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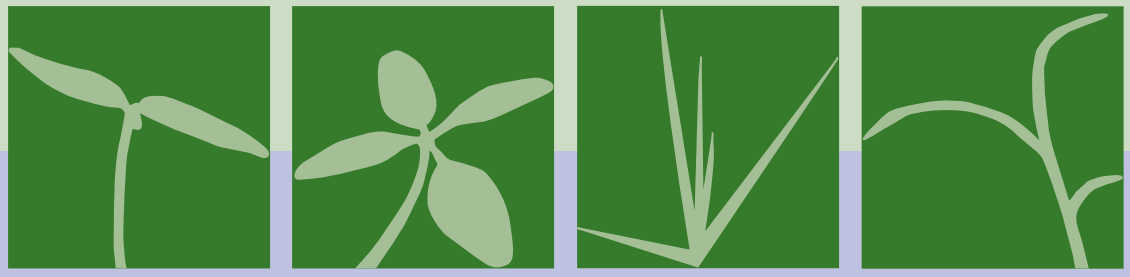

Weed Control Guide for Field Crops

2007

See last pages of book for additional information on management of hard-to-control weeds.

Project GREEEN

Visit the MSU Weed Control Web site at **www.msuweeds.com** supported by Project GREEEN

2007
Weed Control Guide for Field Crops

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Pesticides must be registered with the U.S. Environmental Protection Agency and the Michigan Department of Agriculture before they can be legally used in Michigan. This bulletin suggests using pesticides in the management of crop pests. Purchase only those pesticide products labeled for 1) the crop you wish to use it on and 2) the pest you wish to manage on that crop. Remember, the pesticide label is the legal document on pesticide use. The label must be read carefully and all instructions and limitations followed closely. The use of a pesticide in a manner not consistent with the label can lead to the injury of crops, humans, animals, and the environment, and also lead to civil fines and/or condemnation of the crop. Pesticides are management tools for the control of pests in crops but only when they are used in an effective, economical, and environmentally sound manner.

See pesticide emergency information — See page 172.

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Weeds reduce crop yields by competing for water, nutrients and light. Some weeds release toxins that inhibit crop growth, and others may harbor insects, diseases or nematodes that attack crops. Weeds often interfere with harvesting operations, and at times contamination with weed seeds or other plant parts may render a crop unfit for market. Profitable crop production depends on effective weed control.

Effective weed control in field crops requires the use of a combination of management techniques, including cultural methods and herbicides. Growing the same crop year after year and using the same weed control techniques encourage the development of problem weeds. Rotation of crops, herbicides and tillage methods help reduce this problem.

Cultural Control of Weeds

Crop competition is a very useful method of weed control. Maintaining production practices that optimize crop growth means the crop plants can compete more effectively with weeds. Several crop management practices can improve the competitive ability of the crop. These practices include crop and variety selection, planting date, population, soil fertility, drainage, etc. Recommended crop production practices are also beneficial weed control practices.

Crop and herbicide rotation may also be helpful in maintaining adequate weed control. Many weeds cannot tolerate crop rotation. Using the same herbicide program each year allows weeds tolerant of the herbicides to expand. Rotate herbicide programs to prevent this problem and to reduce the likelihood of resistant weeds (e.g., triazine-resistant weeds) becoming a problem.

Cultivation

Timely, shallow cultivation may be necessary following herbicide treatment. Be sure to cultivate as shallowly as possible to prevent bringing new weed seeds from below the herbicide layer to the soil surface.

Do not cultivate most preemergence herbicides for at least 2 weeks after application unless weeds appear. If dry weather persists for 7-10 days after herbicide application, rotary hoe or cultivate shallowly. Delay cultivation after postemergence herbicide applications for at least 7-10 days to allow the chemical to move into weed stems and roots.

Chemical Control of Weeds

The first step for successful weed control with herbicides is to identify the weed species present. Note that some weed species are resistant to all of the present selective herbicides.

Annual weeds are easier to kill when they are small seedlings and when conditions favor rapid growth. However, crop plants are also easily injured under these conditions. Selective herbicides should control the weeds with little or no injury to the crop.

Timing and rate of application are very important with chemical weed control. Spraying at the wrong time often results in poor weed control and crop injury. No crop plant is completely resistant to injury from herbicides. Too much chemical can damage the crop.

Types of Herbicides

Chemical control of weeds can be obtained with either preplant incorporated, preemergence or postemergence herbicides. Many herbicides can be applied by more than one of these methods.

Preplant incorporated herbicides are compounds incorporated into the soil prior to planting. Incorporation of some of these compounds is necessary to prevent losses of volatile active ingredients (e.g., trifluralin) or to overcome photodecomposition losses if the materials (e.g., *EPTC*) are left on the soil surface. Preplant incorporated herbicides have increased activity in the absence of rainfall that is required to move the herbicide into the weed-seed germination zone. This concept is often referred to as herbicide "activation."

Advantages of preplant incorporated herbicides:

(1) No weed competition to the crop with early control of weeds.

(2) Weeds are already controlled when wet weather causes delays in cultivation or spraying.

(3) Less reliance on rainfall to position the herbicides in the weed seed germination zone of the soil.

(4) Much more effective control of some perennial weeds (nutsedge) than with preemergence applications.

Disadvantages of preplant incorporated herbicides:

(1) Incorporation operation represents added cost and fuel usage in herbicide application.

(2) Soil compaction is increased by the incorporation operation.

(3) Herbicide may be diluted by improper incorporation (too deep), resulting in reduced weed control.

(4) "Streaking" pattern of good and poor weed control can result from incomplete incorporation. Two-pass incorporation helps prevent this problem.

(5) Planting operations may be slowed somewhat because of the added incorporation operation.

Preemergence herbicides are compounds applied to the soil surface after the crop has been planted but before the crop seedlings emerge through the soil.

Advantages of preemergence herbicides:

(1) No weed competition to the crop with early control of weeds.

(2) Weeds are already controlled when wet weather delays cultivation or spraying.

(3) Planting and herbicide application may be one operation.

(4) In the case of corn, herbicides can be used which may be a hazard to nearby 2,4-D- or dicamba-sensitive crops and plants if applied later in the season.

Disadvantages of preemergence herbicides:

(1) Preemergence applications are generally ineffective under dry soil conditions. Some preemergence herbicides are ineffective if dry conditions persist for only a few days; other herbicides may give weed control after as much as 10 days to 2 weeks of dry weather.

(2) On sandy soil, heavy rains may leach the herbicide down to the germinating crop seed and cause injury.

(3) Perennial weeds usually are not controlled by preemergence herbicide applications.

Postemergence herbicides are compounds applied to the foliage of weeds. They may burn off the aboveground parts of weeds (contact herbicides) or they may be translocated throughout the plants and kill the growing points (systemic herbicides).

Advantages of postemergence herbicides:

(1) They are not applied until the weeds are present in the field.

(2) Can be used on any soil type, and soil moisture conditions are usually not a problem.

(3) Are usually more effective (though more injurious to the crop) at high temperatures.

Disadvantages of postemergence herbicides:

(1) Should not be applied to weeds when the foliage is wet with dew or rain.

(2) There is a risk of crop injury for certain crops.

(3) With many postemergence herbicides, timing of application is critical for effective control.

(4) Rain may prevent application at the proper time.

Temperature greatly influences the effectiveness and volatility of many postemergence herbicides. Ideally, herbicides should be applied when temperatures range between 65° and 80°F. Low temperatures (below 60°F.) can result in reduced weed control; temperatures above 80°F. can result in crop injury. Late afternoon herbicide applications are less likely to result in injury than are early morning applications. Early morning application predisposes the crop plant to danger periods of high temperatures, which increase the potential for herbicide injury.

Volatile herbicides, such as dicamba *(Banvel/Clarity/Distinct)* or ester formulations of 2,4-D, may vaporize at temperatures as low as 70°F. Wind may then move sufficient vapors to areas with sensitive crops to cause crop injury. Amine formulations of 2,4-D may eliminate some of the danger of vapor drift; however, spray drift (droplets) may still occur. Extreme caution is required when applying herbicides near sensitive crops.

Herbicide Formulations and Additives

Herbicides are available in a variety of formulations; granular and those mixed in water are most common. Usually, equal weed control can be expected from granular and those mixed in water. In some cases, granules have given less control. Generally, this has been due to (1) use of equipment giving non-uniform distribution of the granules or (2) formulations with too high a concentration, resulting in inadequate volume for uniform distribution.

The use of granular formulations does not eliminate the need for calibration. Various materials will "feed" differently because of variations in carrier and particle size. Therefore, granular applicators, like sprayers, should be accurately calibrated.

Herbicide Formulations

ACS— *Aqueous Capsule Suspension*
DC— *Dry Concentrate*
DF — *Dry Flowable Granule*
DG — *Dispersible Granule*
DS — *Dry Soluble Granule*
EC — *Emulsifiable Concentrate*
EW — *Emulsifiable Concentrate*
F — *Flowable*
G — *Granule*
L — *Liquid*
SC— *Suspension Concentrate*
SL — *Soluble Liquid*
SP — *Soluble Powder*
WDG — *Water-dispersible Granules*
WP — *Wettable Powder*

Combinations of Herbicides

Two or more herbicides are usually applied as a tank mix rather than separate applications. Combinations are used to give more consistent or broader spectrum weed control, to decrease herbicide residue (for example, atrazine carryover) or to obtain adequate season-long weed control. Growers and commercial applicators are responsible for poor weed control, crop injury and/or unwanted herbicide residue from herbicides labeled for single application but misused in combinations.

Compatibility of Pesticide-Fertilizer Combinations

Combinations of herbicides, insecticides and/or fungicides applied in either water or liquid fertilizer carriers decrease trips over the field and application costs; however, compatibility is critical. Always test the compatibility of each mixture to be applied even though the product labels allow mixing. Follow the label instructions closely during any mixing operation after you have tested for compatibility.

A single compatibility test requires only a glass quart jar and the pesticides and liquid fertilizer to be mixed. Place 1 pint of liquid fertilizer in the quart jar and add 2 teaspoons of the liquid pesticide. If the pesticide is a wettable powder, add 2 teaspoons of powder in sufficient water to form a slurry and add the slurry to the fertilizer. Cover the jar, shake well, and observe the mixture for 30 seconds. Check the mixture again after 30 minutes. If the mixture does not separate, it is compatible; however, check each batch of liquid fertilizer — they may vary in mixing properties. Also, check compatibility if the water source changes — water pH and mineral content influence compatibility.

If more than one pesticide is to be mixed with liquid fertilizer or water, the pesticides should be premixed in liquid fertilizer or water and tested for compatibility by mixing appropriate proportions of all components. The combination should be thoroughly agitated before each additional pesticide is added, and a specific mixing order should be followed.

Generally, unless label directions state otherwise, add the pesticides being tested in the following order:

1. Wettable powders or dispersible granules.
2. Flowables or aqueous liquids.
3. Emulsifiable concentrates.
4. Crop oil concentrates.

Spray tanks should be at least half filled with the carrier before the pesticide premixes are added. If the mixture foams excessively, separates or becomes syrupy, do not apply the mixture. Compatibility agents are available that may be added to improve mixing ability.

Even if all components appear compatible, the field tank mixture will require constant, vigorous agitation to prevent separation or improper pesticide distribution in the tank. Be sure the entire tank is agitated and mixed before spraying. Do not store pesticide mixtures overnight unless they are constantly agitated. Best results are obtained by applying the entire mixture in one day.

Additives for Herbicides— Some Definitions

(1) Adjuvant — any substance that enhances the herbicide's effectiveness, an "added ingredient."
(2) Surfactant — a surface active material that can facilitate emulsifying, dispersing, spreading, wetting, sticking or other surface-modifying characteristics of herbicide solutions.
(3) Crop oil concentrates — contain a mixture of emulsifiers and surfactants. A common ratio is 80% oil and 20% surfactant.
(4) Emulsifier — an agent that promotes the dispersion of one liquid in another.
(5) Wetting agent (spreader) — reduces water surface tension, causing better contact between spray solution and treated surfaces.
(6) Soap — sodium or potassium salts of fatty acids. Can form insoluble materials in hard water. *Detergents* are synthetic materials used for cleaning.
(7) Sticker — Deposit builder. Increases herbicide adhesion to plant surfaces.
(8) Defoaming agent — self-explanatory.
(9) Compatibility agent or cosolvent — may aid in dispersion of otherwise incompatible mixtures.

During the development of a herbicide, the chemical company attempts to formulate the active ingredient to optimize performance, mixing and handling under diverse conditions. Every commercially available herbicide formulation contains its own particular set of additives to accomplish this. Sometimes additional additives are required for specific applications or when compatibility or mixing problems occur. The herbicide label will describe the need and use of these additives. The indiscriminate use of additives should be avoided because they may not improve herbicide performance and may actually reduce weed control or cause crop injury.

Additives can be referred to as "adjuvants." This term merely denotes an added ingredient. Surface active additives are called surfactants. Therefore, all surfactants are also additives or adjuvants.

Compatibility Problems

Compatibility problems in tank mixing herbicides usually occur when mixing directions are not followed. Some common causes of compatibility problems: mixing two herbicides in concentrated form, adding an EC to the spray tank before suspending the wettable powder, insufficient agitation, excessive agitation and air leaks. Problems are much more likely when mixing herbicides with fluid

fertilizers. The fertilizer solution is already loaded to near capacity with nutrients. Adding a herbicide to the already loaded solution may cause problems. Also, the fertilizer may interfere with the herbicide formulation additives. Fertilizers may vary greatly from batch to batch, so the only safe procedure is to test for compatibility in a small container before mixing a large quantity. If compatibility problems are encountered, the addition of *compatibility agents* may help.

Foaming is usually due to excessive agitation or a bypass line that empties above the spray solution level in the spray tank. When foaming is a problem, addition of a *defoamer* can help.

Herbicide Application Equipment

Sprayer Implements — A good weed control sprayer should be made of non-corrosive materials, be easy to clean and have the following features:

(1) A *tank* with a volume of 100 to 300 gallons to reduce filling and mixing operations.

(2) A *pump* with a capacity of at least 4 gallons per minute and pressure up to 100 pounds per square inch (PSI).

(3) An *agitation system* — The bypass from the pressure control is a good source of agitation. Direct the bypass line into the bottom of the tank.

(4) *Screens* — There should be 50-mesh screens in the intake line and at each nozzle.

(5) *Pressure gauge* — The pressure gauge should accurately measure pressures up to 100 PSI.

(6) *Adjustable spray boom* — The boom should be adjustable from 18 to 36 inches above the ground.

(7) *Nozzles* — Flat fan nozzles of 73 to 110° angle with replacement tips are best suited for most weed control work. Nozzle volume can vary from 1 to 10 gallons per minute, depending on the applications. Good general-use nozzles are 8002 or 8004. These nozzles permit the boom to be carried closer to the ground and thus reduce spray drift.

Herbicide Incorporation

Disks, especially large tandem disks, are poor tools for incorporation. Depth and ridging are difficult to control and non-uniform distribution of the herbicide in the soil is likely.

The disk should be used at a depth of 4 to 5 inches and a speed of 4 to 6 mph. Incorporation must be done in two directions.

A field cultivator can give acceptable one-pass incorporation of herbicides if special care is taken in setup and operation. Wide sweeps give better incorporation than points. Shanks should be close enough to allow for this, and three sets of sweeps are also required. It is important to follow with a leveling tool, such as a flex-tine drag or spring-tooth harrow, to smooth out ridges behind the cultivator.

The speed of the cultivator should be at least 6 mph, at a depth of 3 to 4 inches. Actual incorporation will occur at one-half the tool depth. Caution must be taken not to run the rear portion of the cultivator lower than the front. If the back of the tool is lower, untreated soil can be brought to the surface, burying the herbicide.

Danish-type harrows equipped with “S” tines and rolling baskets can do a good job of one-pass incorporation. Rolling baskets outperform other trailing operations.

Operation considerations are similar to those with the field cultivator. Good soil tilth is a prerequisite for one-pass incorporation.

PTO-driven tools do a good job of one-pass incorporation. However, their application in Michigan may be limited. These tools are operated at lower speeds and are not as wide as other implements.

The most consistent incorporation (no streaking), especially when using a disk or field cultivator alone, is achieved with two passes at an angle to each other. However, new tillage implements have made one-pass incorporation of herbicides a possibility. Although a majority of the questions concerning incorporation concern the best implement to use for one-way incorporation, soil condition influences the success of incorporation more than the tool used. The reliability of one-pass incorporation will also be influenced by the tillage system used.

In clean tillage (low crop residue) situations, preemergence applications made on wet soil will likely perform as well or better than two-pass incorporated treatments. One-pass incorporation is not a good approach with less than optimum soil tilth.

High crop residue levels (corn stalks disked or chisel plowed with one or two secondary tillage operations) make one-pass incorporation difficult. If the residue level is great enough to clog the incorporation tool, two-pass incorporation is advisable. The soil should also have good tilth, as outlined above.

Where ridges are left from fall plowing or use of a chisel plow in the spring, it is advisable to level the ground before herbicide application. Streaking is favored by application of the herbicide to rough ground.

Soil Types

Soil texture (sand, silt, clay) and organic matter influence the effectiveness of soil-applied herbicides. In general, lower rates of herbicides are used on sandy (coarse-textured) soils than on clays or

soils high in organic matter (fine-textured) to obtain the same level of control. **Herbicide rate recommendations in this bulletin are given for medium-textured soils with greater than 3% organic matter.** Clay and organic matter adsorb herbicides, making them less available to kill weeds. Soils with high clay and organic matter content require higher herbicide rates for adequate weed control. Sandy soils with low organic matter content require careful herbicide rate selection to avoid crop injury.

Soil pH can influence the activity of soil-applied herbicides. Some herbicides are more persistent at higher soil pH, and crop rotation must be considered before applying a herbicide. Some herbicides are more available at higher soil pH. Rates must be reduced to avoid crop injury. Knowledge of the soil pH in a field is critical — soil pH may vary greatly within a field.

Organic matter analysis is available through MSU county Extension offices or directly through the MSU Soil Testing Laboratory. Organic matter analysis may be determined on soil samples submitted for N-P-K analysis for an additional charge. Organic matter levels change slowly and may need to be checked every four years.

Soil sample analyses are only as accurate or representative as the soil sample, so each field should be checked individually. See Extension bulletin E-498, "Sampling Soils," for proper soil sampling procedures.

Remember, follow herbicide label recommendations, always know the soil pH, and adjust herbicide rates for soil texture and organic matter as specified on the label.

Accurate Calibration

Accurate applicator calibration is essential for effective chemical weed control without crop injury. Calibrate a new sprayer before use and routinely recalibrate the sprayer during the growing season.

Use the following steps as a guide to calibrate a ground sprayer for broadcast application.

(1) Determine the desired application volume of carrier (usually water) in gallons per acre (GPA). For most weed control applications, 5-30 GPA at 30 to 40 PSI is sufficient.

(2) Adjust the boom height so that the spray overlaps about 30% at the ground (or other surface to be sprayed). With 80-degree nozzles, this places the nozzles about 20 inches apart on the boom and 20 inches above the sprayed surface. Check each nozzle at the recommended pressure for output. Replace any defective nozzles and screens. All nozzles should deliver within 10% of one another.

(3) Fill the spray tank and system with water.

(4) Spray a measurable area in the field, at a fixed speed and at the desired pressure. Spray at least 20% of the total tank volume and at least 2 acres of area.

(5) Measure the volume of water (in gallons) needed to refill the tank.

(6) Determine the area (in acres) that was test sprayed, using the following formula: length of area sprayed (in feet) X boom width (in feet) ÷ 43,560 = acres sprayed.

(7) Divide the volume sprayed by the area sprayed to obtain the actual output of the sprayer in gallons per acre.

(8) Make adjustments to tractor speed, pressure or nozzle size and repeat steps 3–7 to change application rate to the recommended values.

(9) Calculate the amount of formulated pesticide needed to treat the desired area.

The following procedures can be used to calibrate a ground sprayer for either banded or broadcast applications.

(1) Determine the desired application volume in GPA.

(2) Check each nozzle at the recommended pressure for output. Replace any defective nozzles and screens. All nozzles should deliver within 10% of one another.

(3) For band application, accurately determine the width, in inches, of the band sprayed. For broadcast application, measure the distance, in inches, between adjacent nozzles.

(4) Locate this width in the table below and read off the corresponding course distance.

WIDTH (inches)	COURSE DISTANCE (feet)
8	510
10	408
12	340
14	291
16	255
18	227
20	204
22	185
24	170
26	157

(5) In the field to be sprayed, mark off the course of the proper distance.

(6) Fill the tank completely with water only.

(7) Tie a quart container (graduated in ounces) to one nozzle on the sprayer to catch all of that nozzle's spray.

(8) Start a distance back from the beginning of the course to get up to operating speed, and turn the sprayer ON at the beginning of the course and OFF at the end.

(9) Remove the quart container, and read the volume collected IN OUNCES.

(10) OUNCES collected = GPA.

Pesticide Use Precautions

Herbicides, like all pesticides, should be handled with extreme caution and respect. There are three important reasons for using pesticides safely and wisely:

- To protect yourself and others from exposure.
- To avoid harming and polluting the environment.
- To avoid crop injury.

These three points cannot be emphasized enough.

Each herbicide label contains specific information on **personal protective equipment (PPE)** and **restricted entry interval (REI)**. This information is prominantly displayed under the heading of **Agricultural Use Requirements**.

Using more herbicide than is recommended on any label is illegal and can result in crop injury, herbicide carryover or other problems.

The ability of a herbicide to kill weeds without harming crop plants (selectivity) may be partially lost under unfavorable weather conditions. Herbicide drift to non-target crops often results in crop injury. Do not spray under windy conditions.

Herbicide Application

Herbicide Spray Volumes and Rates

The volume of water to use will vary with the herbicide, although generally 10 to 40 gal per acre and a spraying pressure of 30 to 40 PSI are recommended. With wettable powders, use nozzles that deliver at least 15 GPA.

Some contact-type postemergence herbicides (e.g., *Basagran, Ultra Blazer*) require a minimum of 20 GPA spray volume and 40 PSI spray pressure to ensure adequate coverage. Flat fan nozzles are effective for herbicide applications. Hollow cone nozzles can also give good results, especially for postemergence applications at higher pressures. If higher pressures are used, be sure the nozzles are designed to be operated at the increased pressure. Operating nozzles beyond the specified pressure range will result in a poor spray pattern, insufficient coverage and lack of weed control.

Band Application

In cultivated crops, spraying narrow bands of herbicide over the rows will take less material per acre, reducing the cost per acre for the chemical. Where chemical costs are high, band spraying may be justified. Timely cultivation of weeds in the unsprayed area between rows is necessary.

In seasons when the soil is too wet to cultivate, overall spraying has the advantage of controlling weeds between the rows.

When band spraying, be very careful to maintain the proper rate of application on the area sprayed. (If you lower the spray boom to narrow the area covered by a given nozzle, remember that each nozzle is still delivering the same amount of spray mixture as it did on the wider area.) Use nozzles designed for banding — the spray volume with these nozzles is the same across the entire band.

Cleaning Pesticide Sprayers

It is important to clean pesticide sprayers after each use, especially if they are used for more than one crop and for the application of insecticides and fungicides. The need for extensive cleaning can be minimized if one sprayer is dedicated to herbicide application only.

Do not use a sprayer to apply insecticides or fungicides if the sprayer has been used to apply 2,4-D-type herbicides.

In general, rinse the entire sprayer, inside and out, including the boom, hoses and nozzles. Partially fill the spray tank with water and keep the pump running so that the water is circulated throughout the entire system. Spray the water rinsate out through the nozzles. This process should be repeated when changing soil-applied herbicides and at the end of each day. Money can be saved and the environment protected if the water rinsing is done in the field using a water-filled nurse tank and if the water rinsate is applied to the crop according to label rates. Many herbicide labels have specific instructions for cleaning the spray system. Always read and follow these directions carefully.

Unless otherwise specified, thoroughly wash the entire spray system after all postemergence applications. Use 1 gallon of household ammonia in 100 gallons of water as a cleaning agent.

Run the pump so that the cleaning solution is circulated throughout the entire system for at least 2 hours, and then pump it out through the nozzles. Do not dump this cleaning solution, and do not apply it to any crop or cropland. Discard the cleaning solution in an appropriate pesticide rinsate degradation pit. Rinse the entire system with water after all the cleaning solution has drained from the sprayer. Do not leave pesticide solutions or cleaning solutions in the tank overnight.

Corrosion and mechanical damage to pumps, tanks, nozzles, etc., may result from leaving water in the spray system over the winter. To prepare the spray equipment for storage, disconnect all the hoses and allow all water to drain out. Coat all bare metal parts with oil or a rust inhibitor. Disassemble metal nozzles and store them in oil. Prepare the spray pump for storage following the manufacturer's recommendations.

Pesticides and the Environment

Many people who live in rural Michigan get their drinking water from wells. Well water is groundwater, so it is easy to see why you should be concerned about keep-

ing herbicides out of groundwater. Several processes determine the fate of herbicides and whether they will end up in your drinking supply. Sometimes these processes are beneficial and enhance weed control. For example, the leaching of a root-absorbed herbicide into the root zone can enhance weed control. The degradation of pesticides can remove non-essential pesticide residues from the environment. Often, however, these processes are detrimental. Runoff can move a herbicide away from target weeds. As a result, chemical is wasted, weed control is reduced and there is an increased chance of damage to non-target plants, hazard to human health, and pollution of nearby soil and water.

In this section we will examine the fate of pesticides and the various processes that affect their stability and persistence following an application, disposal, or spill.

Adsorption is the binding of chemicals to soil particles. (This term is sometimes confused with absorption, the process by which plants intake chemicals.) The amount and persistence of pesticide adsorption vary with pesticide properties, soil moisture content, soil pH and soil texture. Soils high in organic matter or clay are the most adsorptive; coarse, sandy soils that lack organic matter or clay are much less adsorptive.

A soil-adsorbed herbicide is less likely to volatilize, leach or be degraded by microorganisms. When herbicides are tightly held by soil particles, they are less available for absorption by plants. Therefore, certain herbicides used on highly adsorptive soils may require higher rates or more frequent applications to compensate for the portion of the herbicide that binds to the soil particles and is unavailable for plant uptake.

Volatilization occurs when a solid or a liquid turns into a gas. Volatilization of pesticides increases with higher air temperature and air movement, higher temperature at the treated surface (soil, plant, etc.), low relative humidity and decreasing size of spray droplets. Pesticides also volatilize more readily from coarse-textured soils and from medium- to fine-textured soils with high moisture content.

A pesticide in a gaseous state can be carried away from the treated area by air currents. The movement of pesticide vapors in the atmosphere is called vapor drift. Unlike the drift of sprays and dusts that can sometimes be seen during an application, **vapor drift** is invisible.

Avoid applying volatile herbicides such as dicamba *(Banvel/Clarity/Distinct),* 2,4-D ester, or EPTC (*Eptam*) when conditions favor volatilization. The vapor pressure rating of the herbicide may help indicate the volatility of the material. The higher the vapor pressure rating, the more volatile the pesticide. Herbicide labels usually mention the potential for volatility of the herbicides. Volatilization can sometimes be reduced through the use of low volatile formulations or soil incorporation of the herbicide (e.g., *Eptam*).

Photodegradation is the breakdown of herbicides, such as trifluralin, by the action of sunlight. Herbicides applied to foliage, the soil surface or structures vary considerably in their stability when exposed to natural light. Like other degradation processes, photodegradation reduces the amount of chemical present, which can subsequently reduce the level of weed control. Soil incorporation by mechanical means during or after application, or by irrigation water or rainfall following application, can reduce herbicide exposure to sunlight.

Microbial degradation occurs when microorganisms such as fungi and bacteria use a herbicide as a food source. Microbial degradation can be rapid and thorough under soil conditions favoring microbial growth. These conditions include warm temperatures, favorable pH levels, and adequate soil moisture, aeration (oxygen) and fertility. The amount of adsorption also influences microbial degradation. Adsorbed herbicides are more slowly degraded because they are less available to some microorganisms.

Chemical degradation is the breakdown of a herbicide by soil processes not involving a living organism. The adsorption of herbicides to the soil, soil pH levels, soil temperature and moisture all influence the rate and types of chemical reactions that occur. Some herbicides are persistent at high soil pH while others are more persistent at low soil pH.

Absorption is the process by which plants and microorganisms take up chemicals. It is another process that can transfer herbicides in the environment. Once absorbed, most herbicides are degraded within plants. Residues may persist inside the plant or be released back into the environment as the plant tissues decay.

Crop removal is another herbicide transfer process. When treated crops are harvested, the herbicide residues are removed with them and transferred to a new location. After harvest, many agricultural commodities are washed or processed to remove or degrade much of the remaining residue.

Runoff moves herbicides in water. Runoff occurs as water moves over a sloping surface, carrying herbicides either mixed in the water or bound to eroding soil. The amount of herbicide runoff depends on the grade or slope of the field, the erodibility and texture of the soil, the soil moisture content, the amount and timing of irrigation or rainfall (especially in relation to the time of herbicide application), and properties of the herbicide. For example, a herbicide application made to a heavy clay soil already saturated with water is highly susceptible to runoff. Established vegetation or plant residues also influence runoff

because of their ability to retain soil and moisture.

Herbicide losses from runoff are greatest when heavy rainfall occurs shortly after a herbicide application. If heavy rainfall is expected, delay applying pesticides. Some no-tillage and minimum-tillage cropping systems have been found to reduce herbicide runoff, as do soil incorporation application methods. Finally, surface grading, drainage ditches and dikes, and the use of border vegetation can help reduce the amount and control the movement of runoff waters.

Leaching is another process that moves herbicides in water. In contrast to runoff, which occurs as water moves on the surface of the soil, leaching occurs as water moves through the soil. Several factors influence the leaching of herbicides. These include the water solubility of the herbicide. A herbicide dissolved in water can move readily with the water as it seeps through the soil. Soil structure and texture influence soil permeability (how fast the water moves through soil), as well as the amount and persistence of herbicide adsorption to soil particles. Adsorption is probably the most important factor influencing leaching of herbicides. If a herbicide is strongly adsorbed to soil particles, it is less likely to leach, regardless of its solubility, unless the soil particles themselves move with the water flow.

Groundwater and Surface Water Contamination

Groundwater is the water beneath the earth's surface occupying the saturated zone (the area where all the pores in the rock or soil are filled with water). It is stored in water-bearing geological formations known as **aquifers**. Groundwater moves through aquifers and can be obtained at points of natural discharge such as springs or streams, or by drilling a well into the aquifer.

The upper level of the saturated zone in the ground is call the **water table**. The water table depth below the soil surface fluctuates throughout the year, depending on the amount of water removed from the ground and the amount of water added by recharge and connected surface waters. **Recharge** is water that seeps through the soil from rain, melting snow or irrigation. **Surface waters** are visible bodies of water such as lakes, rivers and oceans.

Both surface water and groundwater are subject to contamination by **point-source and non-point-source pollution**. The key to preventing pesticides in groundwater and surface waters is identification of the source and its route to the water. Point-source contamination refers to situations where movement of a pesticide into water can be traced to a specific site. Non-point sources occur over a wide area. Most pesticides detected in groundwater and surface water can be traced to non-point sources. This type of pollution generally results from land runoff, precipitation, acid rain or percolation rather than from a discharge at a specific, single location, such as a single pipe or wellhead.

The potential for the pollution of groundwater and surface water from improper waste disposal is a major concern. Problems result from domestic waste (e.g., septic systems, landfills, waste treatment plants), industrial waste (e.g., landfills, brine and mine wastes, deep well disposal), and government-generated waste (e.g., radioactive wastes).

Improper agricultural practices are another concern. Inadequate handling of livestock waste storage facilities and improper application of manures and fertilizers can cause unacceptable levels of nitrate in groundwater. Pesticides in groundwater and surface water are receiving considerable national attention. Evidence suggests that, in certain areas, agriculture's relative contribution to groundwater and surface water contamination may be significant.

Herbicides in Groundwater

There are several herbicide breakdown processes that occur in the environment. These processes help determine whether herbicides reach groundwater or are degraded before reaching these underground waters. Geological characteristics, such as the depth of the water table and the presence of sinkholes, are also critical. If the water table is close to the soil surface, fewer opportunities may exist for adsorption and degradation to occur.

On the soil surface and within the first few inches of soil, herbicides can be volatilized, adsorbed to soil particles, taken up by plants, broken down by sunlight, or degraded by soil microorganisms and chemical reactions. The extent of herbicide leaching is affected by both pesticide and soil properties. Weather conditions and management practices also affect leaching of herbicides through the soil. Too much rain or irrigation water can leach herbicides beyond the zone where weeds are controlled. A herbicide that is not volatilized, absorbed by plants, bound to soil or degraded can potentially move through the soil to groundwater.

After herbicides reach groundwater, they may continue to break down but at a much slower rate because of less available light, heat and oxygen. The movement of groundwater is often slow and difficult to predict. Substances that enter the groundwater in one location can turn up years later in other locations. A major difficulty in dealing with groundwater contaminants is that the sources of pollution are not easily recognizable. The problem is occurring underground, out of sight.

Herbicides in Surface Water

Non-point-source contamination of surface water can occur in several ways. Pesticides can reach surface water through drift or volatilization or by wind erosion of dust particles carrying pesticides into the atmosphere followed by rainfall deposition in the water; from groundwater discharging into surface water; and in surface water runoff.

Pesticides have been detected in rainfall in many states in the Midwest, including Iowa, Indiana, Wisconsin and Ohio. The greatest number of detections and the highest concentrations were observed in May. When detected, most pesticide concentrations are below 1 part per billion (ppb).

The majority of pesticides detected in surface water are from surface runoff events. Either the pesticides are attached to the soil particles that are being transported in the runoff water or the pesticides are dissolved in the runoff water. The degree of pesticide loss to surface water is dependent on the degree of surface water runoff in the field. This is dependent on the slope of the field, the vegetative and/or residue cover on the field site, the soil texture and the soil moisture content at the time of the rainfall that produces the runoff event. Pesticide application methods have a strong influence on the potential for the pesticide to be carried in surface water runoff. Preemergence herbicide applications have a greater potential for surface loss than applications in which the herbicide is incorporated and applications in which the herbicide is applied postemergence. The pesticide application rate is important too. The higher the pesticide application rate, the greater the potential amount of pesticide that could be lost in runoff.

Once a pesticide reaches surface water it may or may not degrade. Some pesticides degrade by hydrolysis or by direct or indirect photodegradation. Our knowledge of which pesticides are degraded in surface waters is quite limited.

Keeping Herbicides Out of Groundwater and Surface Water

It is very difficult to purify or clean contaminated groundwater or surface water. Treatment is complicated, time consuming, expensive and often not feasible. The best solution to groundwater and surface water contamination is to prevent the problem in the first place. Management practices can be implemented to effectively reduce pesticide runoff and leaching and protect groundwater and surface water.

- **Use integrated pest management programs**—Minimize herbicide use by combining chemical control with other pest management practices such as tillage, cultivation, crop rotation and pest scouting.
- **Reduce compaction**—Surface water runoff increases when soils are compacted.
- **Rotate crops**—Crop rotation improves water infiltration, which reduces runoff. Crop rotations also may provide more surface crop residue and may reduce the application of specific pesticides repeatedly to a given field site.
- **Utilize conservation practices that reduce erosion and surface runoff**—These practices include but are not limited to no-till and other forms of conservation tillage, increasing crop residues or planting cover crops, planting grass waterways to retard soil and water runoff, and keeping buffer strips to protect surface water boundaries.
- **Consider the geology of your area**—When planning herbicide applications, be aware of the water table depth and the permeability of the geological layers between the surface soil and groundwater.
- **Consider soil and field characteristics**—The susceptibility of the soil or field site to leaching or runoff should be determined. Soil texture and organic matter content, in particular, influence chemical movement into groundwater; the slope of the field influences surface runoff.
- **Select herbicides carefully**—Remember, herbicides that are highly soluble, relatively stable and not readily adsorbed to soil tend to be the most likely to leach. Choose herbicides with the least potential for leaching into groundwater or for runoff into surface water. Read labels carefully and consult a specialist from an Extension office or your pesticide dealer, if necessary.

Refer to the herbicide label for advisory statements regarding groundwater and surface water protection.

Herbicides containing atrazine may not be mixed or loaded within 50 feet of perennial or intermittent streams and rivers, lakes or reservoirs. These herbicides may not be mixed or loaded within 50 feet of any well unless conducted on an impervious pad designed and maintained to contain any product spills, leaks or rinse water.

These herbicides cannot be applied within 66 feet of the points where field surface water runoff enters perennial or intermittent streams and rivers or within 200 feet of lakes or reservoirs.

These herbicides can be applied to HEL (highly erodible land) acres only if the 66-foot buffer or setback from runoff points is planted to a crop or seeded with grass.

- **Follow label directions**—The label carries crucial information about the proper rate, timing and placement of the herbicide.
- **Reduce herbicide application rates**—Use the lowest rate of the pesticide that provides adequate pest control. Band applications of preemergence herbi-

cides reduce the potential of herbicides to leach or run off by 50% or more.

• **Incorporate pesticides**—On fields not considered highly erodible, incorporation of pesticides can be used to reduce runoff by moving some of the pesticide below the soil surface away from overland water flow. Incorporation of herbicides will not be compatible with surface residue requirements in some fields.

• **Calibrate accurately**—Equipment should be calibrated carefully and often. During calibration, check the equipment for leaks and malfunctions.

• **Measure accurately**—Concentrates need to be carefully measured before they are placed into the spray tank. Do not "add a little extra" to ensure the herbicide will do a better job. Such practices only increase the likelihood of injury to the treated crop, the cost of pest control, and the chance of groundwater and surface water contamination.

• **Avoid back-siphoning**—The end of the fill hose should remain above the water level in the spray tank at all times to prevent back-siphoning of chemical into the water supply. Use an anti-backflow device when siphoning water directly from a well, pond or stream. These practices also reduce the likelihood of the hose becoming contaminated with herbicides.

• **Consider weather and irrigation**—If you suspect heavy or sustained rain, delay applying herbicides. Control the quantity of irrigation to minimize the potential for herbicide leaching and runoff.

• **Avoid spray drift and volatilization**—Preemergence herbicide applications have the greatest potential for volatilization and runoff.

• **Clean up spills**—Avoid spills. When they do occur, contain and clean them up quickly with an absorbent material such as cat litter. Chemicals spilled near wells and sinkholes can move directly and rapidly into groundwater. Chemicals spilled near ditches, streams or lakes can move rapidly into surface water.

• **Change the location of mixing areas**—Mix and load pesticides on an impervious pad, if possible. If mixing is done in the field, change the location of the mixing area regularly. Do not mix herbicides adjacent to the water source, and do not let the water run inadvertently on the soil near the mixing area. This will increase herbicide leaching and/or runoff.

• **Dispose of wastes properly**— All herbicide wastes must be disposed of in accordance with local, state and federal laws. Triple-rinse containers. Pour the rinsewater into the spray tank for use in treating the site or the crop. *Do not* pour rinsate on the soil, particularly repeatedly in the same location. This will saturate the soil and increase the potential for herbicide leaching.

• **Store herbicides away from water sources**—Herbicide storage facilities should be situated away from wells, cisterns, springs and other water sources.

Michigan's water resources currently provide a vast supply of clean water for agriculture, homes and industry. They can ensure high water quality for future needs only if they are protected now. Be sure to understand how your activities, including herbicide usage, can affect them.

Storing Pesticides

Pesticides must be stored in a facility that will protect them from temperature extremes, high humidity and direct sunlight. The storage facility should be heated, dry and well ventilated. It should be designed for easy containment and cleanup of pesticide spills and made of materials that will not absorb any pesticide material that leaks out of a container. Store only pesticides in such a facility, and always store them in their original containers.

Do not store any feed, seed, food or fertilizer with pesticides. Do not store any protective clothing or equipment in the pesticide storage facility. Store herbicides separately from insecticides and fungicides to avoid contamination of one material by another and accidental misuse.

Keep the facility locked at all times when not in use to prevent animals, children and irresponsible adults from entering and becoming poisoned. Post the facility as a *Pesticide Storage Facility* to warn others that the area is off-limits. Maintain an accurate inventory of the pesticides stored in the facility at all times in case of emergency.

Always read and follow the *Storage and Disposal* section of pesticide labels for specific storage and handling instructions.

Handling and Mixing Pesticides

Always wear the personal protective equipment (PPE) required by the label, when handling, mixing and applying pesticides, and during cleanup of application equipment.

Mix pesticides downwind and below eye level. Avoid excessive splashing and sloshing. If pesticides are spilled on you, wash them off immediately with lots of water and change clothing. Resume spraying only after cleaning up any spills. Try to use closed handling/mixing systems when appropriate.

Mix only what is required for the area to be sprayed according to label directions. Avoid mixing excessive amounts. To do otherwise will create a hazardous waste that is difficult and expensive to dispose of. Keep unauthorized persons out of the area in which you handle pesticides.

Handling and Disposing of Pesticide Containers

Pesticide containers are considered hazardous waste until they are cleaned or disposed of properly. When possible, reduce the number of pesticide containers by using bulk or returnable containers. Buy pesticides in larger volume containers, in containers that may be recycled, or in water-soluble bags to avoid disposal problems.

All pesticide containers can be rendered non-hazardous waste by triple rinsing (or equivalent). The rinsate should be added to the spray tank. After triple rinsing, perforate both ends so the container cannot be reused.

All metal and plastic triple-rinsed containers should be recycled, if possible. If this option is not available, dispose of them in a state-licensed sanitary landfill. Dispose of all paper containers in a sanitary landfill or a municipal waste incinerator. Do not bury or burn any pesticide containers. Do not reuse any empty pesticide containers for any purpose.

Protect Non-target Organisms

Applying pesticides carelessly can harm non-target organisms that are beneficial to agriculture and our environment. The best way to avoid injury of beneficial insects and microorganisms is to minimize pesticide use. Selective pesticides should be used whenever possible and applied only when necessary as part of a total pest management program.

Bees and other pollinating insects are essential for successful production of many crops, such as deciduous tree fruits, small fruits, most seed crops and certain vegetables. Many pesticides, particularly insecticides, are highly toxic to pollinating honeybees and wild bees. Check herbicide labels to identify those that are toxic to bees. *Gramoxone Inteon* (paraquat), for example, is a herbicide toxic to bees. Be aware of how bee poisonings can occur and how to prevent them.

The following precautions reduce the chance of bee poisoning:

- Do not apply herbicides (such as *Gramoxone Inteon*) that are toxic to bees during bloom. Even shade trees and weeds should not be sprayed during bloom. Mow cover crops and weeds to remove blooms before spraying.
- Reduce drift during application. Aerial applications usually are more hazardous to bees than ground applications.
- Time pesticide applications carefully. Evening applications are less hazardous than early morning ones; both are safer than midday application.
- Do not treat near hives. Bees may need to be moved or covered before you use insecticides near colonies.

Pesticides can be harmful to all kinds of vertebrates such as **fish and wildlife**. Most recognizable are the direct effects from acute poisoning. Fish kills often result from water pollution by a pesticide (usually insecticides). Pesticides can enter water via drift, surface runoff, soil erosion and leaching.

Bird kills from pesticides can occur when birds ingest the toxicant in granules, baits or treated seed; are exposed directly to the spray; consume a treated crop or drink and use contaminated water; or feed on pesticide-contaminated prey.

Worker Protection Standard

Federal rules for farm worker protection, issued in 1992, require farmers to provide additional training and notification to farm workers to prevent accidental or occupational exposure to pesticides. Farmers should contact Extension agents to learn the details of this standard and availability of training materials for education of workers and handlers.

Read and follow the label instructions on **restricted entry intervals (REI)** for every pesticide used. Some pesticide labels require both oral warning and posted signs to notify workers of pesticide applications. If the label doesn't require *both* forms of notification, notify workers *either* orally *or* by posting warning signs at entrances to treated areas. (Greenhouses *must* post warning signs for every application.) When using posted signs, post 24 hours or less before the pesticide application and remove signs within three days after the end of the restricted entry interval. Keep workers out during the entire time the signs are posted (except for early-entry workers wearing the proper personal protective equipment).

Record Keeping

The 1990 Farm Bill requires that all applicators who apply restricted-use pesticides (RUP) keep records and maintain them for two years. Records to be kept include:

- Brand name or product name and the EPA registration number.
- Total amount of the product used.
- Size of the area treated.
- Crop, commodity, stored product or site to which the pesticide was applied.
- Location of the application.
- Month, day and year of the application.
- Name and certification number of the applicator or applicator's supervisor.

Any record form is acceptable as long as the required data are included. Penalties are up to $500 for the first violation and up to $1,000 for subsequent violations. Provisions for protecting the identity of the individual producers are included in the law. Commercial applicators must furnish a copy of the required records to the customer of the RUP application. Contact your Extension office for final revisions.

Restricted Use Pesticides

Several herbicides are currently classifed as restricted use pesticides and, as such, can be purchased and applied only by certified commercial or private pesticide applicators. Certification of pesticide applicators is administered by the Michigan Department of Agriculture. Restricted use pesticides are identified with an asterisk (*) in Table 14 of this guide.

Herbicide Resistance in Weeds

Herbicide-resistant weeds have become a major challenge in weed management systems in Michigan and throughout the Midwest. Herbicide resistance can be defined as the *inherent ability of a plant to survive and reproduce following exposure to a dose of herbicide(s) normally lethal to the wild type. In a plant, resistance may be naturally occurring or induced by such techniques as genetic engineering or selection of variants produced by tissue culture or mutagenesis*. In more simple terms, a herbicide-resistant weed is a weed that was once controlled by a certain herbicide and is no longer controlled by that herbicide. For example, atrazine is a very effective herbicide in controlling common lambsquarters; however with repeated use of atrazine or other triazine herbicides (atrazine, *Sencor*, or *Princep*) common lambsquarters can no longer be controlled with or is resistant to triazine herbicides in several fields throughout Michigan. Herbicide resistance develops by using the same herbicide or herbicides with the same site of action year after year to control a particular weed species without other effective control measures. Repeated use of the herbicide allows for control of all of the susceptible plants of a population and allows for plants of that population that may be naturally resistant to survive and produce resistant offspring. In the case of triazine-resistant common lambsquarters, several resistant populations developed in fields where corn was grown continuously and atrazine was the primary herbicide used to control common lambsquarters.

