

## 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. **Always add ammonium sulfate (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 (Exceed, Hornet, Beacon, Permit, Accent) 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 (Select, 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 Roundup Ready 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

A number of glyphosate formulations are currently available. OSU and Purdue University research indicates similar effectiveness among these products, although differences among formulations may alter rainfastness, 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 20 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 as close to the bud stage as possible.

**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), Distinct (4 to 6 ounces/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 (Roundup Ready corn) applied at 0.75 lbs ae/A will suppress or control Jerusalem artichoke, but a second application may be necessary. Liberty or Liberty ATZ (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 STS (0.5 oz/A), Raptor (4 to 5 oz/A), or Pursuit (1.44 ounces/A) 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. OSU research indicates that low rates of glyphosate tank-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 Max plus 2,4-D ester can also be effective on small plants, especially when mixed with Canopy XL. Canopy XL and Python can provide residual control of later-emerging plants, but most other soil-applied her-

bicides 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.** Distinct (4 to 6 ounces/A) has provided excellent bindweed control in OSU research. Application of NorthStar (5 oz/A), Yukon (6 to 8 oz/A), or combinations of Spirit (1 ounce/A), Accent (2/3 ounce/A), or Equip (1.5 oz) 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 (Roundup Ready corn) applied at 0.75 lb ae/A will suppress bindweed, but a second application may be necessary. A mixture of Lightning plus Distinct (Clearfield corn only) can control bindweed through the growing season.

**Soybeans.** Glyphosate (> 1.125 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 (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.** Balance Pro, Epic, Callisto, Lexar, or Lumax applied preplant or preemergence can provide early-season control of

burcucumber, but a postemergence treatment is generally required. While many postemergence herbicides are effective on small plants, the late-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 (sometimes with high-clearance sprayers) to control late-emerging plants. Exceed has been one of the more effective postemergence treatments due to its effectiveness on emerged plants and the residual control of later-emerging plants. Other herbicides with effective activity on emerged burcucumber include Accent (2/3 ounce/A), Beacon (3/4 ounce/A), Northstar (5 oz), Spirit (1 ounce/A), Distinct (4 oz), dicamba (1/2 pint/A), Buctril, Yukon, Liberty and Liberty ATZ (28 ounces/A and 48 ounces/A- Liberty Link corn), or atrazine plus crop oil concentrate. Use drop nozzles where directed by the label to avoid crop injury in late postemergence applications. Glyphosate (0.75 lb ae/A - Roundup Ready corn) is effective for control of small burcucumber plants.

#### **Soybeans.**

Classic (2/3 to 3/4 ounce/A) and Synchrony STS (0.5 ounce/A) are the most effective postemergence herbicides for control of burcucumber in soybeans. A split application may be more effective than a single application at a higher rate where late-emerging burcucumber are a frequent problem. Glyphosate (Roundup Ready soybeans) will control small burcucumber.

### **Wild Carrot**

Wild carrot (also called Queen Anne's lace) is a biennial weed that is becoming more of a 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 early October. This fall application is targeted at the plants that will flower and produce seed the following year.

**All Crops.** Glyphosate can be used as a preplant treatment in corn and soybeans, although wild carrot control has been variable. For best results, apply glyphosate + 2,4-D (0.75 to 1.5 lbs ae/A + 0.5 lb ai/A) as an early preplant treatment shortly after the plants begin to green up. For wild carrot populations not resistant to 2,4-D, preplant application of 2,4-D ester (1 quart/A) will provide fair control. Tillage is the most effective tool for control of wild carrot in the spring.

**Corn.** The most effective control of wild carrot is obtained with postemergence corn herbicides. Apply 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 Accent (2/3 ounce/A) postemergence with a crop oil concentrate or methylated seed oil. 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 (0.75 lb ae/A - Roundup Ready corn) will suppress or control wild carrot.

**Soybeans.** For the most effective season-long control, apply Classic (2/3 to 3/4 ounce/A) or Synchrony STS (1/2 ounce/A) postemergence. The higher Classic rate provides more effective control. Use crop oil concentrate or methylated seed oil with either treatment to maximize control. Glyphosate (> 0.94 lb ae/A - Roundup Ready soybeans) will suppress or control wild carrot. Preplant application of Canopy XL will suppress wild carrot, especially when mixed with 2,4-D ester (if the wild carrot population is not resistant to 2,4-D).

### **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.

**All crops - fall control.** Dandelion is most easily controlled in the fall. The following treatments can be applied in the fall prior to corn or soybeans: 2,4-D ester (1 quart/A); 2,4-D ester (1 pint/A) plus glyphosate (0.56 lbs ae/A). The combination of 2,4-D plus glyphosate is more effective than 2,4-D alone. Another effective treatment is 2,4-D ester plus Canopy XL plus Express, which can be applied in the fall prior to soybean planting. Simazine plus 2,4-D ester or Basis plus 2,4-D ester is also effective in the fall prior to corn planting. Apply when plants are at least 4 inches in diameter and after a light frost for best results, and when dandelion is in the early bud stage if possible. Mid-October to mid-November may be the best period for application, as long as plants are mostly green.

**All crops - spring control.** One of the most effective spring treatments prior to corn or soybean planting has been a combination of glyphosate (at least 0.75 lb ae/A) plus 2,4-D ester (0.5 to 1.0 lb ae/A) applied after about April 7. A combination of 2,4-D plus glyphosate is more effective than glyphosate alone across a range of weather conditions and dandelion sizes. The higher 2,4-D rate may be more effective, but must be applied 15 to 30 days before soybean planting, depending upon the 2,4-D product used. Labels of most 2,4-D products specify application of 1.0 lb/A at least 30 days before planting, but Weedone 650 and E-99 labels allow application of this rate up to 15 days before planting. Similar preplant intervals should be observed for corn.

**Corn.** The most effective preplant treatments in spring have been Lumax or Lexar plus 2,4-D ester in OSU and Purdue University research. FieldMaster or Expert plus 2,4-D, or other treatments containing glyphosate and 2,4-D can be effective, but are less consistent. Lumax, FieldMaster, Expert or combinations of glyphosate plus 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. Most effective postemergence treatments include Distinct, Equip, Callisto plus atrazine, and mixtures of Steadfast ATZ or Basis Gold with Calliston, Distinct, or dicamba.

**Soybeans.** Preplant application of glyphosate plus 2,4-D ester

plus CanopyXL has generally been the most effective treatment in OSU research. Glyphosate plus 2,4-D ester has been somewhat less consistent than treatments containing the Canopy XL. 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 may be more likely to regrow compared to the glyphosate/2,4-D/CanopyXL treatment. Postemergence application of Classic (3/4 ounce/A) or Synchrony STS (1/2 ounce/A) will suppress dandelion plants that escape preplant treatment. Postemergence application of glyphosate (Roundup Ready soybeans) can control or suppress seedling dandelion and plants that have been injured by preplant herbicides. Combinations of glyphosate plus Classic or FirstRate/Amplify can be more effective than glyphosate alone.

## 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 (1.13 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 (Roundup Ready corn) applied at 0.75 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, Equip, or Accent. 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 (Roundup Ready soybeans) applied at higher labeled rates 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 Harmony Extra or Harmony GT (0.5 to 0.6 ounce/A) 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. Harmony Extra and Harmony GT can be applied using 28 percent nitrogen solution 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 Express (1/3 ounce/A) or 2,4-D ester (0.75 to 1.0 lb ai/A) will prevent formation of the aerial bulblets of wild garlic, but will not control other parts of the plant. Express application is similar to that of Harmony products, with regard to wild garlic size. 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 preplant application of Canopy XL (plus 0.5 lb ai/A of 2,4-D, if at least 7 days before planting) and postemergence application of Classic, Classic/Harmony GT combinations, or Synchrony STS. Harmony Extra can be applied 45 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 main 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. Horsenettle is found mainly in no-till fields, and is difficult to control. It typically emerges after crop planting, and postemergence herbicides 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.

