	0.25 - 0.5 oz
Nuance, Victory	75WDG	1/6 - 1/3 oz

- Tribenuron methyl controls annual broadleaf weeds, including common chickweed, lambsquarters, and field pennycress, and provides partial control of Canada thistle, dandelion, shepherdspurse, and other mustard species.
- Mode of action: group 2 (see page 12-13).
- Can be mixed with bromoxynil, 2,4-D or MCPA for improved control of Canada thistle, ragweeds, dandelion, and other broadleaf weeds. Ester formulations have provided better results than amines.
- Apply after wheat is in the 2-leaf stage but before the flag leaf is visible. Apply when annual weeds are less than 4 inches tall or wide (rosettes). Allow 45 days between application and harvest.
- To reduce the risk of crop injury, mix tribenuron with 2,4-D and apply after crop has reached the tillering stage of growth.
- To control or suppress Canada thistle, apply the higher rate to actively growing thistle plants that are 4 to 8 inches tall with 2 to 6 inches of new growth.
- When applying in water, add 0.06 to 0.50% v/v NIS (1/2 to 4 pints per 100 gallons of water). When applying in liquid fertilizer, add 0.06 to 0.25% NIS. Temporary crop yellowing and stunting may occur when applied in liquid fertilizer. This injury is occasionally severe, and risk of severe injury may increase under saturated soil conditions.
- For flat-fan nozzles, apply in a spray volume of at least 5 gallons per acre. For flood nozzles on spacings of 30, 40, or 60 inches, maintain minimum spray volumes of 10, 13, or 20 gallons per acre, respectively.
- Forage legumes, grasses, and soybeans may be planted 45 days after application.
- Do not graze or feed forage or hay from treated areas to livestock. Dry-harvested straw may be used for bedding and feed.

Small Grains: Oats and Wheat

Herbicide	Formulation	Product Rate Range
2,4-D Amine 2,4-D Ester	Various	0.25 - 1 lb ai/A
MCPA Amine MCPA Ester	4 lb/gal	1/2 - 2 pt 1/2 - 1 1/2 pt

- Mode of action: group 4 (see page 12-13).
- Apply in the spring after full tiller. Labels vary with regard to the wheat stage when 2,4-D should no longer be applied. Weedar and Weedone labels specify application before wheat is forming joints in the stem. Labels of some other 2,4-D products allow application after jointing but before early boot. The risk of injury and yield loss increases when applied after jointing. Amine formulations are less likely to injure the crop than ester formulations, and use of fertilizer solution as the spray carrier may increase the risk of injury. To minimize the risk of injury after jointing, use water as the carrier and do not apply more than 0.25 lb ai/A of ester or 0.5 lb ai/A of amine.
- Application prior to wheat emergence can cause crop injury and stand loss.
- MCPA is less likely than 2,4-D to injure oats. Do not apply 2,4-D ester to oats.
- 2,4-D and MCPA are translocated herbicides that control many winter and summer annual weeds, but are weak on chickweed, henbit, and purple deadnettle. Expect some suppression of early-emerging perennial broadleaf weeds.
- 2,4-D may provide some suppression of wild garlic, especially the ester formulation. Apply 0.75 lb ai/A of 2,4-D ester when wild garlic plants are small.
- In wheat, 2,4-D or MCPA may be applied with 1/4 pint of dicamba (4 lb/gallon formulations) for improved control of some weeds.
- To control problem weeds at harvest, apply 0.5 to 1.0 lb ai/A per acre of 2,4-D during the hard dough stage.
- Do not forage or graze within 7 days (MCPA) or 2 weeks (2,4-D) of treatment. Do not feed treated straw to livestock when 2,4-D is applied as a preharvest treatment.

Herbicide	Formulation	Product Rate Range
Aim	2EC	0.5 - 2 oz

- Aim (carfentrazone-ethyl) is a contact herbicide that controls a limited number of small summer and winter annual weeds. Aim is not effective on biennial or perennial weeds.
- Mode of action: group 14 (see page 12-13).
- Apply Aim in the fall or spring before jointing when weeds are less than 4 inches tall and rosettes are less than 3 inches across.
- Apply with NIS (0.25% v/v). UAN (2 to 4 gallons/100 gallons) or AMS (2 to 4 lbs/A) can be added if recommended for use with other herbicides in a mix with Aim.
- Apply Aim in a spray volume of 10 to 20 gpa with a pressure of 20 to 40 psi. Flat fan nozzles are recommended for adequate spray coverage.
- Add Aim to the spray tank before adding other products.

Herbicide	Formulation	Product Rate Range
Bromoxynil	2S	1 - 2 pt

- Bromoxynil is a contact herbicide that controls annual broadleaf weeds. Product names include Buctril, Moxy, Broclean, and Bronate among others.
- Mode of action: group 6 (see page 12-13).
- In fall-seeded small grains, apply in the fall or spring, but before the boot stage.
- In spring-seeded oats, apply from emergence up to the boot stage.
- For best results, apply before weeds are in the 4-leaf stage or are 2 inches tall, or before rosettes exceed 1 inch in diameter.
- Very safe on small grains, but slight leaf burn may occur occasionally.
- May be applied with dicamba, 2,4-D, MCPA, Express, or Harmony Extra. Maximum growth stage at the time of application and spray additive recommendations vary with the other herbicide in the mixture. Follow label directions to avoid injury to the crop.
- UAN may be used as the spray carrier early in the spring, but this will increase leaf burn. Do not use fertilizer as the carrier after jointing.
- Do not graze treated fields for 30 days after application.

Small Grains: Oats and Wheat

Herbicide	Formulation	Product Rate Range
Callisto	4L	6 oz (preemergence) 3 oz (postemergence)

- Callisto (mesotrione) can be applied preemergence or postemergence in oats for control of broadleaf weeds. Do not apply to wheat or other small grains.
- Mode of action: group 28 (see pages 12-13).
- Apply when weeds are less than 5 inches tall.
- Control of emerged weeds requires the addition of COC (1% v/v) or NIS (0.25% v/v). UAN (2.5% v/v) or AMS (8.5 lbs/100 gallons) may be added, but increases the risk of injury.
- Postemergence applications may cause temporary crop injury, including leaf bleaching and burn, and stunting if injury is extreme.

Herbicide	Formulation	Product Rate Range
Cleansweep D	4.25L	1 - 1.5 pts
Cleansweep M	4L	1 - 1.5 pts

- These products are mixtures of bromoxynil, fluroxypyr, and either 2,4-D (Cleansweep D) or MCPA (CleansweepM) for control of annual broadleaf weeds in wheat, oats, and barley. Supression of some perennial broadleaf weeds is also possible.
- Mode of action: group 6 (bromxynil), group 4 (fluroxypyr, 2,4-D, MCPA. See pages 12-13.
- Cleansweep D: apply from the fully-tillered stage of growth until (but not including) the jointing stage.
- Cleansweep M: apply from the 2-leaf crop stage up to and including flag leaf emergence.
- Weed control is maximized by application when air temperatures are between 55 and 75 degrees, and reduced activity can occur below 45 or above 85 degrees. Weed control and crop tolerance may be reduced if frost occurs within 3 days before or after application.
- Allow 1 hour between application and rainfall.
- Labels for these products do not indicate whether product can be applied in the fall or applied using 28% UAN as the spray carrier. An adjuvant can be added, but labels do not otherwise specify rate or type of adjuvant.
- Allow 4 months between application and planting soybeans or crops other than small grains.

Herbicide	Formulation	Product Rate Range
Dicamba	4L	2 - 4 oz

- Dicamba is sold under various trade names, including Banvel, Oracle, and Sterling Blue. Dicamba is a translocated herbicide that controls annual and winter annual broadleaf weeds, and helps suppress perennial broadleaf weeds.
- Mode of action: group 4 (see page 12-13).
- Can be applied in the fall or spring after emergence of fall-seeded wheat, but before jointing. Application prior to wheat emergence can cause crop injury and stand loss. Can be applied prior to planting, but allow 10 days between application and planting for each 0.25 lb active ingredient dicamba applied.
- In spring oats, apply a maximum of 0.12 lb ai/A before oats exceed the 5-leaf stage.
- For best results, apply when weeds are small and actively growing.
- Dicamba is more effective on Canada thistle and smartweed than 2,4-D or MCPA. For better control of some weeds, Banvel may be mixed with up to 2 pints of 2,4-D amine or 1 1/2 pints of 2,4-D ester.
- Do not graze or harvest for dairy feed before ensilage (milk) stage.

Herbicide	Formulation	Product Rate Range
Finesse/Report Extra	75WDG	0.2 - 0.5 oz

- Finesse/Report Extra is a premix of chlorsulfuron and metsulfuron methyl that can be applied preplant, preemergence or postemergence for control or suppression of downy brome, cheat, and annual ryegrass. Postemergence applications control or suppress these same grasses and also annual annual bluegrass, along with a number of winter annual broadleaf weeds.
- Postemergence applications should be made in the fall for most effective control of grasses, and to avoid crop rotation problems. Apply after the majority of the weeds have emerged, when the crop is in at least the 1-leaf stage.
- Chlorsulfuron is a long-residual sulfonylurea herbicide. Consider rotation guidelines prior to using this product. STS soybeans can be planted 6 months after application. Field corn and non-STS soybeans can be planted 18 months after application.

Small Grains: Oats and Wheat

- Apply with flat fan (at least 3 gpa) or low-volume flood nozzles (at least 10 gpa) for optimum distribution and coverage. Include a NIS (0.125 to 0.5% v/v).
- Can be applied using UAN as the spray carrier, and the rate of UAN determines the rate of surfactant. Consult the label for more information.
- The field can be grazed anytime after herbicide application.

Herbicide	Formulation	Product Rate Range
Huskie	2.47L	13.5 - 15 oz

- Huskie (bromoxynil plus pyrasulfotole) controls winter and summer annual broadleaf weeds in wheat, oats, barley, rye, and triticale.
- Mode of action: group 6 (bromoxynil); group 27 (pyrasulfotole). See pages 12-13.
- Apply in fall or spring after the crop reaches the 1-leaf stage, and up to flag leaf emergence. Weeds should be no larger than the 4- to 6-leaf stage, or 4 inches in diameter, depending upon species.
- Apply with AMS (0.5 to 1 lb/A) or UAN (1 to 2 qts/A) for most consistently effective weed control. Can be applied using nitrogen fertilizer solution as the spray carrier. The fertilizer solution should not exceed 50% nitrogen, and the nitrogen rate should not exceed 30 lbs/A.
- Should generally be applied in a spray volume of at least 10 gpa, but this can be reduced to as low as 5 gpa when conditions are ideal for weed control (small weeds, favorable environment). Use nozzles and spray pressure that result in medium spray droplets. Do not apply with floodjet or cone nozzles.
- Allow 1 hour between application and rainfall.
- Do not graze or harvest forage within 25 days after application. Grain and straw can be harvested 60 days after application.
- Allow 4 months between application and planting soybeans.

Herbicide	Formulation	Product Rate Range
Orion	2.37L	17 oz

- Orion (MCPA plus florasulam) controls annual broadleaf weeds in wheat, oats, rye, and triticale. Weeds controlled include chickweed, mustard species, common ragweed, and lambsquarters.
- Mode of action: group 2 (florasulam); group 4 (MCPA). See pages 12-13.
- Apply early postemergence when the crop is in the 3-leaf to joint stage. Weeds will be most effectively controlled when in the seedling stage and actively growing.
- This product does not require use of an adjuvant. Apply in a spray volume of at least 10 gpa. Increasing the spray volume may improve control where the crop and weed canopy is dense.
- Allow 4 hours between application and rainfall.
- Do not graze for 7 days after application. Apply at least 60 days before harvest.
- Crop rotation restrictions: grasses - 0.5 months; corn - 3 months; alfalfa, soybeans - 9 months; clovers - 12 months.

Herbicide	Formulation	Product Rate Range
Peak	57DF	1/2 oz (1 packet per 6 acres)

- Peak (prosulfuron) controls annual broadleaf weeds in wheat, oats, rye, and some other small grains. Weeds controlled include chickweed, wild garlic, mustard species, and common ragweed (except ALS-resistant biotypes). Peak will suppress Canada thistle.
- Mode of action: group 2 (see page 12-13).
- May be mixed with 2,4-D, dicamba, Buctril, or MCPA to improve control of Canada thistle, giant ragweed, lambsquarters and other broadleaf weeds. Follow restrictions on all labels with regard to growth stage and adjuvants in mixtures.
- Apply in fall or spring after crop emergence and before the second node is detectable in stem elongation (Feeke's Growth Stage 7). Weeds should be 1 to 3 inches tall and actively growing for best results.
- COC (1 to 4 pints/A) is the preferred adjuvant when Peak is applied alone using water as the carrier. Apply with NIS (1 to 2 quarts per 100 gallons of spray) if fluid fertilizer is used as the spray carrier, or if mixing with any other herbicide.

Small Grains: Oats and Wheat

- Apply in a spray volume of at least 10 gpa. Increasing the spray volume may improve control where the crop and weed canopy is dense.
- Do not apply when the crop is under stress due to drought, cold weather, or other factors, or if cold, wet conditions are expected within one week after application.
- Allow 4 hours between application and rainfall.
- Do not graze or feed treated crops to livestock until 30 days after application.
- Crop rotation restrictions: soybeans - 10 months; forage grasses, alfalfa, clovers - 22 months.

Herbicide	Formulation	Product Rate Range
Sharpen	2.85SC	1 to 2 oz/A

- Sharpen (saflufenacil) can be applied preplant or preemergence to wheat, oats, or barley. Mixtures with glyphosate can provide more effective control of emerged weeds in no-till, compared with glyphosate alone. Sharpen provides a low level of residual control of broadleaf weeds, especially at 2 oz.

Herbicide	Formulation	Product Rate Range
Starane	1.5L	1/2 - 2/3 pt

- Starane (fluroxypyr) controls hemp dogbane, common ragweed and a few other broadleaf weeds. Due to a relatively narrow spectrum of activity, Starane should generally be mixed with other herbicides to improve control of specific weeds.
- Mode of action: group 4 (see page 12-13).
- Apply from the 2-leaf growth stage of wheat or oats up to and including flag leaf emergence, and when weeds are less than 4 (1/2 pt/A) to 8 (2/3 pt/A) inches tall.
- Do not plant soybeans within 4 months following Starane application.

Herbicide	Formulation	Product Rate Range
Stinger	3L	1/4 - 1/3 pt

- Stinger (clopyralid) controls ragweeds, wild buckwheat, and Canada thistle, and suppresses sowthistle and dandelion.
- Mode of action: group 4 (see page 12-13).
- Apply from the 3-leaf stage up to early-boot stage of oat or wheat growth. Annual broadleaf weeds should have no more than 5 leaves at the time of application.
- For Canada thistle control, apply 1/3 pint when thistle plants are in the rosette (at least 4 inches tall or across) to prebud stage.
- Can be mixed with most other wheat herbicides for improved control of broadleaf weeds. See label for more information.
- Do not harvest hay from treated fields.
- Crop rotation restrictions: grasses - anytime; alfalfa, soybeans - 10 1/2 months after application; clovers - 18 months.

Small Grains: Oats and Wheat

Herbicide	Formulation	Product Rate Range
Thifensulfuron + tribenuron methyl (active ingredients)		
Harmony Extra TotalSol	50DF	Wheat 0.45 - 0.9 oz Oats 0.45 - 0.6 oz
Nimble, TNT Broadleaf, Treaty Extra	75WDG	Wheat 0.3 - 0.6 oz Oats 0.3 - 0.4 oz
Rapport BroadSpec	75DF	Wheat 0.4 - 1 oz
Rapport Tank Mix	75DF	Wheat 0.6 - 1 oz

- Controls wild garlic and annual broadleaf weeds, including common lambsquarters, mustard species, Pennsylvania smartweed, field pennycress, shepherd's purse, common chickweed, purple deadnettle, and henbit.
- Mode of action: group 2 (see page 12-13).
- Does not control ragweeds. Can be mixed with bromoxynil, 2,4-D or MCPA for improved control of Canada thistle, ragweeds, and some other weeds. Ester formulations have provided better results than amines. Mixing with dicamba may result in reduced control of some broadleaf weeds.
- Apply in fall or spring after wheat is in the 2-leaf stage, but before the flag leaf is visible. Annual broadleaf weeds should be past the cotyledon stage, actively growing, and less than 4 inches tall or across at the time of application.
- Apply when spring oats are in at least the 3-leaf stage, and before jointing. Do not apply to oats more than once per season. Do not use on Ogle, Premier, or Porter varieties. Rapport products are not labeled for use on oats.
- To control wild garlic, apply higher rates when garlic plants are less than 12 inches tall with 2 to 4 inches of new growth. Control will be better if applied during warm weather (60 F or more) to actively growing garlic plants.
- To suppress Canada thistle, apply higher rates when all thistles have emerged, are actively growing, and are 4 to 8 inches tall with 2 to 6 inches of new growth. Application with 2,4-D will improve thistle control.
- The following adjuvant recommednations pertain to all products listed except Rapport BroadSpec and Tank Mix - see Rapport product labels for adjuvant recommendations. If water is the spray carrier, apply with 0.25 to 0.5% v/v NIS (1 to 2 quarts per 100 gallons). If the spray solution contains consists of no more than 50% UAN (and the other 50% is water), apply with 0.06 to 0.25% v/v surfactant (1/2 to 2 pints per 100 gallons). If the spray solution consists of more than 50% nitrogen fertilizer, consult dealer or Dupont representative before adding an adjuvant. Temporary crop injury may occur when applied with surfactant, when fertilizer is used as the spray carrier. This injury is occasionally severe, and risk of severe injury may increase under saturated soil conditions.
- May be applied with flat fan or low-volume flood nozzles. Minimum spray volume is dependent upon nozzle type and size. See label for additional information.
- Most other crops can be planted 45 days after application (60 days for Rapport BroadSpec).
- Do not graze or feed forage or hay from treated areas to livestock.

Herbicide	Formulation	Product Rate Range
WideMatch	1.5L	1.0 - 1.3 pts

- WideMatch is labeled for use on small grains in Ohio, but not in Indiana.
- WideMatch is a premix of clopyralid (Stinger) plus fluroxypyr (Starane) for control of broadleaf weeds, including hemp dogbane, ragweeds, Canada thistle, marestail, and cocklebur. WideMatch should be mixed with other wheat herbicide(s) for control of most winter annual weeds.
- Mode of action: group 4 (see page 12-13).
- Apply from the 3-leaf growth stage of wheat or oats up to and including flag leaf emergence, and before weeds are 4 inches tall.
- For most effective Canada thistle control, apply after the majority of the basal leaves have emerged and before bud stage.

Oats and Wheat — Underseeded With Legumes

Herbicide	Formulation	Product Rate Range
2,4-D Amine	4 lb/gal	1/4 - 1/2 pt
MCPA Amine	4 lb/gal	1/2 pt

- Mode of action: group 4 (see page 12-13).
- Use low pressure (30 psi or less), and apply before jointing, but after the small grain and weeds have formed a canopy over the legumes. Do not apply 2,4-D until the grain is 8 inches tall.
- Controls most annual broadleaf weeds.
- For best results, apply when weeds are small and actively growing.
- MCPA is less likely to injure the legumes than 2,4-D, but both will cause some injury and stand loss. Red and ladino clovers are more tolerant than other legumes. Do not apply MCPA to vetch or sweet clover. Do not apply 2,4-D to sweet clover or alfalfa unless the weed infestation is severe and crop injury can be tolerated.
- To minimize injury, do not use more than 6 gallons of water per acre when applying MCPA amine.
- Do not forage or graze for 7 days (MCPA) or 14 days (2,4-D) after treatment.

Herbicide	Formulation	Product Rate Range
Bromoxynil	2S	1 - 1 1/2 pt

- Can be applied to wheat, oats, barley, rye, and triticale underseeded with alfalfa only.
- Mode of action: group 6 (see page 12-13).
- Apply to small grains from emergence up to boot stage and when seedling alfalfa has 2 to 4 trifoliate leaves.
- Apply when weeds have less than 4 leaves or are less than 2 inches tall, or before rosettes are 1 inch in diameter.
- Apply in a minimum spray volume of 20 gpa with a minimum pressure of 30 psi.
- Some crop leaf burn can result from application, especially under warm, humid conditions. Do not apply when temperatures will exceed 70 F the day of and for 3 days following application. Do not apply when alfalfa is under stress by moisture, temperature, insect, or disease.
- Do not graze or harvest for 30 days following treatment.

Wheat: Harvest Aids

Herbicide	Formulation	Product Rate Range
2,4-D Amine	Various	1.5 lbs ai/A
2,4-D Ester		0.5 - 1.0 lb ai/A

- Various formulations of 2,4-D can be applied with aerial or ground equipment after wheat has reached the hard dough stage.
- Mode of action: group 4 (see page 12-13).
- The Weedar 64 label advises that crop injury can occur, and spot treatment is recommended to minimize the extent of injury.
- Do not feed wheat straw to livestock if a harvest-aid treatment of 2,4-D has been applied.
- Take precautions to reduce spray drift. Corn, soybeans and other sensitive crops are likely to be growing in areas surrounding treated wheat fields. Amine formulations of 2,4-D have less potential than ester formulations to move off-target through volatilization and injure other plants.

Herbicide	Formulation	Product Rate Range
Aim	2EC	1 - 2 oz

- Aim (carfentrazone) can be applied prior to harvest of mature small grains for dessication of velvetleaf, morningglory, pigweeds, and other weeds. Apply at least 3 days before harvest.
- Mode of action: group 14 (see page 12-13).
- The total amount of Aim that can be applied to small grains in one season, including postemergence and harvest aid treatments, cannot exceed 2 oz/A.
- Use a spray volume that results in complete coverage of foliage. Apply with NIS (0.25% v/v) or a COC (1 to 2% v/v). UAN or AMS may also be added.

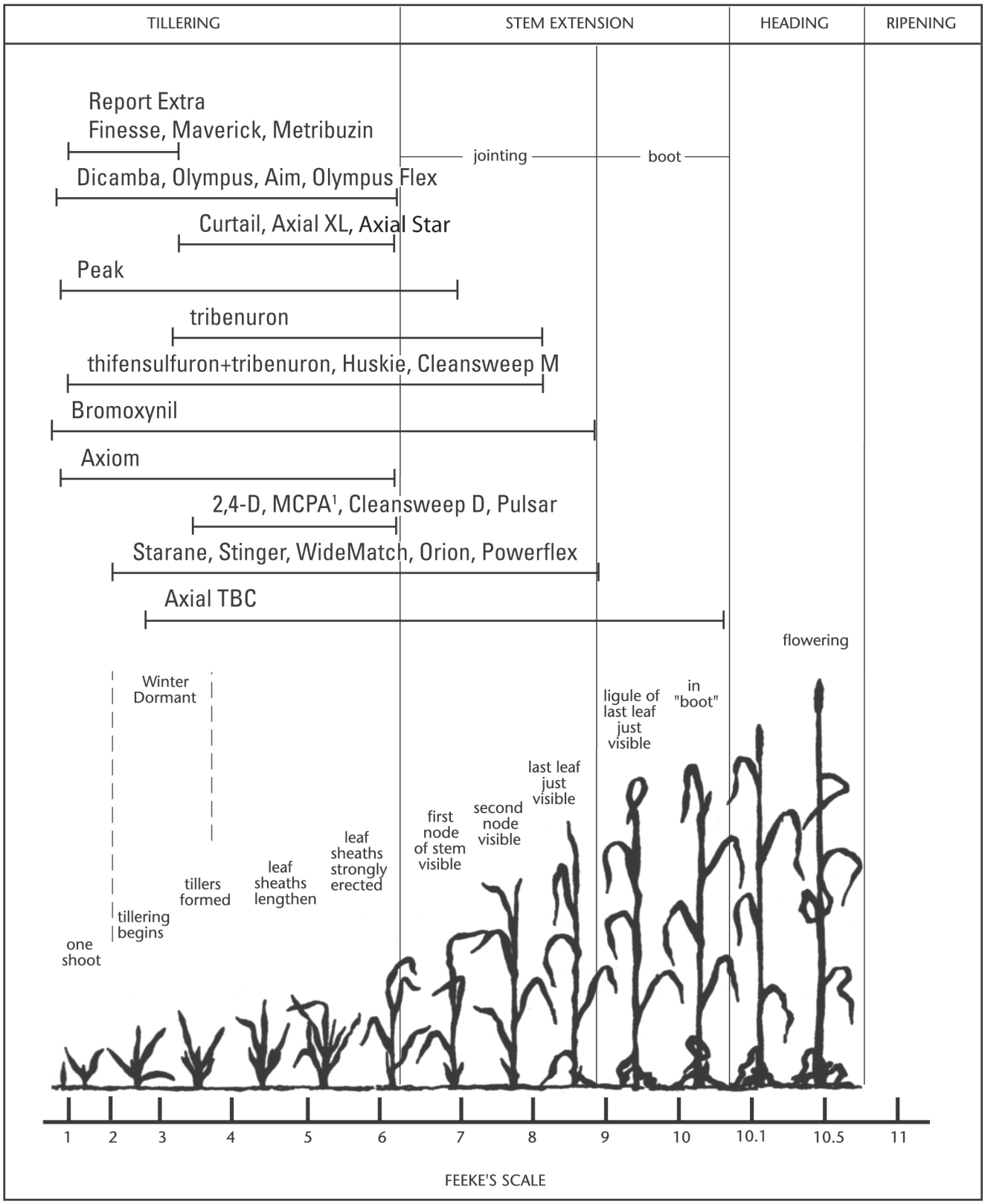
Herbicide	Formulation	Product Rate Range
Dicamba + 2,4-D premix	3.87L	2 pints

- This product is available from various manufacturers, and product names and rates vary.
- Apply when wheat is in the hard dough stage and the green color has disappeared from the nodes of the wheat stem. Apply at least 7 days before harvest.
- Can be mixed with glyphosate products registered for this use.
- Do not use treated wheat for seed unless a germination test is performed on the seed.