While triazine-resistant common lambsquarters is the most widespread resistant weed in Michigan, there are currently 11 different weed species resistant to four different herbicide sites of action in Michigan. Common lambsquarters, common ragweed, common groundsel, common purslane, Powell amaranth, redroot pigweed, ladysthumb, and horseweed are all weeds where triazine-resistant biotypes have been identified in Michigan. Similar to triazine herbicides, herbicides belonging to the phenylurea chemical family disrupt photosynthesis in the plant. Biotypes of common purslane, Powell amaranth, redroot pigweed, and horseweed are all weeds that have developed resistance to herbicides in this family (*Linex, Lorox,* and *Karmex*). Resistance to the ALS-inhibiting herbicides is also common in Michigan. Biotypes of common ragweed, tall waterhemp, common lambsquarters, smooth pigweed, and horseweed have been identified resistant to imidazolinone, sulfonylurea, and sulfonamide herbicides (ALS-inhibitors).

In the past, growers have dealt with herbicide-resistant weeds by incorporating other control measures for the resistant weed into their weed management program. Most of the time this has included using a herbicide with a different site of action. In recent years, the use of glyphosate in Roundup Ready crops has been the control measure of choice. While in many cases glyphosate has provided effective control of resistant weeds, there is a growing concern about the development of glyphosate-resistant weeds. In fact, glyphosate-resistant weeds are becoming a serious problem in several states in the United States. In order to limit the development of herbicide resistance, including glyphosate resistance, an understanding of the practices that lead to herbicide resistance is important.

Farmers should include weed control practices that delay or prevent the development of herbicide resistance. The following is a list of practices to reduce risk of herbicide resistant weeds. Some practices may be impractical in certain situations. No single practice is likely to be successful alone.

Practices to Reduce Risk of Herbicide Resistant Weeds

(1) Rotate herbicides using herbicides of differing sites of action. Do not make more than two consecutive applications of herbicides with the same site of action against the same weed unless other effective control practices are also included in the management system.

(2) Apply herbicides in tank-mixed, prepackaged or sequential mixtures that include multiple sites of action. Combining herbicides with different sites of action and similar persistence in soil will help prevent herbicide resistance.
Note: The herbicide sites of action at greatest risk of developing resistant weed populations are:

A. ACCase inhibitors.
B. ALS inhibitors.
C. Photosynthesis inhibitors.

(See description of sites of action on the following page.)

(3) Scout fields regularly and identify weeds present.

(4) Rotate crops, particularly those with different life cycles.

(5) Combine mechanical control practices such as rotary hoeing and cultivation with herbicide treatments.

(6) Clean tillage and harvest equipment before moving from fields infested with resistant weeds to those that are not infested.

Herbicide Sites of Action

Herbicide site of action refers to the method by which the herbicide kills plants. An understanding of herbicide site of action is useful in developing herbicide programs that prevent herbicide resistance. The following list categorizes herbicides by general sites of action. Individual herbicide families and herbicide examples are listed within each site of action. In addition, the site of action is listed for each herbicide on the weed response tables for each crop.

Herbicide Sites of Action

Site of Action	Chemical Family	Herbicide
ACCase inhibitors	Cyclohexanediones	Sethoxydim *(Poast, Poast Plus)* Clethodim *(Select, Select Max, Arrow)*
	Aryloxyphenoxypropionates	Fluazifop *(Fusilade DX,* component in *Fusion)* Fenoxaprop *(Puma,* component in *Fusion)* Quizalofop *(Assure II, Targa)*
ALS inhibitors	Imidazolinones	Imazaquin *(Scepter)* Imazethapyr *(Pursuit)* Imazethapyr + Imazapyr *(Lightning)* Imazamox *(Raptor)*
	Sulfonylureas	Chlorimuron *(Classic)* Foramsulfuron *(Option)* Halosulfuron *(Permit, Sandea)* Mesosulfuron *(Osprey)* Nicosulfuron *(Accent)* Primisulfuron *(Beacon)* Rimsulfuron *(Matrix, Resolve)* Thifensulfuron *(Harmony GT)* Tribenuron *(Express)* Triflusulfuron *(UpBeet)*
	Sulfonamides	Flumetsulam *(Python*) Cloransulam-methyl *(FirstRate)*
Photosynthesis inhibitors	Triazines	Atrazine Simazine *(Princep)* Metribuzin *(Sencor)* Hexazinone *(Velpar)*
	Phenylureas	Linuron *(Lorox, Linex)*
	Uracils	Terbacil *(Sinbar)*
Photosynthesis inhibitors (non-mobile)	Benzothiadiazoles	Bentazon *(Basagran)*
	Nitriles	Bromoxynil *(Buctril, Moxy,* others)
Growth regulators	Phenoxy acetic acids	2,4-D 2,4-DB *(Butyrac 200, Butoxone 200)* MCPA
	Benzoic acids	Dicamba *(Banvel, Clarity;* component in *Distinct)*
	Pyridines	Clopyralid *(Stinger)*
EPSPS inhibitors	Amino acid derivatives	Glyphosate (See Table 10)
Seedling growth inhibitors (root inhibitors)	Dinitroanilines	Trifluralin (many names) Ethalfluralin *(Sonalan)* Pendimethalin *(Prowl/Pendimax/Prowl H$_2$0)*
Unknown (shoot inhibitors)	Acetamides	Alachlor *(Micro-Tech, IntRRo)* Acetochlor *(Harness, Surpass, Topnotch, Degree,Volley)* Dimethenamid-P *(Outlook)* Metolachlor *(Stalwart, Parallel)* s-metolachlor *(Dual Magnum, Dual II Magnum, Cinch)* Flufenacet (*Define*)
	Thiocarbamates	EPTC *(Eptam)* Cycloate *(Ro-Neet)*

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Herbicide Sites of Action (continued)

Site of Action	Chemical Family	Herbicide
Photosystem I inhibitors	Bipyridiliums	Paraquat *(Gramoxone Inteon)* Diquat *(Reglone)*
Protoporphyrinogen oxidase inhibitors (PPO)	Diphenylether	Acifluorfen *(Ultra Blazer)* Fomesafen *(Flexstar, Reflex)* Lactofen *(Cobra)*
	N-phenylphthalimide	Flumiclorac *(Resource)* Flumioxazin *(Valor)*
	Aryltriazinone	Sulfentrazone *(Spartan)* Carfentrazone *(Aim EW)*
Diterpene synthesis inhibitor (bleaching)	Isoxazolidinone	Clomazone *(Command)*
4–HPPD inhibitor (bleaching)	Pyrazolone Triketone	Topramezone *(Impact)* Mesotrione *(Callisto)*
Glutamine synthetase inhibitor	Amino acid derivatives	Glufosinate *(Liberty)*

Chemicals for Weed Control in Field Crops

IMPORTANT: READ THE FOLLOWING BEFORE USING

Rates are expressed in pounds of active ingredient (a.i.) per acre for the area actually sprayed; rates in formulation column are given as pounds or liquid measure of product unless otherwise noted.

(NOTE: Commercial rates are expressed in pt or qt or gal or lb or oz).

Apply all agricultural chemicals in accordance with regulations and labels as to rates, timing and crops for which they may be used.

Rates recommended in this bulletin are for medium-textured soils with 3% organic matter.

Many herbicides may also be applied as granules or impregnated on dry fertilizer. With these application methods, uniform application of the herbicide is necessary for acceptable weed control.

For incorporated herbicides the recommended mixing depth is 1 to 2 inches.

TABLE 1A – Chemical Weed Control in Corn

Corn — Soil Applied — All Tillage Systems

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses Nutsedge	alachlor (*Micro-Tech)*	2	2 qt 4L	• **May be applied preplant incorporated or preemergence.** • Refer to Table 1I for weed control and crop tolerance ratings. • MUST BE COMBINED WITH ANOTHER HERBICIDE (PREMIX, TANK MIX, OR SEQUENTIAL APPLICATION) FOR CONTROL OF ANNUAL BROADLEAVES. • 2½ lb a.i./A of alachlor should be used for more effective fall panicum control. • Refer to Table 1K for information on delayed herbicide application. • Refer to Table 12 for crop rotation restrictions.
	s-metolachlor *(Dual Magnum, Dual II Magnum, Cinch)*	1.27	1.33 pt 7.6L	• **May be applied preplant incorporated or preemergence.** • Refer to Table 1I for weed control and crop tolerance ratings. • MUST BE COMBINED WITH ANOTHER HERBICIDE (PREMIX, TANK MIX, OR SEQUENTIAL APPLICATION) FOR CONTROL OF ANNUAL BROADLEAVES. • *Dual II Magnum* and *Cinch* contain a safener which increases corn tolerance to s-metolachlor. • *Dual Magnum* or *Dual II Magnum* at 1.33 pt/A is equivalent to *Dual* or *Dual II* at 2 pt/A. • Refer to Table 1K for information on delayed herbicide application. • Refer to Table 12 for crop rotation restrictions.

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Corn — Soil Applied — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses **Nutsedge**	metolachlor *(Stalwart C, Parallel)*	1.3	1.33 pt 7.8L	• **May be applied preplant incorporated or preemergence.** • **Advisory statement:** *Stalwart C/Parallel* is a mix of the R and S-isomers of metolachlor. Limited research has shown that *Stalwart C/Parallel* at 1.33 pt/A provides similar activity to *Dual Magnum/Dual II Magnum/Cinch* (s-metolachlor) at 1.33 pt/A. However, *Stalwart C/Parallel* may not provide the consistency, length of control or performance on more difficult to control weeds when compared with *Dual Magnum/Dual II Magnum/Cinch* (s-metolachor) at 1.33 pt/A. *Stalwart C/Parallel* rates would need to be increased to 2.0 pt/A to provide the same amount of s-metolachlor (the more active isomer) at the 1.33 pt/A rate of *Dual Magnum/Dual II Magnum/Cinch* (s-metolachlor). • Refer to Table 1I for weed control and crop tolerance ratings. • MUST BE COMBINED WITH ANOTHER HERBICIDE (PREMIX, TANK MIX, OR SEQUENTIAL APPLICATION) FOR CONTROL OF ANNUAL BROADLEAVES. • *Parallel* and *Stalwart C* contain a safener which increases corn tolerance to metolachlor. • Refer to Table 1K for information on delayed herbicide application. • Refer to Table 12 for crop rotation restrictions.
	dimethenamid-P *(Outlook)*	0.84	18 oz 6L	• **May be applied preplant incorporated or preemergence.** • Refer to Table 1I for weed control and crop tolerance ratings. • MUST BE COMBINED WITH ANOTHER HERBICIDE (PREMIX, TANK MIX, OR SEQUENTIAL APPLICATION) FOR CONTROL OF ANNUAL BROADLEAVES. • Will be more effective on nutsedge when incorporated. • *Outlook* rates vary based on soil type (see label for details.) • Refer to Table 1K for information on delayed herbicide application. • Refer to Table 12 for crop rotation restrictions.
	acetochlor *(Harness)* OR *(Surpass, Volley)* OR *(TopNotch)* OR *(Degree)*	1.6	1.8 pt 7L OR 2 pt 6.4L OR 4 pt 3.2L OR 3.4 pt 3.8L	• **May be applied preplant incorporated or preemergence.** • Refer to Table 1I for weed control and crop tolerance ratings. • MUST BE COMBINED WITH ANOTHER HERBICIDE (PREMIX, TANK MIX, OR SEQUENTIAL APPLICATION) FOR CONTROL OF ANNUAL BROADLEAVES. • Do not apply acetochlor to the following soils if water depth is 30 feet or less: sands with ground less than 3% organic matter, loamy sands with less than 2% organic matter, or sandy loams with less than 1% organic matter. • *Harness, Surpass, TopNotch,* and *Degree* each contain a safener that increases corn tolerance to acetochlor. • Application rate varies by soil type. See label for details. • *Harness* and *Surpass* require less rainfall for activation than alachlor, s-metolachlor, or pendimethalin. • *TopNotch* and *Degree* are micro-encapsulated formulations of acetochlor. • Refer to Table 1K for information on delayed herbicide application. • Refer to Table 12 for crop rotation restrictions.

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Corn — Soil Applied — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses **Nutsedge**	pendimethalin *(Prowl, Pendimax)* OR *(Prowl H_2O)*	1.5 OR 1.4	1.8 qt 3.3EC OR 1.5 qt 3.8ACS	• **DO NOT apply preplant incorporated.** • Refer to Table 1I for weed control and crop tolerance ratings. • MUST BE COMBINED WITH ANOTHER HERBICIDE (PREMIX, TANK MIX, OR SEQUENTIAL APPLICATION) FOR CONTROL OF ANNUAL BROADLEAVES. • EXTREME CARE MUST BE TAKEN TO ASSURE COMPLETE CLOSURE OF THE SEED FURROW. IF THE SEED FURROW REMAINS OPEN (EVEN PARTIALLY OPEN), SEVERE INJURY WILL OCCUR. • APPLY AFTER PLANTING. • DO NOT INCORPORATE. • Plant at least 1.5 inches deep. • Adjust *Prowl, Pendimax* or *Prowl H_2O* rate according to soil type (refer *to* labels for details). • Do not use on sandy soil with less than 1.5% organic matter. • Refer to Table 1K for information on delayed herbicide application. • Refer to Table 12 for crop rotation restrictions.
	flufenacet + metribuzin *(Axiom)*	0.51 + 0.13	15 oz 68DF	• **May be applied preplant incorporated or preemergence.** • Refer to Table 1I for weed control and crop tolerance ratings. • MUST BE COMBINED WITH ANOTHER HERBICIDE (PREMIX, TANK MIX, OR SEQUENTIAL APPLICATION) FOR CONTROL OF ANNUAL BROADLEAVES. • Not registered for popcorn or sweet corn. • Includes the equivalent of 2.5 oz/A of *Sencor 75DF*. • Do not apply *Axiom* to permeable or coarse-textured soils where the water table is shallow — this may result in groundwater contamination. • Do not apply *Axiom* to sites that are vulnerable to runoff and surface water contamination. • Adjust *Axiom* rate according to soil texture and organic matter. Application rates above those on the label may result in severe corn injury, especially under cool, wet conditions. The margin of crop safety can be narrow. • Refer to Table 12 for crop rotation restrictions.
	flufenacet *(Define)*	0.6	16 oz 60DG OR 19.2 fl oz 4SC	• **May be applied preplant incorporated or preemergence.** • Refer to Table 1I for weed control and crop tolerance ratings. • MUST BE COMBINED WITH ANOTHER HERBICIDE (PREMIX, TANK MIX, OR SEQUENTIAL APPLICATION) FOR CONTROL OF ANNUAL BROADLEAVES. • Not registered for popcorn or sweet corn. • Application rate varies by soil type. See label for details. • Corn seed should be planted a minimum of 1 to 1.5 inches deep. • Refer to Table 1K for information on delayed herbicide application. • Refer to Table 12 for crop rotation restrictions.

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	atrazine (commercial product)	1	1 qt 4L OR 1.1 lb 90DG	• **May be applied preplant incorporated or preemergence.** • Refer to Table 1I for weed control and crop tolerance ratings. • MUST BE COMBINED WITH ANOTHER HERBICIDE (PREMIX, TANK MIX, OR SEQUENTIAL APPLICATION) FOR CONTROL OF ANNUAL GRASSES AND NUTSEDGE. • Mixing, loading, and application setbacks are required for atrazine. See page 11 or label for details. • Refer to Table 1K for information on delayed herbicide application. • Refer to Table 12 for crop rotation restrictions.
	simazine *(Princep, Sim-Trol)*	1	1 qt 4L OR 1.25 lb 80WP OR 1.1 lb 90DG	• **May be applied preplant incorporated or preemergence.** • Refer to Table 1I for weed control and crop tolerance ratings. • MUST BE COMBINED WITH ANOTHER HERBICIDE (PREMIX, TANK MIX, OR SEQUENTIAL APPLICATION) FOR CONTROL OF ANNUAL GRASSES AND NUTSEDGE. • *PRINCEP* AND *SIM-TROL* HAVE SIMILAR CARRYOVER RISK AS ATRAZINE. • WHEN *PRINCEP* OR *SIM-TROL* AND ATRAZINE ARE BOTH APPLIED TO CORN, CARRYOVER RISK IS ADDITIVE. • May be substituted for atrazine for slightly better grass control. • Refer to Table 12 for crop rotation restrictions.
	flumetsulam *(Python)*	0.056	1.14 oz 80DG	• **May be applied preplant incorporated or preemergence.** • Refer to Table 1I for weed control and crop tolerance ratings. • MUST BE COMBINED WITH ANOTHER HERBICIDE (PREMIX, TANK MIX, OR SEQUENTIAL APPLICATION) FOR CONTROL OF ANNUAL GRASSES AND NUTSEDGE. • **ADJUST APPLICATION RATE ACCORDING TO SOIL TYPE AND PERCENT ORGANIC MATTER. SEE LABEL FOR DETAILS.** • Corn should be planted at least 1.5 inches deep. • Do not use if soil pH exceeds 7.8 or crop injury may occur. • Risk of corn injury increases as soil pH increases. • **Do not apply to soils with less than 1.5% organic matter as severe corn injury may occur.** • Risk of corn injury from flumetsulam is greatly reduced if a Clearfield corn hybrid is used. • Do not use if organic matter is >5% *and* soil pH is <5.9 — poor weed control may result. • Do not use on peat or muck soils. • This product has a groundwater advisory statement. • Do not apply to sweet corn or popcorn. • Do not apply within 85 days of harvest. • Do not follow this treatment with a postemergence application of an ALS inhibitor herbicide *(Accent, Beacon, Resolve, Stout, Lightning* [Clearfield Corn]*, Option, Permit, Steadfast)* if plants are under stress. • Control of only light to moderate populations of common ragweed, cocklebur, and jimsonweed. Control may be improved by adding atrazine to the tank mix. • Refer to Table 1K for information on delayed herbicide application. • Refer to Table 12 for crop rotation restrictions. **INSECTICIDE INTERACTION** • See Table 1L. • Do not apply to corn treated with any formulation of *Counter* or *Thimet* insecticides. Other organophosphate insecticides should be applied in a band (surface or T-band) to reduce risk of crop injury.

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Corn — Soil Applied — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	flumetsulam *(Python)* + atrazine (commercial product)	0.04 + 1	0.8 oz 80DG + 1 qt 4L OR 1.1 lb 90DG	• **May be applied preplant incorporated or preemergence.** • Refer to Table 1I for weed control and crop tolerance ratings. • MUST BE COMBINED WITH ANOTHER HERBICIDE (PREMIX, TANK MIX, OR SEQUENTIAL APPLICATION) FOR CONTROL OF ANNUAL GRASSES AND NUTSEDGE. • **ADJUST APPLICATION RATE ACCORDING TO SOIL TYPE AND PERCENT ORGANIC MATTER. SEE LABEL FOR DETAILS.** • Corn should be planted at least 1.5 inches deep. • Do not use if soil pH exceeds 7.8 — crop injury may occur. • Risk of corn injury increases as soil pH increases. • **Do not apply to soils with less than 1.5% organic matter — severe corn injury may occur.** • Risk of corn injury from flumetsulam is greatly reduced if a Clearfield corn hybrid is used. • Do not use if organic matter is >5% *and* soil pH is <5.9 — poor weed control may result. • Do not use on peat or muck soils. • This product has a groundwater advisory statement. • Do not apply to sweet corn or popcorn. • Do not apply within 85 days of harvest. • Do not follow this treatment with a postemergence application of an ALS inhibitor herbicide *(Accent, Beacon, Resolve, Stout, Lightning* [Clearfield Corn]*, Option, Permit, Steadfast)* if plants are under stress. • Mixing, loading, and application setbacks are required for atrazine. See page 11 or label for details. • Refer to Table 1K for information on delayed herbicide application. • Refer to Table 12 for crop rotation restrictions. • Requires a 26-month rotation interval and a successful field bioassay before planting sugarbeets, cucumbers or tomatoes. **INSECTICIDE INTERACTION** • See Table 1L. • Do not apply to corn treated with any formulation of *Counter* or *Thimet* insecticides. Other organophosphate insecticides should be applied in a band (surface or T-band) to reduce risk of crop injury.

(Continued on next page)

Corn — Soil Applied — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	flumetsulam + clopyralid *(Hornet WDG)* + atrazine (commercial product)	0.034 + 0.094 + 1	3.0 oz 68.5DG + 1 qt 4L OR 1.1 lb 90DG	• **May be applied preplant incorporated or preemergence.** • Refer to Table 1I for weed control and crop tolerance ratings. • MUST BE COMBINED WITH ANOTHER HERBICIDE (PREMIX, TANK MIX, OR SEQUENTIAL APPLICATION) FOR CONTROL OF ANNUAL GRASSES AND NUTSEDGE. • Groundwater advisory statement. • Corn should be planted at least 1.5 inches deep. • Application rate varies by soil type. See label for details. • Do not apply to sweet corn or popcorn. • Do not apply within 85 days of harvest. • There is a preharvest interval of 45 days for silage provided application is made before 6 collars or 20 inches • Do not use if organic matter is >5% *and* soil pH is <5.9 — poor weed control may result. • Do not use if soil pH exceeds 7.8 — crop injury may occur. • Risk of corn injury increases as soil pH increases. • **Do not apply to soils with less than 1.5% organic matter — severe corn injury may occur.** • Risk of corn injury from flumetsulam is greatly reduced if a Clearfield corn hybrid is used. • Do not follow this treatment with a postemergence application of an ALS inhibitor herbicide *(Accent, Beacon, Resolve, Stout, Lightning* [Clearfield Corn]*, Option, Permit, Steadfast)* if plants are under stress. • Mixing, loading, and application setbacks are required for atrazine. See page 11 or label for details. • Refer to Table 1K for information on delayed herbicide application. • Refer to Table 12 for crop rotation restrictions. • Requires a 26-month rotation interval and a successful field bioassay before planting sugarbeets, cucumbers or tomatoes. **INSECTICIDE INTERACTION** • See Table 1L. • Do not apply to corn treated with any formulation of *Counter* or *Thimet* insecticides. Other organophosphate insecticides should be applied in a band (surface or T-band) to reduce risk of crop injury.

(Continued on next page)

Corn — Soil Applied — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	mesotrione (*Callisto*)	0.188	6 oz 4SC	• **May be applied preemergence ONLY.** • Refer to Table 1I for weed control and crop tolerance ratings. • MUST BE COMBINED WITH ANOTHER HERBICIDE (PRE-MIX, TANK MIX, OR SEQUENTIAL APPLICATION) FOR CONTROL OF ANNUAL GRASSES AND NUTSEDGE. • May be applied to hybrid field corn (grain and silage) and production seed corn. Refer to seed company recommendations for use in inbred lines. • Not labeled for preplant incorporation. • Must be tank mixed with a preemergence grass herbicide for control of annual grasses. • If corn has emerged before treatment, do not tank mix *Callisto* with an emulsifiable concentrate herbicide or use liquid nitrogen fertilizer as the herbicide carrier. • There are no soil type restrictions. • Atrazine at 1 lb a.i./A tank mixed with *Callisto* will improve control of certain broadleaved weed species, including common ragweed, giant ragweed, and cocklebur. Atrazine improved control of common ragweed in MSU trials. • Excellent crop safety on hybrid field corn. • Do not apply with suspension fertilizers as the carrier. • Do not apply to popcorn, sweet corn, or ornamental (Indian) corn. • **Crop rotation restrictions**: Corn may be replanted immediately. Small grains may be planted 120 days after application. Soybeans, potatoes, sorghum, canola, and sunflower may be planted the following growing season after application. Sugar beets, peas, dry beans, snap beans, alfalfa, curcurbits, red clover, and all other crops may be planted 18 months after application. • Refer to Table 12 for crop rotation restrictions. • Refer to Table 1K for information on delayed herbicide application. **Mesotrione premixes:** • ***Lumax* – A premix of mesotrione + s-metolachlor (+ safener) + atrazine is available. See Table 1H.** • ***Lexar* – A premix of mesotrione + s-metolachlor (+ safener) + atrazine is available. See Table 1H.** • ***Camix* – A premix of mesotrione + s-metolachlor (+ safener) is available. See Table 1H.** • Do not apply *Callisto* postemergence following *Callisto*, *Lumax*, *Lexar* or *Camix* applied preemergence.

Corn — Soil Applied — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Barnyardgrass, foxtail, lambsquarters, mustard and pigweed	rimsulfuron *(Resolve)*	0.016	1.0 oz 25% DF	• Refer to Table 1I for weed control and crop tolerance ratings. • Do not apply to field corn grown for seed, to popcorn or to sweet corn. • Do not apply preemergence to coarse-textured soils (sand, loamy sand or sandy loam) with less than 1% organic matter. • Cultivation 5-7 days after treatment may necessary to improve control in the absence of an activating rainfall (>0.5 inch). • Atrazine at 0.5-1.0 lb a.i./A tank mixed with *Resolve* often improves control of broadleaved weeds (except triazine resistant weeds), especially larger weeds. • Refer to label for special sprayer cleanup instructions. • **Crop rotation restrictions:** Alfalfa, canola, red clover, sorghum, and sugarbeets rotation interval should be extended to 18 months if drought conditions occur after application, unless irrigation has been used with totals greater than 15 inches during the growing season. Refer to label and Table 12 for crop rotation restrictions for other crops. • **Insecticide interaction:** Do not apply *Resolve* to corn previously treated with *Counter 15G* or an in-furrow application of *Counter 20CR.* • See Table 1L for all insecticide interactions.
Annual broadleaves (except lambsquarters)	halosulfuron *(Permit)* + surfactant OR crop oil concentrate	0.03125	2/3 oz 75DS + 0.25% OR 1%	• Controls several broadleaved weeds, including pigweed, ragweed, cocklebur, and velvetleaf. • Ineffective on lambsquarters. • Refer to Table 1I for weed control and crop tolerance ratings. • Liquid nitrogen fertilizer (28% N) added at 4 qt/A may improve velvetleaf and pigweed control. • Apply to corn from spike through lay-by stage (canopy closure). • Use drop nozzles when corn canopy will prevent complete spray coverage of the weeds. • *Permit* may be tank mixed with 2,4-D, *Banvel, Clarity, Buctril, Buctril + atrazine,* atrazine, *Marksman, Accent,* or *Beacon.* • Tank mixes containing dicamba *(Banvel, Celebrity, Celebrity Plus, Clarity, Distinct, Marksman, Northstar, Yukon)* applied to corn under stress may increase the risk of fused leaves in the whorl (rat tail). • There are no restrictions for *Permit* use regarding organophosphate insecticides. • Refer to Table 12 for crop rotation restrictions.

Corn — Postemergence — All Tillage Systems

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	2,4-D amine	0.5	1 pt 4L	• For corn over 6-8 inches, use drop nozzles. • Refer to Table 1I for weed control and crop tolerance ratings. • Ester formulations will cause more crop injury and are not recommended. • Use drift control additives with some 2,4-D amine products to reduce risk of spray particle drift. Check product label. • Not effective on smartweed or wild buckwheat. • Corn hybrids vary in sensitivity to 2,4-D. Consult seed company for details. • If 2,4-D ester is used, an application rate no higher than .25 lb a.i./A is advised. 2,4-D ester is not recommended on corn because of risk of injury. • Most effective when weeds are small (2 to 4 inches). See Table 1J. • Refer to Table 12 for crop rotation restrictions.
	dicamba (*Banvel, Clarity)*	0.5	1 pt 4L	• Refer to Table 1I for weed control and crop tolerance ratings. • Apply postemergence to corn from emergence up to the 5-leaf stage or 8 inches tall, whichever comes first. • *Banvel/Clarity* may be applied at .5 pt/A to corn up to 36 inches tall or 15 days before tassel emergence. Drop nozzles are recommended for corn over 8 inches tall. • Most effective when weeds are small (2-4 inches). See Table 1J. • AMS or 28% liquid nitrogen fertilizer may be added for improved control of larger velvetleaf. See label for details. • **Corn hybrids vary in sensitivity to dicamba. Consult seed company for details.** • Refer to Table 12 for crop rotation restrictions. **OFF-TARGET INJURY** • USE EXTREME CAUTION. DRIFT TO NEARBY SENSITIVE CROPS IS A HAZARD. • To reduce the risk of volatilization, do not apply if the air temperature is expected to exceed 85° F on the day of application. • Use pressure no greater than 20 psi. • Do not apply if soybeans in the vicinity are over 10 inches tall or have begun to bloom. • Drift control agents may be used to reduce the risk of spray particle drift.

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Corn — Postemergence — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	dicamba + diflufenzopyr *(Distinct)* + surfactant + 28% liquid nitrogen OR ammonium sulfate	0.19 + 0.08	6 oz 70DS + 0.25% + 1.25% OR 17 lb/100 gal	• Refer to Table 1I for weed control and crop tolerance ratings. • Apply postemergence to corn between 4 and 10 inches tall. • *Distinct* is labeled for application at 4 oz/A to corn between 10 and 24 inches tall. • May be applied to corn 24 to 36 inches tall when using drop nozzles. DO NOT make applications when corn is within 15 days of tassel emergence. • Two applications may be made per season but must be a minimum of 15 days apart. Do not apply more than a total of 10 oz/A per season. • Do not apply to corn showing injury from a previous herbicide application. • **Corn hybrids vary in sensitivity to dicamba. Consult seed company for details.** • Do not use crop oil concentrate or methylated seed oil — severe crop injury may result. • Do not tank mix *Distinct* with other herbicides that contain growth regulators such as 2,4-D, *Banvel, Celebrity, Clarity, Hornet WDG, Marksman, Northstar, Shotgun, Stinger or Yukon.* • Do not tank mix *Distinct* with *Lorsban 4E, Ambush EC,* or *Warrior EC. S*equential treatments may be made at least 7 days apart. • Most effective when weeds are small (2 to 4 inches). See Table 1J. • Provides limited suppression of annual grasses. • Do not cultivate for at least 7 days after application. • Do not harvest for 72 days after application. • Corn can be planted 7 or more days after application. • Refer to Table 12 for crop rotation restrictions. **OFF-TARGET INJURY** • USE EXTREME CAUTION. DRIFT TO NEARBY SENSITIVE CROPS IS A HAZARD. • Use pressure no greater than 20 psi. • Do not apply if soybeans in the vicinity are 10 inches tall or have begun to bloom. • Drift reduction nozzles and drift control agents may be used to reduce the risk of spray particle drift. • To reduce the risk of off-target injury from herbicide volatilization, do not apply if air temperature is expected to exceed 85°F on the day of application. • Risk of off-target injury from herbicide volatilization is similar to *Clarity*.

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Corn — Postemergence — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	mesotrione (*Callisto*) + crop oil concentrate + 28% liquid nitrogen OR ammomium sulfate	0.094	3 oz 4SC + 1% + 2.5% OR 8.5 lb/100 gal	• May be applied to hybrid field corn (grain and silage) and production seed corn. Refer to seed company for recommendations for use on inbred lines. • Refer to Table 1I for weed control and crop tolerance ratings. • Apply to corn up to 30 inches tall or 8-collar stage, whichever comes first. • Most effective when weeds are small (2-4 inches). See Table 1J. • Do not use methylated seed oil (MSO) or MSO blends. • Do not use liquid fertilizer as the herbicide carrier. • *Callisto* will not control annual grasses. • Atrazine at 0.25-0.5 lb a.i./A tank mixed with *Callisto* often improves control of broadleaved weeds (except triazine-resistant weeds), especially larger weeds. Atrazine improved control of redroot pigweed and common ragweed in MSU trials. Note: Tank mixtures of *Callisto* with atrazine can be applied to corn up to 12 inches tall only. • Must be tank mixed with a postemergence grass herbicide for control of annual grasses. Refer to tank mix herbicide for details. • Do not apply to popcorn, sweet corn, or ornamental (Indian) corn. • Do not apply *Callisto* postemergence to corn treated with *Counter*. Application of *Callisto* to corn treated with *Lorsban* may cause temporary injury. Do not make a foliar application of any organophosphate or carbamate insecticide within 7 days before or 7 days after a *Callisto* application. Do not tank mix *Callisto* with an organophosphate or carbamate insecticide. See Table 1L and label for details. • Do not apply *Callisto* postemergence following *Callisto*, *Lumax*, *Lexar* or *Camix* applied preemergence. • **Crop rotation restrictions:** Corn may be replanted immediately. Small grains may be planted 120 days after application. Soybeans, potatoes, sorghum, canola, and sunflower may be planted the following growing season after application. Sugar beets, peas, dry beans, snap beans, alfalfa, curcurbits, red clover, and all other crops may be planted 18 months after application. See Table 12 for details.

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Corn — Postemergence — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
continued)				
Annual broadleaves	topramezone *(Impact)* + methylated seed oil OR crop oil concentrate + liquid nitrogen OR ammonium sulfate	0.011	0.5 fl oz + 1% OR 1% + 2.5% OR 8.5 lb/100 gal	• May be used on field corn, (silage or grain), seed corn, sweet corn or popcorn. Before using *Impact*, refer to seed company recommendations for use on inbred lines of field corn, popcorn and sweet corn. • Controls many emerged annual broadleaf weeds including lambsquarters, pigweed, velvetleaf, common ragweed and giant ragweed. • Atrazine at 0.25-0.5 lb a.i./A tank mixed with *Impact* often improves control of broadleaved weeds (except triazine resistant weeds), especially larger weeds. Note: Tank mixtures of *Impact* with atrazine can be applied to corn up to 12 inches tall only. • Must be tank mixed with a postemergence grass herbicide for control of annual grasses. Refer to tank mix herbicide for details. • Use with methylated seed oil (MSO) or crop oil concentrate (COC) + liquid nitrogen (UAN) or AMS are recommended. • May be used anytime after crop emergence until 45 days prior to harvest. • May be used in combinations with all corn insecticide programs. • Application rate ranges from 0.5 fl oz to 0.75 fl oz/A; however rates higher than 0.5 fl oz/A have additional crop rotation restrictions in Michigan, see label. • Do not apply *Impact* postemergence following *Callisto, Lumax, Lexar*, or *Camix* preemergence. • **Crop rotation restrictions**: In Michigan, when *Impact* is used at 0.5 fl oz rate, soybeans may be planted 9 months after application. At the 0.75 fl oz rate, soybean plantings are not recommended for 18 months. • MSU has limited research on the soil persistence and carryover potential of *Impact* in Michigan. Caution should be taken if rotating into a sensitive crop. Refer to label and Table 12 for crop rotation restrictions.

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Corn — Postemergence — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	dicamba (*Banvel, Clarity)* + atrazine (commercial product)	0.5 + 1	1 pt 4L + 1qt 4L OR 1.1 lb 90DG	• Apply postemergence to corn from emergence up to the 5-leaf stage or 8 inches tall, whichever comes first. For larger corn, reduce *Banvel/Clarity* rate to .5 pt/A. Do not apply to corn over 12 inches tall. Drop nozzles are recommended for corn over 8 inches tall. See Table 1J. • Refer to Table 1I for weed control and crop tolerance ratings. • Use lower rates on coarser soils or soils low in organic matter. • Treatment must follow a preplant-incorporated or pre-emergence herbicide application for grass control. • **Corn hybrids vary in sensitivity to dicamba. Consult seed company for details.** • Do not use with crop oil concentrate or other additives. • Mixing, loading, and application setbacks are required for atrazine. See page 11 or label for details. • Refer to Table 12 for crop rotation restrictions. **OFF-TARGET INJURY** • Do not apply if soybeans in the vicinity are over 10 inches tall or have begun to bloom. • Drift control agents may be used to reduce the risk of spray particle drift. • See additional remarks and limitations for dicamba (*Banvel/Clarity*).
	bentazon (*Basagran)* + crop oil concentrate	1	1 qt 4L + 1 qt	• Corn is tolerant to *Basagran* at all growth stages. For best results, apply early to small weeds. See Table 1J. • Weak on pigweed, nightshade, and lambsquarters. • Refer to Table 1I for weed control and crop tolerance ratings. • Use a minimum of 40 psi and 20 gal of water/A. • Urea ammonium nitrate (28% liquid nitrogen) may be used at 1 gal/A instead of crop oil concentrate for improved velvetleaf control. Do not use urea ammonium nitrate if common lambsquarters is present. • Refer to Table 12 for crop rotation restrictions.
	bentazon (*Basagran)* + atrazine (commercial product) + crop oil concentrate	0.75 + 0.75	0.75 qt 4L + 0.75 qt 4L OR 0.8 lb 90DG + 1 qt	• Do not apply to corn over 12 inches tall. • Gives better control of some broadleaf weeds, especially pigweed, than *Basagran* alone. • Refer to Table 1I for weed control and crop tolerance ratings. • Combination reduces risk of carryover from post-emergence application of atrazine alone. • Urea ammonium nitrate (28% liquid nitrogen) may be used at 1 gal/A instead of crop oil concentrate. Do not use urea ammonium nitrate if common lambsquarters is present. • Mixing, loading, and application setbacks are required for atrazine. See page 11 or label for details. • Rates may be reduced to 0.5 lb/A for each herbicide if weeds are small. See *Laddok* label for details. • Refer to Table 12 for crop rotation restrictions.

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Corn — Postemergence — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	bromoxynil *(Buctril, Moxy,* others)	0.375	1.5 pt 2L	• Apply to corn between the 4-leaf stage (4 visible leaves) and prior to tassel emergence. • For best results, weeds must be small (see label or Table 1J). • Refer to Table 1I for weed control and crop tolerance ratings. • Good spray coverage is important. • Do not mix with spray additives or liquid fertilizers unless specified for tank mixes. • For ground applications, use minimum of 20 gal of water/A and 30 psi. • Redroot pigweed and mustard must be controlled when very small (refer to label for details). • Refer to Table 12 for crop rotation restrictions.
	bromoxynil *(Buctril, Moxy,* others) + atrazine (commercial product)	0.25 + 0.5	1 pt 2L + 0.5 qt 4L OR 0.6 lb 90DG	• Apply to corn after emergence but before corn is 12 inches tall. • Apply to weeds less than 4 inches tall for effective control. See Table 1J. • Refer to Table 1I for weed control and crop tolerance ratings. • Good spray coverage is important. • Do not mix with spray additives or liquid fertilizers. • Better control of redroot pigweed and wild mustard than bromoxynil alone. • Combination reduces risk of carryover from post-emergence application of atrazine alone. • Mixing, loading, and application setbacks are required for atrazine. See page 11 or label for details. • Refer to Table 12 for crop rotation restrictions.
	flumetsulam + clopyralid *(Hornet WDG)* + surfactant OR crop oil concentrate + 28% liquid nitrogen OR ammonium sulfate	0.03 + 0.09	3.0 oz 68.5DG + 0.25% OR 1% + 2.5% OR 2 lb	• Apply to corn up to 20 inches tall or 6 collars. • Refer to Table 1I for weed control and crop tolerance ratings. • Tank mixing required for control of pigweed and lambsquarters. • Preharvest interval is 85 days. • There is a preharvest interval of 45 days for silage provided application is made before 6 collars or 20 inches. • Do not tank mix *Hornet WDG* with *Basagran, Lightning* or *Laddok* — severe crop injury may occur. • Refer to Table 12 for crop rotation restrictions. • Requires a 26-month rotation interval and a successful field bioassay before planting sugarbeets, cucumbers or tomatoes. **INSECTICIDE INTERACTION** • Do not apply to corn previously treated with *Counter* or *Thimet* insecticide — severe injury may occur. See Table 1L. • A time interval of at least 10 days between application of *Hornet WDG* and organophosphate insecticides is advised.

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Corn — Postemergence — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	dicamba *(Banvel, Clarity)* + primisulfuron *(Beacon)* + surfactant	0.125 + 0.0234	4 oz 4L + 0.5 oz 75DG + 0.25%	• Apply to corn between 4 and 8 inches tall. • Application to corn between 8 and 20 inches is labeled but not recommended because of risk of corn injury. • Refer to Table 1I for weed control and crop tolerance ratings. • Liquid nitrogen fertilizer (28% N) added at 4 qt/A in addition to surfactant may improve control of certain species. • Refer to insecticide interaction remarks for *Beacon* in the Corn—Postemergence section. • **Corn hybrids vary in sensitivity to dicamba. Consult seed company for details.** • Tank mixes containing dicamba *(Banvel, Celebrity, Celebrity Plus, Clarity, Distinct, Marksman, Northstar, Yukon)* applied to corn under stress may increase the risk of fused leaves in the whorl (rat tail). • See additional remarks and limitations for dicamba. • Do not graze or feed forage from treated corn to livestock within 30 days after application. Do not harvest silage within 45 days after application. Do not harvest grain within 60 days after application. • A premix of dicamba and primisulfuron, *Northstar,* is available. See Table 1H for details. • Refer to Table 12 for crop rotation restrictions.
Nightshade, pigweed and velvetleaf	carfentrazone *(Aim)* + surfactant	0.008	0.5 fl oz 2EW + 0.25%	• Apply to corn up to 8 collars. • Apply when weeds are 2-4 inches. • Will control large velvetleaf (up to 36 inches). • Refer to Table 1I for weed control and crop tolerance ratings. • May be tank mixed with other postemergence corn herbicides to control additional weed species. Follow all restrictions on the tank mix herbicide label. See label for details. • Ammonium sulfate (2–4 lbs/A) or 28% liquid nitrogen (2–4 qts/100 gal) may be added if recommended on the label of the tank mix herbicide. • To avoid significant crop response, applications should not be made within 6–8 hours of either rain or irrigation. • *Aim* should be mixed first in the spray tank. • Sprayers should be adjusted to position spray tips a minimum of 18 inches above the crop and operated to avoid the application of excessive herbicide rates directly over the rows and/or into the whorls of treated crop plants. • Under extremely dry conditions, crop oil concentrate (1%) can be used in place of surfactant but is generally not recommended because of risk of severe crop injury. • There are no restrictions regarding harvesting for forage. • Refer to Table 12 for crop rotation restrictions.
ONLY ragweed, cocklebur, jimsonweed and Jerusalem artichoke	clopyralid *(Stinger)*	0.094	0.25 pt 3L	• Apply to field corn up to 24 inches tall. • Refer to Table 1I for weed control and crop tolerance ratings. • Apply in 10 gal. of water or more per acre. • Treat ragweed, cocklebur, jimsonweed, and Jerusalem artichoke up to the 5-leaf stage. • Do not apply more than 0.66 pt/A per year. • Refer to Table 12 for crop rotation restrictions.

Corn — Postemergence — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Perennial sowthistle, Canada thistle	clopyralid *(Stinger)*	0.188	0.5 pt 2L	• Apply to field corn up to 24 inches tall. • Refer to Table 1I for weed control and crop tolerance ratings. • Apply in 10 gal. of water or more per acre. • Treat thistle plants at least 6-8 inches in diameter or height but before the bud stage. • Do not cultivate before treatment. • Cultivation may be used 14-20 days after treatment. • Rate may be increased to 0.66 pt/A for dense infestations. • Do not apply more than 0.66 pt/A per year. • Refer to Table 12 for crop rotation restrictions.
Velvetleaf	flumiclorac *(Resource)* + crop oil concentrate	0.027	4 oz 0.86L + 1 pt	• Very effective on velvetleaf. • Apply to corn between the 2-collar and 10-collar stages. • Refer to Table 1I for weed control and crop tolerance ratings. • Use drop nozzles when corn canopy will prevent complete spray coverage of the weeds. • *Resource* may be tank mixed with atrazine, *Accent, Banvel,* and 2,4-D. • There are no restrictions for *Resource* regarding organophosphate insecticides. • There are no crop rotation restrictions.
Annual broadleaves **Annual grasses** (except green foxtail, giant foxtail, fall panicum, witchgrass and crabgrass)	atrazine (commercial product) + crop oil concentrate	2	2 qt 4L OR 2.2 lb 90DG + 1 qt	• Do not apply to corn over 12 inches tall. • Refer to Table 1I for weed control and crop tolerance ratings. • Emergency use. • Grasses must be less than 1.5 inches tall. See Table 1J. • Timing of application is critical to get best results. • Surfactant at 1 pt/A may be used in place of crop oil concentrate but is less effective. • Greater chance for carryover because treatment is later in season. • Do not add *Banvel/Clarity, Distinct* or 2,4-D or crop injury may occur. • Mixing, loading, and application setbacks are required for atrazine. See page 11 or label for details. • Refer to Table 12 for crop rotation restrictions.

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves **Fall panicum**	primisulfuron (*Beacon)* + crop oil concentrate OR surfactant	0.0356	0.76 oz. 75DG + 1% OR 0.25%	• Apply to corn between 4 and 20 inches tall. • Refer to Table 1I for weed control and crop tolerance ratings. • The recommended rate may be split into two applications. The second application of the split should be made when the new weed growth is at the optimum height. Do not treat corn after tassel emergence. Do not apply more than 0.76 oz. of *Beacon* per acre in one season. • Crop oil concentrate or surfactant must be added to obtain adequate results. Liquid nitrogen fertilizer (28% N) added at 4 qt/A **in addition to** crop oil concentrate or surfactant may improve control of certain species. • Cultivation 7-14 days after treatment may improve control. • A small number of corn hybrids are classifed as "potentially susceptible." Use of *Beacon* on these hybrids is not recommended. Consult the chemical dealer, seed dealer, or manufacturer for the current list of potentially susceptible hybrids. • Inbred lines grown for hybrid seed production may be severely injured by *Beacon* application. Therefore, inbred lines should be thoroughly tested for potential sensitivity to *Beacon* before treating large acreage. • *Beacon* may be tank mixed with other postemergence herbicides for control of a broader spectrum of weeds. See label for details. • Tank mixes containing dicamba *(Banvel, Celebrity, Celebrity Plus, Clarity, Distinct, Marksman, Northstar, Yukon)* applied to corn under stress may increase the risk of fused leaves in the whorl (rat tail). • Refer to label for special sprayer cleanup instructions. • Refer to Table 12 for crop rotation restrictions. **INSECTICIDE INTERACTION** • See Table 1L. • Do not apply *Beacon* to corn previously treated with *Counter 15G* (any application method) or *Counter 20CR* applied in furrow. • *Beacon* application to corn previously treated with *Counter 20CR* banded (surface band or T-band) is not recommended. • Applying *Beacon* to corn previously treated with other soil-applied organophosphate insecticides (*Thimet, Lorsban,* etc.) may result in temporary crop injury. • Soil-applied insecticides other than organophosphates do not increase corn injury from *Beacon.* • Do not treat with a foliar-applied organophosphate insecticide such as *Lorsban* or malathion or with *Basagran* or *Laddok* within 10 days before or 7 days after *Beacon* application.