**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), Equip (1.5 oz), or Accent (2/3 ounce/A) with 1/4 to 1/2 pint/A of dicamba. Other treatments with activity include glyphosate (0.75 lb ae/A - Roundup Ready corn), dicamba (1/2 to 1 pint/A), and Marksman (3.5 pints/A).

**Soybeans.** Postemergence application of Classic (3/4 ounce/A), Synchrony STS (1/2 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 most 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 leave tissue to intercept spray particles reduces herbicide

effectiveness

**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 Distinct can suppress horsetail.

**Soybeans.** Preplant application of glyphosate plus Python can control plants during the season of application and reduce the population in future years.

**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 has also been a problem in some tilled fields in recent years. Horseweed can follow a winter annual or summer annual life cycle. While the majority of the horseweed emerges in the fall, it can also emerge in spring and early summer. Horseweed does not mature until late summer, so unlike many other winter annuals that mature in late spring, horseweed competes directly with corn and soybean growth during the growing season and interferes with harvest also.

Horseweed is more easily controlled when small in the late fall or early spring. As the horseweed becomes larger in the spring and early summer, it becomes more difficult to control. Consider including herbicides with residual activity in spring burndown treatments to prevent emergence of horseweed after crop planting. Many populations of horseweed in Ohio and Indiana appear to be resistant to ALS inhibitors (Classic, FirstRate, Beacon, etc) and herbicides with this site of action will be ineffective for horseweed control. Producers should assume most horseweed populations are ALS-resistant, so use of Roundup Ready soybeans is suggested to ensure that an effective postemergence option is available. However, glyphosate-resistant horseweed has been found in the southern half of Ohio and Indiana, and appears to be spreading northward.

**All crops - preplant control.** The most effective and economical treatments are 2,4-D ester (0.5 to 1.0 lb ai/A), or a combination of 2,4-D ester plus glyphosate (0.56 to 1.125 lb ae/A). Application of 2,4-D alone in the fall will result in a field free of horseweed early the next spring (controls horseweed that would have overwintered). When applied in early spring to small (less than 2 inches) horseweed, 2,4-D ester (1.0 lb ai/A) is usually effective. Combinations of glyphosate plus 2,4-D ester should be used on larger horseweed. Horseweed should be prevented from producing seed in the summer/fall after wheat harvest with application of 2,4-D or glyphosate plus 2,4-D 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, Marksman, dicamba) will suppress or control horseweed sufficiently until the corn is well-established. Liberty (24 to 34 ounces/A) or Liberty ATZ (32 to 40 oz) will control small horseweed when applied postemergence in Liberty Link corn. Glyphosate applied postemergence in Roundup Ready corn will also control marestail, but this strategy should be avoided if Roundup Ready soybeans are in the crop rotation.

**Soybeans.** The presence of ALS and glyphosate resistance in

horseweed populations in Ohio can limit herbicide options for burndown and postemergence treatments. The primary goal of a horseweed management program in no-till soybeans should be effective control of emerged plants prior to planting. Soybeans planted before early to mid May will also require a residual herbicide to control later emerging plants. This type of strategy will reduce the need for postemergence herbicide treatments, which can be limited in effectiveness and exert further selection for herbicide resistance in the population. The following principles are important in horseweed control programs:

- 1) 2,4-D ester should be included in herbicide treatments if at all possible;
- 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 prior to early May should include a residual herbicide to control later-emerging plants.

### Control of emerged horseweed prior to soybean planting

The most effective treatments for control of horseweed up to about 6 inches tall are as follows (ranked roughly in order of effectiveness). Treatments containing fewer than three herbicides may be less effective on an ALS- or glyphosate-resistant population.

- a combination of glyphosate plus 2,4-D ester plus either FirstRate/Amplify, CanopyXL, or Gangster;
- glyphosate + 2,4-D ester;
- Sencor plus Gramoxone plus 2,4-D ester;
- a combination of glyphosate plus FirstRate/Amplify, CanopyXL, or Gangster;

Several other treatments can be effective when plants are less than two inches tall, including: Sencor plus 2,4-D ester; Sencor plus Gramoxone; and 2,4-D ester alone. A combination of 2,4-D ester plus CanopyXL, FirstRate/Amplify, or Gangster can also be used on small plants, but effectiveness will be reduced in ALS-resistant populations.

### Residual control of horseweed (spring application).

Most effective herbicides in fields where horseweed may be ALS-resistant include Gangster, metribuzin (at least 0.4 lb ai/A), and Valor. CanopyXL, FirstRate/Amplify, or Python can be used for residual control in fields where the horseweed is not ALS-resistant.

### Spring herbicide recommendations based on horseweed size

#### Fields treated with herbicide the previous fall.

Fields should be free of over-wintering horseweed in the spring, as long as 2,4-D ester was a component of the fall treatment, but additional emergence of horseweed is likely. It is possible that residual herbicides applied in the fall, such as CanopyXL, Valor, and Sencor, can control horseweed through early June. This is most likely to occur in sparser populations that are not ALS-resis-

tant. Regardless of the herbicide(s) applied in fall, fields should be scouted before planting. Apply herbicide as needed prior to soybean planting to control emerged horseweed, and include residual herbicides if the field is planted before mid May.

#### **Horseweed in the seedling or rosette stage (April).**

This can be an extremely effective horseweed management option, since small plants are easily controlled and residual herbicides applied at this time can provide control through early June. Emerged plants should be adequately controlled by 2,4-D ester (1 lb ai/A). When the 2,4-D rate is limited to 0.5 lb ai/A, combine with glyphosate, Sencor, or Sencor plus Gramoxone. Sencor plus Gramoxone (without 2,4-D) can effectively control seedlings or small rosettes.

#### **Horseweed stem elongated but not more than 4 to 6 inches tall (May).**

Most effective treatment is glyphosate plus 2,4-D ester plus either CanopyXL or FirstRate/Amplify. Glyphosate plus 2,4-D ester is effective where glyphosate resistance is not an issue, and glyphosate plus either CanopyXL or FirstRate/Amplify is effective where ALS resistance and ALS plus glyphosate resistance is not an issue. Use a glyphosate rate of at least 0.75 lb acid equivalent per acre, unless ALS plus glyphosate resistance is present, then use a minimum rate of 1.5 lbs acid equivalent/A. Somewhat more variable but generally effective on this size plant is the combination of Sencor plus Gramoxone (minimum of 1.7 pt/A) plus 2,4-D ester.

#### **Horseweed more than 6 inches tall (mid to late May).**

Horseweed of this size are likely to be difficult to control. Anything less than a 3-way mixture of glyphosate plus 2,4-D ester plus CanopyXL or FirstRate/Amplify is not recommended. Use a glyphosate rate of at least 1.5 lbs acid equivalent/A. Resistance to glyphosate and/or ALS inhibitors can result in situations where effective control is not possible.

### **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 ammonium sulfate (17 lbs/100 gallons of water) in a spray volume of 5 to 10 gpa.

**Corn.** Postemergence application of Accent, Beacon, Steadfast, Equip, or Option provides the most effective control of established johnsongrass infestations. Rhizome johnsongrass plants should be at least 8 inches tall at the time of application. Apply with

crop oil concentrate or methylated seed oil (1% v/v) plus nitrogen fertilizer solution for best results. 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. Other herbicides that will control seedlings and control or suppress rhizome plants include NorthStar, Basis Gold, and Spirit. Lightning (1.28 ounce/A - Clearfield corn) and Liberty and Liberty ATZ (32 ounces/A and 48 ounces/A - Liberty Link corn) can also control seedling johnsongrass and suppress rhizome plants, but will be less effective than the others mentioned here in established johnsongrass infestations.