Herbicide	Formulation	Product Rate Range
Glyphosate	Various	0.75 lb acid/A

- Glyphosate can be applied as a preharvest treatment in wheat to control annual and perennial weeds. Table 24 contains a list of currently available glyphosate products. See labels for specific information on preharvest application.
- Mode of action: group 9 (see page 12-13).
- Apply after the hard dough stage when grain moisture is 30% or less, and at least 7 days prior to harvest.
- Some glyphosate products can be mixed with 2,4-D (0.5 to 1.0 lb ai/A) to broaden the spectrum of control.
- Apply with ground or aerial application equipment using a spray volume of 3 to 10 gpa.
- Wheat grown for seed should not be treated with glyphosate as reduction of germination and vigor may occur.
- Take precautions to reduce spray drift. Corn, soybeans and other sensitive crops are likely to be growing in areas surrounding treated wheat fields.

Figure 1. Wheat Growth stages and Herbicide application.



[1] Labels of some 2,4-D products allow application after jointing but before early boot. (See text for more information.)

Managing Weeds in Legumes

Managing weeds in forages requires a different approach than weed management in row crops. Over 95% of the weed control in a healthy forage crop comes from the competition provided by the forage. However, to maintain a relatively weed-free forage, proper fertilization, cutting management, insect control, the use of disease-resistant varieties, and selective herbicide use are necessary to keep the forage stand competitive.

If weeds become a problem, they can compete or interfere for light, nutrients, water, and space, directly influencing yield and standability. Common chickweed infestations in alfalfa have been reported to reduce forage stand by more than 30%. Common chickweed emerges in the fall and winter, and spring develops a thick lush mat by early spring that can compete with the first forage cutting. Once the chickweed dies in early summer, summer annual weeds such as foxtails, lambsquarters, and pigweed or perennial weeds such as dandelion can replace the dead or dying winter annual weeds and continue to reduce forage yield and quality.

Unlike most grain or fiber crops from which weeds are separated at harvest, weeds are often harvested along with the forage crop, potentially reducing quality. Reductions in quality are often in the form of lower protein content and feed digestibility. Although weeds do have some feed value, this value differs among species. Dandelions come close to equaling alfalfa in protein and total digestible nutrients (TDN). Control of dandelion may not necessarily improve the quality of hay, but it may be of some value in reducing the time necessary to dry the hay, since dandelion dries more slowly than alfalfa. Increased drying time may mean greater harvest losses due to untimely rainfall. Some weeds are toxic to livestock, while others become toxic under certain environmental conditions. For information regarding plants that are toxic to live stock see the following web sites: http://www.vet.purdue.edu/depts/addl/toxic/cover1.htm or http://www.ansci.cornell.edu/plants/index.html.

Grassy weed quality can be similar to that of the forage. In general, weedy grasses have about 75% of the quality of alfalfa. However, controlling quackgrass in alfalfa can increase forage protein levels 4% to 7%. Weeds with woody stems or flower stalks, such as yellow rocket, white cockle, rough fleabane, curly dock, and broadleaved dock, have lower protein levels (about 50% of the quality of alfalfa), so controlling them is even more important.

When weeds are present or persist in spite of good management, herbicides can help improve yield and quality. Weed control at establishment or in the seedling year is most critical for maintaining a healthy forage stand. When weeds are controlled the seedling year, the forage crop seldom requires additional herbicide treatments for at least the first two years of the stand.

Weed management in forages can be divided into two phases: control in the establishment or seedling year and control in an established stand.

Control before and during establishment

Managing weeds in forages begins long before crop establishment. Certain types of weeds are potentially serious problems for forages, so it is important to eliminate them in advance. In particular, perennial broadleafs and grasses such as dandelion, curly dock, Canada thistle, and quackgrass are much easier to manage prior to planting a forage crop. In addition, biennial weeds such as musk thistle, wild carrot, and burdock should be eliminated before establishing forage. If these weeds are not removed before the seeding is made, they commonly persist throughout the life of the forage. The cost of controlling weeds before or at the time of seeding should be considered an investment that will be returned for the life of the stand.

Below are some general rules for managing weeds at establishment or in the seedling year:

1. Weeds that emerge with the crop are generally more destructive.
2. Maintain the forage relatively weed-free for the first 60 days.
3. Weeds that emerge beyond 60 days will not influence that year's forage yield.
4. Later-emerging weeds may still influence forage quality.
5. Winter annual weed competition in early spring is most damaging to forages.
6. Broadleaved weeds are generally more competitive against legumes than grassy weeds.

Herbicides are needed most often during establishment, and several options exist for managing weeds in pure legume seedings. In no-till seedings, adequately controlling the existing vegetation prior to planting is very important, especially perennials. Weed control is also very important while the forage is young and prone to competition from invading species.

Control in established alfalfa

The best weed control in an established forage stand is achieved by maintaining a dense healthy stand through proper fertilization, cutting management, and insect control. Controlling weeds in established forages is normally of greatest benefit in the first cutting. Weeds generally cause less yield loss in the second and succeeding harvests. Before using a herbicide in established stands, evaluate the forage to ensure it is worth the cost of the herbicide.

Below are some general rules to follow before using a herbicide in established forage stands:

1. Thin or irregular stands will not thicken once weeds are removed. Be sure there are sufficient desirable species to fill in the gaps. Use the following guidelines to evaluate stands.

Stems per square foot	**Effect on Yield**
55	Stem density not limiting yield
40-55	Some yield reduction expected
<40	Significant yield reduction

Year	**Minimum number of plants/square foot**
Fall of seeding year	25-30
2nd	10-15
3rd or older	5-6

2. Weeds tolerant of the herbicide may invade the space left by susceptible species, ultimately creating a more severe weed problem.
3. Only well-established vigorous stands should be treated with herbicides.
4. If the forage stand is at least two years old and 25% to 30% are weeds, removing them with an herbicide application is of questionable value.
5. If 50% or greater of the stand are weeds, it is time to rotate to a different crop.
6. Weed control in established stands is most effective when herbicides are applied in the fall or early spring. Application of metribuzin or Velpar in winter when established alfalfa is dormant is the most effective method of broadleaf weed control.

If weeds become a problem in established forages, several herbicide options are available. Chemical control in established forage legumes is often limited to late fall or early spring applications. Also, many products have harvesting, feeding, or grazing restrictions following their use.

Adapted with modifications from the Penn State Field Crop Pest Management/Agronomy Guide.

Table 20. Weed Response to Herbicides in Alfalfa

This table compares the tolerance of forages to herbicides and the relative effectiveness of herbicides on weeds. Ratings are based on labeled application rate and weed size or growth stage. Performance may vary due to weather and soil conditions or other variables.

Forage crop tolerance rating:

0 = Excellent Tolerance; 1 = Good Tolerance; 2 = Fair Tolerance; 3 or greater = Poor Tolerance; and N = No Information.

Weed control rating:

9 = 90% to 100%; 8 = 80% to 90%; 7 = 70% to 80%; 6 = 60% to70%; - = less than 60% control, not recommended.

	Forage Crop Tolerance			Grasses									Broadleaf Weeds																
	Alfalfa	Red Clover	BFT	Barnyardgrass	Crabgrass	Downy Brome	Fall Panicum	Foxtails	Orchardgrass	Quackgrass	Volunteer Grain	Yellow Nutsedge	Canada Thistle	Chickweed	Dandelion	Dock, Curly	Field Pennycress	Henbit	Lambsquarters	Mustard, Wild	Nightshade	Pigweed	Plantain	Ragweed, Common	Ragweed, Giant	Shepherd's purse	Smartweed	Wild Radish	Yellow Rocket
Balan	1	1	1	9	9	9	9	9	-	-	8	-	-	8	-	-	-	-	9	-	-	9	-	-	-	-	-	-	-
Eptam	1	1	1	9	9	9	9	9	6	8	8	8	-	7	-	-	6	9	9	6	8	9	-	-	-	7	-	-	7
Bromoxynil	2	N	N	-	-	-	-	-	-	-	-	-	6	6	-	-	8	8	9	8	9	8	-	9	8	9	9	-	7
Butyrac	1	1	1	-	-	-	-	-	-	-	-	-	-	6	8	-	9	6	8	9	-	8	-	9	9	9	6	-	8
Chateau	1	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	8	9	9	9	9	9	-	7	-	9	7	-	-
Clethodim	0	0	0	9	8+	9	9	9	6	9	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Glyphosate	6	9	9	9	9	9	9	9	8	9	9	7	9	9	8	9	9	9	9	9	9	9	9	9	9	9	9	8	9
Kerb	1	1	1	8	8	9	6	8	7	8	9	-	-	8	-	-	-	8	6	-	6	6	-	-	-	-	-	-	-
Metribuzin	1	N	N	6	5	9	6	6	-	-	-	-	-	9	7	6	9	9	9	9	-	9	8	8	-	9	9	5	9
Paraquat	1	N	N	8	7	9	9	9	-	-	6	-	-	8	-	-	9	9	8	9	9	9	-	9	9	9	9	8	8
Poast/Poast Plus	0	0	0	9	9	9	9	9	6	7	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prowl H2O	1	N	N	8	9	7	9	8	-	-	-	-	-	6-	-	-	-	8+	8	-	-	9	-	-	-	6	6	-	-
Pursuit	1	N	N	6	7	-	7	8	-	-	-	-	6	8	-	-	8	8	6	9	9	9	-	6	7	9	9	9	8
Raptor	2	N	N	6	7	-	7	8+	-	-	-	-	6	8	-	-	8	8	8	9	9	9	-	7	8	9	8	9	8
Sinbar	1	N	N	6	7	9	6	7	-	-	-	-	-	9	6	6	9	9	9	9	6	8	7	8	-	9	8	9	7
Velpar/Velossa	1	N	N	7	7	8	6	7	6	-	-	-	-	9	8	6	9	8	9	9	6	9	8	8	-	9	8	7	9

Forage Legumes

Herbicide	Formulation	Product Rate Range
Butyrac 200 (2,4-DB)	2L	1 - 3 qt

- Mode of action: group 4 (see page 12-13).
- Controls annual broadleaf weeds in seedling forage legumes (alfalfa, clovers, and birdsfoot trefoil) and established alfalfa. Do not use on sweet clover.
- Apply in spring or fall when legumes have 2 to 4 trifoliate leaves. Annual weed seedlings should be no more than 2 to 3 inches tall. Rosettes should be no more than 2 inches across and not bolting. Weeds that emerge in the fall and overwinter in the rosette stage (mustards, field pennycress) may be more easily controlled in late fall than in spring.
- Apply 1 to 2 quarts/A when weeds are less than 1 inch tall, and 2 to 3 quarts when weeds are 1 to 3 inches tall. Use the 3-quart rate for smartweed or curly dock.
- Do not harvest or graze for 60 days following treatment.
- Butyrac 200 can be mixed with Poast Plus for control of a mixed population of grass and broadleaf weeds in alfalfa.

Herbicide	Formulation	Product Rate Range
Bromoxynil	2S	1 - 1 1/2 pt

- Mode of action: group 6 (see page 12-13).
- Apply in the fall or spring to seedling alfalfa with 4 trifoliate leaves when weeds have less than 4 leaves or are less than 2 inches tall, or before rosettes are 1 inch in diameter. Do not apply to established alfalfa
- Apply in a minimum spray volume of 20 gpa with a minimum spray pressure of 30 psi.
- For improved control of pigweed, mix 1 pint of bromoxynil with 1 quart of Butyrac 200.
- Crop leaf burn often occurs from bromoxynil application and is increased by warm, humid conditions. To avoid serious crop injury, do not treat when temperatures will exceed 70 F on the day of and for 3 days following application. Injury can be more severe in mixtures with Butyrac 200.
- Do not apply when alfalfa is under stress from moisture, temperature, insects, or disease.
- Do not graze or harvest for 30 days following treatment.

Herbicide	Formulation	Product Rate Range
Chateau	51 WDG	up to 4 oz

- Chateau (flumioxazin) provides residual control of annual broadleaf weeds in established alfalfa. Does not control emerged weeds.
- Apply when alfalfa has 6 inches of growth or less.
- Mode of action: group 14 (see pages 12-13).
- Do not harvest or graze for 25 days after application.
- Do not apply with adjuvants or mix with products formulated as emusifiable concentrates (EC), unless applying after the last alfalfa cutting for the year.

Forage Legumes

Herbicide	Formulation	Product Rate Range
Clethodim	Various	See labels

- Clethodim controls annual and perennial grasses in alfalfa. Clethodim is sold under various trade names, including Select, Arrow, Section, and Select Max.
- Mode of action: group 1 (see page 12-13).
- Most clethodim products are 2 lb/gal formulations, and should be applied at a rate of 6 to 8 ounces per acre for control of annual grasses up to 8 inches tall. Perennial grasses will generally require higher rates and may require more than one application. Application should be delayed until perennial weeds are at least 4 to 12 inches tall for best results. These products should generally be applied with COC (1% v/v) for best results. UAN or AMS can be added.
- Select Max should be applied at a rate of 9 to 12 oz/A for annual grasses less than 6 inches tall, and 12 to 32 oz/A for larger annual grasses or perennial grasses. Apply with NIS (1 qt/100 gallons) plus AMS (2.5 to 4 lbs/A). COC or MSO can be used instead of surfactant under hot,dry conditions.
- Clethodim can be mixed with other herbicides for control of a mixed population of grass and broadleaf weeds. See labels for more information.
- Allow 15 days between application and grazing, feeding, or harvesting of alfalfa.
- Allow 1 hour between application and rainfall.

Herbicide	Formulation	Product Rate Range
Eptam	7E	3 1/2 - 4 1/2 pt
	10G	30 lb
Balan	1.5EC	3 - 4 qt

- Mode of action: group 3 (Balan), group 8 (Eptam). See page 12-13.
- Control annual grasses and some broadleaf weeds in alfalfa, clovers, and birdsfoot trefoil. High rates of Eptam provide some control of yellow nutsedge and quackgrass.
- Apply to prepared seedbed shortly before seeding, and incorporate 2 to 3 inches deep immediately following application.
- Do not use when a companion crop of grain or forage grass is in the seeding mixture.
- Do not use Eptam on white Dutch clover.
- Do not use Balan on soils high in organic matter.

Herbicide	Formulation	Product Rate Range
Gramoxone SL	2L	1 pt (between cuttings) 1 - 2 pts (seedling - dormant) 2 - 3 pts (established - dormant)
Parazone	3SL	0.7 pt (between cuttings) 0.7 to 1.3 pts (seedling - dormant) 1.3 - 2 pts (established - dormant)

- Paraquat is the active ingredient in these products.
- Mode of action: group 22 (see page 12-13).
- Controls or suppresses small emerged grass and broadleaf weeds in dormant stands or between cuttings. Weeds beyond the seedling stage may not be controlled. Paraquat provides effective control of henbit, but control of common chickweed is variable.
- Apply with NIS (0.125 to 0.25% v/v) in a minimum spray volume of at least 10 gpa. Increase spray volume to 15 to 20 gpa where foliage is dense.
- When using between cuttings, apply no later than 5 days after alfalfa has been removed. Injury to first-year alfalfa will be more severe than to established stands. Stand and yield may be reduced if alfalfa is allowed to regrow more than 2 inches between cutting and application. Do not make more than 2 applications during the first growing season.
- When using on dormant alfalfa, apply during winter or early spring before alfalfa starts new growth. Early-spring application is usually most effective. Do not cut or harvest within 42 days after application. Do not apply more than once during the first growing season.

Forage Legumes

Herbicide	Formulation	Product Rate Range
Kerb	50W	1 - 3 lb

- Mode of action: group 3 (see page 12-13).
- Apply in the fall after the soil temperature is below 60F and until the ground freezes. Alfalfa plants must have reached the first trifoliate leaf stage. Can be applied to seedling alfalfa and established stands of alfalfa, clover, birdsfoot trefoil, and crown vetch, as long as there are no desirable grasses.
- Controls many perennial grasses, volunteer grains, downy brome, and chickweed.
- Use 1 to 1 1/2 pounds per acre to control volunteer grains, downy brome, and chickweed, and 2 to 3 pounds to control quackgrass.
- Do not graze or harvest for 120 days following application.

Herbicide	Formulation	Product Rate Range
Poast	1.5E	12 - 24 oz
Poast Plus	1E	18 - 36 oz

- Poast (sethoxydim) and Poast Plus (sethoxydim plus Dash) control annual and perennial grasses in alfalfa and clover.
- Mode of action: group 1 (see page 12-13).
- Apply with Dash (1 pint/A) or COC (2 pints/A). For best control of crabgrass, volunteer cereals, and quackgrass, also include UAN (1/2 to 1 gallon/A) or AMS (2 1/2 lbs/A).
- For control of volunteer wheat in summer seedings, apply 24 ounces /A of Poast or 36 ounces/A of Poast plus with Dash or COC plus UAN or AMS. Apply in the fall before wheat is 4 inches tall and prior to tillering.
- Apply in spray volume of 5 to 20 gpa with a pressure of 40 to 60 psi. Adjust spray pressure, spray volume, and boom height to ensure penetration of canopy and coverage of grasses.
- The rate is 16 oz/A of Poast or 24 oz/A of Poast Plus per acre for control of most annual grasses up to 8 inches tall. The rate may be reduced for control of barnyardgrass, giant and green foxtails, and fall panicum that are up to 4 inches tall and actively growing.
- Quackgrass and other perennial grasses require higher rates and often two applications. Apply 24 oz/A of Poast or 36 oz/A of Poast Plus when quackgrass is 6 to 8 inches tall, and make a second application at 2/3 the initial rate when regrowth reaches the same height.
- Oats inter-seeded with alfalfa may be killed with a rate of 16 oz/A of Poast or 24 oz/A of Poast Plus before oats exceed 10 inches in height.
- Not recommended for control of cereals planted the previous fall.
- May be mixed with Butyrac 200 for control of a mixed population of grass and broadleaf weeds. Apply this mixture with COC only, and observe feeding, grazing, and harvesting restrictions for Butyrac.
- Mixing Poast or Poast Plus with Pursuit often results in reduced grass control.
- Allow 1 hour between application and rainfall.
- Do not apply to grasses under stress from lack of moisture, herbicide injury, or low temperatures.
- Do not feed, graze, or harvest forage for 7 days following application. Do not feed or harvest dry hay for 14 days following application.

Herbicide	Formulation	Product Rate Range
Prowl H2O	3.8 CS	New stands: 1.1 - 2.1 pts Established: 1.1 to 4.2 qts

- Mode of action: group 3 (see page 12-13).
- Provides residual control of most annual grasses and certain broadleaf weeds.
- Seedling alfalfa: apply prior to weed emergence. Seedling alfalfa must be in at least the 2nd trifoliate stage of growth but not more than 6 inches tall at the time of application.
- Provides residual control of most annual grasses and certain broadleaf weeds.
- Established alfalfa (mowed at least once): apply prior to weed emergence in the fall after last cutting, in the spring, or between cuttings. Alfalfa should have less than 6 inches of regrowth at time of application.
- Some stunting and chlorosis of alfalfa may occur with postemergence applications.
- Apply rates less than 2.1 pts at least 28 days prior to harvest, and wait 50 days for higher rates.

Forage Legumes

Herbicide	Formulation	Product Rate Range
Pursuit	2S	3 - 6 oz

- Pursuit (imazethapyr) is a translocated imidazolinone herbicide that controls annual broadleaf weeds and controls or suppresses grasses. Control of ragweeds and lambsquarters is variable. Does not control ALS-resistant weeds.
- Mode of action: group 2 (see page 12-13).
- Can be applied postemergence to seedling or established alfalfa. Apply in spring or fall when seedling alfalfa is in the 2nd trifoliate stage or larger. For established alfalfa, Pursuit can be applied in the fall after the last cutting, in the spring before or after alfalfa breaks dormancy, or between cuttings. Apply spring treatments before alfalfa growth exceeds 3 inches to allow adequate spray coverage on weeds.
- Pursuit application may cause a temporary yellowing or reduction in alfalfa height.
- Apply in a spray volume of at least 10 gpa with NIS (1 qt/100 gallons) or COC (1 1/2 to 2 pints/A) plus UAN (1 to 2 quarts/A) or spray grade AMS (2 1/2 lbs/A). Control of large or drought-stressed weeds will be maximized when the higher rates of fertilizer are used in combination with a seed-oil based COC (Meth Oil, Priority MSO, or Sun-It II, for example).
- Can be mixed with Buctril/Moxy, 2,4-DB, or Poast Plus to control additional weeds. Control of some grasses may be reduced when mixed with Poast Plus.
- Apply when annual weeds are 1 to 3 inches tall. For low growing weeds such as mustards, apply before the rosette exceeds 3 inches in diameter.
- If replanting is necessary in a field treated with Pursuit, do not replant to alfalfa for 4 months following application. See label for other recrop restrictions.

Herbicide	Formulation	Product Rate Range
Raptor	1AS	4 - 6 oz

- Raptor (imazamox) is a translocated imidazolinone herbicide that controls annual broadleaf and grass weeds. Raptor generally provides better control of lambsquarters and annual grasses than Pursuit. Control of common and giant ragweeds and waterhemp is variable. Raptor provides a shorter period of residual control compared to Pursuit. Does not control ALS-resistant weeds.
- Mode of action: group 2 (see page 12-13).
- Seedling year: apply when alfalfa is in the 2nd trifoliate stage or larger, and when weeds are 1 to 3 inches tall or when rosettes are 1 to 3 inches wide.
- In established stands, Raptor can be applied: 1) in early spring when alfalfa is dormant and winter annual weeds are emerging; 2) before the first cutting; 3) between cuttings; or 4) in the fall after the last cutting. Apply before alfalfa growth exceeds 3 inches to allow adequate spray coverage on weeds. Weeds should be no more than 1 to 3 inches tall or 1 to 3 inches wide (for rosettes) at the time of application.
- Raptor application may cause a temporary yellowing or reduction in alfalfa height.
- Raptor should be applied with NIS (1 to 2 quarts/100 gallons spray) or a COC (1 to 2 gallons/100 gallons) plus UAN (2.5 gallons/100 gallons) or AMS (12 to 15 pounds/100 gallons). AMS is generally the preferred nitrogen source over UAN or 10-34-0. Control of large or drought- or temperature-stressed weeds will be maximized when the higher rates of fertilizer are used in combination with a seed oil-based COC (Meth Oil or Sun-It II, for example).
- Apply in a spray volume of 10 to 20 gpa with a pressure of 20 to 40 psi. Flat fan spray nozzles are recommended for adequate plant coverage. Allow 1 hour between application and rainfall.
- Control may be reduced when weeds are growing slowly under cold or dry conditions. If possible, wait for rain and resumption of active weed growth before applying Raptor. If air temperatures reach or stay below 50 F for 10 or more hours, delay application for 48 hours from the time temperatures increase above 50 F.
- Can be mixed with one or more of the following: bromoxynil, Poast/Poast Plus, clethodim, or 2,4-DB.

Herbicide	Formulation	Product Rate Range
Glyphosate	Various	2% v/v solution

- Table 23 contains a list of currently available glyphosate products. See labels for more information on this type of application.
- Mode of action: group 9 (see page 12-13).
- Apply as a spot treatment in established stands to control problem weeds that cannot be controlled by any other means.
- Apply to actively growing, susceptible weeds.
- To avoid crop injury, avoid contact with desirable, nontarget vegetation (forage).
- For maximum effectiveness on target vegetation, refer to label for recommended timing of application.
- Treat no more than 1/10 of an acre at one time. Further applications may be made to the same area at 30-day intervals.
- Do not graze or harvest for 14 days following application.

Forage Legumes

Herbicide	Formulation	Product Rate Range
Metribuzin	4F	1/2 - 2 pt
	75DF	1/3 - 1 1/3 lb

- Mode of action: group 5 (see page 12-13).
- Use in established alfalfa only. Apply once in the fall or spring to dormant alfalfa (before new growth starts).
- Application rate varies with target weed, and soil texture and organic matter content.
- Controls downy brome and most winter annual weeds, including chickweed, henbit, mustards, and yellow rocket. High rates will suppress dandelion, curly dock, and quackgrass. The 1/3 lb/A rate is for control of chickweed only.
- Do not use on sandy soils or soils with pH greater than 7.5.
- Do not graze or harvest for 28 days following application.

Herbicide	Formulation	Product Rate Range
Sinbar	80W	1/2 - 1 1/2 lb

- Mode of action: group 5 (see page 12-13).
- Use in established alfalfa only. Apply once in the fall or spring to dormant alfalfa (before new growth starts).
- Application rate varies with soil type. Use lower rates for coarser soils. Do not use on soils with less than 1 percent organic matter.
- Do not apply to snow-covered or frozen ground.
- Controls chickweed, henbit, mustards, and yellow rocket. Suppresses dandelion and quackgrass.
- Do not plant any other crop for 2 years after Sinbar application.