Corn — Postemergence — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses (except crabgrass)	foramsulfuron *(Option)* + methylated seed oil (MSO) + 28% liquid nitrogen OR ammonium sulfate	0.033	1.5 oz 35DG + 1.5 pt + 2 qt OR 3 lb	• Apply before corn exceeds 6 collars or 16 inches, whichever comes first. • May be applied with drop nozzles when corn is 16-36 inches tall. • Apply to annual grasses 2-4 inches in height. • Refer to Table 1I for weed control and crop tolerance ratings. • May be tank mixed with atrazine, dicamba, *Beacon*, *Distinct, Hornet WDG, Marksman* or *Northstar* for control of a broader spectrum of broadleaf weeds. • To minimize risk of serious corn injury, tank mixes with dicamba 4L (2 fl oz/A) or *Distinct* (2 oz/A) should be applied before corn exceeds 8 inches. Higher application rates of dicamba 4L or *Distinct* may cause severe corn injury. • Tank mixes containing dicamba *(Banvel, Celebrity, Celebrity Plus, Clarity, Distinct, Marksman, Northstar, Yukon)* applied to corn under stress may increase risk of fused leaves in the whorl (rat tail). • Substitution of surfactant or crop oil concentrate for MSO may result in reduced control. • Cultivation 7-14 days after treatment may improve control. • If corn is destroyed after *Option* application, corn can be replanted 7 days after application and soybeans can be planted 14 days after application. All other crops can be planted 60 days after *Option* application. • Refer to label for special sprayer cleanup instructions. • Refer to Table 12 for crop rotation restrictions. **INSECTICIDE INTERACTION** • See Table 1L. • DO NOT USE *Option* in the same season as *Counter* or *Thimet*. • Use of *Option* following *Lorsban* may result in temporary corn injury. • Foliar applications of an OP insecticide should not be made within 7 days of an *Option* application or injury may result.

(Continued on next page)

Corn — Postemergence — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses (except crabgrasses)	foramsulfuron + iodosulfuron *(Equip)* + methylated seed oil *(MSO)* + 28% liquid nitrogen OR ammonium sulfate	0.028+ 0.0019	1.5 oz 32DG + 1.5 pt + 2 qt OR 3 lb	• Similar grass control compared to *Option*. • Improved control of certain broadleaves compared to *Option*. • Apply postemergence before corn exceeds 4 collars or 12 inches, whichever comes first. • May be applied with drop nozzles when corn is greater than 4 collars and less than 8 collars, or 12-36 inches. • Apply to 1- to 3-inch weeds for greatest control. • Refer to Table 1I for weed control and crop tolerance ratings. • See label for tank mix options. • Tank mixes containing dicamba (*Banvel, Celebrity, Celebrity Plus, Clarity, Distinct, Marksman, Northstar, Yukon*, etc.) applied to corn under stress may increase risk of fused leaves in the whorl (rat tail). • To minimize risk of serious corn injury, tank mixes with dicamba 4L (2 fl oz/A) or *Distinct* (2 oz/A) should be applied before corn exceeds 8 inches. Higher application rates of dicamba 4L or *Distinct* may cause severe corn injury. • Substitution of surfactant or crop oil concentrate for MSO may result in reduced control. • Cultivation 7-14 days after treatment may improve control. • Refer to label for special sprayer cleanup instructions. • Refer to Table 12 for crop rotation restrictions. • Requires a successful field bioassay 18 months after application before planting cucumbers or tomatoes. **INSECTICIDE INTERACTION** • See Table 1L. • DO NOT USE *Equip* in the same season as *Counter* or *Thimet*. • Use of *Equip* following *Lorsban* may result in temporary corn injury. • Foliar applications of an OP insecticide should not be made within 7 days of an *Equip* application or injury may result.

(Continued on next page)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses (except crabgrass)	nicosulfuron (*Accent)* + crop oil concentrate OR surfactant	0.03125	0.67 oz 75DF + 1% + 0.25%	• Apply broadcast to corn up to 20 inches tall (freestanding) or that is exhibiting up to and including 6 leaf collars (V6), whichever is more restrictive. • For corn 20-36 inches tall, use drop nozzles. Do not apply to corn taller than 36 inches or exhibiting 10 collars, whichever is more restrictive. • Refer to Table 1I for weed control and crop tolerance ratings. • A second application may be made 2-4 weeks later. Do not apply more than 1.33 oz./A in one season. • Crop oil concentrate or surfactant must be added to obtain adequate control. Liquid nitrogen fertilizer (28% N) added at 4 qt/A **in addition** to crop oil concentrate or surfactant may improve control of certain species. • Cultivation 7-14 days after treatment may improve control. • *Accent* may be tank mixed with other postemergence herbicides for control of a wider spectrum of weeds. See label for details. • Tank mixes containing dicamba *(Banvel, Celebrity, Celebrity Plus, Clarity, Distinct, Marksman, Northstar, Yukon)* applied to corn under stress may increase the risk of fused leaves in the whorl (rat tail). • Control of green and yellow foxtail may be antagonized with tank mixes of *Accent* with *Buctril, Banvel, Clarity* or *Marksman.* Timely cultivation or a second application may be required for complete control. • Refer to label for special sprayer cleanup instructions. • Refer to Table 12 for crop rotation restrictions. • There are soil pH restrictions after *Accent* application when rotating to sugarbeets, potatoes, cucumbers or tomatoes. Rotation interval to these crops is 10 months if soil pH <6.5. If pH >6.5, rotation interval for these crops is 18 months. For sugarbeets, if pH <7.5 **and** 25 inches of rain falls between application and planting, the rotation interval is 10 months. **ROTATIONAL GUIDELINE** • Sugarbeets: rotation interval is 10 months on soils with pH <7.5 and 18 months on soils with pH ≥7.5. • Potatoes, cucumbers, tomatoes: rotation interval is 10 months on soils with pH ≤6.5 and 18 months on soils with pH >6.5. **INSECTICIDE INTERACTION** • See Table 1L. • Do not apply *Accent* to corn previously treated with *Counter 15G* or an in-furrow application of *Counter 20CR* — severe corn injury may result. • *Accent* may be applied to corn previously treated with a banded (surface band or T-band) application of *Counter 20CR*. However, planned programs that include both *Accent* and *Counter* are not recommended. The risk of crop injury is reduced but not eliminated by banded application of *Counter 20CR*. Risk of corn injury is greatest on soils with 4% or less organic matter. • Applying *Accent* to corn previously treated with other soil-applied organophosphate insecticides (*Thimet, Lorsban,* etc.) may result in temporary crop injury. • Soil-applied insecticides other than organophosphates do not increase corn injury from *Accent.* • Do not apply to corn that has been treated within 7 days before with foliar-applied organophosphate insecticides such as *Lorsban* or malathion or with the herbicides *Basagran* or *Laddok* — severe injury may result. Do not apply these materials within 3 days after *Accent* application.

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Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
continued)				
Annual grasses (except crabgrass)	nicosulfuron + rimsulfuron (*Steadfast*) + crop oil concentrate OR surfactant + 28% liquid nitrogen OR ammonium sulfate	0.023 +0.012	0.75 oz 75DG + 1% OR 0.25% + 2 qt OR 2 lb	• Apply to corn that is up to 20 inches tall and exhibiting up to and including 6 leaf collars, whichever is more restrictive. • Refer to Table 1I for weed control and crop tolerance ratings. • More effective on annual grasses than *Accent Gold* or *Accent Gold WDG*, especially on larger plants. • May be tank mixed with other postemergence herbicides for control of broadleaf weed species. See label for details. • Rainfall within 5-7 days after application will improve residual activity. • To minimize risk of corn injury: – DO NOT treat if nightime temperatures are below 40°F or daytime temperatures are above 92°F. – DO NOT treat Hi-Lysine corn or white corn. – Applications may be made to field corn hybrids of 77-88 CRM if the corn is no more than 12 inches tall with 5 or fewer collars unless a seed company provides a specific warning for the hybrid. – Risk of injury is greater following several days of cool, cloudy conditions. – Risk of injury increases with corn height. • Tank mixes containing dicamba *(Banvel, Celebrity, Celebrity Plus, Clarity, Distinct, Marksman, Northstar, Yukon)* applied to corn under stress may increase the risk of fused leaves in the whorl (rat tail). • Limit the application of *Steadfast* with dicamba-containing herbicides to 12-inch tall/V5 corn. Corn tolerance to dicamba decreases as corn height increases, especially above 8 inches height. • Do not tank mix with *Basagran* or *Laddok* — severe injury may occur. • Tank mixes with 2,4-D may cause severe grass control antagonism. • Refer to Table 12 for crop rotation restrictions. • There are soil pH restrictions after *Steadfast* application when rotating to sugarbeets, potatoes, cucumbers or tomatoes. Rotation interval to these crops is 10 months if soil pH <6.5. If pH >6.5, rotation interval for these crops is 18 months. For sugarbeets, if pH <7.5 **and** 25 inches of rain falls between application and planting, the rotation interval is 10 months. **ROTATIONAL GUIDELINE** • Sugarbeets: rotation interval is 10 months on soils with pH <7.5 and 18 months on soils with pH >7.5. • Potatoes, cucumbers, tomatoes: rotation interval is 10 months on soils with pH <6.5 and 18 months on soils with pH >6.5. **INSECTICIDE INTERACTION** • See Table 1L. • Do not apply *Steadfast* to corn previously treated with *Counter 15G* or an in-furrow application of *Counter 20CR* — severe injury may occur. • *Steadfast* application to corn previously treated with *Counter 20CR* (T-band), *Thimet* or *Lorsban* is not recommended. Risk of injury is especially great on soils with less than 4% organic matter.

(Continued on next page)

Corn — Postemergence — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
continued)				
Annual grasses (except crabgrass)	nicosulfuron + thifensulfuron (*Stout* (mp) + crop oil concentrate + 28% liquid nitrogen OR ammonium sulfate	0.032 + 0.002	0.75 oz + 1% + 2 qt OR 2 lb	• Apply broadcast to corn up to 16 inches tall (freestanding) or that is exhibiting up to and including 5 leaf collars (V5), whichever is more restrictive. • Refer to Table 1I for weed control and crop tolerance ratings. • Crop oil concentrate or surfactant must be added to obtain adequate control. Liquid nitrogen fertilizer (28% N) added at 2 qt/A or ammonium sulfate at 2 lb/A must be added. • Do not use liquid nitrogen fertilizer as the total carrier solution. • Cultivation 7-14 days after treatment may be necessary to improve control in the absence of an activating rainfall. • Do not tank mix with *Basagran* or *Laddok* as severe injury may occur. • Tank mixes with 2,4-D may cause severe grass control antagonism. • Do not tank mix with foliar applied organophosphate insecticides as severe injury may occur. • Do not tank mix with other ALS inhibiting herbicides not specifically recommended on the *Stout* label as severe injury may occur. • Refer to label for special sprayer cleanup instructions. • **Crop rotation restrictions**: Sugarbeets: rotation interval is 10 months on soils with pH<7.5 and 18 months on soils with pH >7.5. Potatoes rotation interval should be extended to 12 months if drought conditions occur after application, unless irrigation has been used with totals greater than 15 inches during the growing season. Refer to label and Table 12 for crop rotation restriction details on other crops.

Corn — Postemergence — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	rimsulfuron *(Resolve)* + nonionic surfactant + liquid nitrogen OR ammonium sulfate	0.016	1.0 oz 25% DF + 0.25% + 2 qt OR 2 lb	• Apply broadcast to corn up to 12 inches tall (freestanding) or that is exhibiting up to and including 5 leaf collars (V5), whichever is more restrictive. • Refer to Table 1I for weed control and crop tolerance ratings. • Allow three weeks between the preemergence and post emergence application of *Resolve*. Do not apply more than 1.5 oz preemergence, 1.0 oz post emergence and 2.0 oz/A in one season. • Do not apply to field corn grown for seed, to popcorn or to sweet corn. • Nonionic surfactant must be added to obtain adequate control. Liquid nitrogen fertilizer at 2 qt/A or ammonium sulfate at 2 lb/A must be added. • Do not tank mix with *Basagran* or *Laddok* as severe injury may occur. • Do not tank mix with foliar applied organophosphate insecticides as severe injury may occur. • Refer to label for special sprayer cleanup instructions. • **Crop rotation restrictions**: Alfalfa, canola, red clover, sorghum, and sugarbeets rotation interval should be extended to 18 months if drought conditions occur after application, unless irrigation has been used with totals greater than 15 inches during the growing season. Refer to label and Table 12 for crop rotation restrictions. • **Insecticide interaction**: Do not apply *Resolve* to corn previously treated with *Counter 15G* or an in-furrow application of *Counter 20CR*. • See Table 1L for all insecticide interactions.

TABLE 1B — Chemical Weed Control in Imidazolinone-Resistant Corn (Clearfield Corn)

In addition to the herbicide options in Tables 1A, the following herbicides and herbicide combinations may be applied to corn hybrids warranted by the seed company to possess **resistance** to direct application of imidazolinone herbicides. These hybrids are designated as Clearfield Corn. These hybrids vary in cross-resistance to other herbicide families (e.g. sulfonylureas), but they all appear to possess adequate resistance to *Lightning.* The following table describes recommended postemergence treatments with *Lightning.* These treatments may follow a preemergence herbicide for control of several annual grass species. See Table 1A for details.

Imidazolinone-Resistant Corn

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves **Giant foxtail**	imazethapyr + imazapyr *(Lightning)* + 28% liquid nitrogen OR ammonium sulfate + surfactant	0.042 + 0.014	1.28 oz 70DG + 1 qt OR 2.5 lb + 0.25%	• **USE ONLY ON IMIDAZOLINONE-RESISTANT/ TOLERANT CORN (IMI CORN).** • Apply before weeds exceed 4 inches tall and corn exceeds 12 inches tall or 5 collars, whichever is more restrictive. • Refer to Table 1I for weed control and crop tolerance ratings. • *Lightning* should be tank mixed with *Banvel, Clarity, Distinct, Buctril* or atrazine for improved ragweed control. See *Lightning* and tank mix herbicide labels for restrictions. • See practices to prevent/delay herbicide-resistant weeds, pg. 18. • Do not graze or feed treated forage, silage, fodder, or grain for at least 45 days after application. • Do not harvest for 45 days after application. • Do not apply *Pursuit* or *Pursuit Plus* the same year as *Lightning*. • Do not make more than one application of *Lightning* to a field in one growing season. • See Table 1L for insecticide restrictions. • Always add both surfactant and nitrogen fertilizer (28% liquid nitrogen or ammonium sulfate). • Use of crop oil concentrate or methylated seed oil increases the risk of crop injury, especially under cool, wet or hot, humid conditions. • Do not use crop oil concentrate or methylated seed oil with tank mixtures including *Buctril.* • Do not use *Lightning* in combination with products containing flumetsulam, thifensulfuron or rimsulfuron. • Refer to Table 12 for crop rotation restrictions. • Requires a successful field bioassay 40 months after application before planting sugarbeets, cucumbers or tomatoes.

TABLE 1C — Chemical Weed Control in Liberty-Resistant/Liberty Link Corn

In addition to the herbicides in Table 1A, the following herbicides and herbicide combinations may be applied to corn resistant to *Liberty* herbicide. These hybrids are designated as Liberty Link.

Liberty-Resistant Corn

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Annual broadleaves**	glufosinate *(Liberty)* + ammonium sulfate	0.42	32 oz 1.67L + 3.0 lbs	• **APPLY ONLY TO CORN RESISTANT TO LIBERTY HERBICIDE.** • Refer to Table 1I for weed control and crop tolerance ratings. • One application of *Liberty* alone will not consistently provide seasonlong control. One of the following strategies is recommended: 1) Preemergence herbicide application followed by *Liberty* postemergence. Preemergence herbicide options include: – Atrazine (1 lb a.i./A). – Any herbicide or herbicide combination labeled for preemergence application in corn. 2) Postemergence tank mixture with *Liberty.* See label for details. 3) Postemergence *Liberty* application followed by a second herbicide application or cultivation, if needed, 12-14 days after *Liberty* application. • Apply to corn up to 24 inches or V7, whichever comes first. • *Liberty* may be applied with drop nozzles to corn 24-36 inches tall. • **Always add ammonium sulfate**. Surfactant is not needed. • Treat when annual weeds are 2–4 inches tall. • Minimum carrier volume of 15 gallons per acre. • Do not use drift control agents — this reduces spray coverage and may result in reduced weed control. • Do not apply *Liberty* within 60 days of harvesting corn forage or within 70 days of harvesting corn grain. • *Liberty* will not control perennnial weeds. • Application should be made between dawn and 2 hours before sunset to avoid the risk of reduced control of lambsquarters and velvetleaf. • No insecticide interaction restrictions. • Application rate ranges from 28 oz to 32 oz/A. See label. • Refer to Table 12 for crop rotation restrictions.

TABLE 1D — Chemical Weed Control in Glyphosate-Resistant Corn

In addition to the herbicides listed in Table 1A, the following herbicides and herbicide combinations may be applied to Roundup-resistant corn. These hybrids are designated as *Roundup Ready* Corn. Some herbicide labels allow higher in-crop application rates and later application timings on *Roundup Ready II* Corn. See label for details.

Roundup Ready Corn

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Annual broadleaves** **Suppression of perennials**	glyphosate + ammonium sulfate	0.75	See Table 10 + 17 lb/100 gal	• **APPLY TO *ROUNDUP READY* CORN ONLY.** • See Table 10 for glyphosate products labeled for postemergence application on *Roundup Ready* corn. • Refer to Table 1I for weed control and crop tolerance ratings. • One application of glyphosate alone will not consistently provide seasonlong control. One of the following strategies is recommended: 1) Preemergence herbicide application followed by glyphosate postemergence. Preemergence herbicide options include: – atrazine (1 lb a.i./A). – Any herbicide or herbicide combination labeled for preemergence application in corn. 2) Postemergence tank mixture with glyphosate. Refer to glyphosate product label for details. Tank mixtures with some residual herbicides may cause temporary burn, discoloration, or growth reduction. 3) Postemergence glyphosate application followed by a second herbicide application or cultivation, if needed, 12-14 days after glyphosate application. • See Table 10 for recommended additives for glyphosate products. • Apply when annual weeds are 2-4 inches tall. • Apply to corn up to 30 inches or 8 collars. • Application rate can be reduced to 0.56 lb a.e./A if: 1) Spray volume is 3-10 gal/A. 2) Weeds are no more than 4 inches tall. 3) Weeds are actively growing. • A second glyphosate application may be made if needed at a rate up to 0.75 lb a.e./A. Make second application before weeds exceed 4 inches. • Use extreme caution to avoid spray drift to sensitive crops. • Do not apply more than 1.5 lb a.e./A in-crop per season. • Do not harvest for forage within 50 days after application. • Control of perennial broadleaf weeds will be improved with a second application of glyphosate. • **Addition of ammonium sulfate will minimize antagonism from hard water or tank mixtures and is always recommended.** • Refer to Table 12 for crop rotation restrictions.

TABLE 1E — Chemical Weed Control in No-Till Corn

Burndown Herbicides

Effective weed control in no-tillage corn production requires complete control of all weeds, cover crops, and sod plants present at the time of planting. Alfalfa and quackgrass sods must be treated prior to planting. Burndown of annual weeds and cover crops can be accomplished with burndown herbicides. Burndown herbicides such as glyphosate (Table 10) or *Gramoxone Inteon* can be used alone prior to planting to avoid excessive cover crop growth. *Gramoxone Inteon* provides faster kill. Glyphosate (Table 10) may provide better control if weed or cover crop growth is dense. Glyphosate is preferred for perennial weeds or seedling grasses before completion of tillering.

Listed below are specific recommendations for control of legume sod and quackgrass sod. Table 1F contains weed response ratings for several sod species.

For weed control in no-till corn planted into grain stubble or row crop residue (with or without a cover crop), a burndown herbicide must be used. Refer to Table 1G for burndown herbicide options.

Herbicides listed in the Corn–Preemergence and Corn–Postemergence sections may be used in all tillage systems including no-till. For many preemergence herbicides, complete closure of the seed furrow is critical to avoid crop injury.

With preemergence herbicides, many situations require little or no adjustment in application rates. However, dense plant residue and total reliance on herbicides for weed control may require that herbicides be used at the higher end of the labelled rate range for the soil type.

No-Till Corn — Legume Sod

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
FALL application followed by preemergence				
Alfalfa sod **Quackgrass** **Annual broadleaves** **Annual grasses**	glyphosate FOLLOWED BY: atrazine + Burndown (See Table 1G)	1.5 2	See Table 10 2 qt 4L	• Apply glyphosate in fall. • Best timing for treatment is 4-6 weeks after last alfalfa harvest. • Alfalfa should be at least 4 inches tall and actively growing. • Quackgrass, if present, should be at least 8 inches tall and actively growing. • Air temperature should be at least 60°F. • Postemergence *Banvel, Clarity, Distinct* or 2,4-D may be needed to control alfalfa escapes. • *Micro-Tech, Harness, Outlook, Surpass, TopNotch, Degree, Define, Dual Magnum, Dual II Magnum* or *Axiom* may be included if annual grasses are expected to be a serious problem. • If weeds are small, the rate of *Gramoxone Inteon* or glyphosate may be reduced. See label for details. • Mixing, loading, and application setbacks are required for atrazine. See page 11 or label for details.

No-Till Corn — Legume Sod (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
FALL application followed by preemergence				
Alfalfa sod **Annual broadleaves** **Annual grasses**	2,4-D ester FOLLOWED BY:	1.25	1.25 qt 4L	• Apply 2,4-D in fall. • Alfalfa should be at least 4 inches tall and actively growing at treatment time. • Air temperature should be at least 60°F.
	atrazine (commercial product) Burndown (See Table 1G)	2	2 qt 4L OR 2.2 lb 90DG	• Apply atrazine + *Gramoxone Inteon* or glyphosate at planting time. • Postemergence *Banvel/Clarity, Distinct* or 2,4-D may be needed to control alfalfa escapes. • Quackgrass is usually not at the proper state of growth (8 inches tall) for maximum effectiveness from glyphosate treatment at corn planting. (See "Quackgrass" section for notes on glyphosate use.) • *Micro-Tech, Outlook, Harness, Surpass, TopNotch, Degree, Define, Dual II Magnum, Dual Magnum,* or *Axiom* may be included if annual grasses are expected to be a serious problem. • If weeds are small, the rate of *Gramoxone Inteon* or glyphosate may be reduced. See label for details. • Mixing, loading, and application setbacks are required for atrazine. See page 11 or label for details.
SPRING application followed by preemergence				
Alfalfa sod **Annual broadleaves** **Annual grasses**	2,4-D ester	1.25	1.25 qt 4L	• Apply 2,4-D 7-10 days before planting. • Planting of corn must be delayed by 7 and 14 days for rates up to 1 pint and for rates from 1-2 pints/A, respectively. • Alfalfa should be at least 4 inches tall at treatment time.
	FOLLOWED BY:			• Apply atrazine and *Gramoxone Inteon* or glyphosate at planting time.
	atrazine (commercial product) + Burndown (See Table 1G)	2	2 qt 4L OR 2.2 lb 90DG	• Postemergence *Banvel/Clarity, Distinct* or 2,4-D may be needed to control alfalfa escapes. • Quackgrass is usually not at the proper stage of growth (8 inches tall) for maximum effectiveness from glyphosate treatment at corn planting. (See "Quackgrass" section for notes on glyphosate use.) • *Micro-Tech, Outlook, Harness, Surpass, TopNotch, Degree, Define, Dual Magnum, Dual II Magnum* or *Axiom* may be included if annual grasses are expected to be a serious problem. • Mixing, loading, and application setbacks are required for atrazine. See page 11 or label for details.

No-Till Corn — Quackgrass Sod

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
FALL application followed by preemergence				
Alfalfa **Quackgrass** **Annual broadleaves** **Annual grasses**	glyphosate	1.5	See Table 10	• Apply glyphosate in fall. • Quackgrass should be at least 8 inches tall and actively growing. • Air temperature should be at least 60°F.
	FOLLOWED BY:			• *Micro-Tech, Outlook, Harness, Surpass, TopNotch, Define, Degree, Dual Magnum, Dual II Magnum or Axiom* may be included if annual grasses are expected to be a serious problem.
	atrazine (commercial product) + Burndown (See Table 1G)	2	2 qt 4L OR 2.2 lb 90DG	• Mixing, loading, and application setbacks are required for atrazine. See page 11 or label for details.

TABLE 1F — Plant Response to Fall or Spring Herbicides in Sod

	Alfalfa	Red Clover	Hairy Vetch	Dandelion	Curled Dock	Bromegrass	Timothy	Bluegrass	Orchardgrass	Quackgrass
Fall Application[e]										
glyphosate (0.75 lb a.e./A)[ad]	**F-G**	**F-G**	**F-G**	**G**	–	**G**	**G**	**G**	**G**	**G-E**
glyphosate (1.5 lb a.e./A)[bd]	**G-E**	**G-E**	**G-E**	**G**	–	**E**	**E**	**E**	**E**	**E**
2,4-D ester (1.0 lb a.i./A)[c]	**F-G**	**F-G**	F	F	–	N	N	N	N	N
glyphosate (0.75 lb a.e./A)[ad] + 2,4-D ester (1.0 lb a.i./A)[c]	**G**	**G**	**G**	**G**	–	**G**	**G**	**G**	**G**	**G-E**
glyphosate (1.5 lb a.e./A)[bd] + 2,4-D ester (1.0 lb a.i./A)[c]	**G-E**	**G-E**	**G-E**	**G**	–	**E**	**E**	**E**	**E**	**E**
Spring Application[f]										
glyphosate (0.75 lb a.e./A)[ad]	F	F	F	F	P	F	F	**G**	P	**G**
glyphosate (1.5 lb a.e./A)[bd]	**F-G**	**F-G**	**F-G**	F	F	**G**	**G**	**G**	F	**E**
2,4-D ester (1.0 lb a.i./A)[c]	**F-G**	**G**	**F-G**	P	P	N	N	N	N	N
glyphosate (0.75 lb a.e./A)[ad] + 2,4-D ester (1.0 lb a.i./A)[c]	**F-G**	**F-G**	**F-G**	F	P-F	F	F	**G**	P	**G**
glyphosate (1.5 lb a.e./A)[bd] + 2,4-D ester (1.0 lb a.i./A)[c]	**G**	**G**	**G**	F	F	**G**	**G**	**G**	F	**E**

P = Poor; F = Fair; G = Good; E = Excellent; N = None; – = Not enough information to rank

a. Rate for 3 lb a.e./gal glyphosate formulations = 32 fl oz/A.
Rate for 3.7 lb a.e./gal glyphosate formulations = 26 fl oz/A.
Rate for 4.5 lb a.e./gal glyphosate formulations = 22 fl oz/A.
Rate for 65% a.e. glyphosate formulations = 18.5 oz/A.

b. Rate for 3 lb a.e./gal glyphosate formulations = 64 fl oz/A.
Rate for 3.7 lb a.e./gal glyphosate formulations = 52 fl oz/A.
Rate for 4.5 lb a.e./gal glyphosate formulations = 44 fl oz/A.
Rate for 65% a.e. glyphosate formulations = 37 oz/A.

c. Rate for 4 lb a.i./gal 2,4-D ester formulations = 1 qt/A.
Rate for 6 lb a.i./gal 2,4-D ester formulations = 21 fl oz/A.

d. Addition of ammonium sulfate (AMS) at 17 lb/100 gal of water often improves control. Always check label for instructions on the addition of a non-ionic surfactant. See Table 10.

e. Ideal timing is 4-6 weeks after mowing. Mow in late August–early September and treat in early to mid-October in central or southern Michigan.

f. Treat when plants reach at least 6 inches tall.

TABLE 1G — Effectiveness of Herbicides for Spring Burndown in Corn*,**

	ANNUAL BROADLEAVES										ANNUAL GRASSES								WINTER ANNUALS/ PERENNIALS							COVER CROPS			
	Cocklebur	Jimsonweed	Lambsquarters	Nightshade	Pigweed	Ragweed (Common)	Ragweed (Giant)	Smartweed	Velvetleaf	Wild Mustard	Barnyardgrass	Crabgrass	Giant Foxtail	Green Foxtail	Yellow Foxtail	Fall Panicum	Witchgrass	Sandbur	Chickweed (common)	Yellow Rocket	Shepard's purse	Pennycress	Marestail (Horseweed)	Dandelion	Quackgrass	Rye	Wheat	Clover	Hairy Vetch
	Maximum Weed Height (inches)																		Herbicide Effectiveness										
atrazine (1 lb a.i./A)[ab]	2	2	2	2	2	2	2	2	2	2	NR	NR	NR	NR	NR	NR	NR	NR	–	**G**	**E**	**G**	**G**	P	P	P	P	P	P
atrazine (2 lb a.i./A)[ab]	3	3	3	3	3	3	3	3	3	3	NR	NR	NR	1.5	1.5	NR	NR	NR	–	**E**	**E**	**E**	**E**	F	F	F	F	F	F
2,4-D ester (0.5 lb a.i./A)[c]	3	NR	3	3	3	3	3	NR	2	3	NR	NR	NR	NR	NR	NR	NR	NR	P	F	**G**	F	**E**	N	N	N	N	F	F
2,4-D ester (1.0 lb a.i./A)[d]	6	3	6	6	6	6	6	3	5	6	NR	NR	NR	NR	NR	NR	NR	NR	F	**G**	**E**	**G**	**E**	P	N	N	N	**G**	**G**
glyphosate (0.37 lb a.e./A)[ef]	5	2	2	2	5	2	NR	NR	NR	5	NR	–	5	5	5	–	–	–	**E**	**G**	**E**	**G**	**G**	P	P	**G**	**G**	P	P
glyphosate (0.75 lb a.e./A)[eg]	16	10	10	10	16	10	5	5	5	16	5	–	16	16	16	–	–	–	**E**	**E**	**E**	**E**	**E**	F	F	**E**	**E**	F	F
Gramoxone Inteon (2.0 pt/A)[h]	3	3	3	3	3	3	3	NR	3	3	3	3	3	3	3	3	3	3	**E**	**G**	**G**	**G**	P	P	P	F	F	P	P
Gramoxone Inteon (2.5 pt/A)[h]	6	6	6	6	6	6	6	NR	6	6	6	6	6	6	6	6	6	6	**E**	**E**	**E**	**E**	P	P	P	**G**	**G**	F	F
Basis (0.5 oz/A) + 2,4-D ester (0.5 lb a.i./A)[c] + atrazine (1 lb a.i./A)[ab]	3	2	3	3	3	3	3	3	3	3	2	NR	2	2	2	2	–	–	–	**G**	**E**	**G**	**E**	–	F	P	P	F	F

P = Poor; F = Fair; G = Good; E = Excellent; N = None; NR = Not Recommended; – = Not enough information to rank

*Burndown effectiveness varies, depending on several factors. This table is intended as a guide to relative effectiveness of burndown herbicide options. **This table assumes tank mix applications with residual herbicides**.

**To avoid excessive cover crop growth, 2,4-D, *Gramoxone Inteon*, or glyphosate (Table 10) may be applied prior to planting.

a. Always add crop oil concentrate at 1 qt/A to maximize foliar activity.

b. Use of liquid nitrogen fertilizer as the herbicide carrier will improve burndown.

c. Rate for 4 lb a.i./gal 2,4-D ester formulations = 1 pt/A.
Rate for 6 lb a.i./gal 2,4-D ester formulations = 10.5 fl oz/A.

d. Rate for 4 lb a.i./gal 2,4-D ester formulations = 1 qt/A.
Rate for 6 lb a.i./gal 2,4-D ester formulations = 21 fl oz/A.

e. Addition of ammonium sulfate at 17 lbs/100 gal of water often improves control. Always check label for instructions on the addition of a non-ionic surfactant. See Table 10.

f. Rate for 3 lb a.e./gal glyphosate formulations = 16 fl oz/A.
Rate for 3.7 lb a.e./gal glyphosate formulations = 13 fl oz/A.
Rate for 4.5 lb a.e./gal glyphosate formulations = 11 fl oz/A.

g. Rate for 3 lb a.e./gal glyphosate formulations = 32 fl oz/A.
Rate for 3.7 lb a.e./gal glyphosate formulations = 26 fl oz/A.
Rate for 4.5 lb a.e./gal glyphosate formulations = 22 fl oz/A.

h. Always add either a non-ionic surfactant or a crop oil concentrate with *Gramoxone Inteon*. Use either 1 pt of non-ionic surfactant or 1 gallon of crop oil concentrate /100 gal water.

TABLE 1H — Herbicide Premixes in Corn

TRADE NAME	COMPANY	FORMULATION	TYPICAL USE RATE	=	EQUIVALENT RATES
Basis	DuPont	75DG	.33 oz/A	=	0.165 oz a.i. rimsulfuron + 0.33 oz Pinnacle
Bicep Lite II Magnum	Syngenta	6L	1.5 qt/A	=	1.33 pt Dual II Magnum + 1 qt atrazine 4L
Bicep II Magnum	Syngenta	5.5L	2.1 qt/A	=	1.33 pt Dual II Magnum + 1.6 qt atrazine 4L
Buctril + Atrazine	Bayer CropSciences	3L	3 pt/A	=	0.75 qt Buctril 2E + 0.75 qt atrazine 4L
Bullet	Monsanto	4L	3 qt/A	=	1.88 qt Micro-Tech + 1.13 qt atrazine 4L
Camix	Syngenta	3.67L	2.0 qt/A	=	5.36 fl oz Callisto + 1.75 pt Dual II Magnum
Cinch ATZ	DuPont	5.5L	2.1 qt/A	=	1.33 pt Cinch + 1.6 qt atrazine 4L
Cinch ATZ Lite	DuPont	6L	1.5 qt/A	=	1.33 pt Cinch + 1.0 qt atrazine 4L
Celebrity	BASF	Co-pack	6.67 oz/A	=	0.67 oz Accent (Celebrity G) + 0.53 pt Banvel (Celebrity B)
Celebrity Plus	BASF	70DG	4.7 oz/A	=	4.0 oz Distinct + 0.67 oz Accent
Degree Xtra	Monsanto	4L	3 qt/A	=	4.3 pt Degree + 1.0 qt atrazine 4L
Expert	Syngenta	4.88L	3 qts/A		1.37 pt Dual II Magnum + 1.6 qt atrazine 4L + 0.75 lb a.e. glyphosate (See Table 10)
Field Master	Monsanto	4.06L	1 gal/A	=	2.3 pt Harness + 1.5 qt atrazine 4L + 0.56 lb a.e. glyphosate (See Table 10)
Fultime	Dow AgroSciences	4L	2.7 qt/A	=	2 qt TopNotch + 1 qt atrazine 4L
Guardsman Max	BASF	5L	3.5 pt/A	=	16 fl oz Outlook + 1.45 qt atrazine 4L
G-Max Lite	BASF	5L	2.7 ptA	=	16 fl oz Outlook + 0.9 qt atrazine 4L
Harness Xtra	Monsanto	6L	2 qt/A	=	2.5 pt Harness + 0.8 qt atrazine 4L

(continued on next page)

TABLE 1H — Herbicide Premixes in Corn (continued)

TRADE NAME	COMPANY	FORMULATION	TYPICAL USE RATE	=	EQUIVALENT RATES
Harness Xtra 5.6L	Monsanto	5.6L	2 qt/A	=	1.8 pt Harness + 1.25 qt atrazine 4L
Hornet WDG	Dow AgroSciences	68.5WDG	3.0 oz/A	=	0.7 oz Python + 0.25 pt Stinger
Keystone	Dow AgroSciences	5.25L	2.2 qt/A	=	1.65 lb a.i. acetochlor + 1.2 qt atrazine 4L
Keystone LA	Dow AgroSciences	5.5L	2.0 qt/A	=	2.0 lb a.i. acetochlor + 0.75 qt atrazine 4L
Laddok	Sipcam Agro	5L	2.4 pt/A	=	0.75 qt Basagran + 0.75 qt atrazine 4L
Lariat	Monsanto	4L	3 qt/A	=	1.88 qt Lasso + 1.13 qt atrazine 4L
Lexar	Syngenta	3.7L	3 qts/A		1.36 pt Dual II Magnum + 5.34 fl. oz. Callisto + 1.3 qt atrazine 4L
Lightning	BASF	70DG	1.28 oz/A	=	1 oz Pursuit 70DG + 0.22 oz a.i. imazapyr
Lumax	Syngenta	3.95L	2.5 qt/A	=	5.36 fl oz Callisto + 1.75 pt Dual II Magnum + 0.63 qt atrazine 4L
Marksman	BASF	3.2L	3.5 pt/A	=	1 pt dicamba 4L + 1 qt atrazine 4L
Northstar	Syngenta	43.8DG	5 oz/A	=	0.5 oz Beacon + 3.6 fl oz dicamba 4L
Parallel Plus	MANA	5.5L	2.29 qt/A	=	1.55 lb a.i. metolachlor + 1.6 qt atrazine 4L
Priority	Tenkoz	62.5DG	1.0 oz/A	=	0.53 fl. oz. Aim EW + 0.75 oz. Permit
Shotgun	United Agri Products	3.25L	1 qt/A	=	0.56 qt atrazine 4L + 0.5 pt 2,4-D ester
Stalwart Xtra	Sipcam Agro	5.5L	2.1 qt/A	=	1.3 pt Stalwart C + 1.6 qt atrazine 4L
Steadfast	DuPont	75WDG	0.75 oz/A	=	0.5 oz Accent + 0..75 oz Resolve
Steadfast ATZ	DuPont	89.3WDG	14 oz/A	=	0.75 oz Steadfast + 0.83 lb atrazine 90 DF
Stout	DuPont	72.5WDG	0.75 oz/A	=	0.675 oz Accent + 0.05 oz Harmony GT 75%
Volley ATZ	Tenkoz	5.25L	2.2 qt/A	=	1.0 qt Volley + 1.2 qt atrazine 4L
Volley ATZ Lite	Tenkoz	5.5L	2.0 qt/A	=	1.25 qt Volley + 0.75 qt atrazine 4L
Yukon	Gowan	67.5WDG	4.0 oz/A	=	4.4 fl oz dicamba 4L + 0.66 oz Permit

TABLE 1I — Weed Response to Herbicides in Corn*

			ANNUAL BROADLEAVES											ANNUAL GRASSES								PERENNIALS				
Soil Applied	SITE OF ACTION	CORN TOLERANCE**	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	T-R LAMBSQUARTERS[a]	NIGHTSHADE (E. BLACK)	PIGWEED (REDROOT)	RAGWEED (COMMON)	RAGWEED (GIANT)	SMARTWEED	VELVETLEAF	WILD MUSTARD	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE	JOHNSONGRASS (seedling)	JOHNSONGRASS (Rhizome)
ALS Inhibitors																										
PYTHON	**B**	3	F	F	**E**	**E**	**G**	**E**	F	P	**G**	**G**	**E**	P	P	P	P	P	P	P	P	N	N	N	N	N
RESOLVE	B	1	**G**	F	F	F	P	**E**	F	—	F	F	**E**	**G**	F	**G**	**G**	**G**	F	F	—	P	P	P	—	—
Photosynthesis Inhibitors																										
ATRAZINE	**C**	1	F	F	**E**	N	**E**	**G**	**E**	**G**	**G**	F	**E**	**G**	P	F	F	**G**	P	P	P	F	F	F	N	N
PRINCEP/SIM-TROL	**C**	1	F	F	**E**	N	**E**	**G**	**E**	F	**G**	F	**E**	**G**	F	F	F	**G**	P	P	P	P	F	F	N	N
Others																										
CALLISTO (Pre only)	O	1	P	–	**E**	**E**	**E**	**E**	F	F	**E**	**E**	–	N	P	N	N	N	N	N	N	P	N	N	N	N
DEFINE	O	2	N	N	P	P	F	**G**	P	N	P	N	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	P[b]	P	N
DUAL II MAGNUM/CINCH	O	1	N	N	P	P	F	**G**	P	N	P	N	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	F[b]	P	N
HARNESS/SURPASS/TOPNOTCH/ DEGREE/VOLLEY	O	2	P	N	F	F	**G**	**G**	F	N	P	P	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	F[b]	P	N
MICRO-TECH	O	2	N	N	P	P	**G**	**G**	P	N	P	N	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	P[b]	P	N
OUTLOOK	O	2	N	N	P	P	**G**	**G**	P	N	P	N	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	F[b]	P	N
PROWL/PENDIMAX/PROWL H_20 (Pre only)	O	3	N	N	**E**	**E**	P	F	P	N	P	F	P	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	N	N	N	P	N
STALWART C/PARALLEL	O	1	N	N	P	P	F	**G**	P	N	P	N	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	F[b]	P	N
Premixes and Tank Mixes																										
AXIOM	O/**C**	3	P	P	**G**	–	F	**E**	F	P	**G**	F	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	P	P	N
HORNET WDG	**B**/O	3	**G**	F	**E**	**E**	**G**	**E**	**E**	**G**	**G**	**G**	**E**	N	N	N	N	N	N	N	N	F	N	N	N	N

Herbicide Site of Action: A = ACCase Inhibitor; B = ALS Inhibitor; C = Photosynthesis Inhibitor; O = Other

Herbicide Effectiveness: P = Poor; F = Fair; G = Good; E = Excellent; N = None; – = Not enough information to rank

**The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.*

**Crop Tolerance: 1=Minimal risk of crop injury; 2=Crop injury can occur under certain conditions (soil applied—cold, wet: foliar applied—hot, humid); 3=Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4=Risk of severe crop injury is high. Recommended only in rescue situations.

[a]Triazine-resistant lambsquarters

[b]Control of yellow nutsedge will be increased if the treatment is incorporated in the top 2 to 3 inches of soil.

TABLE 1I — Weed Response to Herbicides in Corn* (continued)

			ANNUAL BROADLEAVES											ANNUAL GRASSES								PERENNIALS				
Postemergence	SITE OF ACTION	CORN TOLERANCE**	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	T-R LAMBSQUARTERS[a]	NIGHTSHADE (E. BLACK)	PIGWEED (REDROOT)	RAGWEED (COMMON)	RAGWEED (GIANT)	SMARTWEED	VELVETLEAF	WILD MUSTARD	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE	JOHNSONGRASS (seedling)	JOHNSONGRASS (Rhizome)
ALS Inhibitors																										
ACCENT	**B**	2	F	**G**	F	F	P	**E**	P	N	**G**	F	–	**E**	P	**E**	**E**	**E**	**E**	**E**	**G**	F	**G**	F	**E**	**G**
BEACON	**B**	2	**E**	**G**	F	F	**G**	**E**	**E**	**E**	**G**	**G**	F	P	P	F	F	F	**G**	**G**	F	F	**G**	F	**G**	F
EQUIP	**B**	3	**G**	**G**	**G**	**G**	**G**	**E**	F	F	F	F	–	**E**	P	**G**	**G**	**G**	**G**	**G**	F	F	**G**	F	**E**	**G**
LIGHTNING (Clearfield Corn only)[b]	**B**	2	**E**	**G**	F	F	**G**	**E**	F	F	**G**	**G**	**G**	F	F	**G**	F	F	F	F	F	F	P	F	**G**	**G**
OPTION	**B**	3	F	**G**	F	F	**G**	**E**	F	P	–	F	–	**E**	P	**G**	**G**	**G**	**G**	**G**	F	F	**G**	F	**E**	**G**
PERMIT	**B**	1	**E**	**G**	N	N	P	**E**	**G**	**G**	F	**G**	–	N	N	N	N	N	N	N	N	P	N	**E**	N	N
RESOLVE	**B**	1	**G**	P	F	F	F	**E**	F	—	F	F	**E**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	P	F	**G**	F	—	—
STEADFAST	**B**	3	F	**G**	F	F	P	**E**	P	N	**G**	F	–	**E**	F[d]	**E**	**E**	**E**	**E**	**E**	**G**	F	**G**	F	**E**	**G**
STOUT	**B**	3	F	**G**	**G**	**G**	P	**E**	P	P	**E**	**G**	**E**	**E**	P	**E**	**E**	**E**	**E**	**E**	**G**	F	**G**	F	**E**	**G**
Photosynthesis Inhibitors																										
ATRAZINE	**C**	1	**G**	**G**	**E**	N	**G**	**E**	**E**	**G**	**G**	F	**E**	F	P	F	**G**	**G**	P	P	P	F	F	F	N	N
Others																										
AIM	O	3	P	–	F	F	**G**	**G**	P	P	P	**E**	–	N	N	N	N	N	N	N	N	N	N	N	N	N
BANVEL/CLARITY	O	3	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**E**	**E**	F	**G**	N	N	N	N	N	N	N	N	F	N	N	N	N
BASAGRAN	O	1	**E**	**G**	F	F	P	P	F	P	**G**	F	**E**	N	N	N	N	N	N	N	N	**G**	N	**G**	N	N
BUCTRIL/MOXY/OTHERS	O	2	**G**	**G**	**E**	**E**	**G**	F	**G**	**G**	**G**	**G**	F	N	N	N	N	N	N	N	N	P	N	N	N	N
CALLISTO	O	2	F	–	**E**	**E**	**E**	**G**	**G**	**G**	**E**	**E**	–	N	F[d]	N	N	N	N	N	N	P	N	P	N	N
DISTINCT	O	3	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**E**	**E**	**G**	**G**	P	P	P	P	P	P	P	P	**G**	N	N	N	N
GLYPHOSATE (RR Corn only)[ce]	O	1	**E**	**E**	**G**	**G**	**G**	**E**	**G**	**G**	**G**	**G**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**E**	F	**E**	**E**
Post corn																										
IMPACT	O	1	**G**	**E**	**E**	**E**	**E**	**E**	**G**	F	**E**	**E**	P	F	P	P	P	P	P	N	N	—	N	N	—	N
LIBERTY (Liberty Resistant Corn only)[c]	O	1	**E**	**G**	F	F	**G**	**G**	**E**	**G**	**G**	**G**	**E**	F	F	**G**	**G**	F	F	F	P	P	P	P	**G**	F
RESOURCE	O	2	P	P	F	F	P	P	P	P	P	**E**	P	N	N	N	N	N	N	N	N	N	N	N	N	N
STINGER	O	1	**E**	**G**	P	P	F	P	**E**	**E**	F	P	P	N	N	N	N	N	N	N	N	**E**	P	N	N	N
2, 4-D AMINE	O	3	**G**	F	**G**	**G**	**G**	**G**	**G**	**G**	P	F	**G**	N	N	N	N	N	N	N	N	F	N	N	N	N
Premixes and Tank Mixes																										
BANVEL + ATRAZINE (MARKSMAN)	O/**C**	3	**G**	**G**	**E**	**G**	**G**	**E**	**E**	**E**	**E**	**G**	**E**	P	P	P	F	F	P	P	P	F	P	F	N	N
BASAGRAN + ATRAZINE (LADDOK)	O/**C**	1	**E**	**G**	**G**	F	F	**G**	**E**	**G**	**G**	**G**	**E**	P	P	P	F	F	P	P	P	F	P	**G**	N	N
BUCTRIL + ATRAZINE	O/**C**	2	**G**	**G**	**E**	**E**	**G**	**G**	**E**	**E**	**G**	**G**	**G**	P	P	P	F	F	P	P	P	P	P	F	N	N
HORNET WDG	**B**/O	2	**E**	F	F	F	F	P	**E**	**E**	**G**	**G**	**G**	N	N	N	N	N	N	N	N	**E**	N	N	N	N

Herbicide Site of Action: A = ACCase Inhibitor; B = ALS Inhibitor; C = Photosynthesis Inhibitor; O = Other

Herbicide Effectiveness: P = Poor; F = Fair; G = Good; E = Excellent; N = None; – = Not enough information to rank

**The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.*

**Crop Tolerance: 1=Minimal risk of crop injury; 2=Crop injury can occur under certain conditions (soil applied—cold, wet: foliar applied—hot, humid); 3=Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4=Risk of severe crop injury is high. Recommended only in rescue situations.