**Soybeans.** Postemergence application of Assure II (10 ounces/A), Fusilade DX (12 ounces/A), Fusion (12 ounces/A), or Select (8 to 16 ounces/acre) 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 at a lower rate may be necessary to control regrowth.

### **Triazine-Resistant Lambsquarters**

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 Sencor, regardless of the rate applied. These weeds can be controlled by substituting other herbicides for triazine-containing products in weed control programs.

**Corn.** Preplant or preemergence application of products containing isoxaflutole (Balance Pro, Epic), flumetsulam (Python, Hornet), or mesotrione (Callisto, Lumax, Lexar) will control lambsquarters. Preemergence applications of Prowl (1.5 to 3 pints/A) or Lorox (1.25 to 3 pounds/A) will also provide control, but may be more variable than Python, Callisto, or Balance. Do not incorporate Lorox or Prowl 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. Dicamba or Marksman also provides limited residual control when applied preemergence or early postemergence.

Postemergence applications of glyphosate (0.57 - 0.75 lb ae/A - Roundup Ready corn), dicamba (1/2 to 1 pints/A), Distinct (4 to 6 ounces/A), Marksman (3 1/2 pints/A), Callisto (3 oz/A), NorthStar, Yukon, or a combination of Lightning (Clearfield corn) with Distinct have generally provided the most effective control of triazine-resistant lambsquarters. Bromoxynil (1 to 1.5 pints/A), 2,4-D (0.33 to 0.5 lb ai/A), or Liberty (34 ounces/A - Liberty Link corn only) also control small lambsquarters.

**Soybeans.** Because metribuzin is a triazine herbicide, soil-applied products containing this chemical will not control triazine-resistant lambsquarters. These products include Sencor, Axiom, Boundary, and Domain. Other preplant/preemergence soybean herbicides with effective activity on lambsquarters include Treflan, Prowl,

Scepter, Canopy XL, FirstRate, Gangster, Valor, and Python.

Lambsquarters can be extremely difficult to control with postemergence 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 (1/2 ounce/A), or Raptor (4 to 5 ounces/A) when plants are less than 4 inches tall (less than 6 inches tall for glyphosate). 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 methylated seed oil can improve Raptor activity, but also increases soybean injury.

## Common Milkweed

Common milkweed, like hemp dogbane, is a problem 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 as well. Following small-grain harvest or mowing, allow milkweed to regrow to a mature stage prior to treatment.

**Corn.** Postemergence application of glyphosate (0.75 lb ae/A - Roundup Ready 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. Dicamba (1/2 to 1 pint/A), Distinct (4 to 6 ounces/A), or Marksman (3.5 pints/A) provides some control or suppression. Apply when milkweed is at least 8 inches tall. The use of drop nozzles to avoid corn injury is suggested for dicamba applications when corn is more than 8 inches tall. Application of Yukon, NorthStar, or a combination of Spirit (1 ounce/A) with dicamba may provide better control than dicamba alone. Permit (1 to 1.3 ounces/A) applied alone is labeled for suppression of milkweed.

**Soybeans.** Postemergence application of glyphosate (Roundup Ready soybeans) applied at high rates 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 (1/2 ounce/A) will effectively 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 - Roundup Ready 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), Distinct (4 to 6 ounces/A), and dicamba + 2,4-D (half rates of each). Beacon (3/4 ounce/A), Accent (2/3 ounce/A), Spirit (1 ounce/A), Equip (1.5 oz), 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. Yukon and NorthStar are premixes of dicamba with Permit and Beacon, respectively.

**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 enlarge greatly so that they may weigh over 30 pounds and be several feet long. The bulk of this root 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 (Roundup Ready corn) will control or suppress bigroot morningglory. Apply 0.75 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. Distinct 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 may be used as a preplant treatment in early June if planting can be 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 ammonium sulfate (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 - Roundup Ready corn), Option (1.75 oz/A), and Equip (1.5 oz/A) are the most effective corn herbicides for wirestem muhly. Plants should be at least 8 inches tall at the time of application. Postemergence application of Accent (2/3 ounce/A) may suppress wirestem muhly, but usually provides less than 70 percent control.

**Soybeans.** Postemergence application of Assure II (8 ounces/A), Fusilade DX (12 ounces/A), Fusion (8 ounces/A), or Select (8 to 16 ounces/A) provides good to excellent control. Apply Assure II or Select 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, an annual weed, develops late in the growing season and produces purple berries that stain harvested grain. It 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.

**Soybeans.** Preplant or preemergence applications of alachlor products, Axiom, Dual II Magnum, Outlook, Valor, Canopy XL, Scepter, Gangster, and Python will control nightshade. Combinations of these herbicides will provide better control than a single herbicide used alone

Several products are effective on eastern black nightshade if applied early postemergence 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), and glyphosate (0.75 lb ae/A - Roundup Ready 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, Axiom, 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) or Yukon (6 to 8 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. Addition of a crop oil concentrate or 28 percent nitrogen solution (UAN) improves Basagran performance. Apply Laddok with crop oil concentrate or Dash only. Atrazine plus crop oil concentrate may be used as a postemergence spray to control emerged yellow nutsedge when small.

**Soybeans.** Alachlor, Axiom, Dual II Magnum, Boundary, and Outlook can provide good control, but surface applications are variable in activity. Incorporate to a depth of 2 to 3 inches for best results. Preplant application of higher rates of Canopy XL can help suppress yellow nutsedge.

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 (1/2 ounce/A) provides good control of yellow nutsedge plants with 4 to 6 leaves. FirstRate (0.3 ounces/A) can also suppress yellow nutsedge.

## Common Pokeweed

Common pokeweed is a perennial broadleaf weed that reproduces by seed and also has an enlarged taproot that overwinters 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.

**Corn.** Glyphosate (0.75 lb ae/A - Roundup Ready 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, dicamba (1 pint/A) or Distinct (4 to 6 ounces/A), or a combination of dicamba with Spirit (1 ounce/A) or Equip (1.5 oz). Apply when plants are less than 12 inches tall.

**Soybeans.** Glyphosate (>0.75 lb ae/A - Roundup Ready soybeans) applied postemergence when plants are at least 8 inches tall will control or suppress pokeweed. Make a second application if necessary. Synchrony STS (1/2 ounce/A) and Classic/Harmony GT combinations will effectively suppress pokeweed through the growing season.

## 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 ammonium sulfate (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 - Roundup Ready corn) will control quackgrass that is at least 8 inches tall. Postemergence application of Accent (2/3 ounce/A), Steadfast (3/4 ounce/A), Equip (1.5 oz)/A, Option (1.5 oz/A), or Beacon (3/4 ounce/A) will provide good to excellent control of quackgrass up to 8 or 10 inches tall. Apply with crop oil concentrate or methylated seed oil plus nitrogen fertilizer solution for best results. Basis Gold (14 ounces/A) and Spirit (1 ounce/A) also have activity on quackgrass, but are less effective at reducing populations than the previously mentioned herbicides.

**Soybeans.** Postemergence application of Assure II (10 ounces/A), Fusilade DX (12 ounces/A), Fusion (12 ounces/A), or Select (8 ounces/A) 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.

## 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 broadleaf crops like soybeans. 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 often decrease in long-term no-till with proper management. Many populations of giant ragweed in Ohio are resistant to ALS inhibitors (Classic, FirstRate, Beacon, Accent, etc) and herbicides with this mode of action will be ineffective for control of these populations.

**Corn.** A combination of preemergence followed by postemergence herbicides provides the most effective giant ragweed control. Preemergence application of atrazine (2 lb ai/A) or atrazine plus Hornet can provide good control of giant ragweed, depending upon population and soil type. Lumax, Lexar, or combinations of atrazine plus Balance can be adequate in fields with consistently low giant ragweed populations. A follow up postemergence treatment will still be necessary in areas where the giant ragweed population is dense. Most postemergence corn herbicides will control giant ragweed, especially if they contain atrazine or phenoxy herbicides. In no-till corn, a preplant application of 2,4-D ester (0.5 lb ai/A) plus atrazine provides excellent 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.