Herbicide	Formulation	Product Rate Range
Treflan/Trifluralin	TR-10/10G	20 lb

- Mode of action: group 3 (see page 12-13).
- Controls annual grasses in established alfalfa.
- Apply in the spring before weed emergence.
- A single rainfall or overhead irrigation of 1/2 inches or more within 3 days of application is required for this treatment to be effective.
- The year following Treflan application, plant only crops for which Treflan may be applied as a preplant incorporated treatment or injury may result.

Herbicide	Formulation	Product Rate Range
Velpar/Velossa	2L	1 - 3 qt

- Mode of action: group 5 (see page 12-13).
- Use in established alfalfa only. Apply in the fall or spring when alfalfa is dormant or before new growth exceeds 2 inches in height. Can also be applied to stubble after hay crop removal, but before regrowth exceeds 2 inches.
  Application rate varies with soil type.
- For best results, apply when weeds are less than 2 inches tall and rosettes are less than 2 inches across.
- Controls most winter annual broadleaf weeds, including chickweed, mustards, and yellow rocket. Controls dandelion and downy brome.
- Do not plant any crop except corn within 2 years of treatment. Corn may be planted 12 months after treatment where deep tillage is used.
- Do not graze or harvest for 30 days following treatment.

Alfalfa: Preharvest Glyphosate Application

Herbicide	Formulation	Product Rate Range
Glyphosate	Various	See labels

- Some glyphosate products can be used in declining alfalfa stands where crop destruction is desirable or acceptable. Table 23 contains a list of currently available glyphosate products.
- Mode of action: group 9 (see page 12-13).
- A preharvest application will control annual and perennial weeds, and greatly improve control of alfalfa and perennial grasses compared to application after harvest.
- Apply in a spray volume of 3 to 10 gpa just prior to alfalfa harvest in spring or fall.
- Allow a minimum of 36 hours between application and harvest. Optimum harvest time is 3 to 7 days after application to maintain hay quality and maximize perennial control.
- The treated alfalfa can be fed to any livestock including lactating animals.
- If the field is planted to corn following alfalfa harvest, including atrazine in the preplant/preemergence herbicide program will aid in control of perennial grasses. Postemergence application of dicamba or dicamba + 2,4-D may be required for complete control of alfalfa in the corn.

Mixed Grass-Legume Forages: Established Stands Only

Herbicide	Formulation	Product Rate Range
Glyphosate	Various	2% solution (spot treatment)

- Table 24 contains a list of currently available glyphosate products. See labels for more information on this type of application.
- Apply as a spot treatment to problem weeds not controlled by any other means.
- Mode of action: group 9 (see page 12-13).
- Apply to actively growing, susceptible weeds.
- To avoid crop injury, avoid contact with desirable, nontarget vegetation (forage).
- For maximum effectiveness on target vegetation, refer to label for recommended adjuvants and timing of application.
- Treat no more than 1/10 of an acre at one time. Further applications may be made to the same area at 30-day intervals.
- Do not graze or harvest for 14 days following application.

Herbicide	Formulation	Product Rate Range
Metribuzin	4F	3/4 - 1 1/2 pt
	75DF	1/2 - 1 lb

- Can be used in alfalfa-grass mixtures.
- Apply once in the fall or spring when plants are dormant (before new growth starts).
- Mode of action: group 5 (see page 12-13).
- Application rate varies with soil texture and organic matter content.
- Higher rates may injure grass component.
- Do not use on sandy soils or soils with pH greater than 7.5.
- Do not graze or harvest for 28 days following application.

Roundup Ready Alfalfa

Herbicide	Formulation	Product Rate Range
Glyphosate	Various	0.75 lb acid/A (new seedings) 0.75 to 1.5 lb acid/A (established)

- It is currently not legal to plant new seedings of Roundup Ready alfalfa, but established stands can be maintained and continue to be used for hay or forage.
- Glyphosate can be applied to established stands of Roundup Ready alfalfa for control of annual and perennial weeds. Not all glyphosate products are approved for this use – see labels for more information.
- Mode of action: group 9 (see page 12-13).
- Glyphosate should be applied after weeds have emerged but before alfalfa growth or regrowth interferes with spray coverage on weeds.
- Application when annual weeds are less than 6 inches tall will result in most effective control and allow use of lower rates. Perennial weeds should be larger for most effective control. Application in the late fall may be the most effective strategy on cool-season perennials such as dandelion and Canada thistle, when there is adequate time after the last cutting for considerable regrowth of weeds. Multiple applications may be necessary to control some perennials.
- The rate of glyphosate in any single application should not exceed 1.5 lbs a.e./A. Sequential applications should be at least 7 days apart. The combined total per year for all in-crop applications should not exceed 4.5 lbs a.e./A.
- Remove livestock before application and wait a minimum of 5 days after last application before grazing, cutting, or feeding of Roundup Ready alfalfa forage or hay.

Management Strategies for Permanent Grass Pastures/CRP/Grass Hay

Long-term management of weeds in pasture and CRP areas is necessary to maximize pasture productivity and the growth of desirable species established in CRP areas, control weeds that are poisonous to livestock, and to prevent the encroachment of weeds into adjacent crop production fields. Some weed species are considered noxious weeds under state law and must be controlled, or the landowner can be subject to fines.

Many forage and grass species used in pastures and CRP have prolific growth characteristics and are effective at suppressing weeds. Effective establishment and maintenance of these species can greatly minimize weed problems. Factors in establishment include starting weed-free through tillage or the application of glyphosate or other non-selective herbicides, fertilization or liming as necessary based on soil testing, use of the proper seeding rate, and proper maintenance of over-grazed areas. Soil fertility should be periodically monitored and supplemented to maintain a healthy pasture or cover crop that is competitive with weeds. This should include testing the nitrogen level for grass species and pH for legume growth. Where phosphorous and potassium are at proper levels initially, these nutrients should cycle through the residue unless hay harvest is allowed. If the area is harvested for hay, then soil in the area may need to be tested, and nutrients applied to maintain further health of the pasture or CRP cover. Use grazing practices that prevent deterioration of desirable species, since weeds will rapidly infest areas devoid of a competitive stand of grasses and legumes.

Weeds are controlled in pastures and CRP land primarily by mechanical or chemical methods. Mowing is a viable option, depending upon the species to be controlled. Mowing is more effective for control when it can be used several times in the same year. Custom rates for rotary mowing in recent years averaged about $13 per acre, with a range of $6 to $19, based on information from The Ohio State University and Purdue University.

Annual weeds should be mowed prior to or soon after flowering to prevent the production of viable seed. Seed production may occur earlier than the timing of mowing allowed by CRP contracts. Biennial weeds have a two-year cycle. Emergence of plants from seed occurs in the first year, and the plants remain in the vegetative stage as a low-growing rosette with short internodes that grow close to the ground. Mowing is typically not effective for control of plants in this stage, because not enough leaf area can be removed to affect the plant growth. Elongation of the stem and development of a large plant occurs in the second year, as well as flowering and seed production. Mowing can be used in year two to control biennial plant growth and reduce seed production. Perennial weeds reproduce by both seed and plant parts such as stems, tubers and roots. Perennials should be mowed in the early bud stage. This is the point in the life cycle when carbohydrate movement from roots is at the lowest levels. Mowing at this time can help reduce the viability of the plant parts used to produce new plants and prevent seed production, but mowing rarely controls perennials completely. The bottom line - mowing can be used to prevent seed production, and it can effective for weed control when used at plant growth stages when the plant is most vulnerable or least likely to regrow.

A combination of mowing and herbicide applications may be most effective for the control of perennial weeds. Mowing in mid-summer removes weed growth from the first half of the season, and prevents seed production by many annuals and biennials. The initial growth of cool-season perennials is also removed, followed by their regrowth into the fall, when herbicides can be most effective. Mowing CRP areas before the first week of August will allow for maximum regrowth of perennial weeds. Applying herbicide in July or August will prevent seed production by annual weeds, but this is not the most effective timing for control of cool-season perennial weeds.

The most effective herbicide application timing for perennial weed control is generally mid-September through late October depending upon the species. Herbicide effectiveness at that time will be maximized by applying after several days of warm weather when perennial weeds are fairly large and/or in the bud to flower stage. Perennial weeds should be at least 8 to 12 inches tall in order to obtain maximum control of the roots or rhizomes for next year. For warm-season perennials such as johnsongrass, hemp dogbane, milkweeds, common pokeweed, and bindweeds, applications in mid- to late September should provide the most effective control. This strategy can prove effective in controlling perennial weeds, which are not well controlled by mowing alone.

Herbicides can effectively control many weeds in pastures and CRP, and can be a less expensive alternative to mowing. Herbicide effectiveness, similar to mowing, also varies by weed life cycle and timing of application. A primary disadvantage of herbicide application – most herbicides that can be used for control of broadleaf weeds in CRP will injure or kill desirable legumes in the cover. Exceptions to this are bromoxynil, Butyrac, and Plateau, which can be applied to mixed stands of grasses and legumes. These herbicides can be used to control weeds during CRP cover establishment, depending upon the species planted and herbicide. Herbicide selection should take into account the weed species, CRP cover species, application method, and the presence of water in nearby ditches. Most herbicides can be applied to dry ditchbanks, but only some dicamba, 2,4-D, and glyphosate products are labeled for application directly to water. See product labels for more information.

CRP contracts are written with maintenance provisions that include the control of weeds through mowing or herbicides. The CRP contract usually limits mowing to a certain time of the year, so as"not to disturb the acreage under contract during the primary nesting and brood rearing seasons for wildlife except as approved by the CCC." This limitation may reduce the overall effectiveness of mowing as a weed control method, especially for certain perennial species. CRP contracts may allow more

frequent mowing for control of noxious weeds such as Canada thistle. Weed management practices and the herbicides approved for use in CRP can vary between Ohio and Indiana, and also within a state. Landowners should consult contracts and local NRCS offices for more information on approved weed management practices (see below). Labels for some products specify application timing and rate based on the grasses that are being established or are present in a CRP area. This may include recommendations for cool-season vs warm-season grasses, which are categorized in the following table. The tolerance of many native forbs and grasses has not been characterized for some herbicides. Labels for some products warn of this and state that the manufacturer is not responsible for injury to native forbs and grasses.

See the following web sites for information on CRP contract requirements and management practices:

Indiana - http://www.in.nrcs.usda.gov/programs/CRP/crphomepage.html

Ohio - http://www.nrcs.usda.gov/programs/crp/

Cool Season Grasses		**Warm Season Grasses**	
Annual Ryegrass (I)[1]	Bluegrass, Rough (I)	Bahia (N)	Buffalo (N)
Bentgrass (I and N)	Canada wildrye (N)	Bermuda (I)	Eastern gramagrass (N)
Bluegrass, Kentucky (N)	Orchardgrass (I)	Big bluestem (N)	foxtail millet (I)
Perennial ryegrass (I)	Smooth brome (N)	Bluestem yellow	Indiangrass (N)
Tall fescue (I)	timothy (I)	(caucasian)(I)	Pearl millet (I)
Virginia wildrye (N)		Little bluestem (N)	Swithgrass (N)
		Broomsedge (N)	

[1]I = introduced species, N = Native species. CRP guidelines require the use of native species.

Permanent Grass Pastures/CRP/Grass Hay

Herbicide	Formulation	Product Rate Range
2,4-D Amine 2,4-D Ester	Various	1 - 2 lbs ai/A

- 2,4-D is labeled for use in grass pastures, CRP, and fallow land.
- Mode of action: group 4 (see page 12-13).
- Apply 2 pints/A when annual weeds are small and actively growing. Rates of 1.5 to 2 lbs ai/A may be needed for less susceptible annual weeds, and biennial and perennial weeds.
- Spray bull or musk thistles or other biennial weeds in the rosette stage (spring or fall) while they are actively growing. Spray perennials such as Canada thistle in the bud to flower stage or in the fall regrowth stage. Spray susceptible woody species in the spring when leaves are fully expanded.
- The ester formulation is more effective on wild garlic and onion than the amine formulation.
- Do not graze dairy cattle for 7 days after treatment. Remove livestock from treated fields at least 3 days before slaughter.
- Do not apply to newly seeded areas or after heading begins. Do not apply to grass when it is in the boot to milk stage if grass seed production is desired.
- Will injure or kill desirable broadleaf plants in grass/forb mixtures. Do not reseed legumes or rotate to other crops for 3 months or until chemical has disappeared from soil.

Herbicide	Formulation	Product Rate Range
Aim	2EC	0.5 - 2 oz
Rage D-TECH	4.06L	8 - 32 oz

- Aim (carfentrazone) is a contact herbicide that will control velvetleaf, pigweeds, lambsquarters, and a few other annual broadleaf weeds up to 4 inches tall in grass pastures. Aim will not control biennial or perennial weeds.
- Mode of action: group 14 (see page 12-13).
- Can be used in grass pastures, CRP areas, and grasses grown for hay or silage. There is no waiting interval between application of Aim and harvest or grazing.
- Use a spray volume that results in complete coverage of foliage. Apply with NIS (0.25% v/v) or a COC (1 to 2% v/v). UAN or AMS may also be added.
- Rage D-TECH is a premix of Aim plus 2,4-D. Allow 30 days between Rage D-TECH application and harvest for hay, and 7 days before grazing. Remove animals from treated areas at least 3 days before slaughter.

Herbicide	Formulation	Product Rate Range
Bromoxynil	2S	1 - 2 pt

- Controls small winter and summer annual weeds in new CRP seedings. Can be applied during CRP cover establishment, after grasses have emerged. Bromoxynil can be applied to alfalfa, but will injure other legumes.
- Apply when annual weeds have less than 4 leaves or are less than 2 inches tall, or before rosettes are 1 inch in diameter.
- Apply in a minimum spray volume of 20 gpa with a minimum spray pressure of 30 psi.
- For improved control of pigweed, mix 1 pint of Buctril/Moxy with 1 quart of Butyrac 200.

Herbicide	Formulation	Product Rate Range
Butyrac 200 (2,4-DB)	2L	1 - 3 qt

- Controls annual broadleaf weeds in CRP stands of grass, alfalfa, clovers, and/or birdsfoot trefoil. Do not use on sweet clover. Can be used during establishment, but legumes should have emerged and grasses should be tillering or have a minimum of 6 leaves at the time of application.
- Annual weed seedlings should be no more than 2 to 3 inches tall at the time of application, and rosettes should be no more than 2 inches across and not bolting. Weeds that emerge in the fall and overwinter in the rosette stage (mustards, field pennycress) may be more easily controlled in late fall than in spring.
- Apply 1 to 2 quarts/A when weeds are less than 1 inch tall, and 2 to 3 quarts when weeds are 1 to 3 inches tall. Use the 3-quart rate for suppression of smartweed or curly dock.

Permanent Grass Pastures/CRP/Grass Hay

Herbicide	Formulation	Product Rate Range
Cimarron Max	co-pack	See labels.

- Cimarron Max is labeled for use on grass pastures, established CRP areas, and warm and cool season native grasses.
- Cimarron Max is a co-pack of Cimarron (metsulfuron methyl) plus a premix of dicamba and 2,4-D. These are translocated herbicides for control of broadleaf weeds and brushy plants.
- Mode of action: group 2 (metsulfuron); group 4 (2,4-D, dicamba). See page 12-13.
- Do not apply to timothy until 12 months after establishment. Lowest labeled rate should be applied to timothy in late summer or fall.
- Do not apply to bluegrass, bromegrass, or orchardgrass until 6 months after establishment, timothy until 12 months after establishment, and fescue until 24 months after establishment. Lowest labeled rate should be applied late in spring after 5 to 6 inches of new fescue growth, or in the fall.
- On timothy and fescue, use NIS rather than crop oil to minimize injury. Do not use additional surfactants if UAN is used as the spray carrier. Timothy should be at least 6 inches tall prior to application.
- The metsulfuron component is a long-residual herbicide and is labeled with extensive restrictions on over-seeding with legumes, pasture renovation, and crop rotation. Cautionary statements on the pasture label should be read and understood by the user prior to use. See label for list of established CRP grasses that are tolerant to Cimarron MAx.
- Allow 4 hours between application and rainfall.
- Do not graze lactating animals within 7 days of treatment. There is no waiting period for non-lactating animals, but meat animals should be removed from treated areas 30 days prior to slaughter. Treated grasses may be harvested for dry hay, but do not harvest within 37 days of treatment.

Herbicide	Formulation	Product Rate Range
Crossbow/Crossroad	3L	Annuals - 1 - 2 qt Biennials - 2 - 4 qt Perennials - 2 - 4 qt Woody brush - 6 qt

- Crossbow/Crossroad is a premix of 2,4-D plus triclopyr for use in grass pastures and CRP. Can be used in cut-stump, dormant stem, and basal applications.
- Mode of action: group 4 (see page 12-13).
- In CRP areas, apply only to established native grasses (not seedlings). Will injury or kill broadleaf forbs and legumes.
- Apply to foliage during warm weather when brush and broadleaf weeds are actively growing. When applying as a spot spray, thoroughly wet all foliage.
- Be cautious of vapor and particle drift, as Crossbow may injure susceptible crops growing nearby.
- Crossbow is effective for control of small ironweed and poison hemlock plants. For ironweed, apply 2 qt/A in early summer before evidence of leaf rust is seen on the ironweed leaves. Apply when poison hemlock is small for best results.
- A foliar application of a 1 1/2 percent Crossbow solution applied in late April to early June has proven effective for multiflora rose control. Dormant season (late winter to early spring) basal bark applications of a 4 to 5 percent solution will also control multiflora rose. See herbicide label for more specific rate recommendations.
- Grazing restrictions for rates of 2 gallons per acre or less: Do not graze dairy animals for 14 days after treatment. Other livestock: no waiting period between application and grazing, but remove animals from treated areas at least 3 days before slaughter.

Herbicide	Formulation	Product Rate Range
Curtail	2.38L	2 - 4 qt

- Curtail is a premix of clopyralid (Stinger) plus 2,4-D for use on grass pastures and CRP areas..
- Mode of action: group 4 (see page 12-13).
- Apply when annual weeds are small and actively growing. Treat bull or musk thistles in the spring or fall when they are actively growing and in the rosette stage. Treat susceptible woody species in the spring when fully leafed out.
- Apply in the fall for most effective CRP site preparation. Allow at least 30 days after application before seeding native grasses. Where CRP areas will be seeded in the fall, apply Curtail in spring or early summer. Do not exceed 4 qts/A in areas to be seeded.

Permanent Grass Pastures/CRP/Grass Hay

- Use higher rates for Canada thistle, and treat prior to the bud stage.
- Do not treat pastures containing legumes unless injury can be tolerated. Established grasses are tolerant, but new seedlings may be injured.
- Do not graze lactating dairy cattle in treated areas for 14 days after application. Meat animals should be removed from treated areas 7 days before slaughter (this is not necessary if at least 12 weeks have elapsed since application. Do not cut treated grass for hay for 30 days after application.
- Do not transfer livestock from treated grazing areas (or if fed treated hay) to sensitive broadleaf crops without first allowing 7 days of grazing on an untreated pasture (or feeding untreated hay). If livestock are transferred within less than 7 days of grazing untreated pasture or hay, urine or manure may contain enough clopyralid to injure sensitive broadleaf plants.

Herbicide	Formulation	Product Rate Range
Dicamba	4L	Annuals - 1/4 - 1 1/2 pt Biennials - 1/2 - 3 pt Perennials - 1 - 6 qt Woody brush - 1 - 8 qt
Distinct	76.4DF	Annuals - 4 - 8 oz

- Dicamba is sold under various trade names, including Banvel, Clarity, Sterling, and Oracle. Dicamba is a translocated herbicide labeled for use in grass pastures and CRP.
- Dicamba can be applied when seedling grasses are in at least the 3-leaf stage, and can be applied to established grasses. Rates higher than 1 pt/A may severely injure seedling grasses. Dicamba will injure of kill desirable broadleaf plants in grass/forb mixtures.
- Mode of action: group 4 (see page 12-13).
- Use lower rates for susceptible annuals when they are small and actively growing and for susceptible biennials in the early rosette stage. Use higher rates for larger weeds, for less susceptible weeds, for established perennials in dense stands, and for certain woody brush species.
- Remove livestock from treated fields at least 30 days before slaughter. There is no waiting period between application and grazing for non-lactating animals. Do not graze lactating dairy animals for 7 to 60 days after application, depending upon rate applied.
- Allow 6 to 8 hours between application and rainfall.
- Distinct is a premix of dicamba and diflufenzopyr that is more effective than the same rates of dicamba on many weeds, especially Canada thistle and bindweeds. Apply with NIS or MSO, plus AMS.
- Be cautious of spray drift and volatility.

Herbicide	Formulation	Product Rate Range
Dicamba + 2,4-D premix	3.87L	1 - 4 pts

- This product is available from various manufacturers, and product names and rates vary. Controls broadleaf weeds in pastures.
- Mode of action: group 4 (see page 12-13).
- When applied as a spot treatment, rates up to 8 pints/A can be used.
- Apply with NIS (2 to 4 pts/100 gallons) using a spray volume of at least 5 gpa. Increase volume where in dense or tall vegetation.
- Allow 37 days between application and harvesting of grasses for hay or silage.
- Allow 7 days between application and grazing of lactating animals. There is not waiting period between application and grazing of non-lactating animals, but remove animals from treated areas at least 30 days before slaughter.

Herbicide	Formulation	Product Rate Range
Forefront	3L	1.5 - 2.6 pts

- Forefront is a premix of aminopyralid (Milestone) plus 2,4-D that controls annual, biennial and perennial broadleaf weeds, including bull, musk, and Canada thistle.
- Mode of action: group 4 (see page 12-13).
- Forefront should generally be applied when perennial weeds are in the bud or early-flower stage. Most effective control of biennial species will result from application at the end of the first year of growth, or in the following spring when plants are still relatively small.
- The addition of NIS (0.25 to 0.5% v/v) is recommended for control of weeds with pubescent leaf surfaces or advanced in growth stage, or under adverse environmental conditions (too hot, too dry, etc).

Permanent Grass Pastures/CRP/Grass Hay

- Forefront can be used in permanent grass pastures and CRP acres. Do not rotate to any other crop within one year following application. Animals grazing on treated pasture should be grazed on nontreated forage for 3 days before moving to areas where sensitive broadleaf crops will be planted in the future. Manure should be left on the pasture or, if collected at a central location such as a barn, spread on pastures, not cropland. Do not use aminopyralid-treated plant residues, including hay or straw from treated areas, or manure from animals that have grazed forage or eaten hay harvested from treated areas within the previous 3 days, in compost or mulch that will be spread to areas where broadleaf plants may be grown.

Herbicide	Formulation	Product Rate Range
Glyphosate	Various	2% v/v (spot treatment only)

- Glyphosate can be used as a spot treatment to control a variety of herbaceous and woody brush species such as multiflora rose, brambles, poison ivy, and quackgrass. Glyphosate should generally be applied when perennial weeds are in the bud to flower stage, and woody perennials are fully leafed out. Table 24 contains a list of currently available glyphosate products. Consult label for recommended timing of application for maximum effectiveness on target species.
- Glyphosate can be used for site preparation before planting in CRP, postemergence control when grasses are dormant, and selectively with the use of wiper application equipment. Apply 5 to 8 floz/A in the spring during dormancy. Grasses and forbs that have broken dormancy will be injured.
- Mode of action: group 9 (see page 12-13).
- Spray foliage of target vegetation completely and uniformly, but not to the point of runoff.
- Glyphosate is very effective for the selective killing of multiflora rose near desirable trees, due to the lack of soil activity. However, avoid contact with foliage of desirable nontarget vegetation. Apply in late spring or summer when multiflora rose are fully leafed out.
- No more than one tenth of an acre of pasture should be treated at one time. Further applications in the same area may be made at 30-day intervals.
- Do not graze or harvest for 14 days after application.

Herbicide	Formulation	Product Rate Range
Metsulfuron methyl (active ingredient)		
Accurate/Valuron	60DF	1/10 - 1.0 oz

- Accurate and Valuron are labeled for use in pastures and fallow areas.
- Metsulfuron-methyl is a translocated herbicide for control of broadleaf weeds and brushy plants.
- Mode of action: group 2 (see page 12-13).
- Apply to foliage when weeds and brush are actively growing. For annual weeds, apply in spring or early summer before weeds are 4 inches tall. Apply when brushy plants are fully leafed out.
- In OSU trials, metsulfuron-methyl has been highly effective for multiflora rose control; foliar applications provide best control of rose. Apply in late spring or summer when rose plants are fully leafed out. For spot treatment of multiflora rose, blackberry, or Canada thistle, use 1 ounce of Accurate/Valuron per 100 gallons of water. Metsulfuron-methyl is less effective than Stinger or glyphosate for long-term control of Canada thistle.
- Apply with NIS at a rate of 1 to 2 pints per 100 gallons water (1/2 to 1 pint for tall fescue).
- The maximum use rate for fescue pastures is 2/10 ounce/A. Application to fescue may cause stunting, temporary discoloration, and seed head suppression. To minimize injury to fescue, apply later in the spring or fall and/or tank mix with 2,4-D. Bluegrass, orchardgrass, timothy, bromegrass, and bermudagrass pastures have demonstrated good tolerance. Ryegrass is highly sensitive to metsulfuron-methyl. Grasses should be well-established at time of application.
- Metsulfuron-methyl is a long-residual herbicide and is labeled with extensive restrictions on over-seeding with legumes, pasture renovation, and crop rotation (34 months to most crops). Cautionary and other restrictive statements on the pasture label should be read and understood by the user prior to use.
- Allow 4 hours between application and rainfall.
- There is no grazing restriction on the Accurate or Valuron label.