[a] Triazine-resistant lambsquarters

[b] Apply to Clearfield Corn only.

[c] Must add nitrogen fertilizer for velvetleaf control.

[d] Large crabgrass only.

[e] For consistent velvetleaf control, treat before plants exceed 4 inches.

TABLE 1J — Weed and Crop Heights for Postemergence Herbicide Applications in Corn*

Herbicide[b]		ANNUAL BROADLEAVES											ANNUAL GRASSES								CORN	
		COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	T-R LAMBSQUARTERS[c]	NIGHTSHADE (E. BLACK)	PIGWEED (REDROOT)	RAGWEED (COMMON)	RAGWEED (GIANT)	SMARTWEED	VELVETLEAF	WILD MUSTARD	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	MINIMUM[a] HEIGHT	MAXIMUM[a] HEIGHT
	RATE/A	MAXIMUM HEIGHT[a]											MAXIMUM HEIGHT[a]									
Broadcast																						
Accent	0.67 oz	NR	3"	NR	NR	NR	4"	NR	NR	4"	NR	–	4"	NR	4"	4"	4"	4"	4"	3"	None	20" or 6 collars
Aim EW	0.33 oz/0.5 fl oz	NR	–	NR	NR	4"	4"	NR	NR	NR	36"	–	NR	NR	NR	NR	NR	NR	NR	NR	None	8 collars
Atrazine 4L	2 qt	4"	4"	6"	NR	4"	6"	4"	4"	4"	NR	4"	NR	NR	NR	1½"	1½"	NR	NR	NR	None	12"
Banvel/Clarity	1 pt	4"	4"	4"	4"	4"	4"	4"	4"	6"	NR	2"	NR	NR	NR	NR	NR	NR	NR	NR	None	8" or 5 lf
Banvel + atrazine 4L	1 pt + 2 pt	6"	6"	6"	4"	6"	6"	6"	6"	8"	6"	6"	NR	NR	NR	NR	NR	NR	NR	NR	None	8" or 5 lf
Basagran	2 pt	10"	10"	NR	NR	NR	NR	NR	NR	10"	NR	8"	NR	NR	NR	NR	NR	NR	NR	NR	None	None
Basagran + atrazine 4L	1.4 pt + 1.4 pt	8"	8"	8"	NR	NR	6"	5"	6"	12"	10"	8"	NR	NR	NR	NR	NR	NR	NR	NR	None	12"
Beacon	.76 oz	4"	4"	NR	NR	4"	4"	9"	9"	4"	4"	NR	NR	NR	NR	NR	NR	2"	2"	NR	4"	20"
Buctril, Moxy, others	1.5 pt	10"	6"	8"	8"	6"	NR	6"	6"	6"	5"	NR	NR	NR	NR	NR	NR	NR	NR	NR	None	d
Buctril + atrazine	1.5 pt + 1.5 pt	12"	6"	12"	8"	6"	6"	6"	10"	8"	6"	4"	NR	NR	NR	NR	NR	NR	NR	NR	None	12"
Callisto	3 fl oz	NR	NR	5"	5"	5"	5"	3"	3"	5"	5"	NR	NR	NR	NR	NR	NR	NR	NR	NR	None	30" or 8 collars
Distinct	6 oz	4"	4"	4"	4"	4"	4"	4"	4"	6"	4"	2"	NR	NR	NR	NR	NR	NR	NR	NR	4"	10"
Equip	1.5 oz	4"	4"	4"	4"	4"	4"	NR	NR	NR	NR	NR	4"	NR	3"	3"	3"	3"	3"	NR	None	4 collars or 12"
Hornet WDG	3.0 oz	6"	NR	NR	NR	NR	NR	6"	6"	6"	6"	6"	NR	NR	NR	NR	NR	NR	NR	NR	None	20" or 6 collars
Impact	0.5 oz	5"	4"	4"	4"	4"	4"	4"	5"	2"	5"	4"	4"	3"	4"	3"	3"	3"	--	--	none	45 days before harvest
Liberty (Liberty Link only)	24 fl oz	4"	4"	NR	NR	2"	3"	4"	4"	4"	3"	4"	2"	2"	4"	4"	2"	2"	2"	NR	None	24" or 7 collars
Lightning (Clearfield Corn only)	1.28 oz	4"	3"	3"	3"	3"	6"	NR	NR	3"	3"	–	2"	2"	4"	2"	2"	2"	2"	2"	None	12" or 5 collars
Option	1.5 oz	NR	3"	NR	NR	4"	3"	NR	NR	NR	NR	NR	4	NR	3	3	3	3	3	NR	None	6 collars or 16"
Permit	0.67 oz	9"	6"	NR	NR	NR	3"	9"	3"	NR	6"	–	NR	NR	NR	NR	NR	NR	NR	NR	None	canopy closure
Resolve	1.0 oz	3"	NR	NR	NR	NR	3"	NR	--	NR	NR	3"	2"	0.5"	2"	2"	2"	2"	--	--	none	12" or 5 collars
Resource	4 fl oz	NR	NR	NR	NR	NR	NR	NR	NR	NR	5 lf	NR	NR	NR	NR	NR	NR	NR	NR	NR	2 lf	10 collars or canopy closure
glyphosate (RR Corn only)	0.56 lb a.e.	6"	6"	3"	3"	4"	4"	4"	6"	4"	4"	6"	6"	4"	6"	6"	6"	6"	6"	6"	None	30" or 8 collars
Steadfast	0.75 oz	NR	4"	NR	NR	NR	4"	NR	NR	3"	NR	NR	4"	NR	4"	4"	4"	4"	4"	2"	None	20" or 6 collars
Stinger	0.25 pt	5 lf	5 lf	NR	NR	NR	NR	5 lf	5 lf	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	None	24"
Stout	0.75 oz	NR	3"	4"	4"	NR	4"	NR	NR	4"	4"		4"	NR	4"	4"	4"	3"	6"	3"	4"	16" or 5 collars
2,4-D amine	1 pt	4"	NR	4"	4"	4"	4"	4"	4"	NR	NR	4"	NR	NR	NR	NR	NR	NR	NR	NR	None	8"

[a] NR = not recommended; – = not enough information to rank; lf = leaf stage.

[b] Consult label for recommended additives.

[c] Triazine-resistant lambsquarters.

[d] Before tassel emergence.

*The weed heights and growth stages listed in this table are estimates of the maximum size where consistent control is expected. The maximum height for effective control in any specific situation is dependent on environment conditions, including soil moisture, temperature, and relative humidity.

Table 1K - Delayed Herbicide Application in Corn

Preemergence herbicides should be applied as soon after planting as possible. Delayed application increases the risk of poor herbicide performance, especially for grass control. This table lists herbicides commonly applied preemergence that are also labelled for application after corn emergence. Tank mix combinations are not included in the table. All the herbicide treatments should be applied with water as the carrier. Applying herbicides to emerged corn with 28% liquid nitrogen fertilizer as the carrier poses a risk of severe crop injury. Refer to the herbicide labels for information on application rates and specific restrictions for tank mixtures.

Herbicide	**Maximum Corn Stage**
Axiom, Princep, Sim-Trol	Before corn emergence
Python	2 inches (before the first leaf is unfurled)
Bicep II Magnum, Cinch ATZ, Bicep Lite II Magnum, Cinch ATZ Lite, Bullet, Micro-Tech, Stalwart Xtra	5 inches
Define	5 collars
Degree, Degree Xtra, Harness, Harness Xtra, Harness Xtra 5.6L, Fultime, Surpass, TopNotch, Keystone, Keystone LA, Volley, Volley ATZ, Volley ATZ Lite	11 inches
Atrazine	12 inches
Lexar, Lumax	12 inches
Outlook	12 inches
Guardsman Max, G-Max Lite	12 inches
Resolve	12 inches or 5 collars
Hornet WDG	20 inches or 6 collars
Callisto, Camix	30 inches or 8 collars
Prowl, Prowl H2O	30 inches or 8 collars
Dual II Magnum, Cinch, Stalwart C	40 inches
Pendimax (tank mix)	Based on tank mix partner (see label)
Stalwart C (tank mix)	Based on tank mix partner (see label)

TABLE 1L —Herbicide: Organophosphate Insecticide Compatibility Chart for Conventional and Clearfield Corn

Herbicide	Soil applied OPs[1] Counter 15G	Soil applied OPs[1] Counter 20CR (in furrow)	Soil applied OPs[1] Counter 20CR (banded)	Foliar applied OPs[4] Thimet/ phorate	Foliar applied OPs[4] Lorsban	Foliar applied OPs[4] Other[2]	Days before herbicide[5]	Days after herbicide[6]
Accent	Do not use	Do not use	NR	T	T	T	7	3
Beacon	Do not use	Do not use	NR	T	T	T	10	7
Callisto (foliar applied)	Do not use	Do not use	NR	NR	T	T	7	7
Equip	Do not use	Do not use	Do not use	Do not use	T	T	7	7
Hornet WDG (soil applied)	Do not use	Do not use	Do not use	Do not use	T[3]	T[3]	NA	NA
Hornet WDG (foliar applied)	Do not use	Do not use	Do not use	Do not use	T[3]	T[3]	10	10
Lightning (Clearfield Corn only)	Do not use	Do not use	T[3]	T[3]	T[3]	T[3]	—	—
Option	Do not use	Do not use	Do not use	Do not use	T	T	7	7
Resolve	Do not use	Do not use	NR	NR	NR	T	7	3
Steadfast	Do not use	Do not use	NR	NR	NR	T	7	3
Stout	Do not use	Do not use	NR	NR	NR	T	7	3

[1] Do not use = do not apply herbicide to corn previously treated with soil-applied OP insecticide — severe injury may result; NR = application of herbicide to corn previously treated with soil-applied OP is not recommended; T = application of herbicide to corn previously treated with soil-applied OP may result in temporary injury; — = no information or not applicable; NA = not applicable.

[2] Includes diazinon and *Mocap. Aztec* and *Fortress* do not appear to interact with the herbicides listed and can be used without risk of injury.

[3] OP insecticides should be applied in a band treatment to reduce risk of crop injury.

[4] Includes dimethoate, diazinon, *Imidan, Lorsban,* malathion, and *Penncap.* Also includes the herbicides *Basagran* and *Laddok.*

[5] Foliar-applied OP may be safely applied this many days *before* herbicide treatment.

[6] Foliar-applied OP may be safely applied this many days *after* herbicide treatment.

TABLE 2A –Chemical Weed Control in Soybeans

Soybeans — Preplant Incorporated Only

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	trifluralin *(commercial product)*	0.75	1.5 pt 4EC	• Refer to Table 2F for weed control and crop tolerance ratings. • Incorporate in top 2 or 3 inches of soil within 24 hr. after application. • On sandy and sandy loam soils low in organic matter, use 0.5 lb a.i./A (1 pt/A). • Most effective control if application is made 10 days to 2 weeks ahead of planting and field is reworked just prior to planting. • Refer to label and Table 12 for crop rotation restrictions.
	ethalfluralin *(Sonalan HFP)*	0.9	2.5 pt 3EC	• Refer to Table 2F for weed control and crop tolerance ratings. • Incorporate in top 2 or 3 inches of soil within 2 days of application. • Refer to label and Table 12 for crop rotation restrictions.

Soybeans — Soil Applied — All Tillage Systems

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Yellow nutsedge**	alachlor *(IntRRo)* OR (*Micro-Tech)*	2	2 qt 4EC 2 qt 4ME	• **May be applied preplant incorporated or preemergence**. • Refer to Table 2F for weed control and crop tolerance ratings. • Alachlor rate should be increased to 2.5 qt/A for effective nutsedge control and 3 qt/A for effective nightshade control. • Nutsedge control is improved when alachlor is incorporated. • Refer to label and Table 12 for crop rotation restrictions.
	s-metolachlor *(Dual Magnum, Dual II Magnum, Cinch)*	1.27	1.33 pt 7.64EC	• **May be applied preplant incorporated or preemergence**. • Refer to Table 2F for weed control and crop tolerance ratings. • *Dual Magnum*, *Dual II Magnum* or *Cinch* rate should be increased to 1.66 pt/A for effective nutsedge control. • Nutsedge control is improved when s-metolachlor is incorporated. • Refer to label and Table 12 for crop rotation restrictions.

(Continued on next page)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses **Yellow nutsedge**	metolachlor *(Parallel, Parallel PCS Stalwart)*	1.3	1.33 pt 7.8L 1.33 pt 8.0L	• **May be applied preplant incorporated or preemergence.** • **Advisory statement:** *Stalwart/Parallel/Parallel PCS* is a mix of the R and S-isomers of metolachlor. Limited research has shown that *Stalwart/Parallel/Parallel PCS* at 1.33 pt/A provides similar activity to *Dual Magnum/Dual II Magnum/Cinch* (s-metolachlor) at 1.33 pt/A. However, *Stalwart/Parallel/Parallel PCS* may not provide the consistency, length of control or performance on more difficult to control weeds when compared with *Dual Magnum/ Dual II Magnum/Cinch* (s-metolachor) at 1.33 pt/A. *Stalwart/Parallel/Parallel PCS* rates would need to be increased to 2.0 pt/A to provide the same amount of s-metolachlor (the more active isomer) at the 1.33 pt/A rate of *Dual Magnum/Dual II Magnum/Cinch* (s-metolachlor). • Refer to Table 2F for weed control and crop tolerance ratings. • Refer to label and Table 12 for crop rotation restrictions.
	dimethenamid-P *(Outlook)*	0.84	18 oz 6L	• **May be applied preplant incorporated or preemergence.** • Refer to Table 2F for weed control and crop tolerance ratings. • *Outlook* rate should be increased to 21 oz/A for effective nutsedge control. • Nutsedge control is improved when *Outlook* is incorporated. • *Outlook* rates vary with soil texture and organic matter. • *Outlook* may be applied early postemergence on soybeans from the first to third trifoliate, but this application will not control emerged weeds. • Refer to label and Table 12 for crop rotation restrictions.
Annual grasses	flufenacet + metribuzin *(Axiom)*	0.55	13 oz 68DF	• **May be applied preplant incorporated or preemergence.** • Refer to Table 2F for weed control and crop tolerance ratings. • See Table 2E for individual product rate equivalents for the premix. • *Axiom* rates labeled for use in soybeans are too low to provide season-long annual grass control. • DO NOT apply *Axiom* to coarse-textured soils where the water table is shallow or to sites that are vulnerable to surface water contamination. • Refer to label and Table 12 for crop rotation restrictions.
	flufenacet *(Define)* OR *(Define SC)*	0.45	12 oz 60DF OR 14.4 oz 4SC	• **May be applied preplant incorporated or preemergence**. • Refer to Table 2F for weed control and crop tolerance ratings. • *Define* rates labeled for use in soybeans are too low to provide season-long annual grass control. • DO NOT apply *Define* to coarse-textured soils where the water table is shallow or to sites that are vulnerable to surface water contamination. • Refer to label and Table 12 for crop rotation restrictions.
	pendimethalin *(Prowl/Pendimax)* OR *(Prowl H_2O)*	1 0.95	2.4 pt 3.3EC OR 2.0 pt 3.8ASC	• **May be applied preplant incorporated or preemergence**. • Refer to Table 2F for weed control and crop tolerance ratings. • Preemergence applications may be made up to 2 days after planting. • DO NOT apply after soybean cracking or emergence. • Applications close to or after planting may result in soybean injury, including stem swelling and brittleness. Early preplant or preplant incorporated applications reduce the risk of injury. • Refer to label and Table 12 for crop rotation restrictions.

Soybeans — Soil Applied — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses, Velvetleaf, Lambsquarters	clomazone *(Command 3ME)*	0.75	2 pt 3ME	• **DO NOT apply preplant incorporated.** • Refer to Table 2F for weed control and crop tolerance ratings. • Poor weed control will result if *Command 3ME* is incorporated. • Several ornamental, horticultural and agronomic crops are sensitive to *Command* spray drift and volatilization. • Precautions should be taken to avoid spray drift. • DO NOT apply *Command* within 1,200 ft. of housing developments, commercial fruit and vegetable production, and greenhouses. • DO NOT apply in winds above 10 mph or at pressures above 30 PSI. • **Special precaution:** A special sprayer clean-out procedure is required for *Command 3ME*. See label for specific instructions. • Refer to label and Table 12 for crop rotation restrictions.
Annual grasses **Annual broadleaves** (EXCEPT nightshade)	flufenacet + metribuzin *(Domain)*	0.375	10 oz 60DF	• **May be applied preplant incorporated or preemergence**. • Refer to Table 2F for weed control and crop tolerance ratings. • See Table 2E for individual product rate equivalents for the premix. • *Domain* may be applied at broadcast use rates of 9-16 oz/A. • DO NOT use if soil pH is greater than 7.5, or if soil organic matter is less than 0.5%, or on sands with less than 1.0% organic matter. • DO NOT apply *Domain* to coarse-textured soils where the water table is shallow or to sites that are vulnerable to surface water contamination. • Some soybean varieties have low tolerance to metribuzin and should not be planted. Consult product label, MSUE, or agribusiness for a listing of varieties. • *Domain* will provide 3-6 weeks of weed control. Increase application rate, use tank mixtures, or use in a sequential herbicide program to increase the length of control. • Refer to label and Table 12 for crop rotation restrictions.
Annual grasses, **Annual broadleaves** (EXCEPT cocklebur, jimsonweed)	imazethapyr + pendimethalin *(Pursuit Plus)*	0.9	2.5 pt 2.9EC	• **May be applied preplant incorporated or preemergence**. • Refer to Table 2F for weed control and crop tolerance ratings. • See Table 2E for individual product rate equivalents for the premix. • Common ragweed may only be suppressed. • Preemergence applications may be made up to 2 days after planting. • DO NOT apply after soybean cracking or emergence. • Applications close to or after planting may result in soybean injury, including stem swelling and brittleness. Early preplant or preplant incorporated applications reduce the risk of injury. • Refer to label and Table 12 for crop rotation restrictions.

Soybeans — Soil Applied — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses, Annual broadleaves (EXCEPT jimsonweed)	s-metolachlor + metribuzin *(Boundary 6.5EC))*	1.22	1.5 pt 6.5EC	• **May be applied preplant incorporated or preemergence**. • Refer to Table 2F for weed control and crop tolerance ratings. • See Table 2E for individual product rate equivalents for the premix. • *Boundary 6.5EC* may be applied at broadcast use rates of 1.25-2.4 pt/A. • Product rates depend on soil texture, organic matter, pH, and desired length of control. • Some soybean varieties have low tolerance to metribuzin and should not be planted. Consult product labels, MSUE, or agribusiness for a listing of varieties. • DO NOT use on sands or soils with less than 0.5% organic matter. DO NOT use on loamy sand soils with less than 2% organic matter. • On soils with pH above 7.0, use the 1.5 pt/A rate only of *Boundary 6.5EC*. • *Boundary* will provide 3-6 weeks of weed control. Increase application rate, use tank mixtures or use in a sequential herbicide program to increase the length of control. • Refer to label and Table 12 for crop rotation restrictions.
Annual grasses, Annual broadleaves	s-metolachlor + fomesafen *(Prefix CP)*	1.0 0.25	1.1 pt 7.64EC 1 pt 2L	• **Apply preemergence only.** • Refer to Table 2F for weed control and crop tolerance ratings. • Co-pack of *Prefix* (s-metolachlor) + *Reflex* (fomesafen). See Table 2E for individual product rate equivalents for the co-pack. • *Prefix CP* will provide 4-5 weeks of control and/or suppression of both broadleaf and grass weeds. • Sequential herbicide programs are needed to increase the spectrum of weed control and for season-long control. • Refer to Table 12 for crop rotation restrictions.
Annual broadleaves (EXCEPT nightshade)	metribuzin *(Sencor)*	0.375	5.33 oz 75DF	• **May be applied preplant incorporated or preemergence**. • Refer to Table 2F for weed control and crop tolerance ratings. • Product rates depend on soil texture, organic matter and pH. • DO NOT use if soil pH is greater than 7.5, or if soil organic matter is less than 0.5%, or on course-textured soils with less than 2.0% organic matter. • Some soybean varieties have low tolerance to metribuzin and should not be planted. Consult product labels, MSUE or agribusiness for a listing of varieties. • Tank mixtures or prepackaged herbicide mixes are needed for eastern black nightshade and annual grass control. • *Sencor* will not control triazine-resistant weed species. • Refer to label and Table 12 for crop rotation restrictions.

(Continued on next page)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves (EXCEPT nightshade)	cloransulam-methyl *(FirstRate)*	0.031	0.6 oz 84DG	• **May be applied preplant incorporated or preemergence**. • Refer to Table 2F for weed control and crop tolerance ratings. • Excellent common and giant ragweed control. • Product rate depends on soil organic matter. If soil organic matter is greater than 3.0%, *FirstRate* can be applied at 0.75 oz/A. • The cumulative application rate may not exceed 1.05 oz/A per season. • Tank mixtures or prepackaged herbicide mixes are needed for easterm black nightshade and annual grass control. • *FirstRate* will not control ALS-resistant weed species. • Refer to label and Table 12 for crop rotation restrictions.
	chlorimuron-ethyl + metribuzin *(Canopy)*	0.14	3 oz 75DF	• **May be applied preplant incorporated or preemergence.** • Refer to Table 2F for weed control and crop tolerance ratings. • See Table 2E for individual product rate equivalents for the premix. • *Canopy* use rates range between 2.25 and 4 oz/A. • DO NOT apply *Canopy* at rates greater than 2.25 oz/A to soils with a composite pH greater than 7.0; use of higher rates may result in unacceptable injury to this year's crop and the following crop. • DO NOT apply *Canopy* to soils with a composite pH exceeding 7.6. • Tank mixtures or sequential herbicide programs are needed to increase the spectrum of weed control. • Rotation intervals are dependent on soil pH and rate. Refer to label and Table 12 for crop rotation restrictions.
	chlorimuron-ethyl + thifensulfuron methyl *(Synchrony XP)*	0.027	1.5 oz 28.4DG	• **May be applied preplant incorporated or preemergence.** • Refer to Table 2F for weed control and crop tolerance ratings. • See Table 2E for individual product rate equivalents for the premix. • *Synchrony XP* use rates range between 1 and 3 oz/A; use a minimum of 1.25 oz/A for residual control or suppression of labeled weeds. • DO NOT apply *Synchrony XP* at rates greater than 1 oz/A to soils with a composite pH between 7.1 and 7.6; use of higher rates may result in unacceptable injury to the following crop. • DO NOT apply to soils with a composite pH exceeding 7.6. • Tank mixtures or sequential herbicide programs are needed to increase the spectrum of weed control. • *Synchrony XP* will not control ALS-resistant weed species. • Rotation intervals are dependent on soil pH and rate. Refer to label and Table 12 for crop rotation restrictions.
Annual broadleaves (FAIR on nightshade)	linuron *(Lorox DF)* OR *(Linex)*	0.75	1.5 lb 50DF OR 1.5 pt 4L	• **DO NOT apply preplant incorporated.** • Refer to Table 2F for weed control and crop tolerance ratings. • If heavy rainfall occurs soon after application, injury to the crop may result. • DO NOT use on coarse-textured sandy or sandy loam soils or on soils with less than 1% organic matter. • Plant soybeans at least 1.75 inches deep. • Tank mixtures or sequential herbicide programs are needed to increase the spectrum of weed control. • Refer to label and Table 12 for crop rotation restrictions.

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves (including nightshade)	flumetsulam *(Python WDG)*	0.057	1.14 oz 80DG	• **May be applied preplant incorporated or preemergence**. • Refer to Table 2F for weed control and crop tolerance ratings. • Adjust application rate according to soil type and organic matter. • DO NOT apply to areas where soil pH is greater than 7.8 or to soils with greater than 5% organic matter and pH less than 5.9. • Tank mixtures or sequential herbicide programs are needed to improve control of ragweed, cocklebur and jimsonweed. • *Python* will not control ALS-resistant weed species. • Refer to label and Table 12 for crop rotation restrictions.
	imazaquin *(Scepter)*	0.125	2.8 oz 70DG	• **May be applied preplant incorporated or preemergence**. • Refer to Table 2F for weed control and crop tolerance ratings. • DO NOT plant CORN (unless it is a Clearfield hybrid) following *Scepter* application except in the southern two tiers of counties in Michigan and if 15 inches of rainfall occurs. • Rainfall is critical for rotational crops (see label); the recropping count should start at soybean planting. Refer to label and Table 12 for crop rotation restrictions. • Soybean stunting (shortening of internodes) may occur on sandy soils. • Common ragweed control is best when *Scepter* is applied preemergence. However, eastern black nightshade and velvetleaf control are better when *Scepter* is preplant incorporated. • *Scepter* will not control ALS-resistant weed species. • Tank mixtures or sequential herbicide programs can be used to improve the weed control spectrum.
	imazethapyr *(Pursuit)*	0.063	1.4 oz 70DG	• **May be applied preplant incorporated or preemergence**. • Refer to Table 2F for weed control and crop tolerance ratings. • Common ragweed may only be suppressed; tank mixtures or a sequential herbicide program is needed to improve ragweed control. • *Pursuit* will not control ALS-resistant weed species. • *Pursuit* is very persistent and can limit rotational crops. Refer to label and Table 12 for crop rotation restrictions.
	sulfentrazone + cloransulam-methyl *(Authority First/ Sonic)*	0.14	3.2 oz 70DF	• **May be applied preplant incorporated or preemergence**. • Refer to Table 2F for weed control and crop tolerance ratings. • See Table 2E for individual product rate equivalents for the premix. • Apply *Authority First/Sonic* at 3.2 oz/A as part of a planned 2-pass program or at 6.4 oz/A as a PRE only program. • DO NOT apply after soybean emergence or death or severe injury may occur. • Soybean stunting may occur if excessive rainfall occurs after application but before soybean emergence. • Soybean varieties vary in their tolerance to sulfentrazone. Consult you local seed dealer for more information. • Tank mixtures or sequential herbicide programs can be used to improve the weed control spectrum. • Refer to label and Table 12 for crop rotation restrictions.

(Continued on next page)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves (including nightshade)	flumioxazin + cloransulam-methyl *(Gangster)*	0.095 0.031	3.0 oz 51DG 0.6 oz 84DG	• **DO NOT apply preplant incorporated.** • Refer to Table 2F for weed control and crop tolerance ratings. • Co-pack of *Gangster V (Valor)* + *Gangster FR (FirstRate)* (Table 2E). • Apply within 3 days of planting. DO NOT apply after soybean cracking or emergence — severe injury or stand reduction may occur. • Crop injury may occur when *Gangster* is applied to poorly drained soils and/or under cool, wet conditions. • DO NOT tank mix or apply with *Axiom, Define, Domain, IntRRo, Micro-Tech, Dual* products, *Boundary,* or *Outlook* — crop injury will occur. • Gangster can be tank mixed with pendimethalin (*Prowl* or *Pendimax*) for annual grass control. • Refer to label and Table 12 for crop rotation restrictions.
Black nightshade, Pigweed, Lambsquarters	sulfentrazone *(Spartan)*	0.188	6 oz 4L	• **May be applied preplant incorporated or preemergence**. • Refer to Table 2F for weed control and crop tolerance ratings. • Apply within 3 days of planting. DO NOT apply after soybean cracking or emergence — severe injury or death may occur. • Soybean stunting may occur if excessive rainfall occurs after application but before soybeans emerge. • Some soybean varieties are sensitive to sulfentrazone. Consult your local seed dealer for information. • Reduce *Spartan* rate to 4.5 oz/A if a glyphosate postemergence application is planned in glyphosate-resistant soybeans. • Tank mixtures or sequential herbicide programs can be used to improve the weed control spectrum. • Refer to label and Table 12 for crop rotation restrictions.
Black nightshade, Pigweed, Lambsquarters, Common ragweed	flumioxazin *(Valor)*	0.08	2.5 oz 51DG	• **DO NOT apply preplant incorporated.** • Refer to Table 2F for weed control and crop tolerance ratings. • Apply within 3 days of planting. DO NOT apply after soybean cracking or emergence — severe injury or death may occur. • Crop injury may occur when *Valor* is applied to poorly drained soils and/or under cool, wet conditions. • Soils with high organic matter and/or high clay content may require 3 oz/A. • DO NOT tank mix or apply with *Axiom, Define, Domain, IntRRo, Micro-Tech, Dual* products, *Boundary* or *Outlook* — crop injury will occur. • Valor can be tank-mixed with pendimethalin (*Prowl* or *Pendimax*) for annual grass control. • Refer to label and Table 12 for crop rotation restrictions.

Soybeans — Postemergence for Broadleaf Weeds

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves (EXCEPT pigweed and nightshade) **Yellow nutsedge**	bentazon *(Basagran)* + crop oil concentrate +/OR ammonium sulfate	1	2 pt 4L + 1 qt +/OR 2.5 lb	• Refer to Table 2F for weed control and crop tolerance ratings. • Most effective on small weeds. Rate can be reduced to 1.5 pt/A if weeds are smaller than maximum growth stage (Table 2G). • *Basagran* at 3 pt/A can suppress cocklebur up to 24 inches and velvetleaf up to 12 inches. • Use a minimum of 20 gal. water/A for adequate coverage. • DO NOT apply if soybeans are under stress from herbicide injury, cold or dry weather, or hail damage. • For improved velvetleaf control, 28% liquid nitrogen (2-4 qt/A) or ammonium sulfate (2.5 lb/A) can be used INSTEAD OF crop oil concentrate. However, if common ragweed and common lambsquarters are present, a crop oil concentrate must also be included (Table 2H). • Split applications of *Basagran* (1.5 pt + 1.5 pt) plus crop oil concentrate (1 qt + 1 qt) can be used to control yellow nutsedge and Canada thistle. Applications should be made approximately 10 days apart. For improved Canada thistle control, increase *Basagran* rate to 1 qt for each application. • Allow 30 days between *Basagran* application and soybean harvest. • *Basagran* can be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control (Table 2I). • *Basagran* can be tank mixed for postemergence grass control (Table 2K). • Refer to label and Table 12 for crop rotation restrictions.
Annual broadleaves (EXCEPT velvetleaf and lambsquarters)	acifluorfen *(Ultra Blazer)* + surfactant OR ammonium sulfate	0.38	1.5 pt 2SC + 0.25% OR 2.5 lb	• Refer to Table 2F for weed control and crop tolerance ratings. • Most effective on small weeds (Table 2G). • Use a minimum of 20 gal. water/A for adequate coverage. • DO NOT apply if soybeans are under stress from herbicide injury, cold or dry weather, or hail damage. • 28% liquid nitrogen (2-4 qt/A) or ammonium sulfate (2.5 lb/A) may be added INSTEAD OF surfactant for improved weed control. • Allow 50 days between *Ultra Blazer* application and soybean harvest. • *Ultra Blazer* can be tank mixed with most postemergence soybean herbicides for additional broadleaf weed control (Table 2I). • *Ultra Blazer* can be tank mixed for postemergence grass control (Table 2K). • Refer to label and Table 12 for crop rotation restrictions.

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves (EXCEPT black nightshade and lambsquarters) **Yellow nutsedge, Jerusalem artichoke**	chlorimuron-ethyl *(Classic)* + crop oil concentrate + ammonium sulfate	0.0106	0.67 oz 25DF + 1% + 2-4 lb	• Refer to Table 2F for weed control and crop tolerance ratings. • Labeled rates of 0.5-0.75 oz/A are most effective on small weeds (Table 2G). • For optimal rotational flexibility on soils with pH greater than 7.0, apply no more than 1 oz/A of *Classic* per season. On soils with a pH of 7.0 or less, a maximum of 1.5 oz/A of *Classic* can be applied during the growing season. When the rate of *Classic* is 0.33 oz/A or less, shorter rotation restrictions for alfalfa, cucumber, and watermelon are available. • *Classic* can be applied at 0.25 or 0.33 oz/A when tank mixed with *Harmony GT* (see *Classic* + *Harmony GT* tank mix) or glyphosate. • Apply after the first trifoliate leaf of soybeans has fully expanded. • Apply with crop oil concentrate (1% v/v) or non-ionic surfactant (0.125-0.25% v/v) plus 28% liquid nitrogen (2-4 qt/A) or ammonium sulfate (2-4 lb/A). • Crop oil concentrate provides better control under hot conditions. However, increased injury may result (Table 2H). • DO NOT apply to soybeans or weeds under stress from herbicide injury or cold or dry weather — crop injury or poor weed control may result. Delay application until the stress passes. • 0.75 oz/A is required for Jerusalem artichoke control. • Allow 60 days between *Classic* application and soybean harvest. • *Classic* will not control ALS-resistant weed species. • *Classic* can be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control (Table 2I). • *Classic* can be tank mixed for postemergence grass control (Table 2K). • Soil pH and *Classic* use rates are critical for rotational crops (see label). • Refer to label and Table 12 for crop rotation restrictions.

Soybeans — Postemergence for Broadleaf Weeds (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves (ONLY lambsquarters, smartweed, pigweed, wild mustard and velvetleaf)	thifensulfuron-methyl *(Harmony GT)* + surfactant + ammonium sulfate	0.004	0.08 oz 75DF + 0.125-0.25% + 2-4 lb	• Refer to Table 2F for weed control and crop tolerance ratings. • *Harmony GT* is most effective on small weeds (Table 2G). • Apply after the first trifoliate leaf of soybeans has fully expanded. • Applications of *Harmony GT* may cause temporary wilting, leaf yellowing, and stunting. • DO NOT apply to soybeans or weeds under stress from weed control may result. Delay application until the stress passes. • Allow 60 days between *Harmony GT* application and soybean harvest. • Apply with non-ionic surfactant (0.125-0.25% v/v) or crop oil concentrate (1% v/v) plus 28% liquid nitrogen (2-4 qt/A) or ammonium sulfate (2-4 lb/A). The addition of a nitrogen source is required for velvetleaf control. • Under dry conditions, *Harmony GT* can be applied with crop oil concentrate, but soybean injury is likely to be more severe. • Use a minimum of 10 gal. water/A. For heavy weed pressure, increase volume to 15 gal/A. • *Harmony GT* will not control ALS-resistant weed species. • *Harmony GT* can be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control. Follow label directions closely regarding spray additives (Table 2I). • *Harmony GT* can be tank mixed with *Assure II* and *Fusion* for grass control (Table 2K). • **Special precaution:** A special sprayer clean-out procedure is required (see label). • Refer to label and Table 12 for crop rotation restrictions.
Annual broadleaves (EXCEPT black nightshade and common ragweed)	chlorimuron-ethyl *(Classic)* + thifensulfuron methyl *(Harmony GT)* + surfactant + ammonium sulfate	0.004	0.25 oz 25DF + 0.08 oz 75DF + 0.125-0.25% + 2-4 lb	• Refer to Table 2F for weed control and crop tolerance ratings. • Refer to Table 2G for maximum weed sizes. • *Classic* can be applied at 0.25 or 0.33 oz/A with *Harmony GT* without being limited by soil pH. • Apply after the first trifoliate leaf of soybeans has fully expanded. • Under dry conditions, *Classic* + *Harmony GT* can be applied with crop oil concentrate, but soybean injury is likely to be more severe. • For eastern black nightshade control, add *Cobra* (4-6 oz/A) or *Reflex* or *Flexstar* (1 pt/A) or *Ultra Blazer* (1 pt/A) or *Pursuit DG* (0.7 oz/A). DO NOT use crop oil concentrate if *Pursuit* is tank mixed for nightshade control (Table 2I). • *Classic* rate needs to be at 0.33 oz/A for common ragweed control. • *Classic* rate needs to be at 0.5 oz/A for yellow nutsedge control. • *Classic* rate needs to be at 0.75 oz/A for Jerusalem artichoke control. • DO NOT apply to soybeans or weeds under stress from herbicide injury or cold or dry weather — crop injury or poor weed control may result. Delay application until the stress passes. • *Classic* + *Harmony GT* can be tank mixed for grass control. Additive should be a non-ionic surfactant; DO NOT use crop oil concentrate (Table 2K). • Allow 60 days between application and soybean harvest. • These herbicides will not control ALS-resistant weed species. • Soil pH and *Classic* use rates are critical for rotational crops (see label). • Refer to label and Table 12 for crop rotation restrictions.

Soybeans — Postemergence for Broadleaf Weeds (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves (EXCEPT black nightshade) **Yellow nutsedge, Jerusalem artichoke, Common milkweed**	chlorimuron-ethyl + thifensulfuron methyl *(Synchrony XP)* + crop oil concentrate + ammonium sulfate	0.013	0.75 oz 28.4DG + 1% + 2 lb	• Refer to Table 2F for weed control and crop tolerance ratings. • Refer to Table 2G for maximum weed sizes. • ONLY apply 0.75 oz/A of *Synchrony XP* to STS SOYBEANS. • *Synchrony XP* at 0.375 oz/A can be applied to NON-STS soybeans. DO NOT use crop oil concentrate. Instead, use a non-ionic surfactant at 0.25% v/v. • See Table 2E for individual product rate equivalents for the premix. • Apply after the first trifoliate leaf of soybeans has fully expanded. • For eastern black nightshade control, add Cobra (4-6 oz/A) or *Reflex* or *Flexstar* (1 pt/A) or *Ultra Blazer* (1 pt/A) or *Pursuit DG* (0.7 oz/A). Reduce the rate of crop oil concentrate to 0.5% if tank mixed with *Cobra*. DO NOT use crop oil concentrate if *Pursuit* or *Ultra Blazer* is tank mixed for nightshade control (Table 2I). • Allow 60 days between *Synchrony XP* application and soybean harvest. • *Synchrony XP* will not control ALS-resistant weed species. • *Synchrony XP* will suppress pokeweed, perennial sowthistle, and dandelion. • *Synchrony XP* can be tank mixed for control of some grasses (Table 2K). • Soil pH and *Synchrony XP* use rates are critical for rotational crops (see label). • Rotation intervals are dependent on soil pH and rate. Refer to label and Table 12 for crop rotation restrictions.
Annual broadleaves (EXCEPT lambsquarters and common ragweed) **Jerusalem artichoke**	imazethapyr *(Pursuit)* + crop oil concentrate + ammonium sulfate	0.063	1.4 oz 70DG + 1% + 12-15 lb/100 gal	• Refer to Table 2F for weed control and crop tolerance ratings. • Refer to Table 2G for maximum weed sizes. • Apply with crop oil concentrate (1% v/v) or non-ionic surfactant (0.25% v/v) plus 28% liquid nitrogen (2.5% v/v) or ammonium sulfate (12-15 lb/100 gal) (Table 2H). • Will control yellow and green foxtails, barnyardgrass and crabgrass up to 3 inches tall, and giant foxtail up to 6 inches tall. • Apply after the first trifoliate leaf of soybeans has fully expanded. • Allow 85 days between *Pursuit* application and soybean harvest. • *Pursuit* will not control ALS-resistant weed species. • *Pursuit* can be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control. Follow label directions closely regarding spray additives (Table 2I). • *Pursuit* can be tank mixed with postemergence grass herbicides for volunteer corn control only (Table 2K). • *Pursuit* is very persistent and can limit rotational crops. Refer to label and Table 12 for crop rotation restrictions.

Soybeans — Postemergence for Broadleaf Weeds (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves (EXCEPT common ragweed) **Annual grasses**	imazamox *(Raptor)* + crop oil concentrate + ammonium sulfate	0.04	5 oz 1L + 1% + 12-15 lb/100 gal	• Refer to Table 2F for weed control and crop tolerance ratings. • Refer to Table 2G for maximum weed sizes. • Apply with crop oil concentrate (1% v/v) or non-ionic surfactant (0.25% v/v) plus 28% liquid nitrogen (2.5% v/v) or ammonium sulfate (12-15 lb/100 gal) (Table 2H). • Apply after the first trifoliate leaf of soybeans has fully expanded but before soybean bloom. • Will control barnyardgrass, foxtails and panicum but ONLY SUPPRESS crabgrass. • Application rate must be 5 oz/A for annual grass and common lambsquarters control OR apply *Prowl/Pendimax* pre-emergence for control of these weeds. • Common ragweed less than 3 inches will be suppressed. • Increase common ragweed control by tank mixing with *Cobra* (4-6 oz/A), *Ultra Blazer* (8-16 oz/A), or *Flexstar* (6-8 oz/A). Higher rates can cause grass antagonism (Table 2I). • *Raptor* will not control ALS-resistant weed species. • DO NOT tank mix with postemergence grass herbicides unless for volunteer corn — antagonism will occur and grass control will equal that of *Raptor* alone. • Refer to label and Table 12 for crop rotation restrictions.
Annual broadleaves (EXCEPT velvetleaf, smartweed, lambs-quarters and cocklebur)	fomesafen *(Reflex)* + crop oil concentrate + ammonium sulfate	0.25	1 pt 2L + 1% + 10 lb/100 gal	• Refer to Table 2F for weed control and crop tolerance ratings • *Reflex* can be applied ONLY in counties south of HWY 55. • DO NOT apply *Reflex* to the same field in CONSECUTIVE years. • *Reflex* is most effective when weed are small (Table 2G). • *Reflex* can be reduced to 0.75 pt/A to control certain smaller weeds (Table 2G). • Apply before soybeans bloom. • Apply with crop oil concentrate (0.5-1.0% v/v) or non-ionic surfactant (0.25-0.5% v/v). 28% liquid nitrogen (2.5% v/v) or ammonium sulfate (10 lb/100 gal) can be added to either crop oil concentrate or surfactant for improved weed control (Table 2H). • Apply at 10-20 gal. water/A at 30-60 psi. • *Reflex* can be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control. Follow label directions closely regarding spray additives (Table 2I). • *Reflex* can be tank mixed for postemergence grass control (Table 2K). • Refer to label and Table 12 for crop rotation restrictions.

Soybeans — Postemergence for Broadleaf Weeds (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves (EXCEPT velvetleaf, lambsquarters and cocklebur)	fomesafen *(Flexstar)* + crop oil concentrate + ammonium sulfate	0.25	1 pt 1.88L + 0.5-1.0% + 8.5 lb/100 gal	• Refer to Table 2F for weed control and crop tolerance ratings. • *Flexstar* can be applied ONLY in counties south of HWY 55. • DO NOT apply *Flexstar* to the same field in CONSECUTIVE years. • *Flexstar* is *Reflex* formulated with additional surfactants. • *Flexstar* is most effective when weeds are small (Table 2G). • *Flexstar* can be reduced to 0.75 pt/A to control certain smaller weeds (Table 2G). • Apply before soybeans bloom. • Apply with crop oil concentrate (0.5-1.0% v/v) or non-ionic surfactant (0.25-0.5% v/v). 28% liquid nitrogen (2.5% v/v) or ammonium sulfate (8.5 lb/100 gal) can be added to either crop oil concentrate or surfactant for improved weed control (Table 2H). • Apply at 10-20 gal. water/A at 30-60 psi. • *Flexstar* can be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control. Follow label directions closely regarding spray additives (Table 2I). • *Flexstar* can be tank mixed for postemergence grass control (Table 2K). • Refer to label and Table 12 for crop rotation restrictions.
Annual broadleaves (EXCEPT velvetleaf, smartweed, and lambsquarters)	lactofen *(Cobra)* + crop oil concentrate	0.125	8 oz 2EC + 0.5%	• Refer to Table 2F for weed control and crop tolerance ratings. • *Cobra* can be applied at 6-10 oz/A when tank mixed with other herbicides or when applied alone. Refer to Table 2G for maximum weed sizes. • DO NOT apply to soybeans in the cotyledon stage. • DO NOT apply to soybeans or weeds under stress from herbicide injury, cold or dry weather, or hail damage — crop injury or poor weed control may result. Delay application until the stress passes. • *Cobra* causes more soybean leaf burn than other postemergence herbicides. • For best results, apply with crop oil concentrate (0.25-1.0% v/v), depending on environmental conditions (see label). Surfactant (0.25% v/v), may be substituted for crop oil concentrate when weeds are actively growing under high temperature, high humidity and high soil moisture conditions (Table 2H). • The addition of 28% liquid nitrogen (2.5% v/v) or ammonium sulfate (2-4 lb/A) to crop oil concentrate (0.5% v/v) or non-ionic surfactant (0.25% v/v) may enhance weed control. • Apply at a minimum of 20 gal. water/A at 40 psi. • Allow 45 days between *Cobra* application and soybean harvest. • *Cobra* can be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control. Follow label directions closely regarding spray additives (Table 2I). • *Cobra* can be tank mixed for postemergence grass control (Table 2K). • Refer to label and Table 12 for crop rotation restrictions.