**Soybeans.** Preplant or preemergence applications of Canopy XL (5.1 to 7.9 ounces/A), FirstRate (0.6 to 0.75 oz/A), Gangster, or

Scepter (2.8 oz) can provide adequate control of light to moderate infestations of giant ragweed, but are becoming more variable due to ALS-resistance. Best results have occurred from early preplant treatments in no-till, in combination with 2,4-D ester (0.5 to 1.0 lb ai/A) or glyphosate plus 2,4-D ester. These herbicides alone generally will not provide adequate control in dense populations, and should be followed with a postemergence application to control later-emerging plants. 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 is also recommended for consistently effective control.

The most effective postemergence treatments in OSU trials for control of giant ragweed (4 to 8 inches tall) include: FirstRate/Amplify (0.3 ounce/A), Flexstar (1.3 pints/A), Basagran + Reflex/Flexstar (1 pint + 1 pint/A), Basagran + Cobra (1 pint + 6 ounces/A), Pursuit + Cobra (1.44 ounces/A + 4 to 6 ounces/A), and Reflex + 2,4-DB (1 1/4 pints + 2 ounces/A). Results with Classic and Synchrony STS have been more variable than with FirstRate/Amplify. In STS soybeans, combinations of Synchrony STS + Cobra will provide more consistent control than Synchrony alone. Control with FirstRate, Classic, Synchrony, and Pursuit is becoming more variable due to ALS-resistance. In Roundup Ready soybeans, a single application of glyphosate (0.75 lb ae/A) when ragweed are about 8 inches tall can provide effective control. In OSU research, two applications of glyphosate (0.75 lb ae/A followed by 0.38 lb ae/A) has provided the most consistent control.

Early postemergence applications where ragweed populations are dense may need to be followed by a second application to control late-emerging plants. A slightly later initial application may reduce the need for a sequential treatment, but be sure to apply before ragweed plants exceed the maximum labeled size. Where a split postemergence application is planned, applying one-half the labeled rate when giant ragweed are small (around 2 to 3 inches), and following with a second application at the same rate 2 to 3 weeks later can be very effective. Any of these herbicide treatments will perform best when applied to young, actively growing plants under hot, humid conditions and adequate soil moisture.

## 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-rossette stage for fair to good control. Good control can be achieved 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), Distinct (4 to 6 ounces/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 (0.75 lb ae/A - Roundup Ready corn) or Equip (1.5 oz/A) will control or suppress sowthistle.

**Soybeans.** Preplant or preemergence applications of Canopy XL provide fair to good control. Postemergence application of Classic (3/4 ounce/A) or Synchrony STS (1/2 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 Express (0.3 ounce/A) or Harmony Extra (0.6 ounce/A) 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 Max applied at 1.33 to 2 pts/A. This treatment will provide control during the season of application and also reduce the population in future years.

**Corn.** Preplant application of atrazine provides fair control during the season of application, but will not reduce the population.

**Soybeans.** Preplant application of Valor will control star-of-Bethlehem during the season of application, but 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 ammonium sulfate (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 tank-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 appli-

cation 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 hard frost. For best results, fall applications should be followed by deep tillage 7 to 10 days after application, but do not till for 5 weeks before and for 1 week after herbicide application.

**Wheat.** Stinger (1/3 pint/A), Express (1/3 ounce/A), Curtail (2 to 2 2/3 pts/A), or Harmony Extra (0.6 ounce/A) controls or suppresses Canada thistle, preventing harvest problems. Stinger provides the most complete thistle kill, but is more expensive than the other three herbicides. Express provides better control than Harmony Extra, but is less broad-spectrum with regard to other weeds; either herbicide can be tank-mixed with 2,4-D for improved thistle control. Dicamba 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 (0.75 lb ae/A - Roundup Ready 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.

Distinct (4 to 6 ounces/A) and 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 ATZ (Liberty Link corn) will burn down 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 Accent with dicamba. Most of these treatments will control or suppress the above-ground part of the plant, which will help prevent further spread. The use of drop nozzles is suggested to avoid injury with dicamba or 2,4-D if corn is more than 8 inches tall.

**Soybeans.** Glyphosate (1.125 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. Crop oil concentrate 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 STS (1/2 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. The increase in population of this weed seems to be due to its greater tolerance to herbicides in general, compared to other pigweeds, and especially ALS inhibitor herbicides. In addition, most waterhemp populations have developed resistance to ALS inhibitors. 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.

**Corn.** Most preplant/preemergence corn herbicides provide good control of waterhemp, especially when mixed with atrazine (the activity of Python and Hornet will be variable because of ALS resistance). 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, Distinct, Callisto, and glyphosate (Roundup Ready corn) are effective. Liberty (24 to 34 ounces/A - Liberty Link corn) will control small waterhemp.

**Soybean.** For best results, apply Sencor, Valor, Canopy XL, Treflan, Dual II Magnum, Axiom, Outlook, Boundary, or alachlor preemergence. If the population is dense or late-emerging waterhemp are observed, a postemergence treatment may be required. Effective postemergence treatments include Ultra Blazer, Cobra, Reflex, Flexstar, Stellar, Storm, and glyphosate (Roundup Ready soybeans). These should be applied when waterhemp are less than 4 inches tall for best results. Classic, Synchrony STS, Harmony GT, Pursuit, and Raptor are likely to be extremely variable on waterhemp, since much of the waterhemp appears to be ALS-tolerant or ALS-resistant.

## Winter Annuals

Many winter annual weeds, including common chickweed, purple deadnettle, henbit, and cressleaf groundsel, have become increasingly problematic in corn, soybean, and wheat production. These weeds emerge primarily in the late-summer through fall (and sometimes early spring), overwinter, and flower and set seed in late spring or early summer. They can directly interfere with wheat establishment and growth in the fall or spring. While they do not necessarily compete directly with corn and soybean growth, winter annuals cause a number of other problems, including some of the following:

- the dense mat of chickweed and other winter annuals can slow soil drying and warming and interfere with planting and tillage in the spring
- harbor insects in the spring, which later infest corn or soybeans
- purple deadnettle and several other winter annuals appear to serve as alternate hosts for soybean cyst nematode

The goals of a winter annual management programs should be control with herbicide or tillage in the fall or early spring to: 1) prevent problems with crop establishment; 2) prevent problems

with pests associated with winter annuals; and 3) prevent additional winter annual seed production. Fall herbicide treatments are an extremely effective tool for managing winter annual weeds, and fields where these weeds have been a problem over the past several years should be considered as good candidates for fall herbicide treatments. Some general suggestions to maximize effectiveness of these treatments follow:

- Optimum time of application for control of emerged winter annuals is between mid-October and mid-November. We have applied as late as the first week of December under very cold conditions, and still achieved effective control. However, we suggest applying herbicides under relatively warm conditions if possible.
- When using residual herbicides (Canopy, Sencor, Valor, etc) with the goal of controlling weeds as long as possible into the following crop, delay application until November to minimize herbicide degradation.
- We recommend including 2,4-D with all treatments, to reduce the risk of herbicide resistance and help control dandelions and a few other weeds. A rate of 1 pint/A should be adequate with most treatments.
- Treatments with glyphosate should be applied with ammonium sulfate. Include surfactant if recommended by the glyphosate product label. Most other treatments should be applied with crop oil concentrate.
- If possible, wait a minimum of a week or so after crop harvest to apply herbicides, which allows time for crop residue to settle and maximizes contact of spray with weeds.

Ohio State and Purdue University have conducted studies on the effectiveness of fall herbicide treatments over the past several years, and the following treatments have been among the more effective in this research.