Permanent Grass Pastures/CRP/Grass Hay

Herbicide	Formulation	Product Rate Range
Milestone	2L	3 - 7 oz

- Milestone (aminopyralid) controls annual, biennial and perennial broadleaf weeds, including bull, musk, and Canada thistle.
- Mode of action: group 4 (see page 12-13).
- Milstone should generally be applied when perennial weeds are in the bud or early-flower stage. For Canada thistle control, apply 5 to 7 oz/A in the spring to plants in the prebud stage, or apply in the fall to plants that have regrown to a size of at least 8 inches. For control of bull or musk thistle, apply 3 to 5 oz/A in spring or early summer to rosette or bolting plants, or apply 4 to 5 oz/A in fall to plants in the late bolt through early-flowering stage.
- The addition of NIS (0.25 to 0.5% v/v) is recommended for control of weeds with pubescent leaf surfaces or advanced in growth stage, or under adverse environmental conditions (too hot, too dry, etc).
- Milestone can be used in permanent grass pastures, CRP acres, wildlife areas, and other non-cropland areas. Do not rotate to any other crop within one year following application. Animals grazing on treated pasture should be grazed on nontreated forage for 3 days before moving to areas where sensitive broadleaf crops will be planted in the future. Manure should be left on the pasture or, if collected at a central location such as a barn, spread on pastures, not cropland. Do not use aminopyralid-treated plant residues, including hay or straw from treated areas, or manure from animals that have grazed forage or eaten hay harvested from treated areas within the previous 3 days, in compost or mulch that will be spread to areas where broadleaf plants may be grown.

Herbicide	Formulation	Product Rate Range
PastureGard	2 EL	2 - 8 pt (broadcast) 50% v/v (basal or cut stump)

- Pasture Guard is premix of triclopyr and fluroxypr for use on permanent pastures, CRP, and other non-crop areas.
- Mode of Action: group 4 (see pages 12-13).
- Can be applied as a foliar spray, or as a basal bark or cut stump application for woody species. Basal and cut stump applications must use diesel, kerosene, or other commercial carrier.
- Apply as a basal application to control trumpetcreeper and Virginia creeper.
- There are no grazing restrictions for non-lactating animals. Do not let lactating animals graze treated areas until the following season after application. Allow 14 days between application and harvest for hay. Animals grazing on treated forage must be removed from treated forage 3 days before slaughter.

Herbicide	Formulation	Product Rate Range
Plateau	2L	4 to 12 oz

- Controls small annual grass and broadleaf weeds at rates of 4 to 6 oz/A, while rates of 8 to 12 oz/A will control a number of biennial and perennial weeds. The lower rates should be used for CRP cover that contains legumes.
- Apply with nonionic surfactant (1 qt/100 gallons). Plateau can be more effective when applied with methylated seed oil (1.5 to 2 pts/A) instead of surfactant, but will be more injurious to the CRP cover. The addition of nitrogen fertilizer solution may improve control of certain weeds, but will also increase risk of injury to CRP cover crops.
- Plateau can be used during the establishment of CRP cover. To minimize injury to grasses, delay application until they have reached the 5-leaf stage.
- See the Plateau label for information on tolerance of grass and legume species.

Permanent Grass Pastures/CRP/Grass Hay

Herbicide	Formulation	Product Rate Range
Remedy Ultra	4L	1 - 3 pt (broadcast)

- Remedy Ultra (triclopyr) is a translocated herbicide for control of herbaceous broadleaf and woody weeds in permanent grass pastures, CRP, and other non-crop areas.
- Mode of Action: group 4 (see pages 12-13).
- Can be applied as a foliar spray, or basal bark or cut stump application for woody species.
- Controls only emerged herbaceous weeds that are fully leafed out at the time of application.
- Will injure desirable broadleaf forbs.
- There are no grazing restrictions for non-lactating animals. Do not let lactating animals graze treated areas until the following season after application. Allow 14 days between application and harvest for hay. Animals grazing on treated forage must be removed from treated forage 3 days before slaughter.

Herbicide	Formulation	Product Rate Range
Spike	20P	10 - 20 lb

- Spike (tebuthiuron) controls brush and woody plants, including multiflora rose, in rangeland and grass pastures. Requires sufficient rainfall to move herbicide into root zone. See label for rates on specific species.
- Mode of action: group 7 (see page 12-13).
- Apply anytime throughout the year except when soil is frozen or saturated with moisture. For best results, apply prior to the resumption of active seasonal growth in the spring.
- There are no grazing restrictions following the application of Spike.
- May kill or injure desirable legumes and grasses where contact is made. Apply as a spot treatment or when grasses are dormant to minimize injury.
- Do not apply on or near field crops or other desirable vegetation. Do not apply where soil movement is likely. Refer to label for additional restrictions.

Herbicide	Formulation	Product Rate Range
Stinger	3L	2/3 - 1 1/3 pt

- Stinger (clopyralid) is a translocated herbicide for use in grass pastures and set-aside land.
- Mode of action: group 4 (see page 12-13).
- Controls a limited number of broadleaf weeds, including cocklebur, ragweeds, and nightshade. Controls Canada thistle at higher rates. Suppresses sowthistle and buffalobur.
- Apply when weeds are young and actively growing. Canada thistle should be at least 4 inches tall or across (rosette), but apply before the bud stage.
- Established grasses are tolerant, but new grass seedings may be injured. Some forages, especially legumes, are especially sensitive to Stinger. Do not spray pastures containing legumes unless injury can be tolerated.
- Allow 6 to 8 hours between application and rainfall.
- There is no waiting period between application and grazing. Do not use hay, straw, or manure from treated areas for composting or mulching on susceptible broadleaf crops. Do not transfer animals from treated grazing areas onto sensitive broadleaf crop areas without first allowing 7 days of grazing on an untreated pasture. Otherwise, urine may contain enough Stinger to injure sensitive broadleaf plants.
- Apply only once per 12 month period. Wheat, grasses, field corn, or sugar beets may be planted anytime after treatment. Check the label for recrop intervals on other broadleaf crops.

Table 21. Weed Response to Herbicides in Grass Pastures/CRP/Grass Hay

This table compares the relative effectiveness of herbicides on weeds. Ratings are based on labeled application rate and weed size or growth stage. Control of perennial weeds may require more than one application. Performance may be better or worse than indicated in the table, due to weather or soil conditions, or other variables.

Weed control rating:
9 = 90% to 100% control
8 = 80% to 90% control
7 = 70% to 80% control
6 = 60% to 70% control
- = not recommended or insufficient information

		2,4-D	Cimarron Max	Crossbow	Curtail	Dicamba	Forefront	Glyphosate	Metsulfuron	Milestone	PastureGard	Remedy Ultra	Stinger
	Site of action	4	2/4	4	4	4	4	9	2	4	4	4	4
Winter annual													
	Chamomile, mayweed	7	9	7	9	8	7	9	9	-	-	-	9
	Chickweed, common	-	9	8	6	9	8	9	9	7	8	8	6
	Cockle, corn	7	9	8	7	9	6	9	-	-	-	-	-
	Cockle, cow	7	9	8	7	9	6	9	-	-			-
	Horseweed (marestail)	9	9	9	9	9	9	9	9	8	6	7	9
	Mustard spp.	9	9	9	9	7	9	9	9	-	-	9	6
	Pennycress, field	9	9	9	9	8	9	9	9	-	-	-	6
	Pepper weed spp.	9	9	9	9	7	9	9	9	-	-	-	6
	Shepherd's purse	8	9	9	8	7	8	9	9	-	-	-	6
Summer annual													
	Cocklebur, common	8	9	9	9	9	9	9	9	9	8	8	9
	Lambsquarters, common	8	9	9	8	9	9	9	9	9	9	9	6
	Nightshade, black	7	8	8	7	8	9	8	7	9	-	-	-
	Pigweed spp.	8	9	8	8	9	8	9	9	8	9	-	6
	Ragweed, common	9	9	9	9	9	9	9	-	9	9	9	9
	Ragweed, giant	9	9	9	9	9	9	9	-	9	9	9	9
	Velvetleaf	8	9	8	8	9	8	8	8	-	9	-	-
Biennial													
	Burdock, common	9	9	9	8	7	9	9	9	9	9	9	8
	Carrot, wild	8	9	9	8	7	8	8	9	-	7	8	6
	Evening primrose, common	8	8	9	7	7	9	9	-	8	-	8	-
	Hemlock, poison	7	8	9	8	8	7	8	-	-	-	9	-
	Lettuce, wild	9	9	8	9	8	9	8	9	-	-	-	9
	Parsnip, wild	8	8	9	8	8	8	8	8	-	-	-	-
	Teasel	7	9	8	9	8	8	8	9	-	-	-	8
	Thistle, bull	8	9	9	9	9	9	9	9	9	6	6	9
	Thistle, musk	9	9	9	9	9	9	9	9	9	6	7	9
	Yellow rocket	8	9	9	8	8	8	8	9	-	-	-	-

Table 21. (continued)

		2,4-D	Cimarron Max	Crossbow	Curtail	Dicamba	Forefront	Glyphosate	Metsulfuron	Milestone	PastureGard	Remedy Ultra	Stinger
Herbaceaous perennials													
	Aster spp.	8	8	8	9	8	8	8	6	-	-	-	9
	Bedstraw spp.	6	6	9	7	-	9	8	-	9	-	-	7
	Bindweed, field	7	7	8	7	8	7	8	-	-	7	7	-
	Bindweed, hedge	8	8	8	8	8	7	8	-	-	7	8	-
	Buttercup spp.	8	9	9	8	7	8	8	9	8	7	8	9
	Chickweed, mouseear	6	9	8	1	7	6	8	9	-	8	8	6
	Chicory	8	9	7	8	7	9	8	9	9	9	8	8
	Clover spp.	6	9	8	9	8	9	8	9	9	8	9	9
	Cockle, white	6	6	8	8	8	6	9	-	-	-	-	8
	Daisy, oxeye	8	8	9	9	9	9	8	-	8	-	-	9
	Dandelion	9	9	9	9	8	8	7	9	9	8	8	8
	Dock spp.	7	8	8	8	7	9	8	8	9	7	-	8
	Dogbane, hemp	8	8	6	8	7	5	8	7	-	6	9	6
	Garlic or onion, wild	7	9	7	7	6	6	8	9	-	-	-	-
	Goldenrod spp.	8	8	7	8	9	8	9	7	6	7	8	7
	Groundcherry spp.	6	6	7	6	6	6	7	-	-	-	-	-
	Hemlock, spotted water	7	7	9	7	7	7	8	-	-	-	-	-
	Horsenettle	6	9	8	6	7	8	7	9	9	6	6	-
	Ironweed	7	7	9	7	7	8	9	-	8	6	7	-
	Knotweed, Japanese	6	6	6	7	7	-	7	-	-	-	-	7
	Milkweed, common	6	6	7	6	7	-	8	-	-	-	7	-
	Nettle, stinging	7	7	8	7	7	9	8	-	9	-	9	-
	Plaintain spp.	9	9	9	6	7	9	8	7	-	9	5	6
	Pokeweed, common	6	6	8	9	-	8	8	-	8	-	-	-
	Snakeroot, white	7	7	8	7	8	6	8	-	-	-	-	7
	Sorrel, red	-	9	9	7	8	-	8	9	-	-	-	7
	Sowthistle, perenniel	7	8	9	7	8	9	8	8	9	-	-	7
	Thistle, Canada	7	7	7	9	8	9	9	7	9	-	6	9
	Yarrow, common	6	6	-	7	8	9	8	-	9	-	-	7
Woody Perennials													
	Blackberry spp.	6	8	7	6	6	-	7	8	-	-	7	6
	Dewberry spp.	6	8	7	6	6	-	6	8	-	-	-	6
	Grape, wild	7	7	8	7	7	-	7	7	-	-	-	-
	Honeysuckle spp.	6	9	8	6	-	-	7	9	-	-	-	-
	Locust, black	6	6	7	6	7	8	7	6	8	-	8	-
	Multiflora rose	6	9	8	6	6	7	9	9	7	-	8	-
	Nightshade, bittersweet	6	6	-	6	6	-	8	-	-	-	-	7
	Olive, autumn	6	6	7	6	7	-	7	-	-	-	-	-
	Poison ivy, oak	6	6	8	6	7	-	7	6	-	-	8	-
	Sumac spp.	6	6	8	6	7	-	7	-	-	-	8	6
	Trumpetcreeper	6	6	7	6	6	-	6	-	-	-	6	-
	Virginia creeper	6	6	8	6	7	-	7	6	-	-	6	-

Control of Problem Weeds

The following section outlines strategies and herbicide treatments for management of weeds that are especially problematic in crop production. For annual weeds, this usually involves selection of the proper herbicides and application method. Perennial weeds require other strategies, such as application of translocated herbicides (glyphosate, dicamba, 2,4-D) in the fall following wheat harvest when perennials are in an advanced stage of growth. This allows movement of herbicide into the roots or other underground plant parts. Perennial weeds can be present in any tillage system, but tend to be more of a problem in minimum tillage, due to the lack of disturbance of underground plant parts. Root systems, rhizomes, tubers, and similar underground parts of perennial plants are a source of reinfestation even when above ground growth is controlled. It is extremely difficult to eliminate perennial weeds with a single herbicide application, and effective management will require attention every year. The following general strategies should be considered for management of perennial weeds.

1. Perennial weeds often occur first at the edges of crop fields, near fencerows and wooded areas. Taking steps to control perennial weeds in these areas when infestations are light will prevent further spread into the rest of the field. This can be accomplished by tillage or herbicide application in the infested area, without having to treat the rest of the field.

2. Apply glyphosate, or combinations of glyphosate with dicamba or 2,4-D, in the fall when perennial broadleaf weeds are in the bud to flower stage, or as late as possible before a hard frost. Add AMS (17 lb/100 gallon water) to glyphosate for maximum effectiveness on perennial weeds. Perennial grasses should have at least 10 to 14 inches of growth at the time of treatment. The best opportunity for this treatment is in wheat stubble. If the wheat stubble is mowed in summer to control seed production by annual weeds, mow before early August to allow time for regrowth of perennial weeds. It may be possible to apply herbicide after corn or soybean harvest in the fall, but allow time for perennials to recover from damage by harvest equipment.

3. Preplant application of glyphosate, 2,4-D, dicamba or combinations of these can help reduce the population of early emerging perennial weeds such as quackgrass and dandelion.

4. Postemergence herbicides can suppress or control perennial weeds, but this is often limited to suppression through the growing season. In corn, dicamba, 2,4-D, Stinger, and many ALS inhibitors (Hornet, Beacon, Permit, nicosulfuron) have activity on perennial broadleaf weeds when applied postemergence. Combinations of an ALS inhibitor with 2,4-D or dicamba have generally provided the most effective control, especially for hemp dogbane and perennial vines. In soybeans, ACCase inhibitors (clethodim, Fusilade, Fusion, and Assure II) will control or suppress many perennial grasses, including johnsongrass, quackgrass, and wirestem muhly. Synchrony STS and Classic/Harmony GT combinations can suppress common milkweed, pokeweed, and perennial sowthistle, and Basagran can control the above-ground growth of Canada thistle. Blazer, Cobra, Reflex, and Flexstar can burn back the above-ground growth of vines, such as bindweeds and honeyvine milkweed.

5. Postemergence application of glyphosate in glyphosate-resistant soybeans and corn can be a very effective tool for reducing perennial weed populations. Late postemergence application, when perennial weeds are in the bud to flower or boot to seedhead stage, will provide the most effective and complete plant control. When applied early postemergence, a second application may be required to control regrowth.

6. Glyphosate can be selectively applied to weeds in soybeans with a ropewick or sponge applicator. Weeds should be substantially taller than the soybeans, and herbicide applied in mid- to late-season for best results. This can be an effective method of managing hemp dogbane and common milkweed.

7. A preharvest application of approved glyphosate products in soybeans, corn, or wheat may help control perennial weeds, since their above-ground growth is still intact. In wheat and corn, 2,4-D is also labeled as a preharvest treatment. This treatment may have to be applied with aerial or high-clearance ground equipment.

8. Tillage can aid greatly in control of biennial and perennial weeds, but mainly is effective at removing those with a single deep taproot, such as pokeweed, dandelion, and wild carrot. Tillage with a chisel plow, disk, or field cultivator may actually help spread perennials with creeping root systems, such as Canada thistle and hemp dogbane.

Glyphosate Rates and Equivalents

Numerous glyphosate products are currently available. OSU and Purdue University research indicates similar effectiveness among these products, although labels may vary with regard to rainfast intervals, surfactant recommendations, etc. Glyphosate rates in the following section are stated as pounds of glyphosate acid equivalent (ae) per acre. Product rates will vary, since the concentration of the glyphosate acid varies among products. Table 24 contains a list of currently available glyphosate products, and rate equivalents for these products. Consult labels and local use guides for specific product rate information.

Jerusalem Artichoke

Jerusalem artichoke is a perennial broadleaf weed that spreads by seed, rhizomes, and tubers. The tubers overwinter in the soil and may become as large as a small potato. Jerusalem artichoke is extremely competitive with all crops and may reach a height of 6 to 8 feet. The flowers of Jerusalem artichoke resemble those of annual sunflower, but are much smaller.

Noncrop/Fallow Areas. A 2 percent solution of glyphosate as a spot treatment provides fair to good control. For broadcast applications, use 2.25 lbs ae of glyphosate/A. This treatment will be most effective when plants are close to or in the bud stage.

Corn. Postemergence application of Spirit (1 oz/A), NorthStar (5 oz/A), Stinger (1/2 pt/A), WideMatch (1.3 pts/A), Hornet (3 to 5 oz/A), or Lightning (1.28 oz/A - Clearfield corn only) will control or suppress small (3 to 6 inch) artichoke plants. These herbicides are most effective when mixed with dicamba (NorthStar is a premix of Beacon and dicamba). Marksman (3.5 pints/A), dicamba (1/2 to 1 pint/A), Status (5 oz/A), 2,4-D amine (0.5 lb ai/A), or dicamba + 2,4-D (1/2 pint + 1/4 pint/A) applied when artichoke are at least 6 inches tall provides fair to good control. Glyphosate (glyphosate-resistant corn) applied at 0.75 lbs ae/A will suppress or control Jerusalem artichoke, but a second application may be necessary. Ignite (Liberty Link corn only) applied postemergence will often suppress artichoke through the growing season.

Soybeans. Glyphosate (Roundup Ready soybeans) will suppress or control Jerusalem artichoke. A second application may be necessary. Late post applications, when plants are in the early bud stage, will provide the most complete control of underground plant parts. A single postemergence application of Classic (3/4 oz/A), Synchrony XP (0.75 oz/A), Raptor (4 to 5 oz/A), Pursuit (1.44 ounces/A), or Ignite (22 oz/A - Liberty Link soybeans only) will control or suppress artichoke. Split applications of Classic (1/2 oz/A followed by 1/2 oz/A) will provide more effective control than a single application. The first Classic application should be made when artichokes are less than 8 inches tall and have fewer than 8 leaves, and followed with a second application 14 to 21 days later.

Atriplex

Atriplex is a summer annual weed in the lambsquarters family that is increasing in prevalence throughout Ohio and eastern Indiana, although most is found north of Interstate 70. Atriplex resembles common lambsquarters, but often has narrower leaves and emerges earlier in the season. Orientation of leaves at the base of the stem is a key difference between lambsquarters and Atriplex. Atriplex has opposite leaf orientation at the lowest 4 to 8 nodes and leaves are usually alternate at all higher nodes. Lambsquarters can have opposite leaf orientation at the lowest one or two nodes, and all higher nodes are alternate. Atriplex usually reaches a maximum height of 3 feet, while lambsquarters can exceed this height. Atriplex has been a problem primarily in soybeans, where it has survived preplant glyphosate and 2,4-D application and postemergence Harmony GT application.

Soybeans. Controlling emerged Atriplex prior to planting with burndown herbicides is important. Because it emerges early in the spring, Atriplex may have considerable size at the time of burndown herbicide application. Burndown herbicides seem to be most effective on small plants, while larger plants can be difficult to control. University research indicates that low rates of glyphosate mixed with 2,4-D ester are effective on small plants, and herbicide rates should be increased with increasing plant size or cold temperatures. Gramoxone plus 2,4-D ester can also be effective on small plants, especially when mixed with Synchrony XP. Chlorimuron-containing products or Python can provide residual control of later-emerging plants, but most other soil-applied herbicides are variable in effectiveness. Postemergence application of glyphosate (0.75 to 1.5 lbs ae/A - Roundup Ready soybeans) will control small Atriplex and help control plants that escape burndown treatments. Increase glyphosate rates as Atriplex size increases. Most other postemergence soybean herbicides are ineffective for Atriplex control.

Field and Hedge Bindweed

Field and hedge bindweed are perennial vines that are similar in appearance. Both are often mistaken for annual morningglory. However, they are much more difficult to control than annual morningglory because of their deep, overwintering rootstocks. Tillage and crop rotation, in combination with selected herbicide use, helps reduce infestations. Chemical controls are the same for both types of bindweed.

Noncrop/Fallow Areas. To control bindweeds in wheat stubble or after corn or soybean harvest, apply glyphosate (2.25 to 3 lbs ae/A or 2% solution for spot treatment), glyphosate + 2,4-D (1.5 lbs ae/A + 0.5 lb ai/A), or glyphosate + dicamba (1.5 lbs ae/A + 1 pint/A) when plants are at or past the full-bloom stage. Apply fall treatments before a killing frost, and do not till for at least 7 days following application. Do not treat weeds under stress from drought.

Corn. Status (5 oz/A) has provided excellent bindweed control in university research. Application of NorthStar (5 oz/A), Yukon (6 to 8 oz/A), or combinations of Spirit (1 ounce/A) or nicosulfuron with dicamba will suppress bindweed plants less than 6 inches tall. Starane (2/3 pt/A) and WideMatch (1.33 pts/A) suppress bindweeds. Glyphosate (glyphosate-resistant corn) applied at 1.1 lb ae/A will suppress bindweed, but a second application may be necessary. A mixture of Lightning plus Status (Clearfield corn only) can control bindweed through the growing season.

Soybeans. Glyphosate (1.5 lbs ae/A - Roundup Ready soybeans) will suppress or control bindweeds. A second application may be necessary. Late postemergence applications, when plants are in the bloom stage, will provide the most complete control of underground plant parts. Postemergence application of Ultra Blazer (2 pints/A), Reflex (1.25 pints/A), Cobra/Phoenix (12.5 ounces/A), or Flexstar (1.3 pints/A), or combinations of Basagran with these products may burn back the above-ground foliage of bindweeds under favorable conditions. Results are best with high temperature, high humidity, and good soil moisture. Apply when bindweeds are from 12 to 18 inches long.

Burcucumber

Burcucumber is an annual broadleaf weed that reproduces by seed. It is more prevalent than wild cucumber and distinguished from this weed by its white flowers and flat, egg-shaped pods. The pods, which are in clusters, bear single seeds and are covered with barbed, prickly bristles. Burcucumber is extremely

competitive, and vines may spread as far as 25 feet from a single plant. Seed may germinate throughout the spring and summer, making season-long control difficult. The vines cover soybeans and twine around corn, hindering harvest operations.

Corn. Products that contain high rates of isoxaflutole (Balance Flexx, Corvus) or mesotrione (Lumax, Lexar) applied preemergence can provide early-season control of burcucumber, but a postemergence treatment is also required. While many postemergence herbicides are effective on small plants, the later-emerging burcucumber plants often grow rapidly enough to cause problems. A successful burcucumber control program often involves preemergence herbicides that provide early-season control, followed by late postemergence applications when corn is about 30 to 40 inches tall (sometimes with high-clearance sprayers) to control late-emerging plants. Herbicides with effective activity on emerged burcucumber include nicosulfuron, Beacon, Impact, Callisto, Northstar, Spirit, Status, dicamba, bromoxynil, Yukon, or Ignite (Liberty Link corn). Callisto and Spirit provide residual control in addition to control of existing plants.Use drop nozzles where directed by the label to avoid crop injury in late postemergence applications. Glyphosate (0.75 lb ae/A - glyphosate-resistant corn) is effective for control of small burcucumber plants.

Soybeans. Classic (2/3 to 3/4 ounce/A) and Synchrony XP (0.75 ounce/A) are the most effective postemergence herbicides for control of burcucumber in soybeans.Glyphosate (Roundup Ready soybeans) and Ignite (Liberty Link soybeans) will control small burcucumber. For all of these products, a split application may be more effective than a single application at a higher rate where late-emerging burcucumber are a frequent problem.

Wild Carrot

Wild carrot (also called Queen Anne's lace) is a biennial weed that is a frequent problem in continuous no-tillage cropping systems. Infestations often first appear at the borders of fields and the seed is spread throughout the field by the combine during corn and soybean harvest. It can be distinguished by its finely divided or lacy leaf shape, a white flower head, and its carrot-like odor. Wild carrot spreads by seed. The ultimate goal of controlling wild carrot, regardless of the method, should be to prevent seed production. A dense population of wild carrot can cause severe yield losses in corn and soybeans. Some wild carrot populations in Ohio are resistant to 2,4-D.

Wheat Stubble. Mow the wheat stubble before early August. Apply glyphosate (1.1 to 1.5 lbs ae/A) or glyphosate + 2,4-D (0.75 lb ae/A + 0.5 lb ai/A) in October. This fall application is targeted at the plants that will flower and produce seed the following year.