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Soybeans — Postemergence for Broadleaf Weeds (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves (EXCEPT velvetleaf, smartweed, and lambsquarters)	lactofen *(Phoenix)* + surfactant	0.195	12.5 oz 2EC + 0.125%	• Refer to Table 2F for weed control and crop tolerance ratings. • *Phoenix* can be applied at 8-12.5 oz/A when tank mixed with other herbicides or when applied alone. Refer to Table 2G for maximum weed sizes. • *Phoenix* is *Cobra* formulated with additional surfactants. • DO NOT apply to soybeans or weeds under stress from herbicide injury, cold or dry weather, or hail damage — crop injury or poor weed control may result. Delay application until the stress passes. • Apply with non-ionic surfactant (0.125-0.25% v/v). Crop oil concentrate (1 pt/A) is recommended when weeds are stressed by hot and dry conditions, though soybean injury will be more severe (Table 2H). • Apply early when the soybean canopy doesn't interfere with coverage. • Allow 45 days between *Phoenix* application and soybean harvest. • *Phoenix* can be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control. Follow label directions closely regarding spray additives (Table 2I). • *Phoenix* can be tank mixed for postemergence grass control (Table 2K). • Refer to label and Table 12 for crop rotation restrictions.
Annual broadleaves (EXCEPT lambsquarters, pigweed, nightshade)	cloransulam-methyl *(FirstRate)* + surfactant + ammonium sulfate	0.016	0.3 oz 84WDG + 0.25% + 8.5-17 lb/100 gal	• Refer to Table 2F for weed control and crop tolerance ratings. • Refer to Table 2G for maximum weed sizes. • Applications prior to first trifoliate stage may cause temporary yellowing. • Apply prior to 50% soybean flowering. • Apply with non-ionic surfactant (0.125-0.25% v/v) plus 28% nitrogen liquid (2.5% v/v) or ammonium sulfate (8.5-17 lb/100 gal). Apply with crop oil concentrate (1.2% v/v) when weeds are stressed by hot and dry conditions; soybean injury will be more severe (Table 2H). • 28% liquid nitrogen or ammonium sulfate must be added for velvetleaf control. • *FirstRate* will not control ALS-resistant weed species. • *FirstRate* can be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control. Follow label directions closely regarding spray additives (Table 2I). • *FirstRate* can be tank mixed for postemergence grass control (Table 2K). However, grass antagonism may occur under certain conditions. • Refer to label and Table 12 for crop rotation restrictions.

Soybeans — Postemergence for Broadleaf Weeds (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
ONLY Pigweed and Cocklebur	imazaquin *(Scepter)* + surfactant	0.063	1.4 oz 70DG + 0.25%	• Refer to Table 2F for weed control and crop tolerance ratings. • Refer to Table 2G for maximum weed sizes. • Apply with non-ionic surfactant (0.25% v/v) or with crop oil concentrate (1% v/v). • Allow 90 days between *Scepter* application and soybean harvest. • *Scepter* will not control ALS-resistant weed species. • *Scepter* can be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control. Follow label directions closely regarding spray additives (Table 2I). • *Scepter* can be with tank mixed with *Fusion* for postemergence grass control, unless the grass population is predominantly yellow foxtail and barnyardgrass (sequential applications recommended) (Table 2K). • DO NOT plant CORN (unless it is a Clearfield hybrid) following *Scepter* application, except in the southern two tiers of counties in Michigan and if 15 inches of rainfall occurs. • Rainfall is critical for rotational crops (see label); the recropping count should start at soybean planting. • Refer to label and Table 12 for crop rotation restrictions.
ONLY Velvetleaf	flumiclorac *(Resource)* + crop oil concentrate	0.041	6 oz 0.86L + 1 qt	• Refer to Table 2F for weed control and crop tolerance ratings. • Refer to Table 2G for maximum weed sizes. • 28% liquid nitrogen (1-2 qt/A) or ammonium sulfate (2-2.5 lb/A) may be added to crop oil concentrate (1 qt/A) to enhance weed control. • *Resource* can be applied at 4 oz/A when tank mixed with other herbicides for additional broadleaf weed control (Table 2I). • Allow 60 days between *Resource* application and soybean harvest. • *Resource* can be tank mixed for postemergence grass control (Table 2K). • Refer to label and Table 12 for crop rotation restrictions.

Soybeans — Postemergence Grass Control

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Grasses **Volunteer corn**	sethoxydim *(Poast)* OR *(Poast Plus)* + crop oil concentrate	0.19	 16 oz 1.5SC OR 24 oz 1SC + 1 qt	• Refer to Table 2F for weed control and crop tolerance ratings. • Treat actively growing grasses. Refer to Table 2J for *Poast/Poast Plus* rates and maximum weed and volunteer corn sizes. • Reduced rates of *Poast* (12 oz/A) and *Poast Plus* (16 oz/A) may be used when barnyardgrass, green and giant foxtail, and fall panicum are less than 4 inches and the target species. • Apply with 1 qt of crop oil concentrate per acre. Include 28% liquid nitrogen (0.5-1 gal/A) or ammonium sulfate (2.5 lb/A) for crabgrass, volunteer corn and volunteer wheat. • *Poast* and *Poast Plus* are **not as effective** on volunteer corn as *Select/Arrow, Assure II,* or *Fusion*. • Allow 75 days between *Poast* and *Poast Plus* application and soybean harvest. • *Poast* and *Poast Plus* are generally less effective than other postemergence grass herbicides for perennial grass control. Two applications 14-21 days apart are most effective for controlling these weeds (Table 2J). • *Poast* and *Poast Plus* can be tank mixed for postemergence broadleaf control (Table 2K). Rates and additive recommendations vary when tank mixing with various products, depending on target grass species. See label for more information. • Tank mixes with *Pursuit* and *Raptor* are not recommended — grass antagonism will occur. • Grass control is generally better if sequential applications are made with the postemergence grass and broadleaf herbicide. The postemergence grass herbicide should be applied 1 day prior to the postemergence broadleaf herbicide(s) application. If the broadleaf herbicide is applied first, delay application of the *Poast* or *Poast Plus* until the grasses are actively growing, which may be 7 days or more. • Refer to label and Table 12 for crop rotation restrictions.

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Soybeans — Postemergence Grass Control (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Grasses **Volunteer corn**	fluazifop-P-butyl + fenoxaprop *(Fusion)* + crop oil concentrate	0.166	8 oz 2.56EC + 0.5–1%	• Refer to Table 2F for weed control and crop tolerance ratings. • Treat actively growing grasses. Refer to Table 2J for *Fusion* rates and maximum weed and volunteer corn sizes. • Apply with crop oil concentrate (0.5-1% v/v) for best results. A non-ionic surfactant (0.25-0.5% v/v) may be used to replace crop oil concentrate with certain tank mixes; 28% liquid nitrogen or ammonium sulfate may also be added to improve control. • Apply before soybeans bloom. • For perennial grass control, two applications 14-21 days apart may be needed, depending on target weed (Table 2J). • *Fusion* can be tank mixed with glyphosate products (Table 10) for control of volunteer *Roundup Ready* corn in *Roundup Ready* soybeans. Include ammonium sulfate (17 lb/100 gal) in all tank mixes with glyphosate. DO NOT add crop oil concentrate. • *Fusion* can be tank mixed for postemergence broadleaf control (Table 2K). Rates and additive recommendations vary when tank mixing with various products, depending on target grass species. See label for more information. • DO NOT tank mix with *Classic, Harmony GT,* or *Synchrony XP* if conditions are dry and the target grasses are yellow foxtail, barnyardgrass, or crabgrass. Sequential applications are recommended. • Tank mixes with *Pursuit* and *Raptor* are not recommended — grass antagonism will occur. • Grass control is generally better if sequential applications are made with the postemergence grass and broadleaf herbicide. The postemergence grass herbicide should be applied 1 day prior to the postemergence broadleaf herbicide(s) application. If the broadleaf herbicide is applied first, delay application of the *Fusion* until the grasses are actively growing, which may be 7 days or more. • Refer to label and Table 12 for crop rotation restrictions.

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Soybeans — Postemergence Grass Control (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Grasses **Volunteer corn**	clethodim *(Select/Arrow)* + crop oil concentrate OR *(Select Max)* + crop oil concentrate	0.094 0.068 	6 oz 2EC + 1% OR 9 oz 0.97 EC + 1%	• Refer to Table 2F for weed control and crop tolerance ratings. • Treat actively growing grasses. Refer to Table 2J for *Select/Arrow* and *Select Max* rates and maximum weed sizes. • Apply *Select/Arrow* only with crop oil concentrate (1% v/v). *Select Max* offers greater adjuvant flexibility and may be applied with crop oil concentrate (1% v/v), methylated seed oil (1% v/v) or non-ionic surfactant (0.25% v/v). • The addition of ammonium sulfate at 2.5 to 4 lb/A has been shown to improve control of difficult to control weeds — e.g., quackgrass, rhizome Johnsongrass, volunteer cereals, and volunteer corn. • Allow 60 days between *Select/Arrow* and *Select Max* application and soybean harvest. • For perennial grass control, higher rates and sequential applications may be needed (Table 2J). • *Select/Arrow* and *Select Max* can be tank mixed with glyphosate products (Table 10) for control of volunteer *Roundup Ready* corn in *Roundup Ready* soybeans. Include ammonium sulfate (17 lb/100 gal) in all tank mixes with glyphosate. DO NOT add crop oil concentrate. • *Select/Arrow* and *Select Max* can be tank mixed for post-emergence broadleaf control (Table 2K). However, some tank-mixes with POST broadleaf herbicides have shown reductions or failures in control of certain grass species. Rates and additive recommendations vary when tank mixing with various products, depending on target grass species. See label for more information. • Tank mixes with *Pursuit* and *Raptor* are not recommended — grass antagonism will occur. • Grass control is generally better if sequential applications are made with the postemergence grass and broadleaf herbicide. The postemergence grass herbicide should be applied 1 day prior to the postemergence broadleaf herbicide(s) application. If the broadleaf herbicide is applied first, delay application of the *Select/Arrow* and *Select Max* until the grasses are actively growing, which may be 7 days or more. • Refer to label and Table 12 for crop rotation restrictions.

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Soybeans — Postemergence Grass Control (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(Continued)				
Grasses **Volunteer corn**	quizalofop-P-ethyl *(Assure II/Targa)* + crop oil concentrate	0.044	7 oz 0.88L + 1%	• Refer to Table 2F for weed control and crop tolerance ratings. • Treat actively growing grasses. Refer to Table 2J for *Assure II/Targa* rates and maximum weed sizes. • Apply with crop oil concentrate (1% v/v) for best results. • A non-ionic surfactant (0.25% v/v) may be used to replace crop oil concentrate with certain tank mixes. • Allow 80 days between *Assure II/Targa* application and soybean harvest. • For perennial grass control, higher rates and sequential applications may be needed (Table 2J). • *Assure II/Targa* can be tank mixed for postemergence broadleaf control (Table 2K). Rates and additive recommendations vary when tank mixing with various products, depending on target grass species. See label for more information. • *Assure II/Targa* can be tank mixed with glyphosate (Table 10) to control volunteer *Roundup Ready* corn in *Roundup Ready* soybeans. DO NOT add crop oil concentrate — use a non-ionic surfactant at 0.25% v/v. With "loaded" glyphosate products, the surfactant rate can be reduced to 0.125% v/v. Include ammonium sulfate (17 lb/100 gal) in all tank mixes with glyphosate. • Tank mixes with *Pursuit* and *Raptor* are not recommended — grass antagonism will occur. • A reduction in control of certain grasses may occur when *Assure II/Targa* applied to moisture-stressed plants or tank mixed with *Classic* or *Basagran*. A reduction in control is not usually observed for volunteer corn, giant foxtail or johnsongrass control in these tank mixtures. However, to maintain control of other grasses, increase the *Assure II/Targa* rate by 2 oz/A in tank mixes. DO NOT tank mix with *Classic* or *Basagran* if the target grass is barnyardgrass, quackgrass, crabgrass or yellow foxtail. • Grass control is generally better if sequential applications are made with the postemergence grass and broadleaf herbicide. The postemergence grass herbicide should be applied 1 day prior to the postemergence broadleaf herbicide(s) application. If the broadleaf herbicide is applied first, delay application of the *Assure II/Targa* until the grasses are actively growing, which may be 7 days or more. • Refer to label and Table 12 for crop rotation restrictions.

TABLE 2B – Weed Control in Glyphosate-Resistant Soybeans

Soybeans that are resistant to glyphosate are designated *Roundup Ready* soybeans. Glyphosate products labeled for postemergence use on *Roundup Ready* soybeans can be broadcast applied postemergence on *Roundup Ready* soybeans only. Read carefully all remarks and limitations written below and on the labels for each of the glyphosate products registered for use in *Roundup Ready* soybeans. See Table 10 for a list of glyphosate products registered for use in *Roundup Ready* soybeans.

Weed Control in *Roundup Ready* Soybeans

Weed Controlled	Herbicide	Rate lb/A	Formulation/A	Remarks and Limitations
Annual grasses, **Annual broadleaves,** **Suppression of:** **Yellow nutsedge,** **Other perennials**	glyphosate (See Table 10) + ammonium sulfate	0.75 a.e.	See Table 10 + 17 lb/100 gal	• **APPLY TO *ROUNDUP READY* SOYBEANS ONLY.** • Refer to Table 2F for weed control and crop tolerance ratings. • Many glyphosate products are registered for application to *Roundup Ready* soybeans. Read the label and see Table 10 to determine application rates and additives needed for different products. • Glyphosate should be applied at a minimum rate of 0.75 lb a.e./A in *Roundup Ready* soybeans. • Addition of ammonium sulfate (17 lb/100 gal) will minimize antagonism from hard water and improve weed control if weeds are under stress or large. • INCONSISTENT control will occur if glyphosate rates are reduced. • Apply before annual weeds are 4 inches tall in narrow-row soybeans and 6 inches tall in 30-inch-row soybean. DO NOT let weeds compete for longer than 6 weeks after soybean planting, or soybean yield may be reduced. • A second glyphosate application may be made if needed to control late-emerging weeds. Narrow-row soybeans reduce the chances of late weed emergence. • Sequential programs of either a preemergence herbicide followed by glyphosate or two timely applications of glyphosate will improve the consistency of weed control, particularly common lambsquarters and giant ragweed control. • Glyphosate application rate can be increased to control weeds that are under stress or large (10-12 inches tall) (see label). Large weeds may be competitive with soybeans and reduce yield. • Use extreme caution to avoid spray drift to sensitive crops. • Apply from soybean cracking through full flower (R2 soybean). • DO NOT apply more than 2.25 lb a.e./A in-crop per season. • For VOLUNTEER *ROUNDUP READY* CORN control, tank mix glyphosate (Table 10) with *Assure II/Targa, Fusion, Select/Arrow* or *Select Max* (Table 2K). Consult product remarks and limitations in E-434 and labels for additive choices and rates. • Control of PERENNIAL BROADLEAVES will be improved with a second application of glyphosate prior to soybean full flower. • For QUACKGRASS control, treat when quackgrass is 6-8 inches tall. • For YELLOW NUTSEDGE suppression, apply glyphosate when nutsedge is 3-4 inches tall. Adding Classic at 0.75 oz/A OR making a second glyphosate application 2-3 weeks later will improve suppression.

(continued on next page)

Weed Controlled	Herbicide	Rate lb/A	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses, Annual broadleaves, Suppression of: Yellow nutsedge, Other perennials				• Tank mixes of glyphosate with other broadleaf herbicides can reduce control of certain annual weed species. CAUTION should be taken when tank mixing herbicides with glyphosate not to reduce overall control. However, certain tank mixes may improve control of individual weed species. • The addition of micronutrient fertilizers (e.g., manganese) can antagonize glyphosate, resulting in a reduction in weed control. Avoid antagonisms by making separate herbicide and fertilizer applications or using a full-chelated form of the fertilizer and including ammonium sulfate to minimize the antagonism.
	glyphosate + imazaquin *(Backdraft SL)* + surfactant + ammonium sulfate	0.84	5 pt 1.35SL + 0.25% + 17 lb/100 gal	• **APPLY TO *ROUNDUP READY* SOYBEANS ONLY.** • Refer to Table 2F for weed control and crop tolerance ratings. • *Backdraft SL* is a premix of *Scepter* + glyphosate. See Table 2E for individual product rate equivalents for the premix. • Apply to weeds up to 4 inches tall. • Addition of ammonium sulfate will minimize antagonism from hard water and improve weed control if weeds are under stress or large. • Use extreme caution to avoid spray drift to sensitive crops. • Rainfall is critical for rotational crops (see label); the recropping count should start at soybean planting. • Refer to label and Table 12 for crop rotation restrictions.
	glyphosate + imazethapyr *(Extreme)* + surfactant + ammonium sulfate	0.81	3 pt 2.17L + 0.25% + 17 lb/100 gal	• **APPLY TO *ROUNDUP READY* SOYBEANS ONLY.** • Refer to Table 2F for weed control and crop tolerance ratings. • *Extreme* is a premix of *Pursuit* + glyphosate. See Table 2E for individual product rate equivalents for the premix. • Apply to weeds up to 4 inches tall. • Addition of ammonium sulfate will minimize antagonism from hard water and improve weed control if weeds are under stress or large. • Use extreme caution to avoid spray drift to sensitive crops. • *Pursuit* is very persistent and can limit rotational crops. Refer to label and Table 12 for crop rotation restrictions.
	glyphosate + s-metolachlor *(Sequence)* + ammonium sulfate	1.64	2.5 pt 5.25EW + 17 lb/100gal	• **APPLY TO *ROUNDUP READY* SOYBEANS ONLY.** • Refer to Table 2F for weed control and crop tolerance ratings. • *Sequence* is a premix of *Dual Magnum* + glyphosate. See Table 2E for individual product rate equivalents for the premix. • Apply from soybean cracking up through the third trifoliate. • Cosmetic leaf crinkling or necrotic spots may occur under certain conditions. • DO NOT apply more than 3.5 pt/A of *Sequence* per season. • Refer to label and Table 12 for crop rotation restrictions.

TABLE 2C – Weed Management in No-Till Soybeans

Effective weed control in no-till soybeans requires control of **all weeds and cover crops** prior to soybean emergence. This can be accomplished by:

1. Late fall applications prior to planting soybeans the following spring (FALL).
2. Early spring applications — up to 30 days prior to soybean planting (EPP).
3. Applications at or very close to the time of planting (PRE).

Regardless of the time of herbicide application, burndown herbicide(s) must be applied to control **all** of the existing vegetation. If some plant species are not controlled prior to soybean emergence, they will be competitive with the soybean crop, ultimately leading to soybean yield loss.

Burndown herbicide options include herbicides without residual activity: glyphosate (Table 10), *Gramoxone Inteon* (paraquat), 2,4-D ester and Express. These herbicides control only existing vegetation and **DO NOT** have residual activity to control weeds that have not yet emerged. The following table lists the effectiveness of these herbicides in burndown applications to control existing vegetation. Selection of these herbicides should be made on the basis of weed type, weed height and the speed of control. In general, *Gramoxone Inteon* will provide faster control than glyphosate or 2,4-D ester, but glyphosate will provide better control of dense weeds or cover crops. Glyphosate is preferred for control of perennial weeds or grasses prior to the completion of tillering. 2,4-D ester provides effective control of several annual, biennial and perennial broadleaf weeds but does not control grasses. Each of these herbicides has one or more weed species that it does not control (e.g., 2,4-D ester does not control chickweed). Therefore, these herbicides are often tank-mixed for broad-spectrum burndown applications. Sometimes application rates of burndown herbicides need to be increased to control large weeds or dense weed infestations. Please consult the herbicide labels for information. None of these burndown herbicides have soil activity to stop new weeds from emerging. Herbicides that persist in the soil to stop new weeds from emerging may be included in the burndown application.

Certain residual herbicides have burndown activity on some weed species. **Table 2C** gives the maximum weed height for **burndown** control of summer annual broadleaves and grasses. These herbicides are not as broad-spectrum as glyphosate, *Gramoxone Inteon* or 2,4-D ester for burndown of existing vegetation. Therefore, the residual herbicides are always tank-mixed with glyphosate, 2,4-D ester, *Gramoxone Inteon* or combinations of glyphosate + 2,4-D ester. These residual herbicides will control germinating summer annual grasses and broadleaf weeds. The **effectiveness** of these residual herbicides on summer annual grass and broadleaf weed control is not the same. **Table 2F** gives the effectiveness ratings of these residual herbicides on annual weeds. The **length of weed control** from these residual herbicides is not the same. Some herbicides persist longer in the soil and are, therefore, more effective than other herbicides when applied in the fall. There are fewer noticeable differences in the length of summer annual weed control when these herbicides are applied in the spring (EPP) or at planting (PRE). **Table 2C** gives the **length of summer weed control** (0 = no residual weed control; 1 = short residual control; 2 = moderate residual control; 3 = long residual control). When applying residual herbicides in the FALL for summer annual weed control, choose a herbicide with a "3" rating. When applying residual herbicides in the spring, EPP, choose a herbicide with a "3" or "2" rating. When applying residual herbicides at or very close to the time of planting (PRE), choose a herbicide with a "3", "2" or "1" rating.

A few important comments for each herbicide in **Table 2C** are listed below.

Burndown Herbicides without Residual Activity

Glyphosate: Glyphosate can be applied in the **Fall, EPP** or **PRE** to control existing vegetation. Application rates range from 0.75 to 1.13 lb ae/A, depending on weed size. Lower rates may be used to control smaller weeds at lower spray volumes — consult label. Consult **Table 2C** for maximum weed heights and effectiveness ratings. There are many formulations of glyphosate. Consult **Table 10** for a list of glyphosate products, use rates and the need for additional surfactant. Ammonium sulfate (AMS) at 17 lb/100 gal should be added to glyphosate, regardless of formulation. The addition of 2,4-D ester greatly improves control of horseweed (marestail), giant ragweed, mustards and some other key no-till weeds (see the following comments about 2,4-D ester). Herbicides with residual activity can also be tank-mixed with glyphosate or glyphosate + 2,4-D ester.

Gramoxone Inteon (2 SL): Gramoxone Inteon can be applied **EPP** or **PRE** to control existing vegetation. Apply Gramoxone Inteon at 2 pt/A for weeds less than 3 inches tall and 3.0 pt/A for weeds less from 3 to 6 inches tall. Consult Table 2C for maximum weed heights and effectiveness ratings. Always add surfactant at 0.125 to 0.25% v/v. Regrowth of rye or wheat may occur if plants are not fully tillered when treated. Burndown effectiveness is highly dependent on the environment, with better burndown in warm, sunny conditions. For improved burndown control, Gramoxone Inteon can be tank-mixed with 2,4-D ester or with a herbicide with residual activity.

2,4-D ester: 2,4-D-ester can be applied in the **Fall**, **EPP** or **PRE** to control existing annual and perennial broadleaf weeds. One qt/A of 2,4-D ester can be applied in the fall and up to 30 days prior to soybean planting; 1 pt/A of 2,4-D ester can be applied up to 7 days prior to soybean planting. Consult **Table 2C** for maximum weed heights and effectiveness ratings. 2,4-D ester does not control common chickweed. 2,4-D can be tank-mixed with a number of herbicides for improved weed control.

Express XP (75 DF): Express can be applied in the **Fall** and in the spring 45 days or more prior to soybean planting. Apply Express at 0.16 to 0.33 oz/A; use the higher rate for denser weed populations or weeds that are only partially controlled. Consult **Table 2C** for maximum weed heights and effectiveness ratings. Always add crop oil concentrate at 1% v/v. Express is very effective on common chickweed. For best burndown results, the addition of 2,4-D ester is recommended. Express can also be tank-mixed with herbicides with residual activity.

Burndown Herbicides with Residual Activity

Authority First/Sonic (70 DF): Authority First/Sonic can be applied **EPP** (up to 14 days) or **PRE** to control existing vegetation and to provide residual weed control. Authority First/Sonic contains Spartan (sulfentrazone) and FirstRate (see Table 2E). Apply Authority First/Sonic at 3.2 oz/A prior to planned 2-pass programs in glyphosate-resistant soybean and 6.4 oz/A in conventional soybean. Always add surfactant at 0.25% v/v + 28% N or ammonium sulfate (AMS) or crop oil concentrate + 28% N or AMS. Soybean varieties vary in their sensitivity to sulfentrazone, a component in Authority First/Sonic. Consult your local seed dealer for information. Consult **Table 2C** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2F** for residual weed control. Consult label and Table 12 for crop rotation restrictions. Authority First/Sonic should be tank-mixed with 2,4-D ester, glyphosate, glyphosate + 2,4-D ester, or Gramoxone Inteon to broaden the spectrum of burndown weed control.

Backdraft SL (1.35 SL): Backdraft can be applied in the ***Fall***, **EPP** (up to 45 days) or **PRE** to control existing vegetation and to provide residual weed control. Backdraft contains glyphosate and Scepter (see Table 2E). Apply Backdraft at 5 pt/A. Always add surfactant at 0.25% v/v + 17 lb/100 gal of ammonium sulfate (AMS). Consult **Table 2C** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2F** for residual weed control (Scepter). Effectiveness from the residual component of Backdraft is greater the closer it is applied to planting. Consult label and Table 12 for crop rotation restrictions. For fall applications, adjust the rotational crop intervals by basing the interval on the date of soybean planting, not herbicide application. Apply with 2,4-D ester for improved horseweed (marestail) and perennial weed control.

Canopy (75 DG): Canopy can be applied in the **Fall**, **EPP** (up to 45 days) or **PRE** to control existing vegetation and to provide residual weed control. Canopy contains Classic (chlorimuron) and Sencor (see Table 2E). Canopy use rates range between 2.25 and 4 oz/A. DO NOT apply Canopy at rates greater than 2.25 oz/A to soils with a composite pH greater than 7.0; use of higher rates may result in unacceptable injury to this year's crop and the following crop. DO NOT apply Canopy to soils with a composite pH exceeding 7.6. Always add a crop oil concentrate at 1% v/v or surfactant at 0.25% v/v. Consult **Table 2C** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2F** for residual weed control. Effectiveness from the residual components of Canopy is greater the closer it is applied to planting. Consult label and Table 12 for crop rotation restrictions. For fall applications, adjust the rotational crop intervals by basing the interval on the date of soybean planting, not herbicide application. The addition of 2,4-D ester in fall or EPP applications is recommended and is required for control of certain weeds. Canopy can be tank-mixed with Express (fall) or glyphosate to improve common chickweed control.

Canopy EX (29.5 DG): Canopy EX can be applied in the **Fall** and in the spring 45 days or more prior to soybean planting. Canopy EX contains Classic (chlorimuron) and Express (see Table 2E). Canopy EX use rates range from 1.1 to 3.3 oz/A, depending on soil pH. DO NOT apply Canopy EX at rates greater than 1.1 oz/A to soils with a composite pH greater than 7.0. DO NOT apply Canopy EX to soils with a composite pH exceeding 7.6. Always add a crop oil concentrate at 1% v/v or surfactant at 0.25% v/v. Consult **Table 2C** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2F** for residual weed control. Consult label and Table 12 for crop rotation restrictions. For fall applications, adjust the rotational crop intervals by basing the interval on the date of soybean planting, not herbicide application. Canopy EX will not control ALS-resistant weeds. For best burndown results, the addition of 2,4-D ester is recommended.

Extreme (2.17 L): Extreme can be applied in the **Fall**, **EPP** (up to 45 days) or **PRE** to control existing vegetation and to provide residual weed control. Extreme contains glyphosate and Pursuit (see Table 2E). Apply Extreme at 3 pt/A. Always add surfactant at 0.25% v/v + 17 lb/100 gal of ammonium sulfate (AMS). Consult **Table 2C** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2F** for residual weed control (Pursuit). Effectiveness from the residual component of Extreme is greater the closer it is applied to planting. Consult label and Table 12 for crop rotation restrictions. For fall applications, adjust the rotational crop intervals by basing the interval on the date of soybean planting, not herbicide application. Apply with 2,4-D ester for improved horseweed (marestail) and perennial weed control.

FirstRate (84 DG): FirstRate can be applied **EPP** (up to 14 days) or **PRE** for control of existing vegetation and to provide residual weed control. Apply FirstRate at 0.3 to 0.6 oz/A, use the 0.6 oz/A rate for improved residual control. Always add crop oil concentrate at 1% v/v and 28% N at 2.5% v/v. Consult **Table 2C** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2F** for residual weed control. FirstRate will not control ALS-resistant weeds. To broaden the spectrum of weed control, tank-mix with glyphosate, Gramoxone Inteon or 2,4-D ester. More effective burndown occurs when conditions are warm and sunny.

Linex/Lorox (4 L): Linex/Lorox can be applied **EPP** (up to 30 days) or **PRE** for control of existing vegetation and to provide residual weed control. Apply Linex/Lorox at 1 pt/A. Always add crop oil concentrate at 1% v/v (preferred) or 0.25% v/v surfactant. Consult **Table 2C** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2F** for residual

weed control. Effectiveness from Linex is greater the closer it is applied to planting. To broaden the spectrum of weed control, tank-mix with glyphosate or 2,4-D ester.

Python WDG (80 DG): Python can be applied **EPP** (up to 30 days) or **PRE** for control of existing vegetation and to provide residual weed control. Apply Python at 1.14 oz/A. Always add crop oil concentrate at 1% v/v. Python can also be applied in the **Fall** for burndown activity of winter annual weeds, but it is not likely to provide extended residual control in the spring. Consult **Table 2C** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2F** for residual weed control. Effectiveness from Python is greater the closer it is applied to planting. Python will not control ALS-resistant weeds. To broaden the spectrum of weed control, tank-mix with glyphosate, Gramoxone Inteon or 2,4-D ester. More effective burndown occurs when conditions are warm and sunny.

Sencor (75 DF): Sencor can be applied **EPP** (up to 30 days) or **PRE** for control of existing vegetation and to provide residual weed control. Apply Sencor at 5.33 oz/A. Always add crop oil concentrate at 1% v/v. Sencor can also be applied in the Fall for burndown activity of winter annual weeds, but it is not likely to provide extended residual control in the spring. Consult **Table 2C** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2F** for residual weed control. Effectiveness from Sencor is greater the closer it is applied to planting. Sencor will not control triazine-resistant weeds. To broaden the spectrum of weed control, tank-mix with glyphosate, Gramoxone Inteon or 2,4-D ester.

Sequence (5.25 EW): Sequence can be applied **EPP** (up to 30 days) or **PRE** to control existing vegetation and to provide residual weed control. Sequence contains glyphosate and Dual Magnum (see Table 2E). Apply Sequence at 2.5 pt/A. Ammonium sulfate (AMS) at 17 lb/100 gal should be added. Consult **Table 2C** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2F** for residual weed control (Dual Magnum). The addition of 2,4-D ester may enhance horseweed (marestail) and perennial weed control.

Synchrony XP (28.4 DG): Synchrony XP can be applied **EPP** (up to 45 days) or **PRE** to control existing vegetation and to provide residual weed control. Synchrony XP contains Classic (chlorimuron) and Harmony GT (see Table 2E). Synchrony XP use rates range between 1 and 3 oz/A, depending on soil pH. If the composite soil pH is between 7.1 and 7.6, do not apply more than 1 oz/A. DO NOT apply to soils with a composite pH exceeding 7.6. Use a minimum of 1 oz/A of Synchrony XP for burndown activity and a minimum of 1.25 oz/A for residual control of labeled weeds. Always add a crop oil concentrate at 1% v/v. Consult **Table 2C** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2F** for residual weed control. Effectiveness from the residual components of Synchrony XP is greater the closer it is applied to planting. Consult label and Table 12 for crop rotation restrictions. Synchrony XP will not control ALS-resistant weeds. For best burndown results, the addition of 2,4-D ester is recommended.

Valor (51 DG): Valor can be applied **EPP** (up to 14 days) or **PRE** for control of existing vegetation and to provide residual weed control. Apply Valor at 2 to 3 oz/A, 2.5 oz/A is the typical use rate. Always add crop oil concentrate at 1% v/v; for burndown activity. Valor can also be applied in the **Fall** for burndown activity of winter annual weeds, but it is not likely to provide extended residual control in the spring. Consult **Table 2C** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2F** for residual weed control. Effectiveness from Valor is greater the closer it is applied to planting. More effective burndown occurs when conditions are warm and sunny. Valor has poor postemergence activity on horseweed (marestail), but it had good preemergence activity. Valor should be tank-mixed with 2,4-D ester, glyphosate, glyphosate + 2,4-D ester, or *Gramoxone Inteon* to broaden the spectrum of burndown weed control.

Effectiveness of Herbicides for No-Till Soybeans

Fall or Spring Burndown	LENGTH OF CONTROL[d]	ANNUAL BROADLEAVES / GRASSES												WINTER ANNUALS / PERENNIALS									COVER CROPS			
		Cocklebur	Jimsonweed	Lambsquarters	Nightshade (E. Black)	Pigweed	Ragweed (Common)	Ragweed (Giant)	Smartweed	Velvetleaf	Wild mustard	Barnyardgrass	Foxtails	Chickweed (Common)	Deadnettle	Henbit	Horseweed (Marestail)	Pennycress	Shepherd's-purse	Yellow rocket	Dandelion	Quackgrass	Rye	Wheat	Clover	Hairy Vetch
		Maximum Weed Height (inches)												Herbicide Effectiveness												
Glyphosate (0.75 lb ae/A)[a]	0	6	6	6	6	6	6	6	6	6	6	6	6	**E**	F	**G**	**E**	**E**	**E**	**E**	F	**G**	**E**	**E**	F	F
Glyphosate (1.13 lb ae/A)[a]	0	12	12	12	12	12	12	12	12	12	12	12	12	**E**	**G**	**G**	**E**	**E**	**E**	**E**	F	**G**	**E**	**E**	F	F
Gramoxone Inteon (2 pt/A)	0	3	3	3	3	3	3	3	–	3	3	3	3	**E**	P	**G**	P	**G**	**G**	**G**	P	P	F	F	P	P
Gramoxone Inteon (3 pt/A)	0	6	6	6	6	6	6	6	–	6	6	6	6	**E**	F	**G**	P	**E**	**E**	**E**	P	P	**G**	**G**	F	F
2,4-D ester[b] (1 pt/A)	0	3	–	3	3	3	3	3	–	2	3	–	–	P	P	P	**E**	**G**	**G**	**G**	P	N	N	N	F	F
2,4-D ester[c] (1 qt/A)	1	6	3	6	6	6	6	6	3	5	6	–	–	P	F	F	**E**	**E**	**E**	**E**	F	N	N	N	**G**	**G**
Express XP (0.16 oz/A)	0	–	–	3	–	–	–	–	–	–	3	–	–	**E**	**G**	**G**	P	**G**	F	P	F	N	N	N	N	N
Authority First/ Sonic (0.32 oz/A)	2	10	4	–	–	–	8	10	6	6	2	–	–	P	P	P	**E**	**G**	F	F	P	N	N	N	P	P
Backdraft SL (5 pt/A)	3	18	3	8	10	6	6	4	6	5	16	5	12	**E**	F	**G**	**G**	**G**	**E**	**G**	F	**G**	**G**	**G**	P	P
Canopy (3 oz/A)	3	–	–	3	–	3	3	3	3	–	3	2	2	**G**	**G**	**G**	F	**E**	**E**	**E**	F	N	P	P	P	P
Canopy EX (1.65 oz/A)	3	–	–	–	–	3	3	3	3	3	3	–	–	**E**	**G**	**G**	**G**	**E**	**E**	**E**	F	N	P	P	P	P
Extreme (3 pt/A)	2	18	6	8	12	18	9	9	6	5	18	6	18	**E**	F	**G**	**G**	**G**	**E**	**G**	F	**G**	**G**	**G**	P	P
FirstRate (0.3 - 0.6 oz/A)	2	10	4	–	–	–	8	10	6	6	2	–	–	P	P	P	**E**	**G**	F	F	P	N	N	N	P	P
Linex/Lorox (1 pt/A)	2	6	–	6	–	–	6	–	6	6	6	2	2	**G**	P	P	P	P	P	P	P	P	P	P	P	P
Python WDG (1.14 oz/A)	2	–	–	–	–	–	–	–	–	–	–	–	–	**G**	P	P	**G**	**G**	F	**G**	P	N	N	N	P	P
Sencor (5.33 oz/A)	1	1	–	1	–	1	1	–	–	–	–	–	–	**G**	**G**	**G**	F	**G**	**G**	**G**	P	N	N	N	P	P
Sequence (2.5 pt/A)	2	12	12	6	6	12	12	12	6	6	18	6	18	**E**	F	**G**	**E**	**E**	**E**	**E**	F	**G**	**E**	**E**	F	F
Synchrony XP (1.5 oz/A)	3	–	–	3	–	3	3	3	3	3	3	–	–	P	**G**	**G**	F	**E**	**E**	**E**	F	N	P	P	P	P
Valor (2.5 oz/A)	2	–	–	–	–	–	–	–	–	–	–	–	–	P	F	F	P	**G**	**E**	**G**	F	N	N	N	P	P

P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None; – = Not labeled or recommended.

[a] See Table 10 for glyphosate products, formulations and rates. Lower glyphosate rates may be used for smaller weeds at lower spray volumes. Consult label.

[b] Wait a minimum of 7 days before planting soybean.

[c] Wait a minimum of 30 days before planting soybean.

[d] Length of summer weed control: 0 = no residual control; 1 = short residual control; 2 = moderate residual control; 3 = long residual control.

TABLE 2D – Soybeans — Preharvest Application

Soybeans — Preharvest Application

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses, Annual broadleaves, Perennial weeds	glyphosate + ammonium sulfate	0.75–3 lb a.e.	See Table 10 + 17 lb/100 gal	• See Table 10 for a list of glyphosate products, formulations and rates. • DO NOT apply to soybeans grown for seed. • Apply up until 7 days before harvest. • DO NOT graze or harvest the treated crop for livestock feed within 25 days of application. • Apply in 10-40 gal of water. • Apply 0.75 lb a.e./A for annual weeds. • Consult glyphosate product label for specific rate needed for perennial weeds.
Annual grasses, Annual broadleaves	paraquat *(Gramoxone Inteon)* + surfactant	0.19	12 oz 2SL + 0.125%	• *Gramoxone Inteon* is a **restricted-use** pesticide. • Indeterminate varieties: Apply when at least 65% of pods are mature brown (seed moisture less than 30%). • Immature soybeans will be injured. • Do not apply within 15 days of harvest. • Apply *Gramoxone Inteon* in 20 gal. water (ground) or 5 gal. water (air).

TABLE 2E – Herbicide Premixes in Soybeans

TRADE NAME	COMPANY	FORMULATION	TYPICAL USE RATE	=	EQUIVALENT RATES
Authority First/ Sonic	FMC/Dow	70DF	3.2 oz/A	=	4 fl oz Spartan + 0.3 oz FirstRate
Axiom	Bayer	68DF	13 oz/A	=	9.6 oz Define + 2.3 oz Sencor DF
Backdraft SL	BASF	1.35SL	5 pt/A	=	1.5 pt glyphosate 3L a.e. + 2.14 oz Scepter
Boundary 6.5EC	Syngenta	6.5EC	1.5 pt/A	=	1 pt of Dual Magnum + 5 oz of Sencor DF
Canopy	DuPont	75DF	3 oz/A	=	1.28 oz Classic + 2.57 oz Sencor
Canopy EX	DuPont	29.5DG	1.65 oz/A	=	1.5 oz Classic + 0.15 oz Express
Domain	Bayer	60DF	10 oz/A	=	4 oz Define + 4.8 oz Sencor DF
Extreme	BASF	2.17L	3 pt/A	=	1.5 pt glyphosate 3L a.e. + 1.4 oz Pursuit DG
Fusion	Syngenta	2.56EC	0.5 pt/A	=	8 fl oz Fusilade DX + 4.8 fl oz Puma
Gangster	Valent	co-pack	3.0 oz 0.6 oz	of of	Valor (Gangster V) + FirstRate (Gangster FR)
Prefix CP	Syngenta	co-pack	1.1 pt/A 1 pt/A	of of	Dual Magnum (Prefix) + Reflex
Pursuit Plus	BASF	2.9EC	2.5 pt/A	=	2.1 pt Prowl 3.3EC + 1.4 oz Pursuit DG
Sequence	Syngenta	5.25EW	2.5 pt/A	=	0.98 pt Dual Magnum + 21 oz Touchdown Total
Synchrony XP	DuPont	28.4DG	0.75 oz/A	=	0.64 oz Classic + 0.07 oz Harmony GT

TABLE 2F – Weed Response to Herbicides in Soybeans*

Soil Applied	SITE OF ACTION	CROP RESPONSE	ANNUAL BROADLEAVES												ANNUAL GRASSES								PERENNIALS				
			COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PIGWEED	RAGWEED (COMMON)	RAGWEED (GIANT)	SMARTWEED	VELVETLEAF	WILD MUSTARD	HORSEWEED (MARESTAIL)	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	BINDWEED (FIELD)	BINDWEED (HEDGE)	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE
ALS-Inhibitors																											
FIRSTRATE	B	2	**G**	**G**	**G**	P	**E**	**E**	**G**	**E**	**G**	**E**	**G**	F	F	F	F	F	F	P	P	N	N	N	N	P
PURSUIT	B	1	F	F	**G**	**E**	**E**	F	F	**G**	**G**	**E**	P	F	F	**G**	**G**	**G**	P	P	P	P	P	N	N	F
PYTHON	B	1	F	F	**E**	**G**	**E**	F	F	**G**	**G**	**E**	**G**	P	P	F	P	P	P	P	P	N	N	N	N	N
SCEPTER	B	1	**E**	**G**	**G**	**G**	**E**	F	**G**	**G**	**G**	**G**	P	F	P	**G**	**G**	**G**	P	P	P	N	N	N	N	F
Triazine																											
SENCOR	C	2	F	F	**E**	N	**E**	**G**	F	**E**	**G**	**E**	**G**	P	F	**G**	**G**	**G**	F	F	P	N	N	N	N	N
Other Sites of Action																											
COMMAND 3ME **(PRE only)**	O	1	F	F	**G**	P	P	**G**	P	**G**	**E**	P	—	**G**	**E**	**E**	**E**	**G**	**G**	**G**	F	N	N	N	N	N
DEFINE	O	1	N	N	P	P	F	N	N	N	N	N	N	F	F	**G**	**G**	**G**	F	F	P	N	N	N	N	P
DUAL MAGNUM/PARALLEL/STALWART	O	1	N	N	P	F	**G**	P	N	P	N	P	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	N	F[a]
INTRRO/MICROTECH	O	1	N	N	P	**G**	**G**	P	N	P	N	P	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	N	P[a]
LOROX/LINEX **(PRE only)**	O	2	P	P	**G**	F	**G**	**G**	F	**G**	F	**G**	P	F	F	F	F	F	F	F	P	N	N	N	N	N
OUTLOOK	O	1	N	N	P	**G**	**G**	P	N	P	N	P	N	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	N	F[a]
PROWL H_20/PROWL/PENDIMAX	O	2	N	N	**G**	P	F	P	N	P	F	P	P	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	N	N	N	N	N
SONALAN **(PPI only)**	O	1	N	N	**G**	F	**G**	P	N	P	N	P	-	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N	N
SPARTAN	O	3	P	P	**E**	**E**	**E**	F	P	F	F	P	F	F	F	F	F	F	F	P	P	N	N	N	N	F
TRIFLURALIN **(PPI only)**	O	1	N	N	**G**	F	**G**	P	N	P	N	P	-	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N	N
VALOR **(PRE only)**	O	2	P	F	**G**	**G**	**G**	**G**	F	F	F	**G**	**G**	P	P	F	F	F	P	P	P	N	N	N	N	P
Premixes																											
AUTHORITY FIRST/SONIC	B/O	3	**G**	**G**	**G**	**G**	**E**	**E**	**G**	**E**	**G**	**E**	**G**	F	F	F	F	F	F	P	P	N	N	N	N	F
AXIOM	O/C	1	P	P	F	P	F	P	P	P	P	P	P	F	F	**G**	**G**	**G**	F	F	P	N	N	N	N	P
BOUNDARY	C/O	2	F	F	**G**	F	**E**	**G**	F	**E**	**G**	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	N	F[a]
CANOPY	B/C	2	**G**	**G**	**E**	N	**E**	**G**	**G**	**E**	**G**	**E**	**G**	F	F	F	F	F	F	F	P	P	P	N	N	F
CANOPY EX **(FALL only)**[b]	B/B	1	**G**	**G**	**G**	N	**G**	**G**	F	**G**	**G**	**E**	**G**	P	P	F	F	F	P	P	P	P	P	N	N	P
DOMAIN	O/C	2	F	F	**G**	P	**E**	**G**	F	**E**	**G**	**E**	**G**	F	F	**G**	**G**	**G**	F	F	P	N	N	N	N	N
GANGSTER **(PRE only)**	B/O	2	**G**	**G**	**G**	**G**	**E**	**E**	**G**	**E**	**G**	**E**	**G**	F	F	F	F	F	F	P	P	N	N	N	N	P
PREFIX (PRE only)	O/O	2	P	P	**G**	**E**	**E**	**G**	F	**G**	P	**E**	F	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	N	P
PURSUIT PLUS	O/B	2	F	F	**G**	**E**	**E**	F	F	**G**	**G**	**G**	P	**G**	**G**	**E**	**G**	**G**	**G**	**G**	**G**	N	N	N	N	F
SYNCHRONY XP	B/B	2	**G**	**G**	**E**	N	**E**	**G**	**G**	**E**	**G**	**E**	**G**	F	F	F	F	F	F	F	P	P	P	N	N	F

P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None; – = Not enough information to rank

Herbicide Site of Action: A = ACCase inhibitor; B = ALS inhibitor; C = Triazine; O = Other.

Crop Response: 1=Minimal risk of crop injury; 2=Crop injury can occur under certain conditions (soil applied—cold, wet: foliar applied—hot, humid); 3=Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label.

[a] Control of yellow nutsedge will be increased if this treatment is incorporated in the top 2-3 inches of soil.