- Glyphosate or glyphosate plus 2,4-D: Very effective treatment for control of dandelions and winter annuals. Can be used prior to corn or soybeans. Primary disadvantage is the lack of residual activity into the following spring, which means that two in-season herbicide applications are likely to be necessary. The minimum rate for glyphosate applied alone in fields with dandelion, wild carrot, and other simple perennials and biennials should be 0.75 lb acid equivalent per acre. When applied with 2,4-D, the glyphosate rate can be reduced to 0.38 lb ae/A unless the population density of these species is extremely high or other perennial weeds are present.
- 2,4-D (1.0 - 1.5 lb ai/A): Economical treatment for dandelion and most winter annuals, but will not control chickweed. Can be used prior to corn or soybeans. Primary disadvantage - no residual activity into the spring. Populations of wild carrot can be resistant to 2,4-D, and control of these will be unacceptable. Cressleaf groundsel and curly dock may not be completely controlled, because they have tolerance to 2,4-D.
- Canopy XL plus Express plus 2,4-D: Effective treatment for dandelion and winter annuals. Provides residual activ-

varies with rate of Canopy XL applied. Disadvantage – possibility of developing ALS resistance (so use of 2,4-D with this treatment is essentially mandatory) and lack of control of ALS-resistant maretail in the spring. Use before soybeans only. Low rates of Canopy XL may not completely control 2,4-D-resistant wild carrot.

- Sencor plus 2,4-D: Effective on many winter annuals, but rarely provides more than 80% chickweed control in OSU studies (usually conducted in very dense chickweed areas). Sencor appears to antagonize the 2,4-D on dandelion,

reducing the control. Sencor does not control wild carrot. Expect shorter period of residual control on ragweeds compared to CanopyXL or Scepter. Can be applied in fall before corn or soybeans.

- Simazine plus 2,4-D: Effective on winter annuals and dandelion, but a 2,4-D rate of 1 quart/A may be necessary for effective control of dandelion and large purple deadnettle in problem fields. Use in the fall before corn only.
- Basis plus 2,4-D: Controls winter annuals and dandelion. Use in the fall before corn only.

**Table 20. Corn and Soybean Herbicide Premixes.****Liquid Premixes for Corn**

<b>Name</b>	<b>Active Ingredients (lbs active/gallon)</b>	<b>Formulation Equivalents</b>	
Bicep II Magnum 5.5L/ or Cinch ATZ	S-metolachlor (2.4) atrazine (3.1)	2.1 qts =	1.3 pts Dual II Magnum 7.64EC + 1.6 qt atrazine 4L
Buctril/atrazine 3L or Moxy/atrazine 3L	bromoxynil (1.0) atrazine (2.0)	2 pts =	1 pt Buctril/Moxy 2S + 1 pt atrazine 4L
Bullet 4L	alachlor (2.5) atrazine (1.5)	4 qts =	2.5 qts Lasso 4EC + 1.5 qts atrazine 4L
Degree Xtra 4L	acetochlor (2.69) atrazine (1.35)	3 qts =	2 qts Degree 3.8L + 1 qt of atrazine 4L
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 qts atrazine 4L 1.5 pts Touchdown IQ
Field Master 4L	acetochlor (2.0) atrazine (1.5) glyphosate (0.56)	4.0 qts =	1.14 qts Harness 7L + 1.5 qts atrazine 4L + 24 oz Roundup Original 3S
FulTime 4L	acetochlor (2.4) atrazine (1.6)	3.0 qts =	2.25 qts Topnotch 3.2L + 1.2 qts atrazine 4L
Guardsman Max 5L	dimethenamid-P (1.7) atrazine (3.3)	3 pts =	14 oz Outlook 6EC + 1.23 qts atrazine 4L
Harness Xtra 5.6L/ Confidence Xtra 5.6L	acetochlor (3.1) atrazine (2.5)	2.4 qts =	1.06 qts Harness 7L + 1.5 qts atrazine 4L
Harness Xtra 6L/ Confidence Xtra 6L	acetochlor (4.3) atrazine (1.7)	2.4 qts =	1.47 qts Harness 7L + 1 qt atrazine 4L
Keystone 5.25L	acetochlor (3.0) atrazine (2.25)	2.6 qts =	2.44 qts TopNotch 3.2L 1.5 qts atrazine 4L
Laddok S-12 5L	bentazon (2.5) atrazine (2.5)	1.67 pts =	1 pt Basagran 4L + 1 pt atrazine 4L
Lariat 4L	alachlor (2.5) atrazine (1.5)	4 qts =	2.5 qts Lasso 4EC + 1.5 qts atrazine 4L
Liberty ATZ 4.3L	glufosinate (1.0) atrazine (3.3)	40.0 oz =	1.5 pts Liberty 1.67L + 1.03 qt atrazine 4L
Lumax 4L	s-metolachlor (2.68) atrazine (1.0) mesotrione (0.27)	3 qts =	1.9 pts Dual II Magnum 7.68EC 0.75 qt atrazine 4L 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 qt atrazine 4L 5.3 oz Callisto 4L
Marksman/Sterling Plus/ Banvel-K+atrazine 3.2L	dicamba (1.1) atrazine (2.1)	3.5 pts =	1 pt Banvel 4L + 1.8 pts atrazine 4L
Ready Master ATZ	glyphosate (1.5) atrazine (2)	2 qts =	32 oz Roundup Original 3S + 1 qt atrazine 4L
Shotgun 3.25L	atrazine (2.25) 2,4-D (1.0)	3 pts =	1.7 pts atrazine 4L + 0.75 pt 2,4-D 4L
Stalwart Xtra 5.5L	atrazine (3.1) metolachlor (2.4)	2.1 qts =	1.6 qts atrazine 4L + 1.3 pts Stalwart C 7.8EC
Volley ATZ 5.25L	atrazine (2.25) acetochlor (3.0)	2.8 qts =	1.6 qts atrazine 4L + 1.3 qts Volley 6.4L
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	
Boundary 7.8EC	metribuzin (1.5) s-metolachlor (6.3)	2 pts =	0.5 lb Sencor 75DF 1.6 pts Dual II Magnum
Extreme 2.17L	imazethapyr (0.17) glyphosate (2)	3 pts =	1.44 oz Pursuit 70 DG + 0.56 lb glyphosate acid
Fusion 2.66EC	fluazifop (2.0) fenoxaprop (0.66)	8 oz =	8 oz Fusilade DX 2L + 8 oz Option II 0.67L
Gangster	Co-pack of Valor + FirstRate		
Rezult	Co-pack of Basagran + Poast Plus		
Stellar 3.1EC	flumiclorac pentyl (0.7) lactofen (2.4)	5 oz =	4 oz Resource + 6 oz Cobra
Storm 4S	bentazon (2.67) acifluorfen (1.33)	1.5 pts =	1 pt Basagran 4L + 1 pint Blazer 2S