Fall/preplant control. Wild carrot is most effectively controlled by fall application of glyphosate + 2,4-D (0.75 lbs ae/A + 0.5 lb ai/A) or combinations of glyphosate or 2,4-D plus Autumn products or Basis. Apply from early October into mid November. For best results in spring, apply glyphosate plus 2,4-D (0.75 to 1.5 lbs ae/A + 0.5 lb ai/A) as an early preplant treatment soon after the plants begin to green up. Tillage is the most effective tool for control of wild carrot in the spring.

Corn. Wild carrot can be controlled or suppressed with postemergence corn herbicides. The most effective postemergence treatments include atrazine (2 pounds active ingredient/A), Spirit (1 ounce/A), Beacon (3/4 ounce/A), NorthStar, Permit (1 to 1.3 ounces/A), Yukon, or nicosulfuron. These should be applied with a COC or MSO. Application of any of these herbicides with dicamba will generally improve control, and the addition of 28% nitrogen may increase effectiveness. Any postemergence treatment containing at least 1.5 pounds active ingredient/A of atrazine will provide fair to good control. Glyphosate (1.1 lb ae/A - glyphosate-resistant corn) will suppress or control wild carrot.

Soybeans. Most effective control in spring results from preplant application of glyphosate plus 2,4-D ester plus a chlorimuron-containing product. Follow fall or spring preplant treatments with a postemergence application of Classic (3/4 ounce/A), Synchrony XP (3/4 ounce/A), or glyphosate (1.1 lb ae/A - Roundup Ready soybeans). Use COC or MSO with Classic and Synchrony to maximize control.

Dandelion

Dandelion is a perennial weed that occurs primarily in no-till fields. Reproduction is by seed and sprouting from a thick, fleshy root or root segments. Dandelion stems do not elongate but produce a rosette of leaves. This weed has become extremely problematic in corn, soybean, and wheat fields in Ohio and Indiana.

Fall herbicide treatments. Dandelion is most effectively controlled with fall herbicide treatments. A combination of 2,4-D plus a chlorimuron-containing herbicide (Canopy/Cloak DF/EX) is the most effective fall treatment in fields where soybeans will be planted. Basis plus 2,4-D is the most effective treatment where corn will be planted (can be applied prior to soybeans at lower rates in certain areas). Other effective treatments include glyphosate (1.1 lbs ae/A), and a combination of glyphosate (0.75 lb ae/A) plus either 2,4-D (0.5 to 1 lb ai/A) or Autumn/Autumn Super. These treatments can be applied in the fall prior to corn or soybeans. Apply when plants are at least 4 inches in diameter and after a light frost for best results. Mid-October to mid-November may be the best period for application, as long as plants are mostly green.

Corn. The most effective spring preplant treatments have been Lumax or Lexar plus 2,4-D ester in OSU and Purdue University research. Expert + 2,4-D, Balance/Corvus + atrazine + 2,4-D, or other treatments containing glyphosate and 2,4-D can be effective, but control has been more variable. Expert or combinations of glyphosate with other preplant herbicides (without the 2,4-D) can also be effective, but may be more variable across a range of weather conditions and dandelion sizes. For best results, do not apply spring treatments before about April 7 and use water as the spray carrier. The most effective postemergence treatments include Status, Laudis/Corvus + atrazine, Callisto plus atrazine, and mixtures of Steadfast ATZ with Callisto or dicamba. Postmergence application of glyphosate (Roundup Ready soybeans) or Ignite + atrazine (Liberty Link corn) can control or suppress

seedling dandelion and plants that have been injured by preplant herbicides. Postemergence herbicides are best suited for control of plants that regrow after a relatively effective fall or spring burndown treatment, and not for control of plants that were not previously treated.

Soybeans. Preplant application of glyphosate plus 2,4-D ester plus a chlorimuron-containing or a cloransulam-containing herbicide has generally been the most effective treatment in university research (chlorimuron can be more effective than cloransulam). Glyphosate plus 2,4-D ester has been less consistently effective than treatments containing chlorimuron or FirstRate. Apply after about April 7 for best results. Valor plus glyphosate plus 2,4-D ester has been among the most effective preplant treatments for rapid activity on dandelion, but dandelions are more likely to regrow compared to the glyphosate/2,4-D/chlorimuron treatment. Postemergence application of Classic (3/4 ounce/A) or Synchrony XP (3/4 ounce/A) can suppress dandelion plants that regrow after preplant treatment. Postmergence application of glyphosate (Roundup Ready soybeans) can control or suppress seedling dandelion and plants that have been injured by preplant herbicides. Postemergence combinations of glyphosate plus Classic or FirstRate can be more effective than glyphosate alone.

Wheat. OSU research results indicate that application of tribenuron (Express/Nuance) plus dicamba to emerged wheat in early November may be the most effective approach to dandelion control in wheat. Fall-applied Huskie also has activity on dandelion. Preplant or preemergence application of glyphosate has the potential to provide some control or suppression, but will be most effective when glyphosate application can be delayed until at least mid-November, or after a frost. Several wheat herbicides can have activity on dandelion when applied in the spring, but control can vary greatly with dandelion growth stage and weather. Herbicides with activity in the spring include Express + 2,4-D, and combinations of Curtail, Stinger, or WideMatch plus Express/Nuance or 2,4-D (see labels for information on allowed mixtures).

Hemp Dogbane

Hemp dogbane is a tall-growing, perennial broadleaf weed often mistaken for common milkweed. It spreads by seed and overwintering rootstock. In Ohio and Indiana, hemp dogbane tends to appear in areas that have not been tilled for a number of years.

Noncrop/Fallow Areas. Glyphosate (3 lbs ae/A or 2% solution for spot treatment) or glyphosate + 2,4-D (1.1 lb ae/A + 0.5 lb ai/A) can be applied when dogbane are in the late-bud to flower stage of growth. Treatments following crop harvest or mowing should be delayed until weeds regrow to a mature stage.

Corn. Glyphosate (glyphosate-resistant corn) applied at 1.1 lb ae/A will suppress or control dogbane, but a second application may be necessary. Most effective postemergence treatments include Starane (2/3 pt/A), WideMatch (1.33 pts/A), or combinations of Spirit (1 ounce/A) or Beacon (3/4 ounce/A) plus 1/2 pint/A of 2,4-D. Other postemergence treatments with activity include NorthStar, Yukon, and combinations of dicamba (1/4 to 1/2 pint/A) with Spirit or nicosulfuron. Dicamba (1/2 to 1 pint/A) applied alone will suppress dogbane, with best results if dogbane plants are at least 8 inches tall. If corn is less than 8 inches tall, the higher rate can be applied. Use drop nozzles where directed by the label to avoid crop injury in late postemergence applications.

Soybeans. Glyphosate (1.5 lb ae/A - Roundup Ready soybeans) is the only effective postemergence treatment. A second application may be necessary. Late postemergence applications, when plants are in the bud to flower stage, will provide the most complete control of underground plant parts.

Wild Garlic

Wild garlic is a perennial plant that produces underground and aerial bulblets. The leaves are hollow, nearly round, and attached to the lower half of the stem. The aerial bulblets of wild garlic contaminate harvested small grains, especially wheat. Price dockage for garlic-tainted grain can be substantial, depending on the degree of contamination. Wild garlic can also cause off-flavor in milk from animals grazing infested pastures. Wild garlic is found throughout Ohio and Indiana, but creates the most problems in the wheat-growing areas of the state.

Wheat. Postemergence application of the higher rates of a thifensulfuron/tribenuron premix product in the spring provides good to excellent control. Apply with surfactant when wild garlic plants are less than 12 inches tall, with 2 to 4 inches of new growth. For best results, apply when wild garlic is actively growing under temperatures of 60 degrees or higher. These products can be applied using 28% UAN as the carrier, but surfactant recommendations may change. Refer to the label for more information on application in liquid fertilizer. Peak (1/4 to 1/2 ounce/A) is also labeled for control of garlic up to 8 inches tall. The higher rate provides more effective control of underground bulblets.

Postemergence application of the high rate of tribenuron or 2,4-D ester (0.75 to 1.0 lb ai/A) can prevent formation of the aerial bulblets of wild garlic, but will not control other parts of the plant. Tribenuron application timing is similar to that described for thifensulfuron/tribenuron products. Apply 2,4-D ester from mid-March to early April when the air temperatures are 60 degrees or higher.

Soybeans. Wild garlic infestations in soybeans sometimes require control measures. Effective treatments include fall or early-spring application of a chlorimuron-containing product, or preplant application of Synchrony XP (plus 0.5 lb ai/A of 2,4-D, if at least 7 days before planting). Postemergence application of Classic, chlorimuron/thifensulfuron combinations, or Synchrony XP can also be used. Harmony Extra can be applied 14 or more days before soybean planting for control of emerged wild garlic plants in early spring.

Horsenettle

Horsenettle is a perennial that spreads through creeping

rootstocks, in addition to reproduction by seed. A distinguishing feature of horsenettle is the bristly stem, which is covered with hairs and spines. Leaves are alternate, oblong, and lobed, with yellow prickles on the petioles, midrib and veins. The plant produces juicy, yellow berries that are about 1/2 inch in diameter and contain the seeds. Horsnettle is found mainly in no-till fields, and is difficult to control. It typically emerges after crop planting, and postemergence herbcides are only marginally effective.

Noncrop/Fallow Areas. Application of glyphosate (3 lbs ae/A or 2% solution for spot treatment), dicamba (2 quarts/A), or 2,4-D ester (2.0 lbs ai/A) when horsenettle is in the late-bud to flowering stage are most effective. Control ranges from fair to good with these treatments. Milestone and and Forefront are effective for horsenettle control in permanent grass pastures and other noncrop areas that will not be rotated into field crops.

Corn. Preplant herbicides are not effective for control of horsenettle. Most effective suppression/control results from postemergence application of NorthStar (5 oz), Yukon (6 to 8 oz), or combinations of Spirit (1 ounce/A) or nicosulfuron with 1/4 to 1/2 pint/A of dicamba. Other treatments with activity include glyphosate (1.1 lb ae/A - glyphosate-resistant corn), dicamba (1/2 to 1 pint/A), and Marksman (3.5 pints/A).

Soybeans. Postemergence application of Classic (3/4 ounce/A), Synchrony XP (3/4 ounce/A), Pursuit (1.44 ounce/A), or glyphosate (Roundup Ready soybeans) can suppress horsenettle.

Horsetail (Equisetum)

Horsetail is a perennial weed that reproduces through spores (instead of seeds) and rhizomes. It is typically found in wet areas and in no-till production, and long-term management of horsetail should involve drainage and tillage where possible. Several herbicides have activity on emerged horsetail, but the lack of leaf tissue to intercept spray particles reduces herbicide effectiveness. Considerable variation occurs among Equisetum species with regard to their response to herbicides, and the following treatments may not be effective in all populations.

Corn. Flumetsulam (Python, Hornet) is the most effective herbicide on emerged plants. Plants can be treated with a preplant application of Python or Hornet, or a postemergence application of Hornet depending upon the emergence pattern and date of crop planting. Postemergence application of Steadfast plus Status can suppress horsetail.

Soybeans. Preplant application of glyphosate plus Python can control plants during the season of application and help reduce the severity of future infestations.

Wheat. MCPA can control or suppress horsetail.

Horseweed (Marestail)

Horseweed (marestail) is an annual weed that often becomes a problem in continuous no-till fields, although it is also occasionally a problem in tilled fields. Horseweed can follow a winter annual or summer annual life cycle. Horseweed can emerge in late summer through fall, and also in early spring through early summer. Horseweed does not mature until late summer, and it interferes with corn and soybean growth during the growing season and also interferes with harvest.

Horseweed is more easily controlled when small in the fall or early spring, and becomes more difficult to control after the stem elongates (bolting). Herbicides with residual activity should be included in spring burndown treatments to prevent emergence of horseweed after crop planting. Many horseweed populations in Ohio and Indiana are resistant to ALS inhibitors (Classic, FirstRate, etc) or glyphosate, and some populations have multiple resistance, to both types of herbicide. More information on marstail management can be found on the OSU Weed Science website, http://agcrops.osu.edu/specialists/weeds/weeds/.

All crops - late summer/fall control. Application of 2,4-D alone or in combination with any other herbicide in the fall will result in a field free of horseweed early the next spring (it controls horseweed that would have overwintered), although the field is likely to be reinfested with horseweed that emerge in spring. Horseweed should be prevented from producing seed in the summer/fall after wheat harvest with application of 2,4-D plus either dicamba or glyphosate in late July or early August.

Corn. Preemergence treatments containing atrazine should control horseweed that emerge after planting. Most postemergence treatments containing a growth regulator herbicide (2,4-D, dicamba) will suppress or control horseweed sufficiently until the corn is well-established. Ignite + atrazine will control small horseweed when applied postemergence in Liberty Link corn.

Soybeans. The presence of ALS and glyphosate resistance in horseweed populations in limit herbicide options for burndown and postemergence treatments. Planting Liberty Link soybeans can be an effective solution in fields with resistant marestail populations. Postemergence application of Ignite in Liberty Link soybeans can control small plants that emerge after soybean planting, but it is important to follow the other practcies outlined here to ensure effective burndown and residual control.

The primary goals of a horseweed management program in no-till soybeans should be effective control of emerged plants prior to planting, and residual control of plants that emerge for 6 to 8 weeks after planting. This approach strategy will reduce the need for treat marestail with postemergence herbicides, which are not often effective due to herbicide resistance. The following principles are important in horseweed control programs:

1) 2,4-D ester should be included in herbicide treatments if at all possible. Use the highest rate possible based on time until soybean planting;

2) herbicides should be applied when horseweed plants are no more than 4 to 6 inches tall;

3) herbicides applied in the fall will control emerged horseweed, but may not adequately control spring-emerging plants; and

4) spring applications should include a residual herbicide to control later-emerging plants.

Control of emerged horseweed prior to soybean planting

The most effective spring treatments for control of horseweed up to about 6 inches tall are as follows:

- glyphosate (1.1 to 1.5 lbs ae/A) + 2,4-D ester;
- Saflufenacil + glyphosate or Ignite + MSO;
- Metribuzin (0.4 lb ai/A) + paraquat (3 - 4 pts/A) + 2,4-D ester + COC;
- Ignite (29 - 36 oz/A) + metribuzin (0.4 lb ai/A) + 2,4-D ester

Saflufenacil products for use in soybeans include Sharpen, Optill, and Verdict. Use rates of all of these provide the equivalent of 1 oz/A of Sharpen. Where it is not possible to use 2,4-D ester, the most effective treatments are: 1) saflufenacil + glyphosate or Ignite; and 2) Ignite + metribuzin. Residual herbicides should be included in preplant burndown treatments. The most effective residual herbicides are those that contain active rates of two modes of action, such as Gangster, Authority XL, Valor XLT, Envive, Sonic/Authority First, Authority MTZ, and a combination of Canopy DF plus metribuzin. These products can help control emerged plants when combined with one of the burndown treatments listed above (do not combine Sharpen with herbicides containing Valor or Authority/Spartan). Application of Valor or metribuzin can provide adequate residual control. Canopy EX, FirstRate, or Python can be used for residual control in fields where the horseweed is not ALS-resistant.

Postemergence control in soybeans

Horseweed cannot be controlled with postemergence herbicides in most soybean fields in Ohio and Indiana, with the exception of Ignite applied postemergence in LibertyLink soybeans. In populations that are not glyphosate- or ALS-resistant, postemergence application of glyphosate, FirstRate, or Classic can control small plants that emerge after soybean planting. A combination of glyphosate plus either Classic or FirstRate has the most chance for success, but primarily for contrl of plants that emerged after soybean planting and are still small.

Johnsongrass

Johnsongrass is an extremely competitive perennial grass prevalent in the southern half of Ohio and Indiana, although it has been observed as far north as Wood County in northwestern Ohio and Lake and Allen Counties in Indiana. It reproduces both by seed and overwintering rhizomes (large, white, scaly, underground stems). Control of rhizome johnsongrass is an ongoing process that should include both cultural and chemical methods.

Most rhizome production occurs when johnsongrass plants reach 2 or more feet in height and begin producing seed heads. Close grazing or mowing to keep johnsongrass less than a foot tall will greatly reduce rhizome production.

Noncrop/Fallow Areas. Glyphosate provides excellent control of johnsongrass that is in the boot to head stage or anytime prior to frost. For spot treatment, use a 2% solution. For broadcast application, apply 0.75 lb ae/A glyphosate plus AMS (17 lbs/100 gallons of water) in a spray volume of 5 to 10 gpa.

Corn. Postemergence application of nicosulfuron, Beacon, NorthStar, or Steadfast provides the most effective control of established johnsongrass infestations. Rhizome johnsongrass plants should be at least 8 inches tall at the time of application. Glyphosate (Roundup Ready soybeans) will control seedling and rhizome johnsongrass. For most effective control of rhizome johnsongrass, apply after plants are in the boot stage. Lightning (1.28 ounce/A - Clearfield corn), Ignite (22 ounces/A - Liberty Link corn), Corvus, and Laudis can also control seedling johnsongrass, but will be less effective than the other herbicides listed here in established johnsongrass infestations.

Soybeans. Postemergence application of Assure II /Targa (10 ounces/A), Fusilade DX (12 ounces/A), Fusion (12 ounces/A), or clethodim provides good to excellent control. Application should be delayed until johnsongrass reaches a height of about 10 to 20 inches (labels vary with regard to minimum height at the time of application — consult individual labels for more information). Glyphosate (Roundup Ready soybeans) will control seedling and rhizome johnsongrass. For most effective control of rhizome johnsongrass, apply after plants are in the boot stage. For any of these herbicides, a second application may be necessary to control regrowth. Postemergence application of Ignite (Liberty Link soybeans) can suppress johnsongrass.

Lambsquarters (triazine-resistant)

Triazine-resistant weeds have developed in areas where triazine herbicides (atrazine, simazine) have been used for many years, primarily in continuous corn areas. The predominant triazine-resistant weed in Ohio is lambsquarters, although some triazine-resistant pigweed also occurs. Triazine-resistant weeds are not controlled by atrazine, simazine, or metribuzin, regardless of the rate applied. Preemergence herbicides should be used in lambsquarters control programs, because postemergence herbicides are variable in their effectiveness.

Corn. Preplant or preemergence application of products containing isoxaflutole (Balance Flexx, Corvus), flumetsulam (Python, SureStart/TripleFlex, Hornet), mesotrione (Callisto, Lumax, Lexar), or saflufenacil (Verdict, Sharpen) will control triazine-resistant lambsquarters. Preemergence applications of pendimethalin will also provide control, but may be more variable than the others. Do not incorporate pendimethalin or apply before corn planting. Products containing acetochlor (Surpass, Harness, etc) provide fair to good control of triazine-resistant lambsquarters, but a tank-mix partner or follow-up postemergence treatment will generally be required for complete control.

Many postemergence corn herbicides can effectively control triazine-resistant lambsquarters, especially when used primarily to control plants that escape effective preemergence herbicide. Using postemergence herbicides as the sole method of control

is likely to result in more variable results. See Table 4 for postemergence herbicide ratings.

Soybeans. Triazine-resistant lambsquarters will not be controlled by metribuzin, but most other preplant/preemergence broadleaf soybean herbicides provide adequate control. Lambsquarters can be extremely difficult to control with postemergence soybean herbicides, especially when they are large or well-established. Best control results from application of glyphosate (Roundup Ready soybeans), Harmony GT (1/12 ounce/A), Synchrony STS (3/4 ounce/A), or Raptor (4 to 5 ounces/A) when plants are less than 4 inches tall. Use of crop oil instead of surfactant will improve control with Harmony GT or Synchrony, but may increase soybean injury on non-STS soybeans. Use of MSO can improve Raptor activity, but also increases soybean injury. Some lambsquarters populations have become less sensitive to glyphosate. Postemergence glyphosate rates of 1.1 to 1.5 lbs a.e./A can provide more consistent control than lower rates. A second application may be necessary to obtain adequate control in some fields, and should generally be applied 3 to 4 weeks after the initial glyphosate application.

Common Milkweed

Common milkweed, like hemp dogbane, is a problem primarily in continuous no-till fields. It may grow 4 to 5 feet tall and reproduces by seed and deep, creeping roots that overwinter and form new plants the following spring.

Noncrop/Fallow Areas. Apply glyphosate (2.25 lbs ae/A or 2% solution for spot treatment) when milkweed are in the late-bud to flower stage of growth. Glyphosate (1.5 lb ae/A) plus 2,4-D ester (0.75 lb ai/A can provide good control. Following small-grain harvest or mowing, allow milkweed to regrow to a mature stage prior to treatment.

Corn. Postemergence application of glyphosate (1.1 lb ae/A - glyphosate-resistant corn) will control or suppress milkweed. A second application may be necessary. Late post applications, when plants are in the bloom stage, will provide the most complete control of underground plant parts. Products containing dicamba provide some control or suppression. Apply when milkweed is at least 8 inches tall. Application of Yukon, NorthStar, or a combination of Spirit (1 ounce/A) with dicamba may provide better control than dicamba alone.

Soybeans. Postemergence application of glyphosate (Roundup Ready soybeans) applied at high rates will control or suppress milkweed. A second application may be necessary. Late post applications, when plants are in the bloom stage, will provide the most complete control of underground plant parts. Classic (3/4 ounce/A) and Synchrony STS (3/4 ounce/A) can suppress milkweed through the growing season.

Honeyvine Milkweed

Honeyvine milkweed is a vining perennial that spreads by seeds and long, creeping roots. It is more of a problem in long-term no-till fields. Control is made difficult by the late emergence and limited leaf area on young plants.

Noncrop/Fallow Areas. High rates of glyphosate, or combinations of glyphosate plus 2,4-D ester will provide some control when applied in fall. Apply when plants are in the bud to bloom stage or before a light frost.

Corn. Postemergence application of glyphosate (0.75 lb ae/A - glyphosate-resistant corn) will control or suppress honeyvine milkweed, but results have been variable. Make a second application if necessary. Best control may result from late postemergence application when plants are flowering. Other postemergence treatments with activity include Starane (2/3 pt/A), WideMatch (1.33 pt/A), 2,4-D ester (0.25 to 0.38 lb ai/A), dicamba (1/2 to 1 pint/A), Status (5 oz/A), and dicamba + 2,4-D (half rates of each). Beacon (3/4 ounce/A), nicosulfuron, Spirit (1 ounce/A), and Permit (1 to 1.3 ounce/A) will suppress small (1 to 6 inch) plants, but these products are likely to be more effective when combined with 2,4-D or dicamba (1/4 to 1/2 pint/A) where allowed by the label.

Soybeans. Postemergence application of glyphosate (Roundup Ready soybeans) will control or suppress honeyvine milkweed, but results have been variable. Apply higher labeled rates and make a second application if necessary. Best control may result from late postemergence application when plants are flowering. Other treatments with activity include Flexstar (1.3 pints/A), Reflex (1.25 pints/A), Ultra Blazer (1.5 pints/A), and Cobra (12.5 ounces/A) or combinations of any of these with Basagran. These treatments can burn back the above-ground foliage under favorable conditions, but will not affect the roots.

Bigroot Morningglory

Bigroot morningglory (also called wild sweet potato) is a vining perennial that reproduces from seed and from roots. The roots are yellowish white and may be several feet long and weigh over 30 pounds. The bulk of the root system is often below the plow line. The stems grow to a length of 10 feet or more, and cause problems by twining on crops.

Noncrop/Fallow Areas. Application of high rates of glyphosate (or a 2% solution for spot treatment) in late August or when plants are in the bud stage can provide some long-term control.

Corn. Postemergence application of glyphosate (glyphosate-resistant corn) will control or suppress bigroot morningglory. Apply 1.1 lb ae/A and make a second application if necessary. Postemergence application of 2,4-D amine (0.5 lb ai/A), 2,4-D ester (0.25 to 0.38 lb ai/A), or mixtures of these with dicamba and suppress plants through the season. Status has similar activity. Applications later in the season when plants are in the bud stage will result in reduction of the morningglory population, but these can be difficult to implement without injuring corn.

Soybeans. Postemergence application of glyphosate (Roundup Ready soybeans) will control or suppress bigroot morningglory. Apply higher labeled rates and make a second application if necessary. Best control may result from late postemergence application when plants are in the bud stage. Cobra (12.5 ounces) can provide limited suppression of vines.

Wirestem Muhly

Wirestem muhly is a perennial grass that spreads by seed and short, scaly rhizomes. The rhizomes, like those of johnsongrass or quackgrass, can be moved from farm to farm by tillage equipment. Wirestem muhly does not begin growth until late spring after the crop has emerged, making it more difficult to control than quackgrass.

Noncrop/Fallow Areas. Glyphosate can be used as a preplant treatment in early June where crop planting is delayed, or it can be applied after harvest when wirestem muhly is at least 8 inches tall and actively growing. For best results, apply at least 0.75 lb ae/A of glyphosate plus AMS (17 pounds/100 gallons water) in a spray volume of 5 to 10 gpa. For spot treatments, use a 2% solution.

Corn. Glyphosate (0.75 lb ae/A - glyphosate-resistant corn) is the most effective herbicide for wirestem muhly. Plants should be at least 8 inches tall at the time of application.

Soybeans. Postemergence application of Assure II/Targa (8 ounces/A), Fusilade DX (12 ounces/A), Fusion (8 ounces/A), or clethodim provides good to excellent control. Apply Assure II or clethodim when wirestem muhly is 4 to 8 inches tall. Apply Fusilade or Fusion when plants are 4 to 12 inches tall. Glyphosate (Roundup Ready soybeans) will control wirestem muhly. Plants should be at least 8 inches tall at the time of application. For any of these treatments, a second application may be necessary to control regrowth.