[b] *Canopy EX* applications in the fall will provide residual weed control of spring emerging weeds, ratings are based on initial control of early emerging weed species.

* The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.

TABLE 2F – Weed Response to Herbicides in Soybeans* (continued)

Postemergence	SITE OF ACTION	CROP RESPONSE	ANNUAL BROADLEAVES											ANNUAL GRASSES								PERENNIALS				
			COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PIGWEED	RAGWEED (COMMON)	RAGWEED (GIANT)	SMARTWEED	VELVETLEAF	WILD MUSTARD	HORSEWEED (MARESTAIL)	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	BINDWEED (FIELD)	BINDWEED (HEDGE)	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE
ACCase-Inhibitors																										
ASSURE II/TARGA	A	1	N	N	N	N	N	N	N	N	N	N	N	**G**	**G**	**E**	**E**	**G**	**E**	**E**	**E**	N	N	N	**E**	N
FUSION	A	1	N	N	N	N	N	N	N	N	N	N	N	**G**	**G**	**E**	**E**	**E**	**G**	**G**	**E**	N	N	N	**G**	N
POAST or POAST PLUS	A	1	N	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	N	F	N
SELECT/ARROW/SELECT MAX	A	1	N	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	N	**G**	N
ALS-Inhibitors																										
CLASSIC	B	2	**E**	**G**	N	N	**E**	**G**	**G**	**E**	**G**	**E**	**G**	N	N	P	P	P	N	N	N	N	N	F	N	**E**
FIRSTRATE	B	1	**E**	**E**	N	N	P	**E**	**E**	**E**	**G**	**G**	**G**	N	N	N	N	N	N	N	N	P	P	F	N	F
HARMONY GT	B	3	F	F	**G**	N	**E**	P	P	**E**	**G**	**E**	N	N	N	N	N	N	N	N	N	N	N	N	N	N
PURSUIT	B	2	**E**	F	P	**E**	**E**	F	**G**	**G**	**G**	**G**	P	F	F	**G**	**G**	**G**	F	F	P	P	P	P	N	F
RAPTOR	B	2	**G**	**G**	**G**	**E**	**E**	F	**G**	**G**	**G**	**E**	–	F	F	**E**	**G**	**G**	F	F	–	P	P	F	P	P
SCEPTER	B	2	**E**	P	N	P	**E**	P	P	P	P	P	P	N	N	F	F	F	N	N	N	N	N	N	N	N
Other Sites of Action																										
GLYPHOSATE[b] (**ROUNDUP READY**)[a]	O	1	**E**	**E**	**G**	**G**	**E**	**G**	**G**	**G**	**G**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	**G**	**E**	F
BASAGRAN	O	2	**E**	**G**	**G**	P	P	F	F	**E**	**G**	**E**	F	N	N	N	N	N	N	N	N	N	N	**G**	N	F
COBRA	O	3	**G**	**G**	P	**G**	**E**	**E**	**E**	P	F	**E**	P	N	N	N	N	N	N	N	N	P	P	P	N	N
FLEXSTAR	O	3	F	**G**	F	**G**	**E**	**E**	**E**	**G**	F	**E**	P	P	P	F	F	F	P	P	N	P	P	P	N	N
PHOENIX	O	3	**G**	**G**	P	**G**	**E**	**E**	**E**	P	F	**E**	P	N	N	N	N	N	N	N	N	P	P	P	N	N
REFLEX	O	1	P	F	P	F	**E**	**G**	**G**	P	P	**E**	P	P	P	P	P	P	P	N	N	P	P	P	N	N
RESOURCE	O	2	P	P	F	P	P	P	P	P	**E**	P	P	N	N	N	N	N	N	N	N	N	N	N	N	N
ULTRA BLAZER	O	3	F	**G**	P	**G**	**E**	**E**	F	**G**	P	**E**	P	N	N	F	F	F	P	P	N	P	P	P	N	N
Premixes*																										
BACKDRAFT[b] (**ROUNDUP READY**)	A/O	2	**E**	**E**	**G**	**G**	**E**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**E**	**E**	**E**	**G**	**G**	**G**	**G**	**G**	**G**	**E**	F
EXTREME[b] (**ROUNDUP READY**)	A/O	2	**E**	**E**	**G**	**E**	**E**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**E**	**E**	**E**	**G**	**G**	**G**	**G**	**G**	**G**	**E**	F
SEQUENCE (**ROUNDUP READY**)	O/O	2	**E**	**E**	**G**	**G**	**E**	**G**	**G**	**G**	**G**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	**G**	**E**	F
SYNCHRONY XP	B/B	1	**E**	**G**	**G**	N	**E**	**G**	**G**	**E**	**E**	**E**	**G**	N	N	N	N	N	N	N	N	N	N	F	N	**E**

P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None; – = Not enough information to rank

Herbicide Site of Action: A = ACCase inhibitor; B = ALS inhibitor; C = Triazine; O = Other.

Crop Response: 1=Minimal risk of crop injury; 2=Crop injury can occur under certain conditions (soil applied—cold, wet: foliar applied—hot, humid); 3=Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4=Risk of severe crop injury is high. Recommended only in rescue situations.

[a] See Table 10 for glyphosate products, formulations, and rates.

[b] Must add ammonium sulfate for velvetleaf control.

* The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.

**Weed response to postemergence broadleaf herbicide combinations may vary because of a change in application rate, a change in spray additive or herbicide antagonism. See Table 2I for the proper additive(s) and see labels for proper herbicide rates. Rates may vary, depending on weed species, weed size and tank mix.

TABLE 2G – Maximum Broadleaf Weed Heights for Postemergence Control in Soybeans*

Herbicide		COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PIGWEED	RAGWEED (COMMON)	RAGWEED (GIANT)	SMARTWEED	VELVETLEAF	WILD MUSTARD (DIAMETER OF ROSETTE)	HORSEWEED (MARESTAIL)
	RATE/A	**WEED HEIGHT[a] (inches)**										
Backdraft SL **(RR)**	5 pt	18	3	8	10	6	6	4	6	5	16	10
Basagran	1.5 pt	6	6	1.5[c]	-	-	-	-	6	2	4	-
	2 pt	10	10	2[c]	-	-	3	6	10	6	8	-
Classic	0.5 oz	6	4	-	-	2	-	-	2	-	4	3
	0.75	12	6	-	-	4	4	6	4	6	6	6
Cobra[b]	6 oz	-	-	-	3L	4L	6L	-	-	-	-	-
	8oz	4L	4L	-	4L	6L	6L	4L	-	-	4L	-
Extreme **(RR)**	3 pt	18	6	8	12	18	9	9	6	5	18	12
FirstRate/Amplify	0.3 oz	10	4	-	-	-	8	10	6	6	4	6
Flexstar[b]	0.75 pt	2L	4L	-	2L	2L	-	-	-	-	4L	-
	1 pt	4L	6L	-	4L	4L	4L	4L	4L	-	6L	-
Glyphosate **(RR)**	0.75 lb a.e.	6	6	6	6	6	6	6	6	6	6	6
Harmony GT	0.08 oz	-	-	4	-	12	-	-	6	6	4	-
Phoenix	10 oz	-	2	-	2	4	4	5	-	-	2	-
	12.5 oz	2	4	-	3	4	6	4	-	-	4	-
Pursuit 70DG	1.44 oz	8	3	<1[c]	2	6	2[c]	3[c]	3	2	3	-
Raptor	5 oz	8	6	3	3	6	3	4	4	4	3	-
Reflex[b]	0.75 pt	-	2L	-	2L	2L	2L	-	2L	-	2L	-
	1 pt	-	4L	-	2L	2L	4L	-	4L	-	4L	-
Resource	6 oz	-	-	3L[c]	-	3L[c]	4L[c]	-	-	6L	-	-
Scepter	1.4 oz	8	-	-	-	4	-	-	-	-	-	-
Sequence **(RR)**	2.5 pt	12	12	6	6	12	12	12	6	6	18	12
Synchrony XP	0.5 oz	8	5	4	-	8	4	4	8	8	5	5
Ultra Blazer	1 pt	-	4	-	<2	<4	2	<2	4	-	<4	-
	1.5 pt	2	6	2[c]	2	4	3	3	6	-	4	-

[a] (-) No control or weed height not listed on label.

[b] Weed stages are based on maximum leaf numbers.

[c] Suppression only.

* The weed heights listed on this table are estimates of the maximum size where consistent control is expected. The maximum height for effective control in any specific situation is dependent on environmental conditions, including soil moisture, temperature, and relative humidity.

TABLE 2H – Suggested Additives for Postemergence Herbicide Applications in Soybeans[a]

Herbicide	Crop Oil Concentrate (COC)	OR	Nonionic Surfactant (NIS)	AND/OR	28% liquid nitrogen (28%N) or ammonium sulfate (AMS)
Assure II/Targa	1% (2% if drought stress)		0.25%		NO
Backdraft SL (**Roundup Ready**)	NO		0.25%		AMS (17 lb/100 gal)
Basagran[b]	1 qt/A		NO		28% N (2-4 qt) or AMS (2.5 lb/A) optional
Classic[b]	1%		0.25%		28% N (2-4 qt) or AMS (2-4 lb/A)
Cobra	0.5%		0.25% if high RH		28% N (2.5%) or AMS (2-4 lb/A)
Extreme (**RoundupReady**)	NO		0.125%		AMS (17 lb/100 gal)
FirstRate[b]	1.2% if dry only		0.25%		Always add 28% N (2.5%) or AMS (8.5-17 lb/100 gal)
Flexstar	1%		0.25%		28% N (2.5%) or AMS (8.5 lb/100 gal) optional
Fusion	0.5 – 1%		0.25– 0.5%		28% N (2.5%) or AMS (17 lb/100 gal) optional
Glyphosate[c] (**Roundup Ready**)	NO				AMS (17 lb/100 gal)
Harmony GT[b]	1% if hot, dry only		0.125–0.25%		28% N (2 qt/A) or AMS (2-4 lb/A) optional
Phoenix	1 pt/A if hot, dry		0.125–0.25%		NO
Poast[d] or Poast Plus	1 qt/A		NO		28% N (0.5-1 gal/A) or AMS (2.5 lb/A) optional
Pursuit	1%		0.25%		Always add 28% N (2.5%) or AMS (12-15 lb/100 gal)
Raptor[e]	1%		0.25%		Always add 28% N (2.5%) or AMS (12-15 lb/100 gal)
Reflex	0.5–1%		0.25–0.5%		28% N (2.5%) or AMS (10 lb/100 gal) optional
Resource	1 qt/A		NO		28% N (1 gal/A) or AMS (2.5 lb/A) optional
Scepter	1%		0.25%		NO
Select/Arrow	1%		NO		28% N (1-2 qt/A) or AMS (17 lb/100 gal) optional
Select Max	1%		0.25%		28% N (1 to 2 qt/A) or AMS (2.5 to 4 lb/A) optional
Sequence (**Roundup Ready**)	NO		NO		AMS (17 lb/100 gal)
Synchrony XP	1%		0.25% non-STS beans		Always add 28% N (2 qt) or AMS (2 lb/A)
Ultra Blazer	NO		0.25%		28% N (2-4 qt/A) or AMS (2.5 lb/A) optional

[a] 0.125% = 1 pt in 100 gal of spray solution; 0.25% = 1 qt in 100 gal; 1% = 1 gal in 100 gal; 4% = 4 gal in 100 gal.

[b] 28% N or AMS should be added for velvetleaf control.

[c] Consult Table 10 for glyphosate formulations and NIS requirements.

[d] 28% N or AMS improves control of large crabgrass, quackgrass, and volunteer corn and cereals.

[e] Use methylated seed oil (MSO) for improved common ragweed control.

TABLE 21 – Additives for Postemergence Broadleaf Weed Control in Soybeans*

Additives are listed for each herbicide tank mixture based on the label of the herbicide in the Primary Herbicide column. Sometimes, a tank mixture may occur on only one label. For example, *Basagran + Classic* is listed as a tank mixture on the *Basagran* label but is not listed as a tank mixture on the *Classic* label. To find the correct additives for a tank mixture, find the first herbicide in the Primary Herbicide column and then move across the column to the box that corresponds with the tank mix partner.

	TANK MIX PARTNER												
PRIMARY HERBICIDE	**BASAGRAN**	**CLASSIC**	**COBRA**	**FIRSTRATE**	**FLEXTAR**	**HARMONY GT**	**PHOENIX**	**PURSUIT**	**RAPTOR**	**REFLEX**	**RESOURCE**	**SYNCHRONY XP**	**ULTRA BLAZER**
Basagran	—	A+	B+	A+	B+	A+	NL	B+	B+	B+	B+	B+	B+
Classic	NL	—	D+	B+	B+	C+	NL	D+	NL	B+	NL	NL	A+
Cobra[1]	D-	D-	—	D+	NL	C-	NL	D+	D+	NL	B-	D-	NL
FirstRate[2]	A+	A+	A+	—	A+	A+	NL	A+	A+	A+	A+	A+	A+
Flexstar[2]	B+	B+	NL	A+	—	C+	NL	B+	B+	NL	B+	B+	NL
Harmony GT	A+	NL	NL	NL	NL	—	NL	NL	NL	NL	NL	NL	NL
Phoenix	C-	C-	NL	C-	NL	C-	—	A-	A-	NL	C-	C-	NL
Pursuit	B+	NL	D+	A+	B+	A+	NL	—	NL	B+	NL	NL	A+
Raptor	B+	A-	D+	A+	B+	NL	NL	NL	—	B+	NL	NL	B+
Reflex[2]	B+	B+	NL	A+	NL	C+	NL	B+	B+	—	B+	B+	NL
Resource	B+	B+	B-	B+	B+	C+	NL	B+	B+	NL	—	B+	B+
Synchrony XP[3]	NL	NL	D+	B+	B+	NL	NL	NL	NL	B+	NL	—	A+
Ultra Blazer	A-	A-	NL	A+	NL	C+	NL	A+	A+	NL	B-	D+	—

Adjuvant

A = 0.25% v/v non-ionic surfactant
B = 1.0% v/v crop oil concentrate
C = 0.125% v/v non-ionic surfactant
D = 0.5% v/v crop oil concentrate
NL = Not on label

Nitrogen Source

— = DO NOT add a N fertilizer source
\+ = Add a N fertilizer sources, AMS or 28% UAN

[1] *Cobra* applied at 4 to 12 oz/A.
[2] These tank mixtures are labeled, adjuvant selection should be based on the tank mix partner label.
[3] Adjuvant selection is when *Synchrony XP* is used on STS designated soybeans.

TABLE 2J – Application Rates of Postemergence Grass Herbicides for Control of Grass Species at Various Heights

	Assure II/Targa	Fusion[a]	Poast	Poast Plus	Select/Arrow	Select Max
				oz/A		
Barnyardgrass						
1–2”	–	–	12	18	4	6
2–3”	8	8	12	18	4	6
3–4”	8	8	12	18	4	6
4–6”	8	–	16	24	6	9
6–8”	–	–	16	24	6	9
Crabgrass						
<1”	–	–	–	–	–	–
1–2”	8	8	16	24	6	6
2–6”	8	–	16	24	6	9
Fall Panicum						
1–2”	–	–	12	18	4	6
2–4”	7	8	12	18	4	6
4–6”	7	8	16	24	6	9
6–8”	–	–	16	24	6	9
Giant Foxtail						
1–2”	–	–	12	18	4	6
2–4”	7	8	12	18	4	6
4–6”	7	8	16	24	6	9
6–8”	7	8	16	24	6	9
8–12”	–	–	–	–	6	9
Green Foxtail						
1–2”	–	–	12	18	–	6
2–4”	7	8	12	18	6	6
4–6”	–	–	16	24	6	9
6–8”	–	–	16	24	6	9
Quackgrass						
4–6”	–	–	–	–	8–16+8	12+12
6–8”	10+7	12+8	24+16	36+24	8–16+8	12+12
8–10”	10+7	12+8	–	–	–	12+12
V. Corn						
1–4”	–	–	12	18	–	–
4–6”	–	–	12	18	4	6
6–12”	5	–	12	18	4	6
12–18”	5	6	16	24	6	9
18–20”	8	6	16	24	6	9
20–24”	8	6	–	–	6	9
Witchgrass						
1–2”	–	–	16	24	–	–
2–4”	7	8	16	24	6	9
4–6”	7	8	16	24	6	9
6–8”	–	–	16	24	6	9
Yellow Foxtail						
1–2”	–	–	16	24	–	6
2–4”	7	8	16	24	6	6
4–6”	–	–	16	24	6	9
6–8”	–	–	16	24	6	9

[a] If grasses are small and not drought stressed, the *Fusion* rate can be reduced to 6 oz/A on barnyardgrass and all foxtails and 4 oz on volunteer corn.

TABLE 2K – Labeled Tank Mixes With Postemergence Grass Herbicides in Soybeans*

BROADLEAF HERBICIDES[1]	GRASS HERBICIDES					
	Assure II/Targa	**Fusion**	**Poast**	**Poast Plus**	**Select/Arrow**	**Select Max**
Basagran	Y[3]	Y	Y[4]	Y[4]	Y[5]	Y[5]
Classic	Y[3]	Y[3]	Y	Y	Y[5]	Y[5]
Cobra	Y	-	Y	Y	Y	Y
Extreme **(RR)**	-	-	-	-	-	-
FirstRate	Y[5]	Y[5]	Y[5]	Y[5]	Y[5]	Y[5]
Flexstar	Y	Y	Y	Y	Y	Y
Glyphosate[2] **(RR)**	Y	Y	Y	Y	Y	Y
Harmony GT	Y[5]	Y[5]	-	-	-	Y
Phoenix	-	-	-	-	Y	Y
Pursuit	-	Y[6]	Y[6]	Y[6]	Y[6]	Y[6]
Raptor	-	-	Y[6]	Y[6]	Y[6]	Y[6]
Reflex	Y	Y	Y	Y	Y	Y
Resource	Y	Y	Y	Y	Y	Y
Scepter	-	Y[3]	-	-	-	-
Synchrony XP	Y[3]	Y	Y	Y	Y[5]	Y[5]
Ultra Blazer	Y	Y	Y	Y	Y[5]	Y[5]

* Y = the products may be tank mixed; - = tank mix is not legally labeled or recommended.

1 Tank mixing saves time and application cost but is only labeled for some herbicides and for a limited number of grasses. Consult remarks and limitations for individual products in this guide and pesticide labels for further information.

2 Volunteer Roundup Ready corn. Consult the POST grass herbicide and glyphosate label for correct additives.

3 DO NOT tank mix when the target grass is barnyardgrass, crabgrass, quackgrass, or yellow foxtail.

4 DO NOT tank mix if quackgrass is the target species.

5 Under certain conditions, grass antagonism may occur.

6 Volunteer corn and shattercane only. Grass antagonism will occur. NOT RECOMMENDED.

TABLE 2L – Feed and Forage Restrictions for Soybean Herbicides[a]

Herbicide	Site of Action[b]	For Use in Feed/Forage?	Preharvest Interval
Herbicides Applied PPI or PRE			
Authority First/Sonic	B/O	No	none listed
Axiom	C/O	No	none listed
Boundary	C/O	**Yes**	none listed
Canopy	B/C	No	none listed
Canopy EX	B/B	No	none listed
Command 3ME	O	No	none listed
Define	O	No	none listed
Domain	C/O	No	none listed
Dual II Magnum/Parallel/Stalwart	O	**Yes**	none listed
FirstRate	B	**Yes**	none listed
Gangster	B/O	No	none listed
IntRRo/Microtech	O	**Yes**	none listed
Lorox/Linex	O	No	none listed
Outlook	O	No	none listed
Prefix	O/O	No	none listed
Prowl H_20/Prowl/Pendimax	O	**Yes**	none listed
Pursuit	B	No	none listed
Pursuit Plus	B/O	No	none listed
Python	B	No	none listed
Scepter	B	No	none listed
Sencor	C	**Yes**	none listed
Sonalan	O	No	none listed
Spartan	O	No	none listed
Trifluralin	O	**Yes**	none listed
Valor	O	No	none listed
Herbicides Applied POST			
Assure II/Targa	A	No	80 days
Backdraft SL	B/O	No	90 days
Basagran	O	**Yes**	30 days
Classic	B	No	60 days
Cobra/Phoenix	O	No	45 days
Extreme	B/O	No	85 days
FirstRate	B	**Yes**	14 days
Fusion	A	No	Prebloom
Glyphosate[c]	O	**Yes**[c]	
Harmony GT	B	No	60 days
Poast/Poast Plus	A	**Yes**	75 days
Pursuit	B	No	85 days
Raptor	B	No	85 days
Reflex/Flexstar	O	No	Prebloom
Resource	O	No	60 days
Scepter	B	No	90 days
Select/Arrow/Select Max	A	No	60 days
Sequence	O/O	No	90 days
Synchrony XP	B/B	No	60 days
Ultra Blazer	O	No	50 days

[a]Restrictions based on herbicide labels. Always read and follow herbicide labels.
[b]Site of Action: A = ACCase inhibitor; B = ALS inhibitor; C = Triazine; O = Other
[c]Consult specific glyphosate labels for feed and forage restrictions.

TABLE 3A — Chemical Weed Control in Small Grains

Direct-Drilled Small Grains (No-Till)

(fall or spring seedings following soybeans, corn or dry edible beans)

In general, complete control of all plants present at the time of planting is required for successful weed control. With direct drilling (no-till), vegetation control is accomplished before planting with burndown herbicides such as paraquat *(Gramoxone Inteon)* or glyphosate. The required application rate varies, depending on weed species and size. Refer to the product labels for details. *Gramoxone Inteon* provides faster kill. Glyphosate is preferred if perennial weeds are present, but fields with serious perennial weed problems should not be direct drilled with a small grain until the perennial weeds have been controlled.

The need for a burndown herbicide depends on the species of weeds present. If no weeds are present, a burndown herbicide is not needed. For fall-seeded small grains, fields with small seedlings of species that do not overwinter (summer annuals only) and are present at low densities do not need a burndown herbicide. If the weeds are large, however, or capable of overwintering (winter annuals, biennials or perennials) or if identification of the weeds cannot be confirmed, a burndown herbicide should be used. For spring-seeded small grains, a burndown herbicide should be used if any weeds are present at planting time, regardless of species or size.

Herbicides applied after small grain emergence are not affected by the tillage system used. All of the herbicides listed below can be used in all tillage systems including direct drilling. No weed problems are unique to no-till small grain production. Therefore, no-till small grain production does not present any special weed control concerns.

Barley and Wheat Without Legume Seedings — All Tillage Systems

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	2,4-D amine	0.5	1 pt 4L	• Apply in the spring to actively growing grain following tillering (usually about 6-8 inches high) but prior to jointing (between 3 and 6 on Feeke's scale). DO NOT TREAT GRAIN IN BOOT TO DOUGH STAGE. The boot stage is when the upper sheath is beginning to swell with the enlarging head. • Do not apply in the fall. • Most effective when weeds are small (less than 4 inches). • Not effective on smartweed and wild buckwheat. • **If 2,4-D ester is used, an application rate no higher than 0.38 lb ai/A is advised. 2,4-D ester mixes easier with 28% liquid nitrogen.**
	bromoxynil *(Buctril, Moxy,* others)	0.35	1.5 pt 2L	• May be applied from emergence up to boot stage (between 1 and 9 on Feeke's scale). • Good coverage is essential. • Bromoxynil must be applied to small weeds for effective control (see label). • Redroot pigweed and mustard must be controlled when very small (refer to label for details). • Very good crop safety.

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Barley and Wheat Without Legume Seedings (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	dicamba *(Banvel, Clarity)*	0.125	0.25 pt 4L	• Apply in spring to actively growing grain with a well established secondary root system or following tillering but prior to jointing (between 3 and 6 on Feeke's scale). • Some wheat varieties are sensitive to dicamba. • DO NOT APPLY *DICAMBA* TO WHEAT VARIETIES WAKEFIELD OR MADISON—SEVERE INJURY AND YIELD LOSS WILL LIKELY OCCUR. • Do not apply to spring-seeded barley. • Most effective when weeds are small (less than 4 inches). • See remarks and limitations for dicamba in "Corn—Postemergence" section. • More effective than 2,4-D on smartweed, wild buckwheat, and perennials.
	thifensulfuron methyl + tribenuron methyl *(Harmony Extra)* + surfactant	0.023	0.5 oz. 75DF + 0.25%	• Apply to winter wheat and barley after the crop is in the 2-leaf stage but before the flag leaf is visible (between 1.2 and 7.9 on Feeke's scale). • Most effective if weeds are small (4 inches or less). • Addition of surfactant is essential for adequate results. • *Harmony Extra* may be tank mixed with 2,4-D amine, MCPA or *Buctril* for more rapid weed kill and improved control of ragweed. Tank mixes with 2,4-D may improve thistle control but also carry a greater risk of crop injury. To reduce this risk, apply 2,4-D at no more than 0.5 pt/A (0.25 lb ai/A) and reduce surfactant concentration to 0.125%. The lower surfactant concentration may reduce velvetleaf control. Observe the timing restrictions for 2,4-D, MCPA, and *Buctril* when tank mixing with *Harmony Extra*. Do not tank mix with dicamba — reduced control (antagonism) may occur. • Tank mixes with *Buctril* may reduce Canada thistle control. • For severe infestation, increase *Harmony Extra* rate to 0.6 oz./A. • For mayweed (dogfennel) control, *Harmony Extra* rate may be reduced to 0.3 oz./A. • Control of common ragweed is inconsistent. • **Caution:** If liquid nitrogen fertilizer is used as the herbicide carrier, leaf burn, yellowing, and stunting are likely. With favorable growing conditions the symptoms are temporary, but this practice is not recommended.

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Barley and Wheat Without Legume Seedings (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	thifensulfuron methyl tribenuron methyl *(Affinity BroadSpec)* + surfactant	0.023	0.75 oz. 50 DF + 0.25%	• Apply to winter wheat and barley after the crop is in the 2-leaf stage but before the flag leaf is visible (between 1.2 and 7.9 on Feeke's scale). • Most effective if weeds are small (4 inches or less). • Addition of surfactant is essential for adequate results. • *Affinity BroadSpec* may be tank mixed with 2,4-D amine, MCPA or *Buctril* for more rapid weed kill and improved control of ragweed. Tank mixes with 2,4-D may improve thistle control but also carry a greater risk of crop injury. • To reduce this risk, apply 2,4-D at no more than 0.5 pt/A (0.25 lb ai/A) and reduce surfactant concentration to 0.125%. The lower surfactant concentration may reduce velvetleaf control. Observe the timing restrictions for 2,4-D, MCPA, and *Buctril* when tank mixing with *Affinity BroadSpec*. Do not tank mix with dicamba — reduced control (antagonism) may occur. • Tank mixes with *Buctril* may reduce Canada thistle control. • For severe infestation, increase *Affinity BroadSpec* rate to 1.0 oz/A. • **Caution**: If liquid nitrogen fertilizer is used as the herbicide carrier, leaf burn, yellowing, and stunting are likely. With favorable growing conditions the symptoms are temporary, but this practice is not recommended. • **Caution**: DO NOT USE *Affinity BroadSpec* plus malathion, as crop injury will occur. • See Table 12 for crop rotation restrictions.
	thifensulfuron methyl *(Harmony GT)* + surfactant	0.023	0.5 oz. 75DF + 0.25%	• Apply to winter wheat and barley after the crop is in the 2-leaf stage but before the flag leaf is visible (between 1.2 and 7.9 on Feeke's scale). • Most effective if weeds are small (4 inches or less). • Addition of surfactant is essential for adequate results. • *Harmony GT* may be tank mixed with 2,4-D amine, MCPA or *Buctril* for more rapid weed kill and improved control of ragweed. Tank mixes with 2,4-D may improve thistle control but also carry a greater risk of crop injury. To reduce this risk, apply 2,4-D at no more than 0.5 pt/A (0.25 lb ai/A) and reduce surfactant concentration to 0.125%. The lower surfactant concentration may reduce velvetleaf control. Observe the timing restrictions for 2,4-D, MCPA, and *Buctril* when tank mixing with *Harmony GT*. Do not tank mix with dicamba — reduced control (antagonism) may occur. • Tank mixes with *Buctril* may reduce Canada thistle control. • For severe infestation, increase *Harmony GT* rate to 0.6 oz/A. • For mayweed (dogfennel) control, *Harmony Extra* rate may be reduced to 0.3 oz/A. • Control of common ragweed is inconsistent. • **Caution:** If liquid nitrogen fertilizer is used as the herbicide carrier, leaf burn, yellowing, and stunting are likely. With favorable growing conditions the symptoms are temporary, but this practice is not recommended.

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Barley and Wheat Without Legume Seedings (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	clopyralid + 2,4-D amine *(Curtail)*	0.094 + 0.5	2 pt 2.38L	• For control of annual broadleaves and suppression of Canada thistle. • Apply to wheat and barley following tillering but prior to jointing (between 3 and 6 on Feeke's scale). DO NOT APPLY AFTER THE BOOT STAGE. The boot stage is when the upper sheath is beginning to swell with the enlarging head. • Do not treat a field with *Curtail* that has been treated previously with 2,4-D or dicamba. • See Table 12 for crop rotation restrictions. • Rotation interval for soybeans and dry beans is extended to 18 months if soils contain less than 2% organic matter and natural precipitation is less than 15 inches during the 10.5 months following treatment.
ONLY ragweed, cocklebur, jimsonweed, and mayweed	clopyralid *(Stinger)*	0.094	0.25 pt 3L	• Apply to wheat or barley from the 3-leaf stage to boot stage (between 1.3 and 9 on Feeke's scale). See label for details. • Do not apply to small grains underseeded with a legume. • May be tank mixed with 2,4-D, dicamba, *Buctril, Harmony Extra* or *Express* for control of additional weeds. See label for details on rates. • See Table 12 for crop rotation restrictions.
Common ragweed, giant ragweed, jimsonweed, cocklebur, velvetleaf, hemp dogbane and mayweed	clopyralid + fluroxypyr *(WideMatch)*	0.25	1.33 pt 1.5L	• Apply to wheat, barley and oats from the 3-leaf stage to boot stage (between 1.3 and 9 on Feeke's scale). See label for details. • Do not apply to small grains underseeded with a legume. • May be tank mixed with 2,4-D, dicamba, *Buctril, Harmony Extra, Affinity BroadSpec* or *Express* for control of additional weeds. See label for details on rates. • Refer to label and Table 12 for crop rotation restrictions. • Do not allow livestock to graze treated areas or harvest treated forage within 7 days of application. • Do not apply closer than 14 days before cutting hay or 40 days before harvesting of grain or straw.
Common ragweed, giant ragweed, cocklebur, velvetleaf, hemp dogbane	fluroxypyr (*Starane*)	0.1238	0.66 pt 1.5L	• Apply from 2-leaf stage up to and including flag leaf emergence (between 1.2 and 9 on Feeke's scale). • Apply to actively growing weeds up to 8 inches tall. • Narrow spectrum of weeds controlled. • Do not apply to small grains underseeded with a legume. • No crop rotation restrictions. • Do not allow livestock to graze treated areas or harvest treated forage within 7 days of application. • Do not apply closer than 40 days before harvesting of grain or straw.

Barley and Wheat Without Legume Seedings (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Perennials (bindweed, thistles)	2,4-D ester	0.75	1.5 pt 4L	• Apply in the spring to actively growing grain following tillering (usually about 6-8 inches high) but prior to jointing (between 3 and 6 on Feeke's scale). DO NOT TREAT GRAIN IN BOOT TO DOUGH STAGE. The boot stage is when the upper sheath is beginning to swell with the enlarging head. • Will provide suppression only. • Injury may occur. • Some control of wild onion and wild garlic.
	dicamba *(Banvel, Clarity)*	0.125	0.25 pt 4L	• Apply in spring to actively growing grain with a well established secondary root system or following tillering but prior to jointing (between 3 and 6 on Feeke's scale). • Some wheat varieties are sensitive to dicamba. • DO NOT APPLY *DICAMBA* TO WHEAT VARIETIES WAKEFIELD OR MADISON — SEVERE INJURY AND YIELD LOSS WILL LIKELY OCCUR. • Do not apply to spring-seeded barley. • Will provide suppression only. • See remarks and limitations for dicamba in "Corn — Postemergence" section. • Some control of wild onion and wild garlic.
Perennials (Canada thistle, sowthistle)	tribenuron methyl *(Express)* + surfactant	0.016	0.33 oz. 75DF + 0.25%	• Apply after the crop has reached the 2-leaf stage but before the flag leaf is visible (between 1.2 and 7.9 on Feeke's scale). • Apply when thistles are actively growing and 4-8 inches tall with 2-6 inches of new growth. • Addition of surfactant is essential for adequate results. • *Express* may be tank mixed with 2,4-D amine, MCPA or *Buctril* for more rapid weed kill and improved control of ragweed. Tank mixes with 2,4-D may improve thistle control but also carry a greater risk of crop injury. To reduce this risk, apply 2,4-D at no more than 0.5 pt/A (0.25 lb a.i./A) and reduce surfactant concentration to 0.125%. The lower surfactant concentration may reduce velvetleaf control. Observe the timing restrictions for 2,4-D, MCPA, and *Buctril* when tank mixing with *Express*. Do not tank mix with dicamba — reduced control (antagonism) may occur. • Tank mixes with *Buctril* may reduce Canada thistle control. • Spectrum of annual weeds controlled is narrower than with *Harmony Extra*. • Do not exceed 0.33 oz. product per acre to any one crop during one growing season. • Do not plant treated area to any crop other than wheat or barley for 60 days after application. • Do not apply to wheat or barley underseeded with another crop. • Injury symptoms will appear on weeds in 1-3 weeks after application. • Very good crop safety. • Special sprayer clean-out procedure required (see *Express* label). • **Caution:** If liquid nitrogen fertilizer is used as the herbicide carrier, leaf burn, yellowing, and stunting are likely. With favorable growing conditions the symptoms are temporary, but this practice is not recommended.

(Continued on next page)

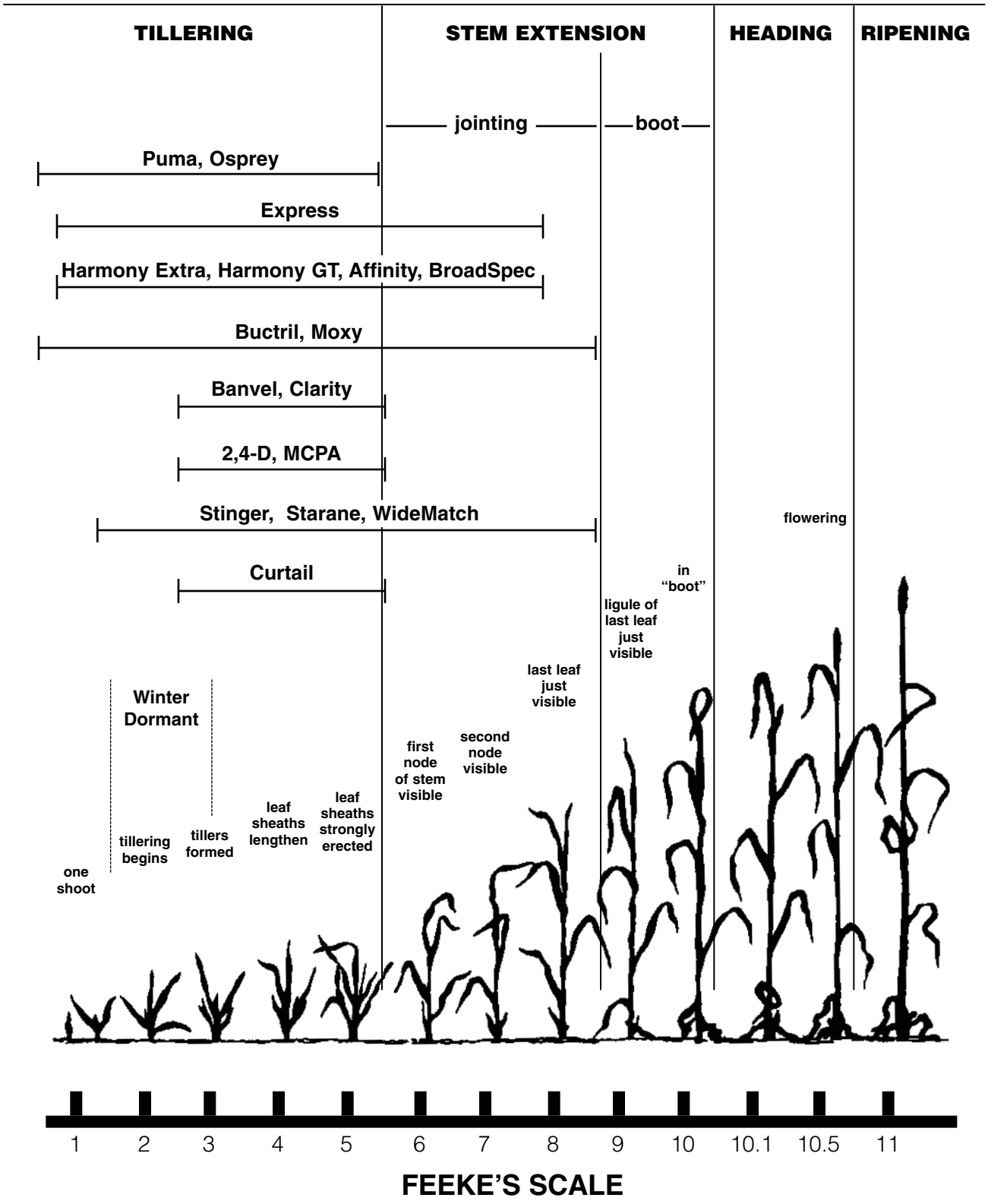
Barley and Wheat Without Legume Seedings (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Perennials (Canada thistle, sowthistle)	thifensulfuron methyl + tribenuron methyl *(Harmony Extra)* + surfactant	0.028	0.6 oz 75DF + 0.25%	• See remarks and limitations on *Harmony Extra* for control of annual broadleaves. • Apply when thistles are actively growing and 4-8 inches tall with 2-6 inches of new growth. • *Harmony Extra* controls a wider spectrum of annual weeds than *Express*. • *Harmony Extra* may be tank mixed with 2,4-D amine, MCPA or *Buctril* for more rapid weed kill and improved control of ragweed. Tank mixes with 2,4-D may improve thistle control but also carry a greater risk of crop injury. To reduce this risk apply 2,4-D at no more than 0.5 pt/A (0.25 lb a.i./A) and reduce surfactant concentration to 0.125%. The lower surfactant concentration may reduce velvetleaf control. Observe the timing restrictions for 2,4-D, MCPA, and *Buctril* when tank mixing with *Harmony Extra*. Do not tank mix with dicamba — reduced control (antagonism) may occur. • Tank mixes with *Buctril* may reduce Canada thistle control. • Do not plant treated area to any crop other than wheat, barley or oats for 60 days after application.
	clopyralid *(Stinger)*	0.125	0.33 pt 3L	• Treat thistle plants between rosette stage and bud stage for suppression. • Apply to wheat and barley from the 3-leaf stage to boot stage (between 1.3 and 9 on Feeke's scale). See label for details. • See remarks and limitations for *Stinger* for annual broadleaves. • See Table 12 for crop rotation restrictions.
Wild garlic, Wild onion	thifensulfuron methyl + tribenuron methyl *(Harmony Extra)* + surfactant	0.028	0.6 oz 75DF + 0.25%	• See remarks and limitations of *Harmony Extra* for control of annual broadleaves. • Apply when wild garlic plants are less than 12 inches tall with 2-4 inches of new growth. • For best results, treat actively growing wild garlic when air temperature is at least 60°F. • Less effective for wild onion control. • Do not plant treated area to any crop other than wheat, barley or oats for 60 days after application.
	dicamba *(Banvel, Clarity)* + 2,4-D	0.125 + 0.5	0.25 pt 4L + 1 pt 4L	• Apply in the spring to actively growing grain following tillering (usually about 6-8 inches high) but prior to jointing. DO NOT TREAT GRAIN IN BOOT TO DOUGH STAGE. The boot stage is when the upper sheath is beginning to swell with the enlarging head. • Some wheat varieties are sensitive to dicamba. • DO NOT APPLY *DICAMBA* TO WHEAT VARIETIES WAKEFIELD OR MADISON — SEVERE INJURY AND YIELD LOSS WILL LIKELY OCCUR. • Do not apply to spring-seeded barley. • May use either ester or amine 2,4-D. • Provides suppression only. • See remarks and limitations for dicamba in "Corn — Postemergence" section.

Barley and Wheat Without Legume Seedings (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Windgrass	fenoxaprop-p-ethyl (*Puma*)	0.082	0.66 pt 1EC	• *Puma* will only control emerged grass weeds. Rate of application varies based on weed species present to be controlled. • Do not apply *Puma* within 57 and 70 days of harvesting barley and wheat, respectively. • *Puma* can be applied on wheat and barley from crop emergence up to the 5-leaf stage, but not after jointing begins (between 1 and 6 on Feeke's scale). • *Puma* will control susceptible grass weeds in the 1-leaf to 2-tiller stage of growth. • May be tank mixed with other herbicides to improve broadleaf weed control. See label for tank mix partners and details on rates. • May be tank mixed with either *Furadan, Sevin*, or *Warrior* insecticides. Do not tank mix with malathion. • May be tank mixed with mancozeb, *Tilt* and *Stratego* (without additional adjuvant), or *Topsin M* fungicides. • No rotation restrictions.
Windgrass, annual bluegrass, annual ryegrass, cheatgrass (suppression) **and certain winter annual mustards**	mesosulfuron *(Osprey)*	1.34	4.75 oz 4.5% WDG	• Apply in the fall after wheat emergence, or in the spring before jointing. • Apply with methylated seed oil (1.5 pts/A)a formulated combination of nonionic surfactant or methylated seed oil plus a nitrogen source (0.8 – 1.6 pts/A). When tank mix partner precludes use of methylated seed oil, apply with nonionic surfactant (0.5% v/v) plus ammonium sulfate (1.5 – 3 lbs/A or 28% UAN (1-2 qts/A). • *Osprey* should be applied using water as the spray carrier, but up to 15 % of the spray solution can be nitrogen fertilizer solution. • Do not use spray additives that alter the spray solution below 6.0 pH. • Do not apply more than a total of 4.75 oz/A per crop year. • May be tank mixed with other herbicides to control a broader spectrum of broadleaf weeds. See label for tank mix partners. • Do not apply within 30 days of harvesting wheat forage and 60 days for grain and straw. • **Crop rotation restrictions**: Rotation interval for corn is 12 months. Refer to label and Table 12 for crop rotation restrictions.

FIGURE 1 — Wheat growth stages according to Zadoks' decimal code and Feeke's scale. Management inputs are indicated.



Oats Without Legume Seedings — All Tillage Systems

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	2,4-D amine	0.38	0.75 pt 4L	• Apply in the spring to actively growing grain following tillering (usually about 6-8 inches high) but prior to jointing. DO NOT TREAT GRAIN IN BOOT TO DOUGH STAGE. The boot stage is when the upper sheath is beginning to swell with the enlarging head. • Most effective when weeds are small (less than 4 inches). • Some yield reduction may occur but generally less than that caused by weeds.
	MCPA	0.38	0.75 pt 4L	• Less injurious and less effective than 2,4-D. • Most effective when weeds are small (less than 4 inches). • Apply at or after full tillering but before the boot stage (the first node is detectable and the grain is usually 6-8 inches tall at full tillering; the boot stage is when the upper sheath is beginning to swell with the enlarging head).
	bromoxynil *(Buctril, Moxy)*	0.38	1.5 pt 2L	• May be applied from emergence up to boot stage. • Good coverage essential. • Bromoxynil must be applied to small weeds for effective control (see label). • Redroot pigweed and mustard must be controlled when very small (refer to label for details). • Very good crop safety.
	thifensulfuron methyl + tribenuron methyl *(Harmony Extra)* + surfactant	0.018	0.4 oz.75DF + 0.25%	• Apply to oats in the 3- to 5-leaf stage but before jointing. • Do not exceed 0.4 oz. product per acre to any one crop during one growing season. • Do not apply to Ogle, Porter, or Premier varieties. • Most effective if weeds are small (4 inches or less). • Addition of surfactant is essential for adequate results. • Control of common ragweed is inconsistent. • Do not graze or feed forage or hay from treated areas to livestock. (Dry-harvested straw may be used for bedding and/or feed.) • Do not plant treated area to any crop other than wheat, barley, or oats for 60 days after application. • Do not apply to oats underseeded with another crop. • Injury symptoms will appear on weeds in 1-3 weeks after application. • Special sprayer clean-out procedure required (see *Harmony Extra* label).
	thifensulfuron methyl *(Harmony GT)* + surfactant	0.018	0.4 oz.75DF + 0.25%	• Apply to oats in the 3- to 5-leaf stage but before jointing. • Do not exceed 0.4 oz. product per acre to any one crop during one growing season. • Do not apply to Ogle, Porter, or Premier varieties. • Most effective if weeds are small (4 inches or less). • Addition of surfactant is essential for adequate results. • Control of common ragweed is inconsistent.

Oats Without Legume Seedings — All Tillage Systems (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Common ragweed, giant ragweed, jimsonweed, cocklebur, velvetleaf, hemp dogbane and mayweed	clopyralid+ fluroxypyr *(WideMatch)*	0.25	1.33 pt 1.5L *(Stinger)*	• Apply to wheat , barley and oats from the 3-leaf stage to boot stage (between 1.3 and 9 on Feeke's scale). See label for details. • Do not apply to small grains underseeded with a legume. • May be tank mixed with 2,4-D, dicamba, *Buctril, Harmony Extra, Affinity BroadSpec* or *Express* for control of additional weeds. See label for details on rates. • Refer to label and Table 12 for crop rotation restrictions. • Do not allow livestock to graze treated areas or harvest treated forage within 7 days of application. • Do not apply closer than 14 days before cutting hay or 40 days before harvesting of grain or straw.
ONLY ragweed, cocklebur and jimsonweed	clopyralid *(Stinger)*	0.094	0.25 pt 3L	• Apply to oats from the 3-leaf stage to boot stage. See label for details. • Do not apply to oats underseeded with a legume. • May be tank mixed with *Buctril* for control of additional weeds. • See Table 12 for crop rotation restrictions.
Common ragweed, giant ragweed, cocklebur, velvetleaf, hemp dogbane	fluroxypyr (*Starane*)	0.1238	0.66 pt 1.5L	• Apply from 2-leaf stage up to and including flag leaf emergence (between 1.2 and 9 on Feeke's scale). • Apply to actively growing weeds up to 8 inches tall. • Narrow spectrum of weeds controlled. • Do not apply to small grains underseeded with a legume. • No crop rotation restrictions. • Do not allow livestock to graze treated areas or harvest treated forage within 7 days of application. • Do not apply closer than 40 days before harvesting of grain or straw.