## Dry Premixes for Corn

Name	Active Ingredients (percentage active)	Formulation Equivalents	
Axiom 65DF	flufencet (54.4%) metribuzin (13.6%)	18.0 oz =	16.3 oz Define + 3.26 oz Sencor 75DF
Basis 75DF	rimsulfuron (50%) thifensulfuron (25%)	0.33 oz =	0.16 oz ai rimsulfuron + 0.11 oz HarmonyGT 75DF
Basis Gold 89.5DF	rimsulfuron (1.34%) nicosulfuron (1.34%) atrazine (86.8%)	14 oz =	0.19 oz ai rimsulfuron + 0.25 oz Accent 75DF + 13.5 oz Atrazine 90DF
Celebrity Plus 75DF	nicosulfuron (10%) dicamba (46.6%) diflufenzopyr (18.1%)	4.7 oz =	0.67 oz Accent 75DF + 4 oz Clarity 4L + 0.8 oz ai diflufenzopyr
Distinct 76.4DF	dicamba (55%) diflufenzopyr (21.4%)	4 oz =	4.4 oz Clarity 4L + 0.9 oz ai diflufenzopyr
Epic 58DF	isoxaflutole (10%) flufenacet (48%)	12 oz =	1.5 oz BalancePro + 9.7 oz Define
Equip 32WDG	foramsulfuron (30%) iodosulfuron (2%)	1.5 oz =	1.3 oz Option 35WDG 0.03 oz ai iodoflufenzopyr
Exceed 57DF	prosulfuron (28.5%) primisulfuron (32.3%)	1 oz =	0.5 oz Peak 57DF + 0.38 oz Beacon 75DF
Hornet 78.5WDG	flumetsulam (18.5%) clopypalid (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 =	0.96 oz Pursuit 70 DG + 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 Banvel 4L
Priority 62.5DF	carfentrazone (12.5%) halosulfuron (50%)	1.0 oz =	0.5 oz AimEW 1.9L + 0.7 oz Permit 75DF
Spirit 57DF	prosulfuron (14.2%) primisulfuron (42.8%)	1.0 oz =	0.25 oz Peak 57DF + 0.57 oz Beacon 75DF
Steadfast 75DF	rimsulfuron (25%) nicosulfuron (50%)	0.75 oz =	0.19 oz ai rimsulfuron 0.5 oz Accent
Steadfast ATZ	rimsulfuron (1.3%) nicosulfuron (2.7%) atrazine (85.3%)	14 oz =	0.19 oz ai rimsulfuron 0.5 oz Accent 14 oz atrazine 90DF
Yukon 67.5DF	halosulfuron dicamba	4 oz =	0.67 oz Permit 75DF 4.4 oz Banvel 4L

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**Dry Premixes for Soybeans**

<b>Name</b>	<b>Active Ingredients (percentage active)</b>	<b>Formulation Equivalents</b>	
Synchrony STS 42DF	chlorimuron (31.8%) thifensufuron (10.2%)	0.5 oz =	0.64 oz Classic 25 DF + 0.068 oz Harmony GT 75 DF
Canopy XL 56DF	chlorimuron (9.4%) sulfentrazone (46.9%)	6.4 oz	2.4 oz Classic 25 DF + 4.0 oz Authority 75 DF
Domain 60DF	metribuzin (36%) flufenacet (24%)	16 oz =	7.7 oz Sencor 75 DF + 6.3 oz Define



**Table 21. 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.**

Herbicide	Months Before Planting									
	Corn	Wheat	Oats	Alfalfa	Clover	Soybeans	Sugar Beets	Tomatoes	Popcorn	Sweet Corn
Accent SP	NR	4	8	12	12	0.5	10/18 <sup>h</sup>	10/18 <sup>h</sup>	10	10 <sup>j</sup>
Atrazine <sup>a</sup>	NR	14	21	21	21	10	21	21	NR	NR
Axiom	NR	12	12	12	12	NR	18	12	12	12
Balance Pro	NR	4	18	10	18	6	10	18	6	6
Basis	NR	4	8	10	18	10	10	1	10	10
Basis Gold <sup>a</sup>	NR	10	18	18	18	10 <sup>m</sup>	18	18	10	10
Beacon	14 days <sup>i</sup>	3	8	8	18	8	18	18	8	8
Bicep/Cinch ATZ <sup>a</sup>	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 <sup>a</sup>	NR	15	15	21	21	10	21	21	1	1
Bullet <sup>a</sup>	NR	15	18	18	18	10	18	18	NR	NR
Callisto	NR	4	4	10	18	10	18	18	8	8
Canopy XL <sup>k</sup>	10	4	30	12	18	NR	30	12 <sup>b</sup>	10	18
Celebrity Plus	NR	4	8	12	12	4	10/18 <sup>h</sup>	10/18 <sup>h</sup>	10	10 <sup>j</sup>
Classic	9 <sup>n</sup>	3	3	12 <sup>n</sup>	12 <sup>n</sup>	NR	30	9 <sup>bn</sup>	9 <sup>n</sup>	18
Command/Commit	9	12 <sup>cd</sup>	16 <sup>cd</sup>	16 <sup>cd</sup>	16 <sup>cd</sup>	NR	9	9-12 <sup>f</sup>	9	9
Curtail	1	1	1	10.5	18	10.5 <sup>i</sup>	6	18	10.5	10.5
Define	NR	12	12	12	12	NR	4	12	12	12
Degree	NR	4	18	18	18	9	18	18	9	9
Degree Xtra	NR	14	21	21	21	10	21	21	9	9
Domain	1	12	18	12	18	NR	18	18	12	18
Epic	NR	12	12	12	12	6	10	12	6	12
Equip	0.5	2	9	18	BA	9	18	BA	0.5	0.5
Exceed <sup>p</sup>	1	3	3	18	18	18/10 <sup>st</sup>	18	18/10 <sup>st</sup>	3	3
Expert <sup>a</sup>	NR	15	15	18	18	10	18	18	NR	NR
Extreme	8.5	3	18	4	40	NR	40	40	18	18
Field Master <sup>a</sup>	NR	14	21	21	21	10	21	21	NR	9
FirstRate/Amplify	9	3	30+BA	9	30+BA	NR	30+BA	30+BA	9	18
Flexstar	10	4	4	18	18	NR	18	18	12	12
FulTime <sup>a</sup>	NR	15	15	18	18	10	18	18	9	9
Gangster	9	3	9	12+BA	30+BA	NR	30+BA	30+BA	9	18
Guardman Max <sup>a</sup>	NR	15	18	18	18	10	18	18	18	18
Harness	NR	4	18	18	18	9	18	18	9	9
Harness Xtra <sup>a</sup>	NR	14	21	21	21	10	21	21	9	9
Hornet	NR	4	4	10.5	26+BA	10.5	26+BA	26+BA	10.5	18/10.5 <sup>u</sup>
Keystone a	NR	15	21	21	21	10	21	21	21	21
Laddok <sup>a</sup>	NR	9	9	9	9	9	15	15	NR	NR
Lariat <sup>a</sup>	NR	15	18	18	18	10	18	18	NR	NR
Liberty ATZ <sup>a</sup>	NR	10	10	10	21	10	21	21	10	10
Lightning	8.5	4	18	9.5	40+BA	9	40+BA	40+BA	18	18
Lumax/Lexara	NR	18	18	18	18	18	18	18	18	18
Marksman <sup>a</sup>	NR	10	18	18	18	10	18	18	NR	NR
Northstar	14 days <sup>i</sup>	3	8	8	18	8	18	18	8	8
Option	7 days	2	2	2	2	14 days	2	2	2	2
Osprey	12	7 days	10	10	10	3	10	10	12	12
Olympus	18	4	18	18	18	18	18	18	18	18
Peak <sup>q</sup>	1	NR	NR	22	22	10	22	22	10	10
Permit	NR	3	8	9	9	10	24	8	3	3
Princep <sup>a</sup>	NR	14	21	21	21	10	18	18	10	10

**Table 21. Restrictions on Crop Rotation—Continued**

Herbicide	Months Before Planting						Sugar Beets	Tomatoes	Popcorn	Sweet Corn
	Corn	Wheat	Oats	Alfalfa	Clover	Soybeans				
Priority	1	2	2	12	12	9	24	12 <sup>b</sup>	3	3
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 <sup>o</sup>	9	8.5	8.5
Ready Master ATZ	NR	14	21	21	21	10	21	21	NR	NR
Reflex	10	4	4	18	18	NR	18	18	10	10
Scepter	9.5 <sup>g</sup>	4	11	18	18	NR	40	18	18	18
Sencor	4	4	12	4	12	NR	18	4	4	4
Spirit <sup>p</sup>	1	3	3	18	18	10 <sup>s</sup>	18	10	8	8
Stalwart Xtra <sup>a</sup>	NR	14	21	21	21	10	21	21	NR	NR
Steadfast	NR	4	8	12	12	0.5	10/18 <sup>h</sup>	10/18 <sup>h</sup>	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
Shotgun <sup>a</sup>	NR	14	21	21	21	10	21	21	NR	NR
Surpass/Topnotch	NR	4	18	18	18	9	18	18	9	9
Synchrony STS	9 <sup>n</sup>	3	3	12 <sup>n</sup>	12 <sup>n</sup>	NR	30	9 <sup>b,n</sup>	9	18
Valor	2	2	12+BA	12+BA	12+BA	NR	12+BA	12+BA	12+BA	4
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 <sup>b</sup>	3	3

<sup>a</sup> 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. If more than 3 pounds active ingredient is applied, or herbicide is applied after June 10, plant only corn or sorghum the following year. Do not plant sugar beets, tobacco, or vegetable crops the year following application.