Eastern Black Nightshade

Eastern black nightshade, a summer annual weed, develops late in the growing season and produces purple berries that stain harvested grain. Nightshade can be identified by the purple color on the underside of the older leaves. It is a shade-tolerant plant that can survive underneath the crop canopy. In addition to reducing yields and crop quality, the succulent plant and berries can "gum up" a combine so badly that it will not clear grain properly. Nightshade is a problem in soybeans primarily. Most effective control results from a combination of preemergence and postemergence herbicides.

Soybeans. Preplant or preemergence applications of many preplant/preemergence soybean herbicides will control black nightshde, but products that contain only chlorimuron or metribuzin will not. A follow up postemergence treatment may be necessary to control plants that emerge in mid-season. Several postemergence products are effective on eastern black nightshade if applied when weeds are small. These include Ultra Blazer (1.5 pints/A), Cobra (12.5 ounces/A), Reflex (1.25 pints/A), Flexstar (1.3 pints/A), Pursuit (1.44 ounce/A), Raptor (4 to 5 ounces/A), glyphosate (0.75 lb ae/A - Roundup Ready soybeans), and Ignite (22 oz/A - Liberty Link soybeans). Pursuit provides residual nightshade control, while most other postemergence herbicides have little to no residual activity.

Yellow Nutsedge

Yellow nutsedge is a perennial sedge that reproduces mainly by small, overwintering tubers located at the ends of rhizomes. The tubers begin sprouting about May 1 in Ohio. The plant looks like a grass, but has a triangular stem. It is more of a problem in wet areas and during wet years.

Corn. Alachlor, acetochlor, metolachlor/s-metolachlor, Define, Outlook, can provide good control, but surface applications are variable in activity. Preplant incorporation (2 to 3 inches deep) of these materials will provide more consistent nutsedge control than preemergence application. Control also is enhanced by combining atrazine with these herbicides.

Postemergence application of Permit (1 to 1.3 ounces/A), Yukon (6 to 8 oz/A), or Permit Plus (0.75 oz/A) when nutsedge is 4 to 12 inches tall provides the most effective control. Basagran (1.5 to 2 pints/A) or Laddok (2.3 pints/A) applied postemergence when nutsedge is 6 inches tall also suppresses or controls nutsedge, but is less effective than Permit for reduction of nutsedge populations. Atrazine plus COC may be used as a postemergence spray to control emerged yellow nutsedge when small. Postemergence applications of glyphosate can control nutsedge, but activity is usually slow.

Soybeans. Alachlor, metolachlor/s-metolachlor, and Outlook can provide good control, but surface applications are variable in activity. Preplant incorporation (2 to 3 inches deep) of these materials will provide more consistent nutsedge control than preemergence application.

Postemergence application of Basagran (1 1/2 to 2 pints/A) when plants are at least 6 inches tall provides good nutsedge control. Classic (1/2 to 3/4 ounce/A) or Synchrony STS (3/4 ounce/A) provides good control of yellow nutsedge plants with 4 to 6 leaves. FirstRate (0.3 ounces/A) can also suppress yellow nutsedge. Postemergence application of glyphosate can control nutsedge, but activity is usually slow.

Common Pokeweed

Common pokeweed is a perennial broadleaf weed that reproduces by seed and also has an enlarged taproot that over-winters to provide a source of new growth the following spring. This plant is becoming more prevalent as no-tillage continues to increase. Common pokeweed can be identified by its pinkish-red colored stem and its fleshy appearance and alternate leaf pattern. The plant produces many purple berries that can stain soybeans at harvest.

Noncrop/Fallow Areas. Apply glyphosate at 1.1 to 1.5 lbs ae/A, or at 0.75 lb ae/A in combination with 2,4-D ester (0.5 to 0.75 lb ai/A) in late September or early October when plants are 8 to 24 inches tall, but before frost. For spot treatment, apply glyphosate in a 2% solution.

Cut Stump Treatments. Application of undiluted glyphosate directly to the freshly cut stump of pokeweed can provide effective control. Plants should be several feet tall at the time of cutting for best results.

Corn. Glyphosate (1.1 lb ae/A - glyphosate-resistant corn) applied postemergence when plants are at least 8 inches tall will control or suppress pokeweed. Make a second application if necessary. Other effective postemergence treatments include NorthStar, Yukon, Callisto, dicamba (1 pint/A), Status (5 oz/A), or a combination of dicamba with Spirit (1 ounce/A). Apply when plants are less than 12 inches tall.

Soybeans. Glyphosate (1.1 to 1.5 lb ae/A - Roundup Ready soybeans) applied postemergence when plants are at least 8 inches tall will control or suppress pokeweed. Control will be reduced where glyphosate is applied to very small plants, or too late in the season when plants are extremely large. Make a second application if necessary. Synchrony STS (3/4 ounce/A) and Classic/Harmony GT combinations will often suppress pokeweed through the growing season. Thorough spray coverage on the foliage of larger plants is essential to maximize herbicide activity.

Quackgrass

Quackgrass is a cool season perennial grass reproducing from seed and a dense network of small rhizomes. Weed growth often begins in early March if there are a few successive warm days. It tends to be the biggest problem where grass or grass/legume forage mixtures are grown or in areas where continuous no-till corn is grown. Growth of quackgrass is most vigorous during the spring, while temperatures are relatively cool.

Noncrop/Fallow Areas. Apply glyphosate in the spring or fall when quackgrass is at least 6 to 8 inches tall and actively growing. Apply at a rate of 0.75 lb ae/A plus AMS (17 pounds/100 gallons water) in spray volume of 5 to 10 gpa. For spot-treatment, use a 2% solution.

Corn. Atrazine provides some suppression or control of quackgrass when split-applied at high rates, but the current atrazine label allows a maximum of only 2.5 pounds per year. This rate may not be sufficient in many fields, and additional herbicides or applications will usually be necessary.

Glyphosate (0.75 lb ae/A - glyphosate-resistant corn) will control quackgrass that is at least 8 inches tall. Postemergence application of nicosulfuron, Steadfast (3/4 ounce/A), or Beacon (3/4 ounce/A) will provide good to excellent control of quackgrass up to 8 or 10 inches tall. Capreno and Laudis have activity on quackgrass also.

Soybeans. Postemergence application of Assure II/Targa (10 ounces/A), Fusilade DX (12 ounces/A), Fusion (12 ounces/A), or clethodim provides good to excellent control. These products should be applied when quackgrass is about 6 to 10 inches tall. Glyphosate (Roundup Ready soybeans) will control quackgrass that is at least 8 inches tall. For any of these herbicides, a second application at a lower rate may be necessary to control regrowth.

Common Ragweed (herbicide-resistant)

Many common ragweed populations in Ohio and Indiana are resistant to ALS inhibitors (Classic, FirstRate, Beacon, etc), especially in fields with a history of non Roundup Ready soybeans. Populations with multiple herbicide resistance, to both glyphosate and ALS inhibitors or ALS inhibitors and PPO inhibitors (Flexstar, Cobra, Valor) have also been indentified. Common ragweed with resistance to both ALS and PPO inhibitors can be controlled by postemergence application of glyphosate in Roundup Ready soybeans. Likewise, populations with resistance to both glyphosate and ALS inhibitors can still be controlled by Flexstar or Cobra. However, the most effective management strategy for multiple-resistant populations may be to plant corn, in order to take advantage of the effectiveness of corn herbicides on herbicide-resistant ragweed. Use of Ignite in Liberty Link soybeans can also be an effective tool to manage populations that have been poorly controlled by other types of herbicides.

Corn. Resistant common ragweed populations should not be difficult to control in corn, due to the effectiveness of triazines, dicamba, and other corn herbicides. Preemergence corn herbicides can provide season-long control of common ragweed, when used at recommended rates. In glyphosate-resistant corn fields with history of poor performance of glyphosate on common ragweed, postemergence herbicide treatments should include other herbicides along with glyphosate if the preemergence herbicides fail to adequately control the ragweed. Most effective partners for glyphosate in these mixtures include Status, Impact, Callisto, Laudis, and dicamba. The rate of the partner herbicide should be high enough to control common ragweed that appears to be resistant to glyphosate. In Liberty Link corn, postemergence application of Ignite or Ignite plus atrazine effectively controls ragweed plants that escape residual herbicides.

Soybeans. It is essential that no-till soybean fields with resistant populations receive an effective burndown treatment with 2,4-D ester to ensure that that the field is weedfree at the time of planting. A combination of preemergence and postemergence herbicides will provide the most effective control of populations resistant to ALS inhibitors and/or glyphosate (there are no effective preemergence herbicides where the ragweed is resistant to both ALS and PPO inhibitors). Where the population is known to still be sensitive to ALS inhibitors, any of the following preemergence herbicides can provide effective control: Canopy, FirstRate, Gangster, Valor XLT, Envive, Sonic, Authority First, or Scepter. Where the population is ALS-resistant, but still sensitive to PPO inhibitors, Valor, Envive, Valor XLT, Gangster, or metribuzin can provide fair to good control.

Postemergence application of glyphosate (Roundup Ready soybeans) should control any common ragweed population that is not glyphosate-resistant. Ignite (22 oz/A - Liberty Link soybeans) will control common ragweed that is resistant to glyphosate, ALS inhibitors, or PPO inhibitors. FirstRate (0.3 oz) or Flexstar (1.3 pts) will control glyphosate-resistant common ragweed, and Flexstar (1.3 pts) or Cobra/Phoenix (12.5 oz) will control populations that are resistant to both glyphosate and ALS inhibitors. Apply postemergence herbicides when ragweed plants are no more than 6 inches tall for most effective control. Where it is necessary to mix Flexstar or Cobra with glyphosate to control

glyphosate-resistant plants, apply with the adjuvants specified on the labels for these products. This is likely to result in the use of MSO (Flexstar) or COC (Cobra). Similarly, Flexstar GT should be applied with COC or MSO in glyphosate-resistant populations.

Giant Ragweed

This annual weed emerges as early as March and will continue to germinate through the spring and early summer. Giant ragweed is extremely competitive and is most difficult to control in soybeans and other broadleaf crops. Its ability to germinate and emerge from deep in the soil allows it to escape many soil-applied herbicides. The most dense populations occur in tilled soil. Populations can decrease in long-term no-till with proper management. Many populations of giant ragweed in Ohio and Indiana are resistant to ALS inhibitors (Classic, FirstRate, Beacon, etc), especially in fields with a history of non Roundup Ready soybeans. Populations with resistance to glyphosate have also been identified, and some of these have multiple-resistance, to both ALS inhibitors and glyphosate.

Corn. Early-emerging giant ragweed plants should be removed prior to planting with tillage or a preplant herbicide treatment. A preplant application of 2,4-D ester (0.5 lb ai/A) plus atrazine provides effective control of giant ragweed plants that emerge early in the spring before planting. For preplant control of large plants, the addition of glyphosate or Gramoxone may be necessary.

A combination of preemergence followed by postemergence herbicides provides the most effective giant ragweed control, and this approach should be used in any field where control of giant ragweed has been inadequate in previous years. Most effective preemergence treatments are those that contain atrazine and another broadleaf herbicide with activity on giant ragweed. These include Lumax, Lexar, or a combination of atrazine plus either SureStart/TripleFlex, Hornet, Balance Flexx, Corvus, or Verdict/Sharpen.

A follow up postemergence treatment is usually necessary in fields infested with giant ragweed, and some preemergence products (Surestart/TripleFlex, Verdict) are intended for use only in preemergence plus postemergence programs . Many postemergence corn herbicides will control giant ragweed, especially if they contain atrazine or dicamba (see Table 4 - corn herbicide effectiveness ratings). In glyphosate-resistant corn fields with a history of poor performance of glyphosate on giant ragweed, postemergence herbicide treatments should include other herbicides along with glyphosate. Most effective partners for glyphosate in these mixtures include Status, Impact, Callisto, Laudis, and dicamba. The rate of the partner herbicide should be high enough to control giant ragweed that appears to be resistant to glyphosate. In Liberty Link corn, postemergence application of Ignite or Ignite and atrazine effectively controls ragweed plants that escape residual herbicides.

Soybeans. A combination of preemergence followed by postemergence herbicides provides the most effective giant ragweed control, and this approach should be used in any field where control of giant ragweed has been inadequate in prior years. Early-emerging giant ragweed plants should be removed prior to planting with tillage or a preplant herbicide treatment. While 2,4-D ester alone can control small plants, it should be combined with glyphosate or Gramoxone when plants are more than a few inches tall. Where the use of 2,4-D is not possible, application of saflufenacil (Sharpen, Optill, or Verdict) and either glyphosate or Ignite, or a combination of Ignite and metribuzin should be effective. Glyphosate is somewhat variable for burndown of early-emerging giant ragweed plants, and use of the appropriate rate based on plant size is important. The addition of 2,4-D ester or saflufenacil is also recommended for consistently effective control, especially in fields with a prior history of poor glyphosate performance on giant ragweed.

Include herbicide(s) with residual activity in the preplant burndown treatment (or apply these after planting where tillage is used), which involves the use of Scepter or a product containing chlorimuron or cloransulam (Canopy/Cloak DF/EX, Synchrony XP, FirstRate, Valor XLT, Envive, Sonic, Authority First, Gangster, or Authority XL). These herbicides will reduce the giant ragweed population and slow the growth of remaining plants to build more flexibility in the postemergence application window. None of these herbicides will control ALS-resistant giant ragweed, however.

Where residual herbicides have been applied and are effective, or the giant ragweed population is very low, it is possible to obtain adequate control with a single postemergence application. However, where ragweed populations are moderate to dense, early postemergence herbicide applications need to be followed by a second application to control late-emerging plants. The most effective postemergence treatments for control of giant ragweed (4 to 8 inches tall) in non-GMO soybeans include: FirstRate (0.3 ounce/A), Flexstar (1.3 pints/A), FirstRate + Flexstar (0.3 ounces + 1 pint/A), Basagran + Cobra (1 pint + 6 ounces/A), and Pursuit + Cobra (1.44 ounces/A + 4 to 6 ounces/A). Results with Classic and Synchrony XP have been more variable than with FirstRate. In STS soybeans, combinations of Synchrony XP plus Cobra will provide more consistent control than Synchrony alone. FirstRate, Classic, Sychrony, and Pursuit do not control ALS-resistant ragweed.

In Roundup Ready soybeans, make an initial postemergence application of glyphosate when ragweed are about 6 to 10 inches tall. Glyphosate rate for this application should be 1.1 to 1.5 lbs ae/A (use the higher rate in fields where giant ragweed has not been adequately controlled in the past). Make a second application of glyphosate (0.75 lbs ae/A) three to four weeks later as needed to control later-emerging plants or to improve control of plants that survive the first application. In continuous Roundup Ready soybean fields and fields with a history of giant ragweed control problems, it is essential to make two postemergence glyphosate applications at the rates and timings indicated here (in addition to the use of a burndown with 2,4-D and residual herbicides as described above). Failure to do so is likely to result in giant ragweed escapes later in the season, and these plants will be extremely difficult to control.

Use of Ignite in Liberty Link soybeans and can be an excellent tool to manage giant ragweed, especially those populations that have become resistant to ALS inhibitors or glyphosate. Apply Ignite (22 oz/A) postemergence initially when ragweed plants are about 4 to 6 inches tall. Make a second application of Ignite (22 oz/A) about three weeks later as needed to control later-emerging plants or to improve control of plants that survive the first application.

Glyphosate- and ALS-resistant giant ragweed. Giant ragweed populations with resistance to glyphosate occur in Ohio and Indiana, and some populations have resistance to both glyphosate and ALS inhibitors. Postemergence control of these populations in soybeans can be extremely difficult, and the most effective management strategy may be to plant corn, in order to take advantage of the effectiveness of corn herbicides on resistant ragweed. It is essential that no-till soybean fields with resistant populations receive a preplant treatment of 2,4-D ester, to ensure that that the field is weedfree at the time of planting. Preemergence soybean herbicides listed in the previous section can be included in the preplant herbicide treatment, although they will not control plants that are ALS-resistant (they may still have activity on the plants in the population that are not resistant).

Use of Ignite in Liberty Link soybeans is the most effective tool for management of glyphosate-resistant giant ragweed populations. Apply Ignite (22 oz/A) postemergence initially when ragweed plants are about 4 to 6 inches tall. Make a second application of Ignite (22 oz/A) about three weeks later as needed to control later-emerging plants or to improve control of plants that survive the first application. OSU and Purdue research has shown that glyphosate- and ALS-resistant populations can also be managed with multiple applications of PPO inhibitors (Flexstar, Cobra), although this approach may lead to the development of resistance to these herbicides as well. The best approach with PPO inhibitors is to make an initial application of Flexstar (1.3 to 1.6 pts/A) or Flexstar GT when plants are 4 to 8 inches tall. This should be followed with postemergence application of Cobra (10 oz/A) three to four weeks later. Where a PPO inhibitor is mixed with glyphosate to control glyphosate-resistant plants, apply with the adjuvants specified on the labels for the Flexstar or Cobra in order to optimize their activity. This is likely to result in the use of MSO (Flexstar) or COC (Cobra), and one of these adjuvants should be added to Flexstar GT in this situation also.

Perennial Sowthistle

Perennial sowthistle is a perennial broadleaf weed that spreads by seed and creeping roots. Identifying characteristics are a smooth stem with milky juice and a whitish coating on the surface, long lobed leaves with spiny edges, and yellow flower that is about 1 1/2 inches across.

Noncrop/Fallow Areas. Apply glyphosate (2.25 lbs ae/A or a 2% solution for spot treatment) when plants are in the full-rosette stage for fair to good control. Effective control can be obtained using dicamba (2 quarts/A) or 2,4-D ester (2 lb ai/A) when plants are in the bud to flower stage. Avoid tillage for 7 days after application.

Corn. Atrazine applied preplant/preemergence (1.5 pounds/A) or postemergence (2 pounds/A) can provide good control of sowthistle. Dicamba (1/2 to 1 pint/A), Status (5 oz/A), or Marksman (3.5 pints/A) provide fair control when applied to sowthistle at least 6 inches tall. Apply dicamba with drop nozzles if corn is more than 8 inches tall to avoid crop injury. Stinger (1/3 to 2/3 pint/A) or Hornet (3 to 5 oz/A) provides fair control when applied at the rosette to bud stage. Postemergence application of glyphosate (1.1 lb ae/A - glyphosate-resistant corn) will control or suppress sowthistle.

Soybeans. Preplant or premeergence applications of a chlorimuron-containing product (Canopy, Valor XLT, Envive, or Synchrony XP) provides fair to good control. Postemergence application of Classic (3/4 ounce/A) or Synchrony XP (3/4 ounce/A) when sowthistle are in the early- to mid-rosette stage provides suppression to fair control. Postemergence application of glyphosate (Roundup Ready soybeans) will control or suppress sowthistle.

Wheat. Application of high rates of tribenuron or a thifensulfuron/tribenuron premix product when sowthistle are 4 to 8 inches tall provides fair control. Stinger (1/3 pint/A) or Curtail (2 to 2 2/3 pints/A) provides fair control when applied at the rosette to bud stage.

Star-of-Bethlehem

Star-of-Bethlehem is a bulbous perennial emerging in early spring and maturing in late spring or early summer. The leaves of this weed appear grass-like, and are green and fleshy with a prominent whitish midrib. The leaves originate from a central bulb. Flowers have 6 white petals with a green stripe on the underside of each petal. Star-of-Bethlehem has been most problematic in no-till soybean fields, but is also found in no-till corn. The thick vegetation and bulb density of this plant can interfere with crop establishment and reduce crop vigor.

All Crops. The most effective preplant treatment is Gramoxone SL applied at 2 to 3 pts/A. This treatment will provide control during the season of application and also reduce the severity of future infestations.

Corn. Preplant application of atrazine provides fair control during the season of application, but will not reduce the population.

Soybeans. Preplant application of Valor, Gangster, or Envive can suppress star-of-Bethlehem during the season of application, but will not reduce the population.

Canada Thistle

Canada thistle is a perennial weed that spreads both by seed and creeping roots. Canada thistle plants emerge early in the spring and tend to grow in dense, spreading patches. This weed is extremely competitive and can be a problem in all crops.

Noncrop/Fallow Areas. The most effective treatment for control of Canada thistle is glyphosate applied in late spring or early fall when thistles are in the bud-to-flower stage. Fall treatment will be most successful when thistles have been mowed or clipped off earlier in the season and allowed to regrow to the bud stage (or to a height of at least 10 to 14 inches). This method may be used in noncrop areas and fallow fields, or following small-grain harvest.

For fall treatment, apply 0.75 lb ae/A of glyphosate plus AMS (17 lbs per 100 gallons water) in a spray volume of 5 to 10 gallons per acre, or 1.5 lb ae/A of glyphosate in spray volumes greater

than 10 gallons per acre. For most effective control of thistle, do not mix other herbicides with glyphosate. High rates (1 to 2 quarts/A) of dicamba or 2,4-D are generally less effective than glyphosate, but a low-cost application of 2,4-D will provide some long-term control of thistle. Alternatively, any of these herbicides may be applied as a spot treatment using a 2 percent solution. Treatment with glyphosate, dicamba, or 2,4-D in this manner should be delayed until thistles regrow enough to begin producing buds, or applied as late in the fall as possible. Thistle plants will survive a few light frosts, but apply before the first freeze.

Wheat. Stinger (1/3 pint/A), Curtail (2 to 2 2/3 pts/A), and combinations of 2,4-D with high rates of Express/Nuance controls or suppresses Canada thistle, preventing harvest problems. Stinger provides the most complete thistle kill, but is more expensive than the other three herbicides. Huskie, or dicamba + 2,4-D will also often suppress Canada thistle to the point that it does not interfere with harvest.

Corn. Most effective postemergence control of the entire plant results from application of Stinger (2/3 pint/A), Hornet (4 to 5 ounces/A) plus a few ounces of Stinger, or glyphosate (1.1 lb ae/A - glyphosate-resistant corn). Apply Stinger/Hornet when thistles are at least 4 inches tall and before the bud stage. Glyphosate should be applied when thistles are in at least the bud stage for best results; earlier applications will control thistle through the growing season.

Status (5 oz/A) or Hornet (4 to 5 ounces/A) will effectively control the above-ground part of the plant. Postemergence application of Basagran (1 quart/A), Laddok (2.3 pints/A), or Liberty plus atrazine (Liberty Link corn) will control above-ground growth of actively growing Canada thistle in the 8-inch to bud stage. Other treatments with activity on thistle include Buctril/atrazine, Marksman, dicamba, dicamba + 2,4-D, NorthStar, Yukon, and combinations of Spirit, Steadfast, Lightning (Clearfield corn only) or nicosulfuron with dicamba. Most of these treatments will control or suppress the above-ground part of the plant, which will help prevent further spread.

Soybeans. Glyphosate (1.1 lb ae/A - Roundup Ready soybeans) is the most effective postemergence treatment. Late post applications, when plants are in the bud to flower stage, will provide the most complete control of underground plant parts. To prevent yield loss where thistle populations are high, apply when thistles are small and retreat regrowth as necessary. Postemergence applications of Basagran (2 pints/A) will control above-ground parts of the plant or suppress growth of Canada thistle. Regrowth usually occurs, but this treatment will reduce competition from Canada thistle in soybeans and help prevent production of more rootstock. Apply when thistle plants are from 8 inches tall to the bud stage. COC should be included in the spray mixture. A second application at the same rate may be made 7 to 10 days later, if necessary. Other products and mixtures with activity on thistle include Flexstar and mixtures of Basagran with Reflex, Flexstar, Ultra Blazer, or Cobra. Postemergence application of Pursuit (1.44 ounces/A), Classic (2/3 to 3/4 ounce/A), FirstRate (0.3 oz/A), and Synchrony XP (3/4 ounce/A) may also suppress thistle growth, but results have been variable.

Tall Waterhemp

Tall waterhemp is an annual weed that closely resembles smooth and redroot pigweeds and is starting to spread through Ohio and Indiana. Tall waterhemp has no hair on the stem or leaves, while most other pigweeds have some hair. It has a long and narrow leaf shape with wavy leaf margins and a shiny or glossy appearance. While a number of herbicides are effective for control of waterhemp, this weed's ability to germinate and emerge late in the season make it difficult to control with one herbicide application. The increase in population of this weed seems to also be due to its greater tolerance to herbicides in general, compared to other pigweeds,and especially to glyphosate and ALS-inhibiting herbicides. Many waterhemp populations have developed resistance to ALS inhibitors in Ohio and Indiana, and some are resistant to glyphosate also. Waterhemp populations in other parts of the Midwest have developed resistance to triazines, glyphosate, HPPD inhibitors (Callisto, Impact, Laudis, Balance Flexx), or PPO inhbibitors (Flexstar, Cobra, Ultra Blazer), and some are resistant to several herbicide sites of action.

Corn. Many preplant/preemergence corn herbicides provide effective control of waterhemp, especially when mixed with atrazine (see Table 5 - corn herbicide effectiveness ratings). A follow-up postemergence treatment may be necessary in dense populations or if rainfall promotes emergence later in the season. Postemergence treatments containing atrazine, 2,4-D, dicamba, Status, Callisto, Laudis, Corvus, Impact, and glyphosate (glyphosate-resistant corn) are effective. Ignite plus atrazine (Liberty Link corn) will control small waterhemp.