Small Grains Seeded to Legumes — All Tillage Systems

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	MCPA	0.19	0.38 pt 4L	• Apply in the spring to actively growing grain following tillering (usually about 6-8 inches high) but prior to jointing. DO NOT TREAT GRAIN IN BOOT TO DOUGH STAGE. The boot stage is when the upper sheath is beginning to swell with the enlarging head. • A canopy of grain and weeds over the seeding will reduce the possibility of injury to the legume. • Apply in 5-6 gal of water/A to minimize crop injury. • Sweet clover is very sensitive to MCPA.
	bromoxynil *(Buctril, Moxy)*	0.38	1.5 pt 2L	• SMALL GRAINS SEEDED WITH ALFALFA ONLY. • Apply after alfalfa has reached at least the 4 trifoliate stage and between emergence and boot stage of wheat or barley. • Do not treat when air temperatures exceed 70°F at and for 3 days following application or unacceptable alfalfa injury may occur. • Do not use any spray additives or increased injury may occur. • Alfalfa leaf burn following application is likely, but plants recover rapidly in favorable growing conditions. • Warm, humid conditions enhance leaf burn. • Less injurious than MCPA. • Do not treat when plants are under stress. • Rate may be reduced to1 pt/A for greater crop safety (see label for weed sizes). • With ground application, use a minimum of 20 gal of water/A and 30 psi. • For best results, weeds must be small (see label for details). • Redroot pigweed and wild mustard must be controlled when very small (refer to label for details). • Weak on common chickweed. • Do not graze or cut for feed for 30 days after application.

TABLE 3B — Harvest Restrictions for Small Grain Herbicides (as indicated on the product labels)

Herbicide	Restrictions
Affinity BroadSpec	Do not graze treated fields or feed treated forage or hay (harvested straw may be used for bedding and/or feed).
Banvel/Clarity	A waiting interval of 7 days is required before harvest. Do not use preharvest-treated wheat for seed unless a germination test is performed on the seed with an acceptable result of 95% germination or better. If small grains are used for pasture or hay, consult the label for harvesting restrictions.
Buctril	Do not graze treated fields for 45 days following application.
Curtail/Stinger	Do not cut treated grass for hay within 30 days after application. Remove meat animals from freshly treated areas 7 days before slaughter. Withdrawal is not needed if 2 weeks have elapsed since application. Do not graze dairy animals in treated areas for 14 days after application. Do not use hay or straw from treated areas or manure from animals grazed in treated areas for composting or mulching on susceptible broadleaf crops. Do not transfer livestock from treated grazing areas onto sensitive broadleaf crop areas without first allowing 7 days of grazing on an untreated pasture. Otherwise, urine may contain enough clopyralid to cause injury to sensitive broadleaf plants. Do not permit dairy animals or meat animals being finished for slaughter to forage or graze treated grain fields within 1 week after treatment. Do not harvest hay from treated fields.
Express/ Harmony Extra	Do not graze livestock in treated areas. In addition, do not feed forage or hay from treated areas to livestock (harvested straw may be used for bedding and/or feed).
Harmony GT	Do not graze or feed forage or hay from treated areas to livestock (harvested straw may be used for bedding and/or feed).
MCPA	Do not allow livestock to forage or graze treated areas within 7 days of slaughter.
Osprey	Do not apply *Osprey* herbicide within 30 days of harvesting wheat forage, and 60 days for hay, grain and straw.
Puma	Do not apply within 57 and 70 days of harvesting barley and wheat, respectively.
2,4-D	Do not permit dairy animals or meat animals being finished for slaughter to forage treated grain fields within 2 weeks after treatment. Do not feed treated straw to livestock if a preharvest or emergency treatment is used. See label.
Starane	Do not allow livestock to graze treated areas or harvest treated forage within 7 days of application. Do not apply closer than 40 days before harvesting of grain or straw.
WideMatch	Do not apply less then 90 days before harvest of grain and stover. Do not allow livestock to graze treated areas or harvest treated forage within 47 days of application.

TABLE 3C — Weed Response to Herbicides in Small Grains*

			ANNUAL BROADLEAVES													ANNUAL GRASSES	PERENNIALS						
	SITE OF ACTION	CROP TOLERANCE**	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PIGWEED (REDROOT)	RAGWEED (COMMON)	SMARTWEED	VELVETLEAF	WILD MUSTARD	HOARY ALYSSUM	YELLOW ROCKET	CHICKWEED (COMMON)	MAYWEED (DOGFENNEL)		BINDWEED (FIELD)	CANADA THISTLE	SOWTHISTLE	QUACKGRASS	YELLOW NUTSEDGE	WILD GARLIC	WILD ONION
AFFINITY BROADSPEC	B	1	**G**	—	**E**	P	**E**	F	**E**	**G**	**E**	—	**G**	**G**	**E**	N	P	F	F	N	N	**G**	F
BANVEL/CLARITY	O	3	**G**	**G**	**G**	**G**	**G**	**G**	**G**	F	**G**	F	**G**	**G**	F	F	F	F	F	P	N	F	F
BUCTRIL/MOXY	O	1	**G**	**G**	**E**	**G**	F	**G**	**G**	**G**	F	F	F	P	F	N	P	P	N	N	N	N	N
CURTAIL	O	3	**E**	**G**	**G**	**G**	**G**	**G**	F	F	**G**	**G**	**G**	P	**G**	N	P	F	P	N	N	P	P
EXPRESS	B	1	F	–	**E**	P	F	P	F	P	**E**	–	**G**	**G**	**E**	N	P	F	F	N	N	F	P
HARMONY EXTRA	B	1	**G**	–	**E**	P	**E**	F	**E**	**G**	**E**	–	**G**	**G**	**E**	N	P	F	F	N	N	**G**	F
HARMONY GT	B	1	F	–	**G**	P	**E**	F	**E**	**G**	**E**	–	**G**	**G**	**E**	N	P	P	P	N	N	**G**	F
MCPA	O	2	F	F	**G**	**G**	**G**	**G**	P	F	**G**	**G**	**G**	P	P	N	P	P	P	N	N	P	P
OSPREY	B	1	N	N	N	N	P	N	N	N	**G**	N	N	P	N	**E**	N	N	N	N	N	N	N
PUMA	A	2	N	N	N	N	N	N	N	N	N	N	N	N	N	**G**	N	N	N	N	N	N	N
STARANE	0	2	**G**	F	P	F	P	**E**	F	**G**	F	–	–	–	–	N	F	P	P	N	N	–	–
STINGER	O	2	**E**	**G**	P	P	P	**G**	F	P	P	P	P	P	**G**	N	P	**G**	F	N	N	N	N
2,4-D AMINE	O	3	F	F	**G**	**G**	**G**	**G**	P	F	**G**	**G**	**G**	P	P	N	P	P	P	N	N	P	P
2,4-D ESTER	O	3	F	F	**G**	**G**	**G**	**G**	P	**G**	**G**	**G**	**G**	P	P	N	F	F	P	N	N	F	F
WIDEMATCH	O	2	**E**	**G**	P	F	P	**E**	F	**G**	F	P	P	P	**G**	N	F	**G**	F	N	N	N	N

Herbicide Site of Action: A = ACCase Inhibitor; B = ALS Inhibitor; C = Photosynthesis Inhibitor; O = Other

Herbicide Effectiveness: P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None; – = Not enough information to rank

*The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.

**Crop Tolerance: 1=Minimal risk of crop injury; 2=Crop injury can occur under certain conditions (soil applied—cold, wet: foliar applied—hot, humid); 3=Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4=Risk of severe crop injury is high. Recommended only in rescue situations.

TABLE 4A —Chemical Weed Control in Forage Establishment

Direct-Drilled Forage Legumes (No-Till)

(spring seedings following soybeans, corn or dry edible beans)

In general, the major benefits of weed control in new alfalfa seedings are improved forage quality in the first harvest and insurance against stand loss from intense weed competition. In conventional tillage, weeds present at planting are killed by tillage during final seedbed preparation. With direct seeding (no-till), vegetation control is accomplished before planting with burndown herbicides such as paraquat *(Gramoxone Inteon)* or glyphosate. The required application rate varies, depending on weed species and size. Refer to the product labels for details. *Gramoxone Inteon* provides faster kill. Glyphosate is preferred if perennial weeds are present, but fields with serious perennial weed problems should not be direct drilled with a forage legume. Perennial weeds should be controlled in the previous crop or in the fall prior to a spring seeding. Herbicide options in the fall include glyphosate, 2,4-D ester, or a combination of glyphosate plus 2,4-D amine. Do not apply 2,4-D in the spring prior to spring planting.

The need for a burndown herbicide depends on the presence of weeds at planting time. If no weeds are present, a burndown herbicide is not needed. However, a burndown herbicide will improve first-harvest forage quality if weeds are present at planting time, regardless of species or size.

Herbicides applied after crop emergence are not affected by the tillage system used. All of the herbicides listed for postemergence application can be used in all tillage systems including direct drilling.

Alfalfa, Trefoil and Clover Seedings

(clear seedings without small grain companion crops)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Preplant Incorporated				
Annual broadleaves	EPTC	3	3.5 pt 7L	• Incorporate into soil immediately after application.
Annual grasses	*(Eptam)*			• Seed may be planted immediately after this operation.
				• Do not use when grass is seeded with legumes.
Postemergence— all tillage systems	sethoxydim *(Poast)*	0.19	1 pt 1.53L	• Use on spring seedings.
				• Apply postemergence prior to first cutting.
Annual grasses	OR	OR	OR	• Treat small, actively growing grasses (crabgrass up to 4 inches; foxtail, fall panicum, witchgrass, barnyardgrass up to 8 inches).
	sethoxydim *(Poast Plus)*	0.19	1.5 pt 1L	
	+		+	• Use 5 to 20 gal of water/A at 40-60 psi.
	crop oil concentrate		1 qt	• Avoid spray drift onto corn, sorghum, small grains, and turf.
				• Rainfall within 1 hr of application will reduce control.
				• Does not control nutsedge or broadleaved weeds.
				• *Poast* rate can be reduced to 0.75 pt/A for 1- to 4-inch barnyardgrass, green and giant foxtail, and fall panicum.
				• Addition of liquid nitrogen fertilizer (28% N) at 1 gal/A or ammonium sulfate at 2.5 lb/A will improve large crabgrass control.
Postemergence— all tillage systems	2,4-DB amine *(Butoxone 200* or *Butyrac 200)*	1	2 qt 2L	• Apply postemergence when legume seedlings are at or beyond the 1- to 2-trifoliate leaf stage.
Annual broadleaves				• Can be used if an annual broadleaf problem develops after using Eptam.
				• This treatment is not labeled for use with small grain companion crops.
				• Do not apply to sweet clover or established clovers grown for seed.
				• Do not apply when crop is under stress.
				• Do not apply when the daytime temperature is expected to exceed 90°F within the next 3 days. Do not apply if temperature is expected to fall below 40°F shortly after treatment.

Alfalfa, Trefoil and Clover Seedings (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Postemergence — all tillage systems				
Common chickweed **Volunteer cereals**	Pronamide *(Kerb)*	0.75	1.5 lb 50W	• Apply in the fall following spring or summer seeding. • Apply after soil temperature has dropped below 55°F.

Birdsfoot Trefoil (Only) – Postemergence – All Tillage Systems

(clear seedings without small grain companion crops)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	sethoxydim *(Poast)* OR sethoxydim *(Poast Plus)* + crop oil concentrate	0.19 OR 0.19 +	1 pt 1.53L OR 1.5 pt 1L + 1 qt	• Apply postemergence prior to first cutting. • Treat small, actively growing grasses (crabgrass up to 4 inches; foxtail, fall panicum, witchgrass, barnyardgrass up to 8 inches). • Use 5-20 gal of water/A and 40-60 psi. • Avoid spray drift onto corn, sorghum, small grains, and turf. • Rainfall within 1 hr of application will reduce control. • Does not control nutsedge or broadleaved weeds. • Do not apply more than 5 pt/A in one season. • *Poast* rate can be reduced to 0.75 pt/A for 1-4 inch barnyardgrass, green and giant foxtail, and fall panicum. • Addition of liquid nitrogen fertilizer (28% N) at 1 gal/A or ammonium sulfate at 2.5 lb/A will improve large crabgrass control.
	clethodim *(Select, Arrow)* OR clethodim *(Select Max)* + crop oil concentrate	0.094 OR 0.061 +	6 oz 2L OR 8 oz 1EC + 1%	• Use on spring seedings. • Apply postemergence prior to first cutting. • Treat small, actively growing grass. • Do not plant rotational crops until 30 days after application.
Volunteer corn	sethoxydim *(Poast)* OR sethoxydim *(Poast Plus)* + crop oil concentrate + 28% liquid nitrogen OR ammonium sulfate	0.19 OR 0.19 + + 	1 pt 1.53L OR 1.5 pt 1L + 1 qt + 1 gal OR 2.5 lb	• Apply postemergence prior to first cutting. • Treat actively growing corn up to a maximum of 20 inches tall. • Use 5-20 gal of water/A and 40-60 psi. • Avoid spray drift onto corn, sorghum, small grains, and turf. • Rainfall within 1 hr of application will reduce control. • Does not control nutsedge or broadleaved weeds. • Do not apply more than 5 pt/A in one season.
	clethodim *(Select, Arrow)* OR clethodim *(Select Max)* + crop oil concentrate + 28% liquid nitrogen OR ammonium sulfate	0.063 OR 0.045 + + 	4 oz 2L OR 6.0 oz 1EC + 1% + 2 qt OR 2.5 lb	• Use on spring seedings. • Apply postemergence prior to first cutting. • Treat actively growing volunteer corn up to 12 inches. Increase rate for 12- to 24-inch corn. • Do not plant rotational crops until 30 days after application.

Birdsfoot Trefoil (Only) – Postemergence – All Tillage Systems (continued)

(clear seedings without small grain companion crops)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Volunteer cereals (wheat, barley, oats, rye)	sethoxydim *(Poast)*	0.29	1.5 pt 1.53L	• Apply postemergence prior to first cutting. • Treat actively growing grass up to a maximum of 4 inches tall. • Use 5-20 gal of water/A and 40-60 psi. • Avoid spray drift onto corn, sorghum, small grains, and turf. • Rainfall within 1 hr of application will reduce control. • Does not control nutsedge or broadleaved weeds. • Do not apply more than 5 pt/A in one season.
	OR	OR	OR	
	sethoxydim *(Poast Plus)*	0.29	2.3 pt 1L	
	+		+	
	crop oil concentrate		1 qt	
	+		+	
	28% liquid nitrogen		1 gal	
	OR		OR	
	ammonium sulfate		2.5 lb	
	clethodim *(Select, Arrow)*	0.125	8 oz 2L	• Use on spring or summer seedings. • Apply postemergence prior to first cutting. • Treat actively growing volunteer cereals. • Do not plant rotational crops until 30 days after application.
	OR	OR	OR	
	clethodim *(Select Max)*	0.091	12 oz 1EC	
	+		+	
	crop oil concentrate		1%	
	+		+	
	28% liquid nitrogen		2 qt	
	OR		OR	
	ammonium sulfate		2.5 lb	

Alfalfa (Only) – Postemergence – All Tillage Systems

(clear seedings without small grain companion crops)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	sethoxydim *(Poast)*	0.19	1 pt 1.53L	• Use on spring seedings. • Apply postemergence prior to first cutting. • Treat small, actively growing grasses (crabgrass up to 4 inches; foxtail, fall panicum, witchgrass, barnyardgrass up to 8 inches). • Use 5-20 gal of water/A and 40-60 psi. • Avoid spray drift onto corn, sorghum, small grains and turf. • Rainfall within 1 hr of application will reduce control. • Does not control nutsedge or broadleaved weeds. • 2,4-DB amine may be tank mixed with *Poast* or *Poast Plus* for broadleaf weed control. Temporary leaf burning may occur. Do not apply more than 0.5 lb a.i./A (1 qt/A) of 2,4-DB. Do not add fertilizer to this tank mix. See Remarks and Limitations for 2,4-DB. • Do not apply more than 5 pt/A in one season. • *Poast* rate can be reduced to 0.75 pt/A for 1-4 inch barnyardgrass, green and giant foxtail, and fall panicum. • Addition of liquid nitrogen fertilizer (28% N) at 1 gal/A or ammonium sulfate at 2.5 lb/A will improve large crabgrass control.
	OR	OR	OR	
	sethoxydim *(Poast Plus)*	0.19	1.5 pt 1L	
	+		+	
	crop oil concentrate		1 qt	
	clethodim *(Select, Arrow)*	0.094	6 oz 2L	• Use on spring seedings. • Apply postemergence prior to first cutting. • Treat small, actively growing grass. • Do not plant rotational crops until 30 days after application.
	OR	OR	OR	
	clethodim *(Select Max)*	0.061	8.0 oz 1EC	
	+		+	
	crop oil concentrate		1%	

(clear seedings without small grain companion crops)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Volunteer corn	sethoxydim *(Poast)* OR sethoxydim *(Poast Plus)* + crop oil concentrate + 28% liquid nitrogen OR ammonium sulfate	0.19 OR 0.19	1 pt 1.53L OR 1.5 pt 1L + 1 qt + 1 gal OR 2.5 lb	• Use on spring seedings. • Apply postemergence prior to first cutting. • Treat actively growing corn up to a maximum of 20 inches tall. • Use 5-20 gal of water/A and 40-60 psi. • Avoid spray drift onto corn, sorghum, small grains and turf. • Rainfall within 1 hr of application will reduce control. • Does not control nutsedge or broadleaved weeds. • Do not apply more than 5 pt/A in one season.
	clethodim *(Select, Arrow)* OR clethodim *(Select Max)* + crop oil concentrate + 28% liquid nitrogen OR ammonium sulfate	0.063 OR 0.045	4 oz 2L OR 6.0 oz 1EC + 1% + 2 qt OR 2.5 lb	• Use on spring seedings. • Apply postemergence prior to first cutting. • Treat actively growing volunteer corn up to 12 inches. • Increase rate for 12- to 24-inch corn. • Do not plant rotational crops until 30 days after application.
Volunteer cereals (wheat, barley, oats, rye)	sethoxydim *(Poast)* OR sethoxydim *(Poast Plus)* + crop oil concentrate + 28% liquid nitrogen OR ammonium sulfate	0.29 OR 0.25	1.5 pt 1.53L OR 2 pt 1L + 1 qt + 1 gal OR 2.5 lb	• Use on spring or summer seedings. • Apply postemergence prior to first cutting. • Treat actively growing grass up to a maximum of 4 inches tall. • Use 5-20 gal of water/A and 40-60 psi. • Avoid spray drift onto corn, sorghum, small grains, and turf. • Rainfall within 1 hr of application will reduce control. • Does not control nutsedge or broadleaved weeds. • Do not apply more than 5 pt/A in one season.
	clethodim *(Select, Arrow)* OR clethodim *(Select Max)* + crop oil concentrate + 28% liquid nitrogen OR ammonium sulfate	0.125 OR 0.091	8 oz 2L OR 12 oz 1EC + 1% + 2 qt OR 2.5 lb	• Use on spring or summer seedings. • Apply postemergence prior to first cutting. • Treat actively growing volunteer cereals. • Do not plant rotational crops until 30 days after application.
Annual broadleaves, Foxtail	imazethapyr *(Pursuit)* + 28% liquid nitrogen OR ammonium sulfate + surfactant	0.063	4 oz 2L OR 1.4 oz 70DG + 1 qt OR 2.5 lb + 0.25%	• Apply after alfalfa has 2 fully expanded trifoliate leaves. • May be applied to spring or summer seedings. • May be applied in spring or fall. • Always add surfactant plus either 28% liquid nitrogen or spray grade ammonium sulfate (AMS). • Treat when weeds are less than 3 inches tall. • Will control several broadleaved weeds in new alfalfa seedings, including common chickweed. See Table 4E for details. • Will suppress volunteer cereals. • *Pursuit* is labeled for tank mixing with *2,4-DB, Poast Plus* or *Buctril*. • Tank mixing *Pursuit* with *Buctril* or *2,4-DB* is not recommended because of increased risk of crop injury. • Tank mixing *Pursuit* with *Poast Plus* may result in reduced grass control (grass antagonism).

(Continued on next page)

(clear seedings without small grain companion crops)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves, Foxtail	imazamox *(Raptor)* + 28% liquid nitrogen + surfactant OR crop oil concentrate OR methylated seed oil (MSO)	0.031	4 oz 1L + 2.5% + 0.25 % OR 1% OR 1%	• Apply to new alfalfa seedlings at 2-trifoliate or larger. • Apply when annual weeds are 1-3 inches tall. • More effective on common lambsquarters than *Pursuit*. • Giant foxtail and Pennsylvania smartweed required 6 oz/A for effective control in MSU trials. • Henbit, common purslane and smartweed require 6 oz/A for effective control. • *Raptor* will not control common ragweed, giant ragweed or white cockle. • High densities of common lambsquarters or foxtail require 5 oz/A for effective control. • *Raptor* may be tank mixed with *Poast, Poast Plus, Select,* 2,4-DB or bromoxynil; however, tank mixtures with bromoxynil have a high risk of crop injury because of the adjuvants needed with *Raptor.* • Tank mixing *Raptor* with *Poast, Poast Plus* or *Select* is not recommended because antagonism will occur and grass control will equal that of *Raptor* alone. • See Table 12 for rotation crop restrictions. • Spray grade ammonium sulfate (AMS) at 17 lb/100 gal may be substituted for 28% liquid nitrogen.
Annual broadleaves	bromoxynil *(Buctril, Moxy)*	0.25	1 pt 2L	• Apply postemergence to spring or summer seedings. • Apply after alfalfa has reached at least the 4-trifoliate leaf stage. • Do not treat when air temperatures exceed 70°F at the time of application or for 3 days following application or unacceptable crop injury may occur. • Do not use any spray additives or increased injury will occur. • Leaf burn following application is likely, but plants recover rapidly in favorable growing conditions. • Warm, humid conditions enhance leaf burn. • Do not treat when plants are under stress. • Rate may be reduced to 1 pt/A for greater crop safety (see label for weed sizes). • With ground application, use a minimum of 20 gal of water/A and 30 psi. • For best results, weeds must be small; see label for details. • Redroot pigweed and wild mustard must be controlled when very small (refer to label for details). • Weak on common chickweed.

Glyphosate-Resistant (Roundup Ready) Alfalfa: Alfalfa Establishment

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Annual broadleaves**	glyphosate + ammonium sulfate	0.75	22.0 oz 4.5L + 17 lb/100 gal	• **APPLY TO ROUNDUP READY ALFALFA ONLY** • Apply at a rate of 0.75 ae lb/A before the 4 trifoliate growth stage to eliminate seedlings not containing the Roundup Ready gene. • Apply when annual weeds are 2-4 inches tall. • Can be applied postemergence from alfalfa emergence until 5 days prior to cutting. • Can be applied after cutting to newly emerged weeds but before alfalfa regrowth interferes with spray coverage. • Do not cut or graze alfalfa for a minimum of 5 days following application. • Do not apply more than 44 fl oz/A in a single application or 132 fl oz/A in a crop season. • Addition of ammonium sulfate will minimize antagonism from hard water or tank mixtures and is always recommended. • **Note:** *Roundup OriginalMax* and *Roundup WeatherMax* are the only glyphosate products registered for post-emergence use on glyphosate-resistant *(Roundup Ready)* alfalfa. • Use extreme caution to avoid spray drift to sensitive crops. • Excellent crop safety at all stages of growth. • Most effective before first cutting to eliminate weeds and allow establishment of pure alfalfa stands. • Second applications of glyphosate in the establishment year are generally not needed. • Crude protein and relative feed value was significantly increased compared to untreated alfalfa in MSU trials. • No effect on alfalfa stand density has been observed. • Apply 44 fl oz/A for increased henbit control.

TABLE 4B — Chemical Weed Control in Established Forages

Alfalfa (Established Stand – at Least 1-Year-Old)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Yellow rocket and broadleaved winter annuals	metribuzin *(Sencor)*	0.5	1 pt 4L OR 0.67 lb 75DF	• Apply to alfalfa established for one year or more. • Apply to *dormant* alfalfa in late fall or early spring. • Non-dormant alfalfa may be severely injured. • Application rate varies, depending on soil type (see label). • Sencor rate may be reduced to 0.5 pt/A for common chickweed control.
	terbacil *(Sinbar)*	1	1.25 80W	• Apply to alfalfa established for one year or more. • Apply to *dormant* alfalfa in late fall or early spring. • See label for crop rotation restrictions. • Early spring applications will control other broadleaf weeds and suppress quackgrass infestations. • Application rate varies, depending on soil type (see label).
	hexazinone *(Velpar)*	0.5	0.55 lb 90SP OR 1 qt 2L OR 0.67 lb 75DF	• Apply to alfalfa established for one year or more. • Alfalfa plants should be healthy, vigorous, and not under stress by weather, insects, diseases or extreme weed competition. The crop root system should be well established. • Apply in late fall or early spring before alfalfa growth exceeds 2 inches. Applications to *dormant* alfalfa provide the greatest crop safety. • Application can be made between cuttings before regrowth exceeds 2 inches tall, but alfalfa injury may result if plants are under stress. Do not make more than one application in one growing season. • Do not apply to seedling alfalfa or alfalfa-forage grass mixtures. • Do not apply to snow-covered or frozen ground. • Use at least 20 gal water/A for ground application. • **Rotational restriction:** Corn may be planted 12 mo. following the last application, provided the soil is moldboard plowed prior to planting. Do not plant any other crop for 2 years after application. • Application rate varies, depending on soil type (see label).
Dandelions	metribuzin *(Sencor)*	1	1 qt 4L OR 1.33 lb 75DF	• Apply to alfalfa established for one year or more. • Apply in spring before alfalfa breaks dormancy. • Non-dormant alfalfa may be severely injured. • Perennial grasses may also be suppressed. • Early spring applications will control other broadleaf weeds and suppress quackgrass infestations. • Application rate varies, depending on soil type (see label).

(Continued on next page)

Alfalfa (Established Stand – At Least 1-Year-Old) (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Dandelions	hexazinone *(Velpar)*	1	1.1 lb 90SP OR 2 qt 2L OR 1.33 lb 75DF	• Apply to alfalfa established for one year or more. • Alfalfa plants should be healthy, vigorous, and not under stress by weather, insects, diseases or extreme weed competition. The crop root system should be well established. • Apply in spring before alfalfa growth exceeds 2 inches. Spring applications to *dormant* alfalfa provide the greatest crop safety. • Application can be made between cuttings before regrowth exceeds 2 inches tall, but alfalfa injury may result if plants are under stress. Do not make more than one application in one growing season. • Do not apply to seedling alfalfa or alfalfa-forage grass mixtures. • Do not apply to snow-covered or frozen ground. • Use at least 20 gal of water/A for ground application. • **Rotational restriction:** Corn may be planted 12 mo. following the last application, provided the soil is mold-board plowed prior to planting. Do not plant any other crop for 2 years after application. • Will also provide partial control of quackgrass. • Application rate varies, depending on soil type (see label).
Hoary alyssum, Annual broadleaves	2,4-DB amine *(Butoxone 200* or *(Butyrac 200)*	1	2 qt	• Apply in early April. • Spray when hoary alyssum seedlings are in the 2- to 4-leaf stage. • Do not apply when crop is under stress. • Do not apply when the daytime temperature is expected to exceed 90°F within the next 3 days. Do not apply if the temperature is expected to fall below 40°F shortly after treatment.
Quackgrass	pronamide *(Kerb)*	1.5	3 lb 50W	• Apply in late fall when soil temperatures are below 55°F. • For light to moderate quackgrass infestations, rate can be reduced to 1 lb a.i./A (2 lb/A of formulated product).

Glyphosate-Resistant (Roundup Ready) Alfalfa: Established Alfalfa

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Annual broadleaves**	glyphosate + ammonium sulfate	0.75	22.0 oz 4.5L + 17 lb/100 gal	• **APPLY TO ROUNDUP READY ALFALFA ONLY** • Apply when weeds are actively growing. • Can be applied from spring regrowth until 5 days prior to cutting. • Can be applied after cutting to newly emerged weeds but before alfalfa regrowth interferes with spray coverage. • Do not cut or graze alfalfa for a minimum of 5 days following application. • Do not apply more than 44 fl oz/A in a single application or 132 fl oz/A in a crop season. • Addition of ammonium sulfate will minimize antagonism from hard water or tank mixtures and is always recommended. • **Note:** *Roundup OriginalMax* and *Roundup WeatherMax* are the only glyphosate products registered for post-emergence use on glyphosate-resistant *(Roundup Ready)* alfalfa. • Use extreme caution to avoid spray drift to sensitive crops.

Birdsfoot Trefoil (Established Stand)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Quackgrass	pronamide *(Kerb)*	1.5	3 lb 50W	• Apply in late fall when soil temperatures are below 55°F. • For light to moderate quackgrass infestations, rate can be reduced to 1 lb a.i./A (2 lb/A of formulated product).

Grass Pasture

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Perennial broadleaves	2,4-D ester	1	1 qt 4L	• Apply in fall or spring to actively growing weeds. • Legumes will be injured or killed.
	dicamba *(Banvel/Clarity)*	1	1 qt 4L	• Legumes will be injured or killed. • Apply in fall or spring to actively growing weeds. • Treat when biennials are in the rosette stage.
	2,4-D ester + dicamba *(Banvel/Clarity)*	0.75 + 0.25	1.5 pt 4L + 0.5 pt 4L	• Legumes will be injured or killed. • Apply in fall or spring to actively growing weeds.
	clopyralid *(Stinger)*	0.188	0.5 pt 3L	• Apply only to established forage grasses. • Legumes will be injured or killed. • See Table 12 for crop rotation restrictions. • A premix of clopyralid + 2,4-D amine *(Curtail)* is available.

Preharvest Application — Alfalfa

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Quackgrass	glyphosate	0.75		• **Refer to Table 10A for glyphosate products labeled for preharvest application in alfalfa.**
	(3 lb a.e./gal)		32 fl oz	• Refer to Table 10A to determine if a surfactant is required.
	(3.7 lb a.e./gal)		26 fl oz	• May be applied prior to the last harvest before reestablishment of the site.
	(4.5 lb a.e./gal) + ammonium sulfate		22 fl oz + 17 lb/100 gal	• Fits fall application best. • Alfalfa will be injured but not killed. • Deep tillage following harvest will be required for complete kill of alfalfa and quackgrass. • Does not fit no-tillage systems. • Treat actively growing quackgrass at least 8 inches tall. • Addition of ammonium sulfate (AMS) at 17 lb/100 gal of water often improves control. • Allow a minimum of 36 hours between application and harvest. • A time interval of 3 days between application and harvest is recommended to allow maximum quackgrass control. • Treated crop and weeds can be fed to livestock. • Do not use on alfalfa grown for seed. • See label for further details.

TABLE 4C — Harvest Restrictions for Forage Legume Herbicides (as indicated on the product labels)

Herbicide	Restrictions
Buctril, Moxy	Do not cut for feed or graze spring-treated alfalfa within 30 days following treatment. Do not cut for feed or graze fall or winter treated alfalfa until spring, at least 60 days after treatment.
Eptam	None for preplant application.
Glyphosate	Refer to Table 10 for harvest restrictions.
Kerb	Do not graze or harvest for forage or dehydration within 120 days of application.
MCPA	Do not allow livestock to forage or graze treated areas within 7 days of slaughter.
Poast, Poast Plus	Do not apply within 7 days of feeding, grazing or harvesting for (undried) forage, or within 14 days of feeding or harvesting for (dry) hay.
Pursuit	Do not feed, graze or harvest alfalfa for 30 days following application.
Raptor	There should be an interval of at least 20 days between application and cutting or feeding alfalfa forage or hay.
Select, Select Max	Do not apply within 15 days of grazing, feeding or harvesting (cutting) alfalfa for hay or forage.
Sencor	Do not graze or harvest within 28 days after application.
Sinbar	None.
Velpar	Do not graze or feed forage or hay to livestock within 30 days after application.
2,4-DB	Do not graze established alfalfa or feed straw or hay from treated crops to livestock within 30 days after application. Do not graze or feed seedling alfalfa, clover or birdsfoot trefoil within 60 days after application.

TABLE 4D — Harvest Restrictions for Forage Grass Herbicides (as indicated on the product labels)

Herbicide	Restrictions
Banvel/Clarity	Animals cannot be removed from treated area for slaughter prior to 30 days after last application. There is no waiting period between treatment and grazing for non-lactating animals. Timing restriction for lactating dairy animals following treatment: up to 1 pt/A—7 days before grazing, 37 days before hay harvest; up to 1 qt/A—21 days before grazing, 51 days before hay harvest. See label for details.
Curtail	Do not cut treated grass for hay within 30 days after application. Remove meat animals from freshly treated areas 7 days before slaughter. Withdrawal is not needed if 2 weeks have elapsed since application. Do not graze dairy animals in treated areas for 14 days after application. Do not use hay or straw from treated areas or manure from animals grazed in treated areas for composting or mulching on susceptible broadleaf crops. Do not transfer livestock from treated grazing areas onto sensitive broadleaf crop areas without first allowing 7 days of grazing on an untreated pasture. Otherwise, urine may contain enough clopyralid to cause injury to sensitive broadleaf plants.
Stinger	Do not use hay or straw from treated areas or manure from animals grazed in treated areas for composting or mulching on susceptible broadleaf crops. Do not transfer livestock from treated grazing areas onto sensitive broadleaf crop areas without first allowing 7 days of grazing on an untreated pasture. Otherwise, urine may contain enough clopyralid to cause injury to sensitive broadleaf plants.
2,4-D	Do not graze animals on treated areas within 7 days after treatment. Do not permit dairy animals or meat animals being finished for slaughter to forage treated fields within 3 days of slaughter. Do not cut grass for hay within 30 days after application.

TABLE 4E —Weed Response to Herbicides in Forage Legumes*

			ANNUAL BROADLEAVES													ANNUAL GRASSES							PERENNIALS					
	SITE OF ACTION	CROP TOLERANCE**	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PIGWEED (REDROOT)	RAGWEED (COMMON)	SMARTWEED	VELVETLEAF	WILD MUSTARD	HOARY ALYSSUM	YELLOW ROCKET	CHICKWEED (COMMON)	HENBIT/DEADNETTLE	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	BINDWEED (FIELD)	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE	DANDELION	CURLED DOCK
Seedling Legumes																												
BUCTRIL/MOXY/ OTHERS	O	3	**G**	**G**	**E**	**G**	F	**G**	**G**	**G**	F	F	F	P	**G**	N	N	N	N	N	N	N	P	P	N	N	P	P
EPTAM	O	2	P	P	**G**	P	F	F	F	F	F	F	F	F	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	F	P	N	P
KERB	O	1	P	P	P	P	P	P	P	P	P	P	P	**G**	**G**	F	F	P	F	F	P	P	N	N	**G**	N	N	P
MCPA***	O	4	F	F	**G**	**G**	**G**	**G**	**G**	F	**G**	**G**	F	P	–	N	N	N	N	N	N	N	P	P	N	N	P	P
POAST or POAST PLUS	**A**	1	N	N	N	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	N	N	F	N	N	N
PURSUIT	**B**	2	**E**	F	P	**E**	**E**	F	**G**	**G**	**G**	–	**G**	**G**	F	F	F	**G**	**G**	**G**	F	F	P	P	N	F	P	P
RAPTOR	**B**	2	**G**	**G**	**G**	**E**	**E**	F	**G**	**G**	**E**	–	**G**	**G**	P	F	F	**E**	**G**	**G**	F	F	P	F	P	P	–	–
SELECT/ARROW	**A**	1	N	N	N	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	N	N	**G**	N	N	N
2,4-DB	O	2	P	P	**G**	F	**G**	F	P	F	F	F	F	P	F	N	N	N	N	N	N	N	P	P	N	N	N	F
Established Alfalfa																												
SENCOR	**C**	3	**E**	**G**	**E**	N	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	**G**	**E**	**E**	**G**	**G**	N	N	P	P	**G**	P
SINBAR	**C**	3	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**E**	**E**	**E**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	P	F	F	P	F	P
VELPAR	**C**	3	**G**	**G**	**E**	F	**E**	**E**	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	**E**	**E**	**E**	**E**	**E**	F	F	F	F	**E**	P

Herbicide Site of Action: A = ACCase Inhibitor; B = ALS Inhibitor; C = Photosynthesis Inhibitor; O = Other

Herbicide Effectiveness: P = Poor; F = Fair; G = Good; E = Excellent; N = None; – = Not enough information to rank

*The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.

**Crop Tolerance: 1=Minimal risk of crop injury; 2=Crop injury can occur under certain conditions (soil applied—cold, wet: foliar applied—hot, humid); 3=Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4=Risk of severe crop injury is high. Recommended only in rescue situations.

***See Table 3A for rate, remarks and limitations.

TABLE 4F —Weed Response to Herbicides in Established Forage Grasses*

			ANNUAL BROADLEAVES													ANNUAL GRASSES							PERENNIALS					
	SITE OF ACTION	CROP TOLERANCE**	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PIGWEED (REDROOT)	RAGWEED (COMMON)	SMARTWEED	VELVETLEAF	WILD MUSTARD	HOARY ALYSSUM	YELLOW ROCKET	CHICKWEED (COMMON)		BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	BINDWEED (FIELD)	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE	DANDELION	CURLED DOCK
2,4-D ESTER	O	2	**E**	**G**	**E**	**E**	**E**	**E**	F	**G**	**G**	**G**	**G**	P		N	N	N	N	N	N	N	F	F	N	N	**G**	P
BANVEL/CLARITY	O	2	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**E**	**G**	**E**	**E**		N	N	N	N	N	N	N	**G**	**G**	N	N	**G**	F
STINGER	O	2	**E**	**G**	P	F	P	**E**	F	P	P	P	P	P		N	N	N	N	N	N	N	P	**G**	N	N	**G**	P

Herbicide Site of Action: A = ACCase Inhibitor; B = ALS Inhibitor; C = Photosynthesis Inhibitor; O = Other

Herbicide Effectiveness: P = Poor; F = Fair; G = Good; E = Excellent; N = None; – = Not enough information to rank

*The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.

**Crop Tolerance: 1=Minimal risk of crop injury; 2=Crop injury can occur under certain conditions (soil applied—cold, wet: foliar applied—hot, humid); 3=Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4=Risk of severe crop injury is high. Recommended only in rescue situations.

TABLE 5A –Chemical Weed Control in Dry Edible Beans

Dry Edible Beans — Preplant Incorporated Only

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses (including lambsquarters)	EPTC *(Eptam)*	2.25	1.25 qt 7EC	• **Apply preplant incorporated only.** • Refer to Table 5C for weed control and crop tolerance ratings. • Incorporate immediately after application. • *Eptam* suppresses common ragweed and wild mustard. • ***Prowl* (pendimethalin)**, ***trifluralin***, or ***Sonalan*** should be **tank mixed** with ***Eptam*** for additional broadleaf control, including lambsquarters. • *Pursuit 70DG* (0.72 oz) can be added to tank mixes with *Prowl, trifluralin,* or *Sonalan* for nightshade control. See remarks for *Pursuit*. • *Pursuit 70DG* (0.72 oz) may also be applied preemergence after preplant incorporated applications of *Eptam* tank mixed with *Prowl, trifluralin*, or *Sonalan*. See remarks for *Pursuit*. • A postemergence application of *Basagran, Pursuit* or *Raptor* may be necessary for additional broadleaf control. See remarks for these herbicides. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
Annual grasses, Annual broadleaves (some exceptions)	trifluralin *(commercial product)*	0.5	1 pt 4EC	• **Apply preplant incorporated only.** • Refer to Table 5C for weed control and crop tolerance ratings. • Incorporate immediately after application. • *Trifluralin* provides better pigweed control than *Prowl* or *Sonalan*. • ***Trifluralin*** should be **tank mixed** with ***Eptam***. Other measures may need to be taken for additional broadleaf control. See remarks for *Eptam*. • Refer to label and Table 12 for crop rotation restrictions.
	pendimethalin *(Prowl, Pendimax)* OR *(Prowl H_2O)*	0.75	1.8 pt 3.3EC OR 1.6 pt 3.8ACS	• **Apply preplant incorporated only.** • Refer to Table 5C for weed control and crop tolerance ratings. • Incorporate immediately after application. • *Prowl* provides better velvetleaf control than *trifluralin* or *Sonalan*. • ***Prowl*** should be **tank mixed** with ***Eptam***. Other measures may need to be taken for additional broadleaf control. See remarks for ***Eptam***. • Refer to label and Table 12 for crop rotation restrictions.
	ethalfluralin *(Sonalan)*	0.75	2 pt 3EC	• **Apply preplant incorporated only.** • Refer to Table 5C for weed control and crop tolerance ratings. • Incorporate immediately after application. • ***Sonalan*** should be **tank mixed** with ***Eptam***. Other measures may need to be taken for additional broadleaf control. See remarks for *Eptam*. • Refer to label and Table 12 for crop rotation restrictions.

(Continued on next page)

Dry Edible Beans — Preplant Incorporated Only (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses, Annual broadleaves (some exceptions)	imazethapyr + pendimethalin *(Pursuit Plus)*	0.47	20 oz 2.9 EC	• **Apply preplant incorporated only.** • Refer to Table 5C for weed control and crop tolerance ratings. • DO NOT use on sands or loamy sand soils. • DO NOT use in the Upper Peninsula of Michigan. • DO NOT apply *Pursuit Plus* if cold and/or wet conditions are present or predicted to occur within one week of application. • Delayed maturity may result from applications of *Pursuit Plus*. DO NOT apply if planting is delayed and frost is likely to occur prior to maturity. • 20 oz of *Pursuit Plus* contains 1.1 pt of *Prowl* 3.3EC, which may not be adequate grass control under heavy infestations. • On heavy soils with greater than 2% organic matter and heavy weed pressure, 30 oz of *Pursuit Plus* may be applied. • Dry bean varieties vary in their sensitivity to *Pursuit Plus*. Use ONLY on navy, black turtle, pinto, kidney and cranberry beans. DO NOT use on DOMINO black or OLATHE pinto beans. • DO NOT apply within 60 days of harvest. • DO NOT use if SUGAR BEETS, CUCUMBERS, CANOLA or TOMATOES are in the rotation; requires 40 months and a soil bioassay. • Refer to label and Table 12 for crop rotation restrictions.
	alachlor *(IntRRo)* OR *(Micro-Tech)*	2	2 qt 4EC OR 2 qt 4ME	• **Apply preplant incorporated only.** • Refer to Table 5C for weed control and crop tolerance atings. • Alachlor should be incorporated in the top 2 inches of soil to minimize the danger of bean injury. • DO NOT use on sands or sandy loam soils - injury can occur. • Alachlor provides better nightshade and pigweed control than metolachlor products. • *Prowl, trifluralin* or *Sonalan* can be tank-mixed for lambsquarters control. • *Pursuit 70DG* (0.72 oz) can be tank mixed for nightshade and additional broadleaf control. See remarks for *Pursuit*. • A postemergence application of *Basagran, Pursuit* or *Raptor* may be necessary for additional broadleaf control. See remarks for these herbicides. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.

Dry Edible Beans — Soil Applied

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Yellow nutsedge**	s-metolachlor *(Dual Magnum, Dual II Magnum)*	1.27	1.33 pt 7.64EC	• **May be applied preplant incorporated or preemergence.** • Refer to Table 5C for weed control and crop tolerance ratings. • PREPLANT INCORPORATED *Dual Magnum* minimizes the danger of bean injury. • DO NOT apply if soil is cracking and beans are in the crook stage. • Reduce *Dual Magnum* rate to 1 pt/A on coarse-textured soils with low organic matter. • Preemergence applications require rainfall for incorporation. Rotary hoe if no rainfall occurs within 7 days. • *Dual Magnum* provides better yellow nutsedge control than *alachlor* or *Outlook*. • *Prowl, trifluralin* or *Sonalan* can be tank mixed preplant incorporated for lambsquarters control. • *Pursuit 70DG* (0.72 oz) can be tank mixed for nightshade and additional broadleaf control. See remarks for *Pursuit*. • A postemergence application of *Basagran, Pursuit* or *Raptor* may be necessary for additional broadleaf control. See remarks for these herbicides. • DO NOT apply *Dual Magnum* within 60 days of harvest. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
	metolachlor *(Parallel, Parallel PCS,* Stalwart)	1.3	1.33 pt 7.8EC 1.33 pt 8EC	• **May be applied preplant incorporated or preemergence.** • **Advisory statement:** *Stalwart/Parallel/Parallel PCS* is a mix of the R and S-isomers of metolachlor. Limited research has shown that *Stalwart/Parallel/Parallel PCS* at 1.33 pt/A provides similar activity to *Dual Magnum/Dual II Magnum/ Cinch* (s-metolachlor) at 1.33 pt/A. However, *Stalwart/ Parallel/Parallel PCS* may not provide the consistency, length of control or performance on more difficult to control weeds when compared with *Dual Magnum/Dual II Magnum/Cinch* (s-metolachor) at 1.33 pt/A. *Stalwart/ Parallel/Parallel PCS* rates would need to be increased to 2.0 pt/A to provide the same amount of s-metolachlor (the more active isomer) at the 1.33 pt/A rate of *Dual Magnum/ Dual II Magnum/Cinch* (s-metolachlor). • Refer to Table 5C for weed control and crop tolerance ratings. • See remarks and limitations for *Dual Magnum*. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.