<sup>b</sup> Transplant tomatoes only.

<sup>c</sup> Do not plant in the fall of year of application or the spring of the following year.

<sup>d</sup> 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.

<sup>e</sup> 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.

<sup>f</sup> 9 months for transplant tomatoes; 12 months for all tomatoes.

<sup>g</sup> 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 corn hybrids that are tolerant or resistant to imidazolinone herbicides the following spring.

<sup>h</sup> 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.

<sup>i</sup> Refer to Syngenta literature for a list of hybrids that have good tolerance to Beacon before planting.

<sup>j</sup> Except the sweet corn varieties “merit”, “carnival”, and “sweet success”, for which the minimum rotational interval is 15 months.

<sup>k</sup> If soil pH is greater than 6.8, rotate only to soybeans.

<sup>m</sup> If applied after July 1st, do not plant soybeans the season following application.

<sup>n</sup> If applied after August 1, extend recrop interval by 2 months.

<sup>o</sup> If soil pH is less than 6.2, allow 26 months to rotation of sugarbeets.

<sup>p</sup> 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.

<sup>q</sup> Read label for precautions before planting rotational crop.

<sup>r</sup> Allow 12 months to rotation of sweet corn if 2-2/3 pt of Command is used.

<sup>s</sup> Do not plant soybeans the following season if herbicide is applied after June 30.

<sup>t</sup> 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.

<sup>u</sup> Only certain sweet corn varieties may be grown 10.5 months after application; check herbicide label for those varieties. Otherwise wait 18 months.

**Table 22. 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 1 quart of Roundup Original	Surfactant needed	Manufacturer
		Acid (lb/gallon)	Salt			
Buccaneer	IPA	3	4	32 oz	Yes	Tenkoz, Inc
Buccaneer Plus	IPA	3	4	32 oz	No	Tenkoz, Inc
Clearout 41Plus	IPA	3	4	32 oz	No	Chemical Products Technologies
Cornerstone	IPA	3	4	32 oz	Yes	Agriliance LLC
Cornerstone Plus	IPA	3	4	32 oz	No	Agriliance LLC
Credit	IPA	3	4	32 oz	Yes	Nufarm
Credit Extra	IPA	3	4	32 oz	No	Nufarm
Durango	IPA	4	5.4	24 oz	No	Dow AgroSciences
Gly Star Original	IPA	3	4	32 oz	Yes	Albaugh
Gly Star Plus	IPA	3	4	32 oz	No	Albaugh
Gly Star 5	IPA	4	5.4	24 oz	Yes	Albaugh
Gly-4	IPA	3	4	32 oz	Yes	Universal Crop Protection
Gly-4 Plus	IPA	3	4	32 oz	No	Universal Crop Protection
Gly-Flo	IPA	3	4	32 oz	Yes	MicroFlo
Glyphosate Original	IPA	3	4	32 oz	Yes	Griffin
Glyphos	IPA	3	4	32 oz	Yes	Chemi-Nova
Glyphos X-tra	IPA	3	4	32 oz	No	Chemi-Nova
Glyphomax	IPA	3	4	32 oz	Yes	Dow AgroSciences
Glyphomax Plus	IPA	3	4	32 oz	No	Dow AgroSciences
Glyphomax XRT	IPA	4	5.4	24 oz	No	Dow AgroSciences
Helosate Plus	IPA	3	4	32 oz	No	Helm Agro US
Honcho	IPA	3	4	32 oz	Yes	Monsanto
Honcho Plus	IPA	3	4	32 oz	No	Monsanto
Mirage	IPA	3	4	32 oz	Yes	UAP/Platte
Mirage Plus	IPA	3	4	32 oz	No	UAI/Platte
Rattler	IPA	3	4	32 oz	Yes	Helena
Rattler Plus	IPA	3	4	32 oz	No	Helena
Roundup Original	IPA	3	4	32 oz	Yes	Monsanto
Roundup Original II	IPA	3	4	32 oz	Yes	Monsanto
Roundup Original Max	K	4.5	6	22 oz	No	Monsanto
Roundup WeatherMax	K	4.5	6	22 oz	No	Monsanto
Touchdown HiTech	K	5	6.7	20 oz	Yes	Syngenta
Touchdown IQ	DA	3	4	32 oz	No	Syngenta
Touchdown Total	K	4.17	5.6	24 oz	No	Syngenta

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 23. Glossary of Chemical Names and Manufacturers

Trade Name	Common Name	Formulations	Restricted Use			Manufacturer
			Ground Water Advisory	Surface Water Advisory		
AAtrex, Atrazine	atrazine	4 lb/gal L, 90% DF, 80% WP	Y	Y	Y	Syngenta, others
AimEW	carfentrazone-ethyl	1.9 lb/gal L	N	N	N	FMC
Accent SP	nicosulfuron	75% DF	N	N	N	DuPont
Alachlor	alachlor	4 lb/gal L	Y	Y	N	Micro Flo
Ally	metasulfuron methyl	60% DF	N	N	N	DuPont
Amplify	cloransulam-methyl	84% DF	N	Y	Y	Monsanto
Arrow	clethodim	2 lb/gal L	N	N	N	Makhteshim-Agan
Assure II	quizalofop	0.88 lb/gal L	N	N	N	DuPont
Authority	sulfentrazone	75% DF	N	Y	Y	DuPont
Axiom	flufenacet + metribuzin	68% DF	N	Y	Y	Bayer
Balance Pro	isoxaflutole	4 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	rimsulfuron + thifensulfuron	75 DF	N	N	N	DuPont
Basis Gold	rimsulfuron + nicosulfuron + atrazine	89.5 DF	Y	Y	Y	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
Blanket	sulfentrazone	75% DF	N	Y	Y	Tenkoz
Boundary	metribuzin + s-metolachlor	7.8 lb/gal L	N	Y	N	Syngenta
Brash	dicamba + 2,4-D	3.87 lb/gal L	N	N	N	Agrilience LLC
Broclean	bromoxynil	2 lb/gal L	N	N	N	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
Callisto	mesotrione	4 lb/gal l	N	N	Y	Syngenta
Canopy XL	sulfentrazone + chlorimuron	56% DG	N	Y	Y	DuPont
Celebrity Plus	dicamba + nicosulfuron +diflufenopyr	75% DF	N	Y	Y	BASF
Cimarron	metasulfuron methyl	60% DF	N	N	N	DuPont
Cimarron Max	metasulfuron 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
Classic	chlorimuron-ethyl	25% DF	N	N	N	DuPont
Cobra	lactofen	2 lb/gal L	N	N	N	Valent USA
Command	clomazone	3 lb/gal L (ME)	N	N	N	FMC, others
Commit	clomazone	3 lb/gal L (ME)	N	N	N	Agrilience LLC
Confidence	acetochlor + safener	7 lb/gal L	Y	Y	Y	Agrilience LLC
Confidence Xtra 5.6	atrazine + acetochlor + safener	5.6 lb/gal L	Y	Y	Y	Agrilience LLC
Crossbow	triclopyr + 2,4-D	3 lb/gal L	N	N	N	Dow AgroSciences
Curtail	clopyralid + 2,4-D	2.38 lb/gal L	N	Y	N	Dow AgroSciences
Define	flufenacet	4 lb/gal L	N	Y	Y	Bayer
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 + diflufenopyr	76.4% DF	N	Y	Y	BASF
Domain	flufenacet + metribuzin	60% DF	N	Y	Y	Bayer
Dual II Magnum	s-metolachlor + safener	7.64 lb/gal L, 16% G	N	Y	N	Syngenta