Soybean. For best results, start with a preplant or preemergence herbicide with activity on waterhemp (See Table 14 - soybean herbicide effectiveness ratings). Preemergence herbicides will greatly reduce the waterhemp population, and provide more flexibility in the postemergence application window. A postemergence treatment will usually be required to control late-emerging plants. Effective postemergence treatments include Ultra Blazer, Cobra, Reflex, Flexstar, and Ignite (Liberty Link soybeans), which should be applied when waterhemp plants are less than 4 inches tall. Glyphosate (Roundup Ready soybean) can be effective where the waterhemp population is not resistant to glyphosate.

Volunteer corn

The risk of volunteer corn varies from year to year, depending upon the severity of problems with stalk breakage and unharvested ears in the previous fall. Much of the volunteer corn is now resistant to glyphosate or Ignite, and some has resistance to both herbicides. As a result, volunteer corn will often not be controlled in soybeans by postemergence application of glyphosate or Ignite, and the addition of a postemergence grass herbicide will be required. These herbicides should be added to the first postemergence application in a Roundup Ready soybean field, which will ensure effective control of small volunteer corn.

Soybeans. In non-GMO soybeans, any type of volunteer corn can be controlled by inclusion of Assure II/Targa, Select Max, Fusion, Fusilade or clethodim in postemergence herbicide pro-

grams. Activity of these herbicides is maximized by use of COC or MSO, plus AMS. Control can be more variable when applied in a mixture with a glyphosate product that contains surfactant, in the absence of COC or MSO. Clethodim is often less effective than the other products listed here in mixtures with glyphosate, but this can be overcome through the inclusion of COC or MSO in these mixtures. Local recommendations and product literature can specify use of COC or MSO in mixtures with glyphosate for the other grass control products listed here also.

Corn. Volunteer corn can be impossible to control in continuous corn, especially when the volunteer plants have resistance to both glyphosate and Ignite. Several scenarios can occur in continuous corn, as follows: 1) where non-GMO corn was planted in 2010, glyphosate-resistant or Liberty Link corn can be planted in 2011, and treated with glyphosate or Ignite; 2) where Liberty Link corn was planted in 2010, glyphosate-resistant corn can be planted in 2011, and treated with glyphosate; or 3) where glyphosate-resistant corn was planted in 2010, Liberty Link corn can be planted in 2011, and treated with Ignite. Glufosinate can be somewhat variable for control of volunteer corn, but has the potential to at least suppress it to the point of being non-competitive. There are no options for control of volunteer corn where the previous year's corn had both glyphosate resistance and Liberty Link traits.

Table 22. Corn and Soybean Herbicide Premix Information

Liquid Premixes for Corn

Name	Active Ingredients (lbs active/gallon)	Formulation Equivalents	
Bicep II Magnum 5.5L/ Cinch ATZ/Charger Max ATZ	S-metolachlor (2.4) atrazine (3.1)	2.1 qts =	1.3 pts Dual II Magnum 7.64EC + 1.6 lbs ai atrazine
Buctril/atrazine 3L or Moxy/atrazine 3L	bromoxynil (1.0) atrazine (2.0)	2 pts =	1 pt Buctril/Moxy 2S + 0.5 lb ai atrazine
Bullet 4L	alachlor (2.5) atrazine (1.5)	4 qts =	2.5 qts Lasso 4EC + 1.5 lbs ai atrazine
Callisto Xtra 3.7L	mesotrione (0.5) atrazine (3.2)	24 oz =	3 oz Callisto 4L + 0.6 lbs ai atrazine
Capreno 3.45L	tembotrione (2.88) thiencarbazone-methyl (0.57)	3 oz =	2.5 ox Laudis 3.5L + 0.21 oz ai thiencarbazone
Corvus 2.63SC	isoxaflutole (1.88) thiencarbazone-methyl (0.75)	5.6 oz =	5.3 oz Balance Flexx 2L + 0.52 oz ai thiencarbazone
Degree Xtra 4L	acetochlor (2.69) atrazine (1.35)	3 qts =	1.9 lbs ai acetochlor + 1 lb ai atrazine
Expert 4.88L	s-metolachlor (1.74) atrazine (2.14) glyphosate (1.0)	3 qts =	1.36 pts Dual II Magnum 7.64 EC + 1.6 lbs ai atrazine + 0.56 lbs glyphosate acid
FulTime 4L	acetochlor (2.4) atrazine (1.6)	3.0 qts =	1.8 lbs ai acetochlor + 1.2 lbs ai atrazine
Guardsman Max 5L	dimethenamid-P (1.7) atrazine (3.3)	3 pts =	14 oz Outlook 6EC + 1.23 lb ai atrazine
Halex GT 4.38L	s-metolachlor (2.09) mesotrione (0.209) glyphosate (2.09)	3.6 pts =	1 pt Dual II Magnum 7.68EC + 3 oz Callisto 4L + 0.94 lbs glyphosate acid
Harness Xtra 5.6L/ Confidence Xtra 5.6L	acetochlor (3.1) atrazine (2.5)	2.4 qts =	1.86 lb ai acetochlor + 1.5 lbs ai atrazine
Harness Xtra 6L/ Confidence Xtra 6L	acetochlor (4.3) atrazine (1.7)	2.4 qts =	2.6 lb ai acetochlor + 1 lb ai atrazine
Keystone 5.25L	acetochlor (3.0) atrazine (2.25)	2.6 qts =	1.95 lb ai acetochlor + 1.5 lbs ai atrazine
Laddok S-12 5L	bentazon (2.5) atrazine (2.5)	1.67 pts =	1 pt Basagran 4L + 0.5 lb ai atrazine

Table 22. Continued

Liquid Premixes for Corn

Name	Active Ingredients (lbs active/gallon)	Formulation Equivalents	
Lariat 4L	alachlor (2.5) atrazine (1.5)	4 qts =	2.5 qts Lasso 4EC + 1.5 lbs ai atrazine
Lumax 4L	s-metolachlor (2.68) atrazine (1.0) mesotrione (0.27)	3 qts =	2.1 pts Dual II Magnum 7.68EC + 0.75 lb ai atrazine + 6.4 oz Callisto 4L
Lexar 3.7L	s-metolachlor (1.74) atrazine (1.74) mesotrione (0.22)	3 qts =	1.35 pts Dual II Magnum 7.68EC + 1.3 lbs ai atrazine + 5.3 oz Callisto 4L
Marksman/Sterling Plus/ Banvel-K+atrazine 3.2L	dicamba (1.1) atrazine (2.1)	3.5 pts =	1 pt dicamba 4L + 0.9 lb ai atrazine
Shotgun 3.25L	atrazine (2.25) 2,4-D (1.0)	3 pts =	0.85 lb ai atrazine + 0.75 pt 2,4-D 4L
SureStart/TripleFlex 4.25L	acetochlor (3.75) clopyralid (0.38) flumetsulam (0.12)	1.75 pts =	0.82 lb ai acetochlor + 3.5 oz Stinger 3L + 0.5 oz Python 80%WDG
Stalwart Xtra 5.5L	atrazine (3.1) metolachlor (2.4)	2.1 qts =	1.6 lbs ai atrazine + 1.3 pts Stalwart C 7.8EC
Volley ATZ 5.25L	atrazine (2.25) acetochlor (3.0)	2.8 qts =	1.6 lb ai atrazine + 2.1 lb ai acetochlor
Verdict 5.57EC	dimethenamid-P (5.0) saflufenacil (0.57)	13 oz =	11 oz Outlook 6EC + 2.6 oz Sharpen 2.85L
WideMatch 1.5L	clopyralid (0.75) fluroxypyr (0.75)	1.3 pts =	5 oz Stinger 3L + 10 oz Starane 1.5L

Liquid Premixes for Soybeans

Name	Active Ingredients (lbs active/gallon)	Formulation Equivalents	
Authority Assist 4L	sulfentrazone (3.33) imazethapyr (0.67)	6 oz =	5 oz Spartan 4L + 2 oz Pursuit 2L
Boundary 6.5EC	metribuzin (1.25) s-metolachlor (5.25)	2.1 pts =	0.43 lb metribuzin 75DF 1.4 pts Dual II Magnum
Extreme 2.17L	imazethapyr (0.17) glyphosate (2)	3 pts =	4 oz Pursuit 2L + 0.56 lb glyphosate acid
Flexstar GT	fomesafen (0.66) glyphosate (2.63)	3.75 pts =	1.3 pts Flexstar + 1.2 lbs glyphosate acid
Fusion 2.66EC	fluazifop (2.0) fenoxaprop (0.66)	8 oz =	8 oz Fusilade DX 2L + 8 oz Option II 0.67L
Prefix	s-metolachlor (4.34) fomesafen (0.95)	2 pts =	1.1 pts Dual Magnum 7.62EC + 0.95 pt Reflex 2L
Rezult	Co-pack of Basagran + Poast Plus		
Sequence 5.25L	glyphosate (2.25) s-metolachlor (3)	3.5 pts =	1 lb glyphosate acid + 1.3 pts Dual II Magnum
Storm 4S	bentazon (2.67) acifluorfen (1.33)	1.5 pts =	1 pt Basagran 4L + 1 pint Blazer 2S
Spartan Advance	sulfentrazone (0.56) glyphosate acid (3.0)	30 oz =	4.2 oz Spartan 4L + 0.7 lbs glyphosate acid
Tackle 4.128SL	imazethapyr (0.128) glyphosate (3)	32 oz =	2 oz Pursuit 2L + 0.75 lb glyphosate acid
Verdict 5.57EC	dimethenamid-P (5.0) saflufenacil (0.57)	5 oz =	4.2 oz Outlook 6EC + 1 oz Sharpen 2.85L

Dry Premixes for Corn

Name	Active Ingredients (percentage active)	Formulation Equivalents	
Basis Blend 30DF	rimsulfuron (20%) thifensulfuron (10%)	0.825 oz =	0.64 oz Resolve 25DF + 0.11 oz HarmonyGT 75DF
Distinct 70DF	dicamba (48.6%) diflufenzopyr (21.4%)	4 oz =	4 oz dicamba 4L + 0.9 oz ai diflufenzopyr
Hornet 78.5WDG	flumetsulam (18.5%) clopyralid (60%)	5.0 oz =	1.16 oz Python 80 DG + 6.7 oz Stinger 3L
Lightning 70DG	imazethapyr (52.5%) imazapyr (17.5%)	1.28 oz. =	2.7 oz Pursuit 2L + 0.22 oz ai imazapyr
Northstar 47.4DF	primisulfuron (7.5%) dicamba (39.9%)	5.0 oz =	0.5 oz Beacon 75DF + 4.0 oz dicamba 4L
PermitPlus 74DF	halosulfuron (66.2%) thifensulfuron (7.8%)	0.75 oz =	0.66 oz Permit 75DF + 0.12 oz Harmony SG
Prequel 45WDG	rimsulfuron (15%) isoxaflutole (30%)	1.66 oz =	1 oz Resolve 25DF + 0.66 oz isoxaflutole 75WDG
Resolve Q 22.4WDG	rimsulfuron (18.4%) thifensulfuron (4%)	1.25 oz =	0.92 oz Resolve 25DF + 0.1 oz Harmony SG
Spirit 57DF	prosulfuron (14.2%) primisulfuron (42.8%)	1.0 oz =	0.25 oz Peak 57DF + 0.57 oz Beacon 75DF
Status 56DF	dicamba (40%) diflufenzopyr (16%)	5 oz =	4 oz dicamba 4L + 0.8 oz ai diflufenzopyr
Steadfast Q 37.7WDG	rimsulfuron (12.5%) nicosulfuron (25.2%)	1.5 oz =	0.76 oz Resolve 25DF 0.7 oz Accent Q 54.5WDG
Steadfast ATZ	rimsulfuron (1.3%) nicosulfuron (2.7%) atrazine (85.3%)	14 oz =	0.76 oz Resolve 25DF 0.7 oz Accent Q 54.5WDG 0.8 lb ai atrazine
Yukon 67.5DF	halosulfuron dicamba	4 oz =	0.67 oz Permit 75DF 4.4 oz dicamba 4L

Dry Premixes for Soybeans

Name	Active Ingredients (percentage active)	Formulation Equivalents	
Authority First 70WDG	sulfentrazone (62.1%) cloransulam (7.9%)	3 oz =	2.5 oz Spartan 75DF + 0.28 oz FirstRate 84DF
Authority MTZ 45WDG	sulfentrazone (18%) metribuzin (27%)	10 oz =	2.4 oz Spartan 75DF + 0.17 lb ai metribuzin
Authority XL	sulfentrazone chlorimuron	4 oz =	3.3 oz Spartan 75DF + 1.24 oz Classic 25DF
Canopy/Cloak 75DF	chlorimuron (10.7%) metribuzin (64.3%)	4 oz =	1.7 oz Classic 25DF + 0.16 lb ai metribuzin
Canopy EX/Cloak EX/ Fallout 29.5DF	chlorimuron (22.7%) tribenuron (6.8%)	1.5 oz =	1.4 oz Classic 25DF + 0.14 oz Express 75DF
Envive 41.3 DG	chlorimuron (9.2%) thifensulfuron (2.9%) flumioxazin (29.2%)	3 oz =	1.1 oz Classic 25DF + 0.11 oz Harmony GT 75DF + 1.7 oz Valor 51 WDG
Gangster	co-pack of FirstRate + Valor	2.4 oz =	2 oz Valor 51WDG + 0.4 oz FirstRate 84DF
Optill 68WDG	imazethapyr (50.2%) saflufenacil (17.8%)	2 oz =	4 oz Pursuit 2L + 1.0 oz Sharpen 2.85L
Sonic 70WDG	sulfentrazone (62.1%) cloransulam (7.9%)	3 oz =	2.5 oz Spartan 75DF + 0.28 oz FirstRate 84DF
Synchrony XP 28.4WDG	chlorimuron (21.5%) thifensufuron (6.9%)	0.75 oz =	0.64 oz Classic 25DF + 0.069 oz Harmony GT 75DF
Valor XLT 40.3WDG	chlorimuron (10.3%) flumioxazin (30%)	3 oz =	1.23 oz Classic 25DF + 1.76 oz Valor 51WDG

Table 23. Restrictions on Crop Rotation

This table gives the recrop intervals for the planting of rotational crops following the application of corn and soybean herbicides. If a herbicide is not listed on the table, there are no restrictions on rotation, provided the crop on which that herbicide is applied is grown to full maturity and harvested. Refer to the following scale:

NR = No restriction, assuming that the corn or soybean crop is taken to harvest. Where the corn crop fails and soybeans will be planted within 1 to 2 months of corn herbicide application, consult the label for further precautions.

BA = Conduct a field bioassay prior to rotating to this crop; consult the label for more information. Where products containing atrazine or Princep are used, see the footnote below for precautions on rotation to soybeans and other crops. **Consult herbicide labels for precautions regarding rotation to seed corn or specialty corn.**

	Months Before Planting									
Herbicide	**Corn**	**Wheat**	**Oats**	**Alfalfa**	**Clover**	**Soybeans**	**Sugar Beets**	**Tomatoes**	**Popcorn**	**Sweet Corn**
Atrazine[a]	NR	14	21	21	21	10	21	21	NR	NR
Authority Assist	10	4	18	12	40	NR	40+BA	40	18	18
Authority First	10v	4	12	12	30+BA	NR	30+BA	30+BA	10[v]	10[v]
Authority MTZ	10	4	18	12	18	NR	36	18	10	18
Authority XL[l]	10	4	12	12	18	NR	36	12[b]	10	18
Autumn	1	4	9	18	18	9	18	18	1	1
Balance Flexx	NR	4	18	10	18	6	10	18	6	6
Basis (1.25 oz)	NR	3	9	10	10	2-10[w]	10	1	10	10
Beacon	14 days[i]	3	8	8	18	8	18	18	8	8
Bicep/Cinch ATZ[a]	NR	15	15	18	18	10	18	18	NR	NR
Boundary	8	4.5	12	4.5	12	NR	18	12	12	12
Buctril/atrazine[a]	NR	15	15	21	21	10	21	21	1	1
Bullet[a]	NR	15	18	18	18	10	18	18	NR	NR
Callisto	NR	4	4	10	18	10	18	18	NR	NR
Callisto Xtra	NR	8	18	8	18	8	18	18	NR	NR
Canopy/Cloak DF[k]	10	4	30	10	12	NR	30	10[b]	10	18
Canopy/Cloak EX/ Fallout[k]	10	4	4	10	12	1.5	30	10[b]	10	18
Capreno	NR	4	18	18	18	10	18	18	10	10
Classic	9[n]	3	3	12[n]	12[n]	NR	30	9[bn]	9[n]	18
Command/Commit	9	12[cd]	16[cd]	16[cd]	16[cd]	NR	9	9-12[f]	9	9
Corvus	NR	4	17	17	17	9	17	17	9	9
Curtail	1	1	1	10.5	18	10.5[i]	6	18	10.5	10.5
Define	NR	4	12	12	12	NR	4	12	12	12
Degree	NR	4	18	9	9	9	9	18	NR	NR
Degree Xtra	NR	14	21	21	21	10	21	21	NR	NR
Envive[k]	10	4	30	12	18	NR	30	12b	10	18
Expert[a]	NR	15	15	18	18	10	18	18	NR	NR
Extreme/Tackle	8.5	3	18	4	40	NR	40	40	18	18
FirstRate	9	3	30+BA	9	30+BA	NR	30+BA	30+BA	9	18
Flexstar/Rhythm/ Flexstar GT	10	4	4	18	18	NR	18	18	12	12
FulTime[a]	NR	15	15	15	18	10	18	18	NR	NR
Gangster	9	3	9	12+BA	30+BA	NR	30+BA	30+BA	9	18
Guardsman Max[a]	NR	15	18	18	18	10	18	18	18	18
Halex GT	NR	4	4	10	18	10	18	18	NR	NR
Harness	NR	4	18	9	9	9	9	18	NR	NR
Harness Xtra[a]	NR	14	21	21	21	10	21	21	NR	NR
Hornet	NR	4	4	10.5	26+BA	10.5	26+BA	26+BA	10.5	18/10.5[u]
Impact	NR	3	3	9	18	9	18	18	NR	NR
Keystone a	NR	15	15	15	21	10	15	21	NR	NR
Laddok[a]	NR	9	9	9	9	9	15	15	NR	NR
Lariat[a]	NR	15	18	18	18	10	18	18	NR	NR
Laudis	NR	4	4	10	18	8	18	10	NR	NR
Lightning	8.5	4	18	9.5	40+BA	9	40+BA	40+BA	18	18
Lumax/Lexar[a]	NR	4.5/10	10	18	18	10	18	18	NR	NR
Marksman[a]	NR	10	18	18	18	10	18	18	NR	NR
Metribuzin	4	4	12	4	12	NR	18	4	4	4
Nicosulfuron	NR	4	8	12	12	0.5	10/18[h]	10/18[h]	10	10[j]
Northstar	14 days[i]	3	8	8	18	8	18	18	8	8

Table 23. Continued

Herbicide	Months Before Planting									
	Corn	Wheat	Oats	Alfalfa	Clover	Soybeans	Sugar Beets	Tomatoes	Popcorn	Sweet Corn
Optill	8.5	4	18	4	4	NR	40+BA	40+BA	18	18
Osprey	12	7 days	10	10	10	3	10	10	12	12
Peak[q]	1	NR	NR	22	22	10	22	22	10	10
Permit/PermitPlus	NR	2	2	9	9	9	24	8	3	3
Princep[a]	NR	14	21	21	21	10	18	18	10	10
Prefix	10	4.5	4.5	18	18	NR	18	18	12	10
Prequel	NR	4	18	10	18	10	10	18	10	10
Prowl/Pendimax	NR	4	8	8	8	NR	12	8	8	8
Pursuit	8.5	3	18	4	40	NR	40	40	18	18
Python	NR	4	4	4	26+BA	NR	26+BA	26+BA	9	18
Raptor	8.5	3	9	3	18	NR	18[o]	9	8.5	8.5
Reflex/Dawn	10	4	4	18	18	NR	18	18	10	10
Resolve	NR	4	9	10	10	10	10	1	10	10
Scepter	9.5[g]	4	11	18	18	NR	40	18	18	18
Shotgun[a]	NR	14	21	21	21	10	21	21	NR	NR
Sonic	10[v]	4	12	12	30+BA	NR	30+BA	30+BA	10[v]	10[v]
Spartan Advance	12	4	12	12	12	NR	36	12	12	12
Spartan	10	4	30	12	18	NR	30	30	10	18
Spirit[p]	1	3	3	18	18	10[s]	18	10	8	8
Stalwart Xtra[a]	NR	14	21	21	21	10	21	21	NR	NR
Steadfast/Ironclad	NR	4	8	12	12	0.5	10/18[h]	10/18[h]	10	10
Steadfast ATZ	NR	10	18	18	18	10	18	18	10	10
Stinger	NR	NR	NR	10.5	18	10.5	NR	18	10.5	10.5
SureStart/TripleFlex	NR	4	9	9	9	9	26+BA	26+BA	NR	10.5 - 18
Surpass/Topnotch	NR	4	9	9	9	9	9	18	NR	NR
Synchrony[k] (PRE)	10	4	4	10	12	NR	30	10[b]	10	18
Synchrony[k] (POST)	9[n]	3	3	12[n]	12[n]	NR	30	9[b,n]	9	18
Valor/Encompass	0.5-1	1	12+BA	12+BA	12+BA	NR	12+BA	12+BA	12+BA	4
Valor XLT[k]	10	4	30	12	18	NR	30	12b	10	18
Verdict (>10 oz)	NR	4	9	9	9	9	9	9	NR	9
Volley	NR	4	21	21	21	10	21	21	NR	10
Volley ATZ	NR	15	21	21	21	10	21	21	NR	NR
WideMatch	NR	NR	NR	10.5	BA	10.5	4	BA	4	4
Yukon	1	2	2	9	9	9	24	8[b]	3	3

[a] Restrictions on rotation following the application of products containing atrazine or Princep will vary, depending on the product. There are a few general guidelines to follow to reduce the potential for injury to crops planted where these products are used. Plant only corn or sorghum the year (including fall) of application. Where oats, forage legumes, or forage grasses will be planted the following spring, do not apply more than 0.8 pounds active ingredient. Do not plant sugar beets, tobacco, or vegetable crops the year following application.

[b] Transplant tomatoes only.

[c] Do not plant in the fall of year of application or the spring of the following year.

[d] Cover crops may be planted prior to 12 months, but stand reduction may occur. Do not graze or harvest these cover crops for feed or food.

[e] Moldboard plow to a depth of 12 inches before planting sugar beets in the spring. Recrop interval to sugar beets is extended to 13 months if less than 20 inches of rain falls during the growing season of application.

[f] 9 months for transplant tomatoes; 12 months for all tomatoes.

[g] Corn can be planted 9.5 months after application if at least 15 inches of rainfall is received from 2 weeks prior to last application through November 15 of the same year. If this requirement is not met, plant only a Clearfield corn hybrid the following spring.

[h] Rotation interval for Accent is 10 months where soil pH is 6.5 or less, and 18 months where soil pH is greater than 6.5.

[i] Refer to Syngenta literature for a list of hybrids that have tolerance to Beacon before planting.

[j] Except the sweet corn varieties "merit", "carnival", and "sweet success", for which the minimum rotational interval is 15 months.

[k] For rates higher than 1 oz/A (Synchrony), 1.1 oz/A (Canopy EX), 2.2 oz/A (Canopy DF), or 2.5 oz (Envive, Valor XLT), plant only soybeans the following year where composite soil pH is greater than 7.0 (or greater than 6.8 for Valor XLT).

[l] Where soil pH is greater than 7.2, rotation intervals increase to at least 18 months for all crops except small grains.

[m] If applied after July 1st, do not plant soybeans the season following application.

[n] If applied after August 1, extend recrop interval by 2 months.

[o] If soil pH is less than 6.2, allow 26 months to rotation of sugarbeets.

[p] If soil pH is 7.8 or greater and/or less than 12 inches of rainfall occurs within the first 5 months and/or less than 1.0 inch within the first 4 weeks following application, then only plant corn or small grain cereals the following spring. STS soybeans can be planted the following spring after a drought if Spirit was used.

[r] Allow 12 months to rotation of sweet corn if 2-2/3 pt of Command is used.

[s] Do not plant soybeans the following season if herbicide is applied after June 30.

[t] Soybeans and tomatoes should not be planted until 18 months after application north of Interstate 70, but can be planted 10 months after application south of Interstate 70. STS soybeans can be planted the following spring in areas north of Interstate 70.

[u] Only certain sweet corn varieties may be grown 10.5 months after application; check herbicide label for those varieties. Otherwise wait 18 months.

[v] rotation interval extends to 18 months if applied to soil with 1.5% organic matter or less and pH above 7.0.

[w] 60 days south of I70, and 10 months north of I70. Soybeans can be planted 15 days after use of the 0.825 oz rate.

Table 24. Glossary of glyphosate products, including formulations, surfactant recommendations, and manufacturers.

Table XX. Glossary of glyphosate products, including formulations, surfactant recommendations, and manufacturers. This is a non-inclusive list, and other glyphosate products may be available. Be sure to consult the product label to determine if that product is approved for postemergence use on Roundup Ready crops.