(Continued on next page)

Dry Edible Beans — Soil Applied

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses **Yellow nutsedge**	dimethenamid-P *(Outlook)*	0.66	14 oz 6L	• **May be applied preplant incorporated or preemergence.** • Refer to Table 5C for weed control and crop tolerance ratings. • PREPLANT INCORPORATED *Outlook* minimizes the danger of bean injury. • DO NOT apply if soil is cracking and beans are in the crook stage. • Reduce *Outlook* rate to 12 oz/A on coarse-textured soils with low organic matter. • Navy and black beans are more sensitive to *Outook* applications than to *Dual Magnum*. • Preemergence applications require rainfall for incorporation. Rotary hoe if no rainfall occurs within 7 days. • *Outlook* provides better pigweed and nightshade control than *Dual Magnum*. • *Prowl, trifluralin,* or *Sonalan* can be tank mixed preplant incorporated for lambsquarters control. • *Pursuit 70DG* (0.72 oz) can be tank mixed for nightshade and additional broadleaf control. See remarks for *Pursuit*. • A postemergence application of *Basagran, Pursuit,* or *Raptor* may be necessary for additional broadleaf control. See remarks for these herbicides. • DO NOT apply *Outlook* within 70 days of harvest. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
Annual broadleaves	imazethapyr *(Pursuit)*	0.031	0.72 oz 70DG	• **May be applied preplant incorporated or preemergence.** • Refer to Table 5C for weed control and crop tolerance ratings. • DO NOT use on sands or loamy sand soils. • DO NOT use in the Upper Peninsula of Michigan. • DO NOT apply *Pursuit* if cold and/or wet conditions are present or predicted to occur within 1 week of application. • Delayed maturity may result from applications of *Pursuit*. DO NOT apply if planting is delayed and frost is likely to occur prior to maturity. • On heavy soils with greater than 2% organic matter and heavy weed pressure, 1.0 oz of *Pursuit 70DG* may be applied. • Pursuit can be tank mixed and applied preplant incorporated with *Eptam* plus *trifluralin, Prowl,* or *Sonalan*; or *alachlor*, *Dual Magnum* or *Outlook*; or preemergence with *Dual Magnum* or *Outlook*. *Pursuit* in these mixes will control eastern black nightshade. • Preemergence applications require rainfall for incorporation. Rotary hoe if no rainfall occurs within 7 days. • *Pursuit* will NOT control common ragweed. • Dry bean varieties vary in their sensitivity to *Pursuit*. Use ONLY on navy, black turtle, pinto, kidney, and cranberry beans. DO NOT use on DOMINO black or OLATHE pinto beans. • DO NOT apply within 60 days of harvest. • DO NOT use if SUGAR BEETS, CUCUMBERS, CANOLA or TOMATOES are in the rotation; requires 40 months and a soil bioassay. • Refer to label and Table 12 for crop rotation restrictions.

(Continued on next page)

Dry Edible Beans — Soil Applied

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	halosulfuron *(Permit/Sandea)*	0.023	0.67 oz 75DG	• **May be applied preplant incorporated or preemergence.** • Refer to Table 5C for weed control and crop tolerance ratings. • Reduce the rate of *Permit/Sandea* to 0.5 oz/A on lighter textured soils with low organic matter. • *Permit/Sandea* can cause injury under cool and wet growing conditions. • Delayed maturity may result from applications of *Permit/Sandea.* • Dry bean varieties and classes vary in their tolerance to *Permit/Sandea*. From MSU research, CAUTION should be taken when applying *Permit/Sandea* to kidney and black beans. • *Permit/Sandea* can be tank mixed with *Eptam* for grass and additional lambsquarters control. • *Permit/Sandea* can be tank mixed with *metolachlor* products or *Outlook* for annual grass control. • *Permit/Sandea* will not control ALS-resistant weed species. • DO NOT plant SUGAR BEETS within 21 months of a *Sandea* application. • Refer to label and Table 12 for crop rotation restrictions.

Dry Edible Beans — Postemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves (including cocklebur, velvetleaf, and jimsonweed)	bentazon *(Basagran)* + crop oil concentrate	0.75	1.25 pt 4L + 1 qt	• Refer to Table 5C for weed control and crop tolerance ratings. • Most effective on small weeds. Check *Basagran* dry bean label for specific rate and proper weed growth stage. • Beans MUST HAVE one fully expanded trifoliate before application. • Use a minimum of 20 gal. water/A for adequate coverage. • DO NOT apply if dry beans are under stress from herbicide injury, cold or dry weather, or hail damage. • For improved velvetleaf control 28% liquid nitrogen (2-4 qt/A) or ammonium sulfate (2.5 lb/A) can be used INSTEAD OF crop oil concentrate. However, if common ragweed and common lambsquarters are present, a crop oil concentrate must also be included. • Split applications of *Basagran* (1 pt + 1 pt) plus crop oil concentrate (1 pt + 1 pt) can be used for more consistent common ragweed and lambsquarters control. Make the first application when weeds are less than 1 inch tall, and make second application 10-14 days later. • For CANADA THISTLE and YELLOW NUTSEDGE control, apply sequential applications of *Basagran* (1.5 pt + 1.5 pt) plus crop oil concentrate (1 qt + 1 qt) when Canada thistle is 6-8 inches tall and yellow nutsedge is 4-6 inches. Make second application 7-10 days later. • Allow 30 days between *Basagran* application and dry bean harvest. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.

Dry Edible Beans — Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Common ragweed, Pigweed, E.B. nightshade	Fomesafen *(Reflex)* + surfactant	0.25	1 pt 2L + 0.25%	• Refer to Table 5C for weed control and crop tolerance ratings. • Most effective on small weeds; common ragweed 4-inches or less and eastern black nightshade 2-inches or less. • Common ragweed less than 4-inches will be controlled with 0.5 pt/A of *Reflex*. • Apply to dry beans between the first and fourth trifoliate leaf stages. • A non-ionic surfactant at 0.25-0.5% v/v or a crop oil concentrate at 0.5-1.0% v/v must be included for effective control. • *Reflex* can be tank-mixed with *Basagran, Raptor*, or *Pursuit*. Include a COC when tank-mixing *Reflex* + *Basagran*. ONLY include a non-ionic surfactant when tank-mixing with *Raptor* or *Pursuit*. DO NOT add AMS or 28%N. • *Reflex* can only be applied in counties south of Highway 55. • DO NOT apply *Reflex* to the same field in CONSECUTIVE years. • DO NOT apply within 45 days of harvest. • Refer to Table 12 for crop rotation restrictions.
Pigweed, E.B. nightshade, Wild mustard	imazethapyr *(Pursuit)* + surfactant	0.031	0.72 oz 70 DG + 0.25%	• Refer to Table 5C for weed control and crop tolerance ratings. • Most effective on small weeds (less than 2 inches). • Beans MUST HAVE one fully expanded trifoliate before application. • DO NOT apply if dry beans have begun to flower. • Apply *Pursuit* with non-ionic surfactant (0.25% v/v). • DO NOT add 28% liquid nitrogen (2.5% v/v) or ammonium sulfate (2.5 lb/A) unless at least 8 oz of *Basagran* is added to “safen” this application. • Increase the rate of *Basagran* (16 oz) when tank mixed with *Pursuit* to control common cocklebur and jimsonweed. • Delayed maturity may result from applications of *Pursuit*. DO NOT apply if planting is delayed and frost is likely to occur prior to maturity. • Dry bean varieties vary in their sensitivity to *Pursuit*. Use ONLY on navy, black turtle, pinto, kidney, and cranberry beans. DO NOT use on DOMINO black or OLATHE pinto beans. • DO NOT apply within 60 days of harvest. • DO NOT use if SUGAR BEETS, CUCUMBERS, CANOLA, or TOMATOES are in the rotation; requires 40 months and a soil bioassay. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.

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Dry Edible Beans — Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Pigweed, E. B. nightshade, Wild mustard	imazamox *(Raptor)* + bentazon *(Basagran)* + crop oil concentrate + ammonium sulfate	0.032 0.25	4 oz 1L + 8 oz 4L + 1% + 12–15 lb/100 gal	• Refer to Table 5C for weed control and crop tolerance ratings. • Most effective on small weeds (less than 2 inches). • Beans MUST HAVE one fully expanded trifoliate before application. • DO NOT apply if dry beans have begun to flower. • DO NOT apply if planting is delayed and frost is likely to occur prior to maturity. • Apply *Raptor* with crop oil concentrate (1% v/v) or a non-ionic surfactant (0.25% v/v). • At least 8 fl oz of *Basagran* **must** be tank-mixed with *Raptor*, if ammonium sulfate (12-15 lb/100 gal) or 28% liquid nitrogen (2.5% v/v) are added. *Basagran* "safens" this application. • Increase the rate of *Basagran* (16 oz) when tank mixed with *Raptor* to control common cocklebur and jimsonweed, and to provide good control of common lambsquarters (less than 2 inch tall). • DO NOT tank-mix with *Poast, Select/Arrow,* or *Assure II/Targa* — grass antagonism will occur. • DO NOT apply within 60 days of harvest. • DO NOT use the combination of *Raptor* + *Basagran* on adzuki beans. *Basagran* causes significant injury to adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
Grasses	sethoxydim *(Poast)* + crop oil concentrate	0.19	1 pt 1.5SC + 1 qt	• Refer to Table 5C for weed control and crop tolerance ratings. • Treat actively growing grasses (annual grasses up to 8 inches and crabgrass up to 6 inches). • Reduced rates of *Poast* (12 oz/A) may be used when barn yardgrass, green and giant foxtail, and fall panicum are less than 4 inches tall and the target species. • DO NOT apply to grasses under stress — poor weed control will result. • DO NOT cultivate within 5 days prior to and 7 days following application. • Allow 30 days between *Poast* application and dry bean harvest. • *Poast* is generally less effective than other postemergence grass herbicides for perennial grass control. Sequential applications of *Poast* (1.5 pt + 1 pt) plus crop oil concentrate (1 qt + 1 qt) plus 28% liquid nitrogen (1 gal + 1 gal) or ammonium sulfate (2.5 lb + 2.5 lb), 14 to 21 days apart are most effective for controlling quackgrass. Make the first application when quackgrass is 6-8 inches tall. • Tank mixes with *Pursuit* and *Raptor* are not recommended — grass antagonism will occur. • Refer to label and Table 12 for crop rotation restrictions.

(Continued on next page)

Dry Edible Beans — Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Grasses	clethodim *(Select/Arrow)* + crop oil concentrate OR *(Select Max)* + Surfactant	0.094 0.068	6 oz 2EC + 1% OR 9 oz 0.97EC + 0.25%	• Refer to Table 5C for weed control and crop tolerance ratings. • Treat actively growing grasses (annual grasses up to 6 inches). • Reduced rates of *Select/Arrow* (4-5 oz/A) or *Select Max* (6-8 oz/A) may be used when some grass species are small. • The addition of ammonium sulfate at 2.5 to 4 lb/A has been shown to improve control of difficult to control weeds, e.g., quackgrass, rhizome Johnsongrass, volunteer cereals, and volunteer corn. • DO NOT apply to grasses under stress — poor weed control will result. • DO NOT cultivate within 7 days prior to and 7 days following application. • Allow 30 days between *Select/Arrow* or *Select Max* application and dry bean harvest. • *Select/Arrow* or *Select Max* can be tank mixed with *Basagran*. Increase the *Select/Arrow* rate to 8-10 oz/A and the *Select Max* rate to 12 oz/A and apply with crop oil concentrate (1% v/v). • Tank mixes with *Pursuit* and *Raptor* are not recommended — grass antagonism will occur. • *Select/Arrow* (8-16 oz/A) plus crop oil concentrate (1% v/v) plus 28% liquid nitrogen (2.5% v/v) or ammonium sulfate (2.5 lb/A) will control quackgrass 4-12 inches tall. A sequential application of 8 oz/A may be needed 14-21 days later. Sequential applications of *Select Max* (12 + 12 oz/A) are needed to control 4 to 12 inch quackgrass. • Refer to label and Table 12 for crop rotation restrictions.
	quizalofop-P-ethyl *(Assure II/Targa)* + crop oil concentrate OR surfactant	0.044	7 oz 0.88L + 1% OR 0.25%	• Refer to Table 5C for weed control and crop tolerance ratings. • Treat actively growing grasses (annual grasses up to 4 inches). • DO NOT apply to grasses under stress — poor weed control will result. • DO NOT cultivate within 5 days prior to and 7 days following application. • Allow 30 days between *Assure II/Targa* application and dry bean harvest. • *Assure II/Targa* can be tank mixed with *Basagran* for foxtails and barnyardgrass. Increase the *Assure II/Targa* rate by 2 oz. • Tank mixes with *Pursuit* and *Raptor* are not recommended — grass antagonism will occur. • *Assure II/Targa* (10 oz/A) plus crop oil concentrate (1% v/v) or nonionic surfactant (0.25% v/v) will control quackgrass 6-10 inches tall. A sequential application of 7 oz/A may be needed 14-21 days later. • Refer to label and Table 12 for crop rotation restrictions.

Table 5B - Preharvest Treatments in Dry Edible Beans

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Preharvest	glyphosate *(Roundup WeatherMax)* OR *(Roundup OriginalMax)* + ammonim sulfate	0.75 lb a.e.	 22 oz 5.5L OR 22 oz 5.5L + 17 lb/100gal	• Glyphosate should ONLY be used to control weeds that hinder harvest. • ***DO NOT*** use glyphosate for **vine desiccation** — residues of glyphosate have been found in harvested beans if applications are made too early. • If vine desiccation is needed, use *Gramoxone Max*. • Glyphosate should be applied when beans are in the ***hard dough stage*** **(30% moisture or less)**. • Glyphosate applications should be made at least 7 days before harvest. • ONLY one application should be made per year. • DO NOT apply glyphosate to beans grown for seed. • DO NOT feed treated vines and hay from these crops to livestock.
Preharvest **Vine desiccation**	paraquat *(Gramoxone Inteon)* + non-ionic surfactant	0.3-0.5	1.2–2 pt 2SL + 0.25%	• *Gramoxone Inteon* is a restricted-use pesticide. • Apply when crop is mature, at least 80% of the pods are yellowing and mostly ripe and no more than 40% (bush-type beans) or 30% (vine-type beans) of the leaves are still green. • Apply by air in 5 gal water/A or by ground in 20-40 gal of water/A. • If growth is lush and vigorous, make either a single application of the higher rate of *Gramoxone Inteon*; or split applications at the lower rates. Split applications may improve vine coverage. DO NOT exceed 2.0 pt/A of *Gramoxone Inteon*. • Do not harvest within 7 days of application.

TABLE 5C – Weed Response to Herbicides in Dry Edible Beans*

			ANNUAL BROADLEAVES									ANNUAL GRASSES								PERENNIALS				
	SITE OF ACTION	CROP TOLERANCE	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PIGWEED	RAGWEED (COMMON)	SMARTWEED	VELVETLEAF	WILD MUSTARD	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	BINDWEED (FIELD)	BINDWEED (HEDGE)	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE
Preplant Incorporated																								
DUAL MAGNUM/PARALLEL/STALWART	O	2	N	N	P	F	**G**	P	P	N	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	F	N	N	N	N	**G**
EPTAM	O	2	P	P	**G**	F	F	F	F	F	F	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	F	F
OUTLOOK	O	3[a]	N	N	P	**G**	**G**	P	P	N	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	N	F
INTRRO	O	3	N	N	P	**G**	**G**	P	P	N	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	F	N	N	N	N	F
PROWL	O	1	N	N	**G**	P	F	P	P	F	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N	N
PURSUIT	B	3	F	F	P	**E**	**E**	P	F	F	**G**	P	P	F	F	F	P	P	P	N	N	N	N	F
SONALAN	O	1	N	N	**G**	F	**G**	P	P	N	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N	N
TRIFLURALIN	O	1	N	N	**G**	N	**G**	N	P	N	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N	N
PURSUIT PLUS	O/B	3	F	F	**G**	**E**	**E**	P	F	**G**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N	F
Preemergence																								
OUTLOOK	O	3[a]	N	N	P	**G**	**G**	P	P	N	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	N	F
DUAL MAGNUM/PARALLEL/STALWART	O	2	N	N	P	F	**G**	P	P	N	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	F	N	N	N	N	F
PURSUIT	B	3	P	P	P	**E**	**E**	P	F	P	**G**	P	P	F	F	F	P	P	P	N	N	P	N	F
PERMIT/SANDEA	B	3	F	F	F	P	**E**	**G**	P	**G**	**E**	N	N	N	N	N	N	N	N	N	N	N	N	F
Postemergence																								
BASAGRAN[b]	O	2	**E**	**G**	F	P	P	F	**E**	**G**	**E**	N	N	N	N	N	N	N	N	N	N	**G**	N	**G**
POAST	A	1	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	N	F	N
SELECT/ARROW/SELECT MAX	A	1	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	N	**G**	N
ASSURE II/TARGA	A	1	N	N	N	N	N	N	N	N	N	**G**	**G**	**E**	**E**	**G**	**E**	**E**	**E**	N	N	N	**E**	N
PURSUIT[c]	B	3	F	P	P	**E**	**E**	P	F	F	**E**	P	P	F	P	P	P	P	P	N	N	P	N	F
PURSUIT[c] + BASAGRAN	B/O	2	**E**	**G**	F	**E**	**E**	F	**G**	**G**	**E**	P	P	F	P	P	P	P	P	N	N	**G**	N	**G**
RAPTOR[c]	B	3	F	F	F	**E**	**E**	P	F	**G**	**E**	F	P	F	P	P	P	P	P	N	N	P	N	P
RAPTOR[c] + BASAGRAN (8 oz)	B/O	2	**G**	F	F/**G**	**E**	**E**	F	**G**	**G**	**E**	F	P	F	P	P	P	P	P	N	N	F	N	F
RAPTOR[cd] + BASAGRAN (16 oz)	B/O	2	**E**	**G**	**G**	**E**	**E**	F	**E**	**G**	**E**	P	P	F	P	P	P	P	P	N	N	**G**	N	F
REFLEX	O	2	P	F	P	**G**	**G**	**E**	P	P	**E**	N	N	N	N	N	N	N	N	N	N	N	N	N
REFLEX + BASAGRAN	O/O	2	**E**	**G**	F/**G**	**G**	**G**	**E**	**E**	**G**	**E**	N	N	N	N	N	N	N	N	N	N	F	N	**G**
REFLEX + RAPTOR[d]	O/B	3	F	F	F	**E**	**E**	**E**	F	**G**	**E**	F	P	F	P	P	P	N	N	N	N	P	N	P

Herbicide Site of Action: A = ACCase inhibitor; B = ALS inhibitor; C = Photosynthesis inhibitor; O = Other.
P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None

Crop Tolerance: 1 = Minimal risk of crop injury; 2 = Crop injury can occur under certain conditions (soil applied — cold, wet; foliar applied — hot, humid); 3 = Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4 = Risk of severe crop injury is high. Recommended only in rescue situations.

*The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.

[a] Crop tolerance for navy and black beans = 3. For other bean classes, crop tolerance = 2. Preplant incorporation will increase tolerance of navy and black beans to *Outlook*.

[b] Control of **hairy nightshade** with *Basagran* is good.

[c] Control of **hairy nightshade** with *Pursuit* and *Raptor* is excellent.

[d] **Common lambsquarters** will be controlled with this tank mixture ***if*** the weeds are less than 2 inches tall and ***not*** under drought stress.

TABLE 6A –Chemical Weed Control in Potatoes

Potatoes – Preplant Followed by Delayed Preemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses, Annual broadleaves ***Preplant incorporated***	EPTC (*Eptam*)	4	4.5 pt 7EC	• Work into soil immediately after application. • Use 6.75 pt/A if nutsedge is a problem. • Preplant incorporated.
FOLLOWED BY ***Delayed preemergence***	linuron (*Lorox/Linex*)	1	1 qt 4L OR 2 lb 50DF	• These treatments follow *Eptam* preplant incorporated. • Delayed preemergence. • Treatment should be made prior to potato emergence and to germinating weeds or weeds that have emerged but are very small. • If small weeds have emerged, add non-ionic surfactant at 0.125% (1 pt/100 gal. water). • A preemergence application of metribuzin to Atlantic and and Shepody varieties is not recommended because injury can occur, especially under adverse weather conditions and when high metribuzin rates are used. • DO NOT use *Matrix* preemergence on soils with greater than 6% organic matter. • Adding *Matrix* will provide additional annual grass and redroot pigweed control and will suppress cocklebur. • Refer to label and Table 12 for crop rotation restrictions.
	OR metribuzin (*Sencor*) + rimsulfuron (*Matrix*)	 0.5 + 0.024	 OR 0.67 lb 75DF + 1.5 oz 25DF	

Potatoes – Early Preemergence Followed by Delayed Preemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses (especially barnyardgrass) ***Early preemergence***	s-metolachlor (*Dual Magnum*, *Dual II Magnum*)	1.27	1.33 pt 7.64EC	• Apply ***early preemergence*** – make application soon after planting. • If field leveling is necessary, it should be done soon after planting. • Most effective on germinating grasses that have not emerged. • **Advisory statement:** *Stalwart/Parallel/Parallel PCS* is a mix of the R and S-isomers of metolachlor. Limited research has shown that *Stalwart/Parallel/Parallel PCS* at 1.33 pt/A provides similar activity to *Dual Magnum/Dual II Magnum/Cinch* (s-metolachlor) at 1.33 pt/A. However, *Stalwart/Parallel/Parallel PCS* may not provide the consistency, length of control or performance on more difficult to control weeds when compared with *Dual Magnum/Dual II Magnum/Cinch* (s-metolachor) at 1.33 pt/A. *Stalwart/Parallel/Parallel PCS* rates would need to be increased to 2.0 pt/A to provide the same amount of s-metolachlor (the more active isomer) at the 1.33 pt/A rate of *Dual Magnum/Dual II Magnum/Cinch* (s-metolachlor). • DO NOT use *Prowl/Prowl H_2O/Pendimax* on muck soils or loamy sands with less than 1.5% organic matter. • *Outlook* rates range from 12 to 18 oz/A (coarse textured soils) and 18 to 21 oz/A (medium- to fine-textured soils). • Under cold or wet conditions, applications of *Outlook* may result in delayed emergence or early season stunting. • Follow with *Sencor*, or *Lorox/Linex,* or *Sencor* plus *Matrix*.
	OR metolachlor *(Parallel, Parallel PCS, Stalwart)*	 1.3	 OR 1.33 pt 7.8EC	
	OR pendimethalin (*Prowl/Pendimax*)	 0.75	 OR 1.8 pt 3.3EC	
	OR *(Prowl H_2O)*	 	 OR 1.6 pt 3.8 ACS	
	OR dimethenamid-P *(Outlook)*	 0.66	 OR 14 oz 6L	

(Continued on next page)

Potatoes – Early Preemergence Followed by Delayed Preemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
FOLLOWED BY:				
Delayed preemergence	linuron *(Lorox/Linex)*	1	1 qt 4L OR 2 lb 50DF	• Delayed preemergence. • These treatments follow *Prowl/Prowl H_2O/Pendimax* or *Dual Magnum or Parallel/Stalwart* or *Outlook* early preemergence.
	OR		OR	• Apply before potato emergence.
	metribuzin *(Sencor)*	0.5	0.67 lb 75DF	• Most effective on germinating and small emerged weeds. • If small weeds have emerged, add non-ionic surfactant at 0.125% (1 pt/100 gal. water).
	+	+	+	
	rimsulfuron *(Matrix)*	0.024	1.5 oz 25DF	• A preemergence application of metribuzin to Atlantic or Shepody varieties is not recommended because injury can occur, especially under adverse weather conditions and where high metribuzin rates are used. • DO NOT use *Matrix* preemergence on soils with greater than 6% organic matter. • Adding *Matrix* will provide additional annual grass and redroot pigweed control and will suppress cocklebur. • Refer to label and Table 12 for crop rotation restrictions.

Potatoes – Delayed Preemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves, Annual grasses, Yellow nutsedge	linuron *(Lorox/Linex)*	1.5	1.5 qt 4L OR 3 lb 50DF	• If field leveling is necessary, it should be done soon after planting to allow weed emergence before spraying. • Apply delayed preemergence before grasses are 2 inches and broadleaves are 4 inches, but BEFORE POTATOES EMERGE. • On soils with greater than 5% organic matter, apply 2 lb a.i./A of linuron to emerged weeds. • **Advisory statement:** *Stalwart/Parallel/Parallel PCS* is a mix of the R and S-isomers of metolachlor. Limited research has shown that *Stalwart/Parallel/Parallel PCS* at 1.33 pt/A provides similar activity to *Dual Magnum/Dual II Magnum/Cinch* (s-metolachlor) at 1.33 pt/A. However, *Stalwart/Parallel/Parallel PCS* may not provide the consistency, length of control or performance on more difficult to control weeds when compared with *Dual Magnum/Dual II Magnum/Cinch* (s-metolachor) at 1.33 pt/A. *Stalwart/Parallel/Parallel PCS* rates would need to be increased to 2.0 pt/A to provide the same amount of s-metolachlor (the more active isomer) at the 1.33 pt/A rate of *Dual Magnum/Dual II Magnum/Cinch* (s-metolachlor). • *Outlook* rates range from 12 to 18 oz/A (coarse textured soils) and 18 to 21 oz/A (medium- to fine-textured soils). • Under cold or wet conditions, applications of *Outlook* may result in delayed emergence or early season stunting. • Refer to label and Table 12 for crop rotation restrictions.
	+	+	+	
	s-metolachlor *(Dual Magnum, Dual II Magnum)*	1.27	1.33 pt 7.64EC	
	OR		OR	
	metolachlor (Parallel, *Parallel PCS, Stalwart*)	1.3	1.33 pt 7.8EC	
	OR		OR	
	dimethenamid-P *(Outlook)*	0.66	14 oz 6L	

(Continued on next page)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves, Annual grasses, Yellow nutsedge	metribuzin *(Sencor)* + s-metolachlor *(Dual Magnum, Dual II Magnum)* OR metolachlor (Parallel, *Parallel PCS, Stalwart*) OR dimethenamid-P *(Outlook)*	0.5 + 1.27 OR 1.3 OR 0.66	0.67 lb 75DF + 1.33 pt 7.64EC OR 1.33 pt 7.8EC OR 14 oz 6L	• If field leveling is necessary, it should be done soon after planting to allow weed emergence before spraying. • Apply delayed preemergence before weeds are 1 inch and before potatoes emerge. • Use up to 1 lb a.i. of metribuzin/A on high organic (muck) soil. • A preemergence application of metribuzin to Atlantic or Shepody varieties is not recommended because injury can occur, especially under adverse weather conditions and where high metribuzin rates are used. • **Advisory statement:** *Stalwart/Parallel/Parallel PCS* is a mix of the R and S-isomers of metolachlor. Limited research has shown that *Stalwart/Parallel/Parallel PCS* at 1.33 pt/A provides similar activity to *Dual Magnum/Dual II Magnum/Cinch* (s-metolachlor) at 1.33 pt/A. However, *Stalwart/Parallel/Parallel PCS* may not provide the consistency, length of control or performance on more difficult to control weeds when compared with *Dual Magnum/Dual II Magnum/Cinch* (s-metolachor) at 1.33 pt/A. *Stalwart/Parallel/Parallel PCS* rates would need to be increased to 2.0 pt/A to provide the same amount of s-metolachlor (the more active isomer) at the 1.33 pt/A rate of *Dual Magnum/Dual II Magnum/Cinch* (s-metolachlor). • *Outlook* rates range from 12 to 18 oz/A (coarse textured soils) and 18 to 21 oz/A (medium- to fine-textured soils). • Under cold or wet conditions, applications of *Outlook* may result in delayed emergence or early season stunting. • Refer to label and Table 12 for crop rotation restrictions.
	metribuzin *(Sencor)* + rimsulfuron *(Matrix)* + s-metolachlor *(Dual Magnum, Dual II Magnum)* OR metolachlor (Parallel, *Parallel PCS, Stalwart*) OR dimethenamid-P *(Outlook)*	0.5 + 0.024 + 1.27 OR 1.3 OR 0.66	0.67 lb 75DF + 1.5 oz 25DF + 1.33 pt 7.64EC OR 1.33 pt 7.8EC OR 14 oz 6L	• If field leveling is necessary, it should be done soon after planting to allow weed emergence before spraying. • Apply delayed preemergence before weeds are 1 inch tall and before potatoes emerge. • A preemergence application of metribuzin to Atlantic or Shepody varieties is not recommended because injury can occur, especially under adverse weather conditions and where high metribuzin rates are used. • DO NOT use *Matrix* preemergence on soils with greater than 6% organic matter. • Adding *Matrix* will provide additional annual grass and redroot pigweed control and will suppress cocklebur. • **Advisory statement:** *Stalwart/Parallel/Parallel PCS* is a mix of the R and S-isomers of metolachlor. Limited research has shown that *Stalwart/Parallel/Parallel PCS* at 1.33 pt/A provides similar activity to *Dual Magnum/Dual II Magnum/Cinch* (s-metolachlor) at 1.33 pt/A. However, *Stalwart/Parallel/Parallel PCS* may not provide the consistency, length of control or performance on more difficult to control weeds when compared with *Dual Magnum/Dual II Magnum/Cinch* (s-metolachor) at 1.33 pt/A. *Stalwart/Parallel/Parallel PCS* rates would need to be increased to 2.0 pt/A to provide the same amount of s-metolachlor (the more active isomer) at the 1.33 pt/A rate of *Dual Magnum/Dual II Magnum/Cinch* (s-metolachlor). • *Outlook* rates range from 12 to 18 oz/A (coarse textured soils) and 18 to 21 oz/A (medium- to fine-textured soils). • Under cold or wet conditions, applications of *Outlook* may result in delayed emergence or early season stunting. • Refer to label and Table 12 for crop rotation restrictions.

Potatoes – Postemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves, Annual grasses	metribuzin *(Sencor)*	0.25	0.33 lb 75DF	• DO NOT apply postemergence within 3 days after periods of cool, wet or cloudy weather — crop injury may occur. • Treat when weeds are less than 1 inch tall. • Greater possibility of injury to potatoes when sprayed at 12-15 inches. • Not recommended on Atlantic, Shepody, Chip Belle, Bell Chip, or Centennial varieties. • Not recommended for early-maturing varieties such as Superior. • Not recommended for red-skinned varieties. • DO NOT apply postemergence within 60 days of harvest. • Metribuzin at 0.33 lb DF/A can be tank mixed with *Poast* for annual grass and broadleaf weed control on russet or white-skinned potatoes that are NOT early-maturing. See *Poast* remarks for the recommended rate. Crop injury may occur. • Refer to label and Table 12 for crop rotation restrictions.
Annual broadleaves, Annual grasses	metribuzin *(Sencor)* + rimsulfuron *(Matrix)* + non-ionic surfactant	0.25 + 0.0156	0.33 lb 75DF + 1 oz 25DF + 0.125%	• DO NOT apply postemergence within 3 days after periods of cool, wet, or cloudy weather or crop injury may occur. • Treat when weeds are less than 1 inch tall. • Greater possibility of injury to potatoes when sprayed at 12-15 inches. • Not recommended on Atlantic, Shepody, Chip Belle, Bell Chip, or Centennial varieties. • Not recommended for early-maturing varieties such as Superior. • Not recommended for red-skinned varieties. • DO NOT apply postemergence within 60 days of harvest. • Add non-ionic surfactant at 0.125% (1 pint per 100 gal. water). • *Matrix* will improve control of annual grasses, redroot pigweed, triazine-resistant lambsquarters, wild buckwheat, and yellow nutsedge and quackgrass. • Refer to label and Table 12 for crop rotation restrictions.
	s-metolachlor *(Dual Magnum, Dual II Magnum)* OR metolachlor *(Parallel, Parallel PCS, Stalwart)* + metribuzin *(Sencor)*	1.27 1.3 + 0.25	1.33 pt 7.64EC OR 1.33 pt 7.8EC + 0.33 lb 75DF	• Refer to remarks for metribuzin postemergence. • APPLICATION should be made ONLY as a directed or semi-DIRECTED spray to avoid chlorosis, minor necrosis and leaf distortion. • **Advisory statement:** *Stalwart/Parallel/Parallel PCS* is a mix of the R and S-isomers of metolachlor. Limited research has shown that *Stalwart/Parallel/Parallel PCS* at 1.33 pt/A provides similar activity to *Dual Magnum/Dual II Magnum/Cinch* (s-metolachlor) at 1.33 pt/A. However, *Stalwart/Parallel/Parallel PCS* may not provide the consistency, length of control or performance on more difficult to control weeds when compared with *Dual Magnum/Dual II Magnum/Cinch* (s-metolachor) at 1.33 pt/A. *Stalwart/Parallel/Parallel PCS* rates would need to be increased to 2.0 pt/A to provide the same amount of s-metolachlor (the more active isomer) at the 1.33 pt/A rate of *Dual Magnum/Dual II Magnum/Cinch* (s-metolachlor). • Refer to label and Table 12 for crop rotation restrictions.
Redroot pigweed, Wild mustard, Annual grasses	rimsulfuron *(Matrix)* + non-ionic surfactant	0.0156	1 oz 25DF + 0.25%	• DO NOT apply postemergence within 60 days of harvest. • DO NOT apply by air. • Apply to small weeds less than 1 inch tall (quackgrass 4–6 inches) that are actively growing. • For control of redroot pigweed, mustard, and annual grasses. • Suppression of wild buckwheat, yellow nutsedge, quackgrass, and volunteer cereals. • Refer to label and Table 12 for crop rotation restrictions.

Potatoes – Postemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Redroot pigweed**	s-metolachlor *(Dual Magnum, Dual II Magnum)* OR metolachlor *(Parallel, Parallel PCS, Stalwart)*	1.27 1.3	1.33 pt 7.64EC OR 1.33 pt 7.8EC	• Will not control emerged weeds. • DO NOT apply within 40 days of harvest. • DO NOT apply to potatoes at green tip (cracking). • **Advisory statement:** *Stalwart/Parallel/Parallel PCS* is a mix of the R and S-isomers of metolachlor. Limited research has shown that *Stalwart/Parallel/Parallel PCS* at 1.33 pt/A provides similar activity to *Dual Magnum/Dual II Magnum/Cinch* (s-metolachlor) at 1.33 pt/A. However, *Stalwart/Parallel/Parallel PCS* may not provide the consistency, length of control or performance on more difficult to control weeds when compared with *Dual Magnum/Dual II Magnum/Cinch* (s-metolachor) at 1.33 pt/A. *Stalwart/Parallel/Parallel PCS* rates would need to be increased to 2.0 pt/A to provide the same amount of s-metolachlor (the more active isomer) at the 1.33 pt/A rate of *Dual Magnum/Dual II Magnum/Cinch* (s-metolachlor). • Refer to label and Table 12 for crop rotation restrictions.
Annual grasses	sethoxydim *(Poast)* + crop oil concentrate	0.19	1 pt 1.5SC + 1 qt	• Apply to annual grasses up to 8 inches tall (crabgrass up to 6 inches). • *Poast* can be reduced to 0.75 pt/A for 1- to 4-inch tall barnyardgrass, green and giant foxtails, and fall panicum. • Do not apply to grasses under stress — poor weed control may result. • Use 5-20 gal. water/A at 40-60 psi. • No soil activity. • Do not cultivate within 5 days prior to and 7 days following application. • Metribuzin at 0.33 lb DF/A can be tank mixed with *Poast* for annual grass and broadleaf weed control on russet or white-skinned potatoes that are NOT early-maturing. Add crop oil concentrate at 1 qt/A. Crop injury may occur. • If applied separately, wait 1 day after *Poast* application before applying metribuzin. Wait a minimum of 7 days after metribuzin before applying *Poast.* • Do not apply within 30 days of harvest. • Refer to label and Table 12 for crop rotation restrictions.
	clethodim *(Select/Arrow)* + crop oil concentrate OR *(Select Max)* + crop oil concentrate	0.094 0.068	6 oz 2EC + 1% OR 9 oz 0.97EC + 1%	• Use 10-40 gal. water/A at 20-60 psi. • Apply *Select/Arrow* only with crop oil concentrate (1% v/v). *Select Max* offers greater adjuvant flexibility and may be applied with crop oil concentrate (1% v/v), methylated seed oil (1% v/v) or non-ionic surfactant (0.25% v/v). • The addition of ammonium sulfate at 2.5 to 4 lb/A has been shown to improve control of difficult to control weeds — e.g., quackgrass, rhizome Johnsongrass, volunteer cereals and volunteer corn. • DO NOT apply within 30 days of harvest. • DO NOT apply to grasses under stress — poor weed control may result. • Do not cultivate within 7 days prior to and 7 days following application. • *Select*/Arrow can be reduced to 4 oz/A and *Select Max* can be reduced to 6 oz/A for barnyardgrass, giant foxtail and fall panicum shorter than 4 inches and volunteer corn shorter than 6 inches. • Refer to label and Table 12 for crop rotation restrictions.

Potatoes – Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Quackgrass	sethoxydim *(Poast)* + crop oil concentrate + ammonium sulfate	0.29 + 0.19	1.5 pt + 1 pt 1.5SC + 1 qt + 1 qt + 2.5 lb + 2.5 lb	• TWO APPLICATIONS MAY BE NECESSARY FOR QUACKGRASS CONTROL. Make a second application of 1 pt/A 14-21 days following initial treatment. Cultivation may replace second application. • Treat actively growing quackgrass 6-8 inches tall. • See remarks for annual grass control with *Poast*.
	clethodim *(Select/Arrow)* OR *(Select Max)* + crop oil concentrate + ammonium sulfate	0.125–0.25 OR 0.09 + 0.09	8-16 oz 2EC OR 12 oz 0.97EC + 1% + 2.5-4.0 lb	• TWO APPLICATIONS MAY BE NEEDED FOR BEST QUACKGRASS CONTROL. • Make first application when quackgrass is 6-8 inches tall. • Make second application when quackgrass is 6-8 inches tall. • Make second application 14-21 days later when quackgrass has regrown. Cultivation may replace second application. • Use 10-40 gal. water/A at 20-60 psi. • See remarks for annual grass control with *Select*.
	rimsulfuron *(Matrix)* + non-ionic surfactant	0.0156	1 oz 25DF + 0.25%	• Application rate can be increased to 1.5 oz/A. • Apply to quackgrass that is 4-8 inches tall. • Do not apply to quackgrass under stress — poor control may result. • Do not apply within 60 days of harvest. • Do not cultivate for 14 days following application. • Refer to label and Table 12 for crop rotation restrictions.
Volunteer cereals	sethoxydim *(Poast)* + crop oil concentrate	0.29	1.5 pt 1.5SC + 1 qt	• Apply before tillering (up to 4 inches tall). • See remarks for annual grass control with *Poast*. • *Poast* is NOT recommended for spring control of cereals that emerged the previous fall. • See remarks for annual grass control with *Poast*.
	clethodim *(Select/Arrow)* + crop oil concentrate OR *(Select Max)* + crop oil concentrate	0.125 OR 0.09	8 oz 2EC + 1% OR 12 oz 0.97EC + 1%	• Apply to volunteer cereals between 2-6 inches tall. • See remarks for annual grass control with *Select/Arrow* and *Select Max*.

TABLE 6B – Vine Desiccation in Potatoes

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Potato Vine Desiccation	diquat *(Reglone)* + surfactant	0.25–0.5	1–2 pt 2L + 0.25%	• Make a second application of 1-2 pt/A a minimum of 5 days later if vine growth is dense. • A total of 4 pt/A may be applied, with no more than 2 pt/A at a single application. Allow 5 days between applications. • Apply at 50 psi or less in 20-100 gal. clean water/A. Greater water volumes will provide more thorough coverage of heavy vine growth. • Apply at least 7 days before harvest. • DO NOT apply to drought-stressed potatoes. • No soil persistence. A cover crop can be planted immediately.
	endothall *(DESICATE II)* + ammonium sulfate + LI 700	0.75	3 pt 2L + 5 lb + 1 pt	• DO NOT add LI 700 if temperatures are high and/or the field is moisture stressed. • Increase application rate to 4 pt/A if vine growth is lush and dense, or if weather conditions are cool and cloudy. • Apply at 50 psi or less in 5-40 gal. water/A. • Apply at least 10 days before harvest.
	glufosinate *(Rely)* + ammonium sulfate	0.375	3 pt/A 1L + 17 lb/100 gal	• DO NOT use to desiccate potatoes that are being used for seed. • Apply at a total volume of 20-100 gal. water/A with ground equipment. • Increase spray volume to at least 30 gal. water/A when the potato vine canopy is dense or under cool and dry conditions. • Requires a rainfree period for 4 hours after application. • DO NOT make more than one application per harvest. • Apply at least 9 days before harvest.
	urea sulfuric acid *(Enquik)*	–	20 gal	• **DANGER – CORROSIVE. Protective clothing and eyewear required.** • **Special spray equipment required. SEE LABEL.** • Apply in 20 gal. water/A (total spray volume of 40 gal/A) at 50 psi. • Split applications — 15 gal of *Enquik*/A in 25 gal of water/A for the first application and repeated 2 days later is suggested for dense vine canopies.

TABLE 6C – Weed Response to Herbicides in Potatoes*

			ANNUAL BROADLEAVES										ANNUAL GRASSES								PERENNIALS				
	SITE OF ACTION	CROP TOLERANCE	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PIGWEED	RAGWEED (COMMON)	SMARTWEED	VELVETLEAF	WILD MUSTARD	WILD BUCKWHEAT	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	BINDWEED (FIELD)	BINDWEED (HEDGE)	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE
Preplant Incorporated																									
EPTAM	O	1	P	P	**G**	F	F	F	F	F	F	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	F	F
Preemergence																									
DUAL MAGNUM/PARALLEL/ STALWART	O	2	N	N	P	F	**G**	P	P	N	P	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	F	N	N	N	N	**G**
OUTLOOK[a]	O	2	N	N	P	**G**	**G**	P	P	N	P	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	N	F
SENCOR	C	2	F	F	**E**	N	**E**	**G**	**E**	**G**	**E**	**G**	P	F	**G**	**G**	**G**	F	F	P	N	N	N	N	N
LOROX/LINEX[b]	C	1	P	P	**G**	F	**G**	**G**	**G**	F	**G**	F	F	F	F	F	F	F	F	P	N	N	N	N	N
PROWL	O	1	N	N	**G**	P	F	P	P	F	P	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N	N
Delayed Preemergence																									
LOROX/LINEX[b]	C	1	P	P	**G**	F	**E**	**G**	**G**	F	**G**	F	F	F	F	F	F	F	F	P	N	N	N	N	N
SENCOR	C	2	**G**	F	**E**	N	**E**	**E**	**E**	**G**	**E**	**G**	P	F	**G**	**G**	**G**	F	F	P	N	N	N	N	N
MATRIX[cd]	B	1	**G**	F	F	P	**E**	F	F	F	**E**	F	**G**	F	**G**	**G**	**G**	F	F	–	N	N	P	P	P
MATRIX + SENCOR[cd]	B/C	2	**G**	F	**E**	P	**E**	**E**	**E**	**G**	**E**	**G**	**G**	F	**G**	**G**	**G**	F	F	–	N	N	P	P	P
Postemergence																									
SENCOR	C	2	**G**	F	**E**	N	**G**	**E**	**E**	**G**	**E**	F	P	P	F	F	F	F	F	P	N	N	N	N	N
MATRIX[cd]	B	1	**G**	P	F	F	**E**	F	F	F	**E**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	P	N	N	F	**G**	F
MATRIX + SENCOR[cd]	B/C	2	**G**	F	**E**	F	**E**	**E**	**E**	**G**	**E**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	P	N	N	F	F	F
POAST	A	1	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	N	**G**	N
SELECT/ARROW/SELECT MAX	A	1	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	N	**G**	N

Herbicide Site of Action: A = ACCase inhibitor; B = ALS inhibitor; C = Photosynthesis inhibitor; O = Other.
P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None

Crop Tolerance: 1 = Minimal risk of crop injury; 2 = Crop injury can occur under certain conditions (soil applied — cold, wet; foliar applied — hot, humid); 3 = Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4 = Risk of severe crop injury is high. Recommended only in rescue situations.

* The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.

[a] *Outlook* provides good control of hairy nightshade.

[b] *Lorox/Linex* provides good control of emerged wild buckwheat.

[c] Will suppress triazine-resistant lambsquarters.

[d] **Hairy nightshade** is more susceptible to *Matrix* applications than eastern black nightshade.

TABLE 7A – Chemical Weed Control in Sugar Beets

Sugar Beets – Preplant Incorporated

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	cycloate *(Ro-Neet)*	3	2 qt 6L	• Refer to Table 7B for weed control and crop tolerance ratings. • Incorporate immediately to 2-3 inches. • May be followed preemergence by *Pyramin.* • DO NOT apply *Nortron* preemergence. • Injury may occur when *Betamix* or *Betanex* or *Progress* is applied postemergence before the 6-true-leaf stage. • Use reduced rates of postemergence herbicides in split or micro-rate applications to reduce the risk of injury. • *Ro-Neet* provides good velvetleaf suppression. • Refer to label and Table 12 for crop rotation restrictions.

Sugar Beets – Preemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	pyrazon *(Pyramin)*	4	6.2 lb 67DF	• Refer to Table 7B for weed control and crop tolerance ratings. • DO NOT use *Pyramin* on sands or loamy sands — crop injury may occur. • Reduce the *Pyramin* rate to 4.65 lb/A of DF on a sandy loam soil and/or if soil organic matter is less than 3%. • If soils are high in clay and/or organic matter and velvetleaf is a problem, apply 7.8 lb/A of *Pyramin* DF. • To control annual grasses, preplant incorporate *Ro-Neet* OR apply *Poast, Assure II* or *Select* postemergence. *Nortron* preemergence will suppress grasses. • *Pyramin* plus *Nortron* provides better velvetleaf suppression than either herbicide alone. These herbicides are not as effective as *Ro-Neet* preplant incorporated followed by *Pyramin* preemergence or *UpBeet* postemergence. • To approach 100% weed control, it will in most cases be necessary to follow with a postemergence application. • Refer to label and Table 12 for crop rotation restrictions.
	pyrazon *(Pyramin)* + ethofumesate *(Nortron)*	3 + 1.5	4.7 lb 67DF + 3 pt 4SC	• Refer to Table 7B for weed control and crop tolerance ratings. • See all remarks for *Pyramin.* • *Nortron* will provide some suppression of annual grasses, such as foxtail. • *Pyramin* plus *Nortron* provides better velvetleaf suppression than either herbicide alone. These herbicides are not as effective as *Ro-Neet* preplant incorporated followed by *Pyramin* preemergence