Table 23. Glossary of Chemical Names and Manufacturers—Continued

Trade Name	Common Name	Formulations	Restricted Use			Manufacturer
			Ground Water Advisory	Surface Water Advisory		
Epic	flufenacet + isoxaflutole	58% DF	Y	Y	Y	Bayer
Eptam	EPTC	7 lb/gal L, 10% G	N	N	N	Syngenta
Equip	foramsulfuron + iodosulfuron	32% WDG	N	N	Y	Bayer
Exceed	primisulfuron+prosulfuron	57 DF	N	N	N	Syngenta
Expert	atrazine + glyphosate + s-metolachlor + safener	4.88 lb/gal L	Y	Y	Y	Syngenta
Express	tribenuron methyl	75% DF	N	N	N	DuPont
Extreme	imazethapyr + glyphosate	2.17 lb/gal L	N	N	N	BASF
Field Master	glyphosate + acetochlor + atrazine + safener	4.0 lb/gal L	Y	Y	Y	Monsanto
FirstRate	cloransulam-methyl	84% DF	N	Y	Y	Dow AgroSciences
Flexstar	fomesafen	1.88 lb/gal L	N	N	N	Syngenta
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 Max	paraquat	3 lb/gal L	Y	N	N	Syngenta
Guardman Max	dimethenamid-P + atrazine	5 lb/gal L	Y	Y	Y	BASF
Harmony Extra	thifensulfuron + tribenuron methyl	75% DF	N	N	N	DuPont
Harmony GT	thifensulfuron	75% DF	N	N	N	DuPont
Harness	acetochlor + safener	7 lb/gal L, 20% G	Y	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
Intro	alachlor	4 lb/gal L	Y	Y	N	Monsanto
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	5.0 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
Lexar	s-metolachlor+atrazine+mesotrione	3.7 lb/gal L	Y	Y	Y	Syngenta
Liberty	glufosinate	1.67 lb/gal L	N	N	N	Bayer
Liberty ATZ	glufosinate + atrazine	4.3 lb/gal L	Y	Y	Y	Bayer
Lightning	imazethapyr + imazapyr	70% SG	N	N	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
Marksman	dicamba + atrazine	3.2 lb/gal L	Y	Y	Y	BASF
Maverick	sulfosulfuron	75% DF	N	Y	N	Monsanto
MicroTech	alachlor	4 lb/gal L	Y	Y	N	Monsanto
Moxy	bromoxynil	2.0 lb/gal L	N	N	N	Riverside
NorthStar	dicamba + primisulfuron	47.4% WDG	N	N	N	Syngenta
Olympus	propoxycarbazone-sodium	70% WDG	N	N	N	Bayer
Option	foramsulfuron	35% WDG	N	N	Y	Bayer
Oracle	dicamba	4 lb/gal L	N	N	N	Gharda USA
Osprey	mesosulfuron-methyl	4.5% WDG	N	N	N	Bayer
Outlook	dimethenamid-P	6.0 lb/gal L	N	Y	N	BASF
Parallel	metolachlor	8.0 lb/gal L	N	Y	Y	Makhteshim
Peak	prosulfuron	57 DF	N	N	N	Syngenta
Pendimax	pendimethalin	3.3 lb/gal L	N	N	N	Dow AgroSciences
Permit	halosulfuron	75 DF	N	Y	N	Monsanto
Poast	sethoxydim	1.5 lb/gal L	N	N	N	MicroFlo
Poast Plus	sethoxydim + dash	1 lb/gal L	N	N	N	MicroFlo

Table 23. Glossary of Chemical Names and Manufacturers—Continued

Trade Name	Common Name	Formulations	Restricted Use			Manufacturer
			Ground Water Advisory	Surface Water Advisory		
Princep, Simazine	simazine	4 lb/gal L, 90% DF	N	Y	N	Syngenta, others
Priority	carfentrazone + halosulfuron	62.5% DF	N	Y	N	Tenkoz
Prowl	pendimethalin	3.3 lb/gal L	N	N	N	BASF
Prowl H2O	pendimethalin	3.8 lb/gal L	N	N	N	BASF
Pursuit	imazethapyr	2 lb/gal L, 70% DG	N	N	N	BASF
Python	flumetsulam	80% WDG	N	Y	N	Dow AgroSciences
Raptor	imazamox	1.0 lb/gal L	N	N	N	BASF
Ready Master ATZ	atrazine + glyphosate	3.5 lb/gal L	Y	Y	Y	Monsanto
Reflex	fomesafen	2 lb/gal L	N	N	N	Syngenta
Reglone	diquat dibromide	3.73 lb/gal L	N	N	N	Syngenta
Resource	flumiclorac-pentyl	0.86 lb/gal L	N	N	N	Valent
Rezult	bentazon + sethoxydim + Dash	Co-Pack	N	N	N	BASF
Scepter	imazaquin	1.5 lb/gal L, 70% DG	N	N	N	BASF
Select	clethodim	2.0 lb/ gal L	N	N	N	Valent
Sencor	metribuzin	75% DF, 4 lb/gal L	N	Y	N	Bayer
Shotgun	atrazine +2,4-D	3.25 lb/gal L	Y	Y	Y	United Ag Products
Sinbar	terbacil	80% WP	N	Y	Y	DuPont
Spartan	sulfentrazone	75% DF	N	Y	Y	FMC
Spike	tebuthiuron	20% P	N	Y	N	Dow AgroSciences
Spirit	primisulfuron + prosulfuron	57% DF	N	N	N	Syngenta
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
Steadfast	nicosulfuron + rimsulfuron	75% DF	N	N	N	DuPont
Steadfast ATZ	nicosulfuron + rimsulfuron + atrazine	89.3% DF	Y	Y	Y	DuPont
Stellar	flumiclorac-pentyl+lactofen	3.1 lb/gal L	N	N	N	Valent
Sterling	dicamba	4 lb/gal L	N	N	N	Agriliance LLC
Sterling Plus	dicamba + atrazine	3.2 lb/gal L	Y	Y	Y	Agriliance LLC
Stinger	clopyralid	3 lb/gal L	N	Y	N	Dow AgroSciences
Storm	bentazon + acifluorfen	4 lb/gal L	N	N	N	United Phosphorous
Stratos	dicamba + atrazine	3.2 lb/gal L	Y	Y	Y	Gharda USA
Surpass	acetochlor + safener	6.4 lb/gal L	Y	Y	Y	Dow AgroSciences
Synchrony STS	chlorimuron-ethyl + thifensulfuron	42% DF	N	N	N	DuPont
Topnotch	acetochlor+safener	3.2 lb/gal L	Y	Y	Y	Dow AgroSciences
Treflan, Trifluralin	trifluralin	4 lb/gal L, 10% G	N	N	N	Dow AgroSciences, others
Ultra Blazer	acifluorfen	2 lb/gal L	N	N	N	United Phosphorous
Valor	flumioxazin	51% WDG	N	N	N	Valent
Velpar	hexazinone	2 lb/gal L, 90% WP	N	Y	N	DuPont
Volley	acetochlor	6.4 lb/gal L	Y	Y	Y	Tenkoz
Volley ATZ	acetochlor + atrazine	5.25 lb/gal L	Y	Y	Y	Tenkoz
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	Monsanto