Product	Salt	Active Ingredient		Rate equivalent to
		Acid	Salt	1 quart of Roundup Original
		(lb/gallon)		
Buccaneer	IPA	3	4	32 oz
Buccaneer Plus	IPA	3	4	32 oz
Clearout 41Plus	IPA	3	4	32 oz
Cornerstone	IPA	3	4	32 oz
Cornerstone Plus	IPA	3	4	32 oz
Credit	IPA	3	4	32 oz
Credit Extra	IPA	3	4	32 oz
Gly Star Original	IPA	3	4	32 oz
Gly Star Plus	IPA	3	4	32 oz
Gly Star 5	IPA	4	5.4	24 oz
Gly-4	IPA	3	4	32 oz
Gly-4 Plus	IPA	3	4	32 oz
Gly-Flo	IPA	3	4	32 oz
Glyphosate Original	IPA	3	4	32 oz
Glyfos	IPA	3	4	32 oz
Glyfos X-tra	IPA	3	4	32 oz
Glyphomax	IPA	3	4	32 oz
Glyphomax Plus	IPA	3	4	32 oz
Mirage	IPA	3	4	32 oz
Roundup Original	IPA	3	4	32 oz
Roundup Original II	IPA	3	4	32 oz
Roundup Original Max	K	4.5	6	22 oz
Roundup WeatherMax	K	4.5	6	22 oz
Touchdown IQ	DA	3	4	32 oz

Salt: IPA = isopropylamine; K = potassium; DA = Diammonium.

Active ingredient: acid = lbs of active glyphosate per gallon; salt = lbs of final formulated product per gallon.

Surfactants: For products that allow or require use of a nonionic surfactant, the typical rate is 0.25% v/v or 1 quart per 100 gallons of spray.

Table 25. Glossary of Chemical Names and Manufacturers

Trade Name	Common Name	Formulations	Restricted Use	Ground Water Advisory	Surface Water Advisory	Manufacturer
AAtrex, Atrazine	atrazine	4 lb/gal L, 90% DF, 80% WP	Y	Y	Y	Syngenta, others
Accurate	metsulfuron	60% DF	N	N	N	Cheminova
Aim	carfentrazone-ethyl	2 lb/gal L	N	N	N	FMC
Accent Q	nicosulfuron + isoxadifen	54.5% WDG	N	N	N	DuPont
Alachlor	alachlor	4 lb/gal L	Y	Y	N	Micro Flo
Arrow	clethodim	2 lb/gal L	N	N	N	Makhteshim-Agan
Assure II	quizalofop	0.88 lb/gal L	N	N	N	DuPont
Authority Assist	sulfentrazone + imazethapyr	4 lb/gal L	Y	Y	Y	FMC
Authority First	sulfentrazone + cloransulam-methyl	70% WDG	Y	Y	Y	FMC
Authority MTZ	sulfentrazone + metribuzin	45% WDG	Y	Y	Y	FMC
Authority XL	sulfentrazone + chlorimuron-ethyl	70% DF	Y	Y	Y	FMC
Autumn	iodosulfuron-methyl	10% WDG	N	N	N	Bayer
Autumn Super	iodosulfuron-methyl + thiencarbazone	51% WDG	N	Y	Y	Bayer
Axial Star	pinoxaden + fluroxypyr	1.15 lb/gal L	N	N	N	Syngenta
Axial TBC	pinoxaden + florasulam	0.83 lb/gal L	N	N	N	Syngenta
Axial XL	pinoxaden	0.42 lb/gal L	N	N	N	Syngenta
Axiom DF	metribuzin + flufenacet	68% DF	N	Y	Y	Bayer
Balance Flexx	isoxaflutole + cyprosulfamide	2 lb/gal L	Y	Y	Y	bayer
Banvel	dicamba	4 lb/gal L	N	N	N	MicroFlo
Banvel-K+atrazine	dicamba+atrazine	3.2 lb/gal L	Y	Y	Y	MicroFlo
Banvel SGF	dicamba	2 lb/gal L	N	N	N	MicroFlo
Basagran	bentazon	4 lb/gal L	N	N	N	various
Basis Blend	rimsulfuron + thifensulfuron	30 DF	N	N	N	DuPont
Beacon	primisulfuron	75% DF	N	N	N	Syngenta
Bicep II Magnum	s-metolachlor + atrazine + safener	5.5 lb/gal L	Y	Y	Y	Syngenta
Boundary	s-metolachlor + metribuzin	6.5 lb/gal L	N	Y	N	Syngenta
Brash	dicamba + 2,4-D	3.87 lb/gal L	N	N	N	Winfield Solutions
Brawl II	s-metolachlor + safener	7.64 lb/gal L	N	Y	N	Tenkoz
Brawl II ATZ	s-metolachlor + atrazine + safener	5.5 lb/gal L	Y	Y	Y	Tenkoz
Broclean	bromoxynil	2 lb/gal L	N	N	N	UAP-Platte
Brozine	bromoxynil + atrazine	3 lb/gal L	Y	Y	Y	UAP-Platte
Buctril	bromoxynil	2 lb/gal L	N	N	N	Bayer
Buctril/atrazine	bromoxynil + atrazine	3 lb/gal L	Y	Y	Y	Bayer
Bullet	alachlor + atrazine	4 lb/gal L (ME)	Y	Y	Y	Monsanto
Butoxone 200	2,4-DB	2 lb/gal L	N	N	N	Cedar
Butyrac 200	2,4-DB	2 lb/gal L	N	N	N	Albaugh
Cadence	acetochlor + safener	6.4 lb/gal L	N	Y	N	UAP Loveland
Cadence ATZ	atrazine + acetochlor + safener	5.25 lb/gal L	Y	Y	Y	UAP Loveland
Cadet	fluthiacet-methyl	0.91 lb/gal L	N	N	N	FMC
Callisto	mesotrione	4 lb/gal L	N	N	Y	Syngenta
Callisto Xtra	mesotrione + atrazine	3.7 lb/gal L	Y	Y	Y	Syngenta
Canopy	chlorimuron-ethyl + metribuzin	75% DF	N	Y	N	DuPont
Canopy EX	chlorimuron-ethyl + tribenuron	29.5% DF	N	N	N	DuPont
Capreno	tembotrione + thiencarbazone-methyl	3.45 lb/gal L	N	Y	N	Bayer
Charger Max	s-metolachlor + safener	7.64 lb/gal L	N	Y	N	Winfield Solutions
Charger Max ATZ	s-metolachlor + atrazine + safener	5.5 lb/gal L	Y	Y	Y	Agriliance
Chateau	flumioxazin	51% WDG	N	N	N	Valent
Cimarron Max	metsulfuron methyl + dicamba + 2,4-D	co-pack	N	N	N	DuPont
Cinch	s-metolachlor + safener	7.64 lb/gal L	N	Y	N	DuPont
Cinch ATZ	s-metolachlor + atrazine + safener	5.5 lb/gal L	Y	Y	Y	DuPont
Clarity	dicamba	4 lb/gal L	N	N	N	BASF
Clash	dicamba	4 lb/gal L	N	N	N	Nufarm
Classic	chlorimuron-ethyl	25% DF	N	N	N	DuPont
Cleansweep D	bromoxynil + fluroxypyr + 2,4-D	4.25 lb/gal L	N	Y	N	Nufarm
Cleansweep M	bromoxynil + fluroxypyr + MCPA	4 lb/gal L	N	Y	N	Nufarm
Cloak	chlorimuron-ethyl + metribuzin	75% DF	N	Y	N	Nufarm
Cloak EX	chlorimuron-ethyl + tribenuron	29.5% DF	N	N	N	Nufarm
Cobra	lactofen	2 lb/gal L	N	N	N	Valent USA
Colt	fluroxypyr + clopyralid	1.5 lb/gal L	N	Y	N	UAP Loveland
Command	clomazone	3 lb/gal L (ME)	N	N	N	FMC, others
Confidence	acetochlor + safener	7 lb/gal L	N	Y	Y	Winfield Solutions
Confidence Xtra 5.6	atrazine + acetochlor + safener	5.6 lb/gal L	Y	Y	Y	Winfield Solutions
Corvus	isoxaflutole + thiencarbazone+ cyprosulfamide	2.63 lb/gal L	Y	Y	Y	Bayer
Crossbow	triclopyr + 2,4-D	3 lb/gal L	N	N	N	Various
Crossroad	triclopyr + 2,4-D	3 lb/gal L	N	N	N	Albaugh
Curio	chlorimuron-ethyl	25% DF	N	N	N	Nufarm

Table 25. Glossary of Chemical Names and Manufacturers—Continued

Trade Name	Common Name	Formulations	Restricted Use	Ground Water Advisory	Surface Water Advisory	Manufacturer
Curtail	clopyralid + 2,4-D	2.38 lb/gal L	N	Y	N	Dow AgroSciences
Dawn	fomesafen	2 lb/gal L	N	N	N	Cheminova
Degree	acetochlor + safener	3.8 lb/gal L	Y	Y	N	Monsanto
Degree Xtra	acetochlor + atrazine + safener	4.04 lb/gal L	Y	Y	Y	Monsanto
Distinct	dicamba + diflufenzopyr	76.4% DF	N	Y	Y	BASF
Dual II Magnum	s-metolachlor + safener	7.64 lb/gal L, 16% G	N	Y	N	Syngenta
Encompass	flumioxazin	51% WDG	N	N	N	Valent
Envive	flumioxazin + chlorimuron + thifensulfuron	41.3% DG	N	Y	N	DuPont
Eptam	EPTC	7 lb/gal L, 10% G	N	N	N	Syngenta
Expert	atrazine + glyphosate + s-metolachlor + safener	4.88 lb/gal L	Y	Y	Y	Syngenta
Express TotalSol	tribenuron methyl	50% DF	N	N	N	DuPont
Extreme	imazethapyr + glyphosate	2.17 lb/gal L	N	N	N	BASF
Fallout	chlorimuron-ethyl + tribenuron	29.5% DF	N	N	N	Agsurf
Field Master	glyphosate + acetochlor + atrazine + safener	4.0 lb/gal L	Y	Y	Y	Monsanto
Finesse	chlorsulfuron + metsulfuron methyl	75% DF	N	N	N	DuPont
FirstRate	cloransulam-methyl	84% DF	N	Y	Y	Dow AgroSciences
Flexstar	fomesafen	1.88 lb/gal L	N	N	N	Syngenta
Flexstar GT	fomesafen + glyphosate	3.29 lb/gal L	N	N	N	Syngenta
Forefront	aminopyralid + 2,4-D	3 lb/gal L	N	N	N	Dow AgroSciences
FulTime	acetochlor + atrazine + safener	4.0 lb/gal L (ME)	Y	Y	Y	Dow AgroSciences
Fusilade DX	fluazifop	2 lb/gal L	N	N	N	Syngenta
Fusion	fluazifop + fenoxaprop	2.66 lb/gal L	N	N	N	Syngenta
Gangster	flumioxazin + cloransulam	co-pack	N	Y	Y	Valent USA
Gramoxone SL	paraquat	2 lb/gal L	Y	N	N	Syngenta
Guardsman Max	dimethenamid-P + atrazine	5 lb/gal L	Y	Y	Y	BASF
Halex GT	glyphosate + s-metolachlor + mesotrione	4.38 lb/gal L	N	Y	Y	Syngenta
Halomax	halosulfuron	75% WDG	N	Y	N	Aceto
Harass	thifensulfuron	75% WDG	N	N	N	Cheminova
Harmony Extra TotalSol	thifensulfuron + tribenuron methyl	50% DF	N	N	N	DuPont
Harmony SG	thifensulfuron	50% DF	N	N	N	DuPont
Harness	acetochlor + safener	7 lb/gal L, 20% G	N	Y	Y	Monsanto
Harness Xtra	acetochlor+atrazine+safener	5.6 lb/gal L	Y	Y	Y	Monsanto
Hornet	flumetsulam + clopyralid	78.5% WDG	N	Y	N	Dow AgroSciences
Huskie	pyrasulfotole + bromoxynil	2.47 lb/gal L	N	Y	Y	Bayer
Ignite 280 SL	glufosinate	2.34 lb/gal L	N	N	N	Bayer
Impact	topramezone	2.8 lb/gal L	N	N	N	AMVAC
Intensity	clethodim	2 lb/gal L	N	N	N	UAP-Platte
Intensity One	clethodim	1 lb/gal L	N	N	N	UAP-Platte
Intrro	alachlor	4 lb/gal L	Y	Y	N	Monsanto
Ironclad	nicosulfuron + rimsulfuron	75% DF	N	N	N	MANA
Kerb	pronamide	50% WP	N	N	N	Dow AgroSciences
Keystone	atrazine + acetochlor + safener	5.25 lb/gal L	Y	Y	Y	Dow AgroSciences
Laddok S-12	bentazon + atrazine	5 lb/gal L	Y	Y	Y	MicroFlo
Lariat	alachlor + atrazine	4 lb/gal L	Y	Y	Y	Monsanto
Lasso, Lasso II	alachlor	4 lb/gal L, 15G	Y	Y	N	Monsanto, others
Latigo	dicamba + 2,4-D	4.2 lb/gal L	N	N	N	Helena
Laudis	tembotrione	3.5 lb/gal L	N	Y	Y	Bayer
Lexar	s-metolachlor+atrazine+mesotrione	3.7 lb/gal L	Y	Y	Y	Syngenta
Lightning	imazethapyr + imazapyr	70% SG	N	Y	N	BASF
Lorox/Linex	linuron	50% DF, 4 lb/gal L	N	N	N	Griffin LLC
Lumax	s-metolachlor + atrazine + mesotrione	4 lb/gal L	Y	Y	Y	Syngenta
Maestro	bromoxynil	2 or 4 lb/gal L	N	N	N	Nufarm
Marksman	dicamba + atrazine	3.2 lb/gal L	Y	Y	Y	BASF
Maverick	sulfosulfuron	75% DF	N	Y	N	Monsanto
Metribuzin	metribuzin	75% DF	N	Y	N	MANA
Me-Too-Lachlor II	metolachlor + pcr	7.8 lb/gal L	N	Y	Y	Drexel
MicroTech	alachlor	4 lb/gal L	Y	Y	N	Monsanto
Milestone	aminopyralid	2 lb/gal L	N	N	N	Dow AgroSciences
Moxy	bromoxynil	2 lb/gal L	N	N	N	Riverside
NIC-IT	nicosulfuron	2 lb/gal L	N	N	N	Cheminova
Nimble	thifensulfuron + tribenuron	75% WDG	N	N	N	Cheminova
NorthStar	dicamba + primisulfuron	47.4% WDG	N	N	N	Syngenta
Nuance	tribenuron	75% WDG	N	N	N	Cheminova
Olympus	propoxycarbazone-sodium	70% WDG	N	N	N	Bayer
Olympus Flex	propoxycarbazone-sodium + mesosulfuron-methyl	11.25% WDG	N	N	N	Bayer
Optill	saflufenacil + imazethapyr	68% WDG	N	Y	Y	BASF
Oracle	dicamba	4 lb/gal L	N	N	N	Gharda USA
Orion	MCPA + florasulam	2.37 lb/gal L	N	N	N	Syngenta
Outlaw	dicamba + 2,4-D	2.54 lb/gal L	N	N	N	Helena
Outlook	dimethenamid-P	6.0 lb/gal L	N	Y	N	BASF

Table 25. Glossary of Chemical Names and Manufacturers—Continued

Trade Name	Common Name	Formulations	Restricted Use	Ground Water Advisory	Surface Water Advisory	Manufacturer
Parallel	metolachlor + benoxacor	7.8 lb/gal L	N	Y	Y	MANA
Parallel PCS	metolachlor	8 lb/gal L	N	Y	Y	Makhteshim Agan
Parallel Plus	metolachlor + atrazine	5.5 lb/gal L	Y	Y	Y	Makhteshim Agan
Parazone	paraquat	3 lb/gal L	Y	N	N	Makhteshim Agan
PastureGard	triclopyr and fluroxypyr	2 lb/gal L	N	N	N	Dow AgroSciences
Peak	prosulfuron	57 DF	N	N	N	Syngenta
Pendant	pendimethalin	3.3 lb/gal L	N	N	N	BASF
Pendimax	pendimathalin	3.3 lb/gal L	N	N	N	Dow AgroSciences
Permit	halosulfuron	75% DF	N	Y	N	Gowan
PermitPlus	halosulfuron + thifensulfuron	74% DF	N	Y	N	Gowan
Phoenix	lactofen	2 lb/gal L	N	Y	N	Valent USA
Plateau	imazapic	2 lb/gal L	N	N	N	BASF
Poast	sethoxydim	1.5 lb/gal L	N	N	N	MicroFlo
Poast Plus	sethoxydim + dash	1 lb/gal L	N	N	N	MicroFlo
PowerFlex	pyroxsulam	7.5% DF	N	N	Y	Dow AgroSciences
Prequel	rimsulfuron + isoxaflutole	45% WDG	Y	Y	Y	DuPont
Prefix	fomesafen + s-metolachlor	5.3 lb/gal L	N	Y	N	Syngenta
Princep, Simazine	simazine	4 lb/gal L, 90% DF	N	Y	N	Syngenta, others
Prowl	pendimethalin	3.3 lb/gal L	N	N	N	BASF
Prowl H2O	pendimethalin	3.8 lb/gal L	N	N	N	BASF
Pulsar	dicamba + fluroxypyr	1.67 lb/gal L	N	Y	N	Syngenta
Pursuit	imazethapyr	2 lb/gal L	N	N	N	BASF
Python	flumetsulam	80% WDG	N	Y	N	Dow AgroSciences
Rapport BroadSpec	thifensulfuron + tribenuron methyl	50% DF	N	N	N	Nufarm
Rapport Tankmix	thifensulfuron + tribenuron methyl	50% DF	N	N	N	Nufarm
Raptor	imazamox	1.0 lb/gal L	N	N	N	BASF
Reflex	fomesafen	2 lb/gal L	N	N	N	Syngenta
Reglone	diquat dibromide	3.73 lb/gal L	N	N	N	Syngenta
Remedy Ultra	triclopyr	4 lb/gal L	N	N	N	Dow AgroSciences
Report Extra	chlorsulfuron + metsulfuron methyl	75% DF	N	N	N	Cheminova
Resolve	rimsulfuron	25% DF	N	N	N	DuPont
Resolve Q	rimsulfuron + thifensulfuron + isoxadifen	22.4% WDG	N	N	N	DuPont
Resource	flumiclorac-pentyl	0.86 lb/gal L	N	N	N	Valent
Rezult	bentazon + sethoxydim + Dash	Co-Pack	N	N	N	BASF
Rhythm	fomesafen	1.88 lb/gal L	N	N	N	Cheminova
Rifle	dicamba	4 lb/gal L	N	N	N	UAP Loveland
Rifle-D	dicamba + 2,4-D	3.87 lb/gal L	N	N	N	UAP Loveland
Rifle Plus	dicamba + atrazine	3.2 lb/gal L	Y	Y	Y	UAP Loveland
Sandea	halosulfuron	75 DF	N	Y	N	Gowan
Scepter	imazaquin	1.5 lb/gal L, 70% DG	N	N	N	BASF
Section	clethodim	2.0 lb/ gal L	N	N	N	Winfield Solutions
Select	clethodim	2.0 lb/ gal L	N	N	N	Valent
Select Max	clethodim	1 lb/gal L	N	N	N	Valent
Sequence	s-metolachlor + glyphosate	5.25 lb/gal L	N	Y	N	Syngenta
Sharpen	saflufenacil	2.85 lb/gal L	N	Y	Y	BASF
Shotgun	atrazine +2,4-D	3.25 lb/gal L	Y	Y	Y	United Ag Products
Sinbar	terbacil	80% WP	N	Y	Y	DuPont
Sonic	sulfentrazone + cloransulam-methyl	70% WDG	N	Y	Y	Dow AgroSciences
Spartan	sulfentrazone	4 lb/gal L	Y	Y	Y	FMC
Spartan Advance	glyphosate + sulfentrazone	4.6 lb/gal L	Y	Y	Y	FMC
Spike	tebuthiuron	20% P	N	Y	N	Dow AgroSciences
Spirit	primisulfuron + prosulfuron	57% DF	N	N	N	Syngenta
Stalwart	metolachlor	8 lb/gal L	N	Y	N	Sipcam Agro USA
Stalwart C	metolachlor + safener	7.8 lb/gal L	N	Y	N	Sipcam Agro USA
Stalwart Xtra	metolachlor + atrazine + safener	5.5 lb/gal L	Y	Y	Y	Sipcam Agro USA
Starane	fluroxypyr	1.5 lb/gal L	N	N	N	Dow AgroSciences
Status	dicamba + diflufenzopyr + safener	56% WDG	N	Y	Y	BASF
Steadfast Q	nicosulfuron + rimsulfuron + isoxadifen	27.7% DF	N	N	N	DuPont
Steadfast ATZ	nicosulfuron + rimsulfuron + atrazine	89.3% DF	Y	Y	Y	DuPont
Stealth	pendimethalin	3.3 lb/gal L	N	N	N	UAP Loveland
Sterling Blue	dicamba	4 lb/gal L	N	N	N	Winfield Solutions
Sterling Plus	dicamba + atrazine	3.2 lb/gal L	Y	Y	Y	Winfield Solutions
Stinger	clopyralid	3 lb/gal L	N	Y	N	Dow AgroSciences
Storm	bentazon + acifluorfen	4 lb/gal L	N	N	N	United Phosphorus
Stratos	dicamba + atrazine	3.2 lb/gal L	Y	Y	Y	Gharda USA
SureStart	acetochlor + flumetsulam + clopyralid	4.25 lb/gal L	N	Y	Y	Dow AgroSciences
Surpass	acetochlor + safener	6.4 lb/gal L	Y	Y	Y	Dow AgroSciences
Synchrony XP	chlorimuron-ethyl + thifensulfuron	28.4% DF	N	N	N	DuPont
Tackle	imazethapyr + glyphosate	4.128 lb/gal L	N	N	N	Cheminova
Targa	quizalifop	0.88 lb/gal L	N	N	N	Gowan

Table 25. Glossary of Chemical Names and Manufacturers—Continued

Trade Name	Common Name	Formulations	Restricted Use	Ground Water Advisory	Surface Water Advisory	Manufacturer
TNT Broadleaf	thiensulfuron + tribenuron	75% DF	N	N	N	Gowan
Treaty	thifensulfuron methyl	75% DF	N	M	N	Nufarm
Treaty Extra	thifensulfuron + tribenuron methyl	75% DF	N	N	N	Nufarm
Topnotch	acetochlor+safener	3.2 lb/gal L	N	Y	Y	Dow AgroSciences
Treflan, Trifluralin	trifluralin	4 lb/gal L, 10% G	N	N	N	Dow AgroSciences, others
TriCor	metribuzin	75% DF	N	Y	N	United Phosphorus
TripleFlex	acetochlor + flumetsulam + clopyralid	4.25 lb/gal L	N	Y	Y	Monsanto
Trizmet II	metolachlor + atrazine + safener	5.5 lb/gal L	Y	Y	Y	Rosens
Thunder Master	imazethapyr + glyphosate	2.17 lb/gal L	N	N	N	Albaugh
Ultra Blazer	acifluorfen	2 lb/gal L	N	N	N	United Phosphorous
Unity	thifensulfuron	75% DF	N	N	N	Gowan
Valor	flumioxazin	51% WDG	N	N	N	Valent
Valor XLT	flumioxazin + chlorimuron-ethyl	40.3% WDG	N	N	N	Valent
Velossa	hexazinone	2 lb/gal L	N	Y	N	Helena
Velpar	hexazinone	2 lb/gal L, 90% WP	N	Y	N	DuPont
Verdict	saflufenacil + dimethenamid-P	5.57 lb/gal L	N	Y	Y	BASF
Valuron	metsulfuron-methyl	60% DF	N	N	N	Makhteshim Agan
Victory	tribenuron methyl	75% DF	N	N	N	Nufarm
Volley	acetochlor + safener	6.4 lb/gal L	N	Y	Y	Tenkoz
Volley ATZ	acetochlor + atrazine	5.25 lb/gal L	Y	Y	Y	Tenkoz
Volunteer	clethodim	2 lb/gal L	N	N	N	Tenkoz
Warrant	acetochlor	3 lb/gal L	N	Y	Y	Monsanto
Weedmaster	2,4-D + dicamba	3.87 lb/gal L	N	N	N	BASF
WideMatch	clopyralid + fluroxypyr	1.5 lb/gal L	N	Y	N	Dow AgroSciences
Yukon	halosulfuron + dicamba	67.5% WDG	N	Y	N	Gowan

Ohio Poison Information Centers

National Poison Control Center—1-800-222-1222

(This number will automatically connect you to the center closest to you.)

Cincinnati: 45627-0144
Drug and Poison Information Center
University of Cincinnati
Medical Center, Room 7701
3333 Burnet Ave., ML 9004
513-558-5111
800-872-5111

Cleveland: 44106
Greater Cleveland Poison Center
11100 Euclid Avenue
216-231-4455
1-888-231-4455

Columbus: 43205
Children's Hospital
700 Children's Drive
614-228-1323
800-682-7625
614-228-2272 (TTY)*

* Phone number for the deaf.

Emergency Contacts

In the event of gross environmental contamination by pesticides, such as a spill or fire, contact:

Ohio Environmental Protection Agency
24-Hour Emergency Response Group
1800 Watermark Dr.
Columbus 43266
1-800-282-9378 (in Ohio)
614-224-2260 (outside Ohio)

Ohio Department of Agriculture
Pesticide Regulation Section
8995 East Main Street
Reynoldsburg 43068
1-800-282-1955
8:00 a.m. to 4:30 p.m., Monday through Friday

In event of chemical fire, spill, leak, exposure or accident on a highway, railway or waterway, contact:

Chemtrec
Washington, D.C.
800-424-9300

24 hours a day; 7 days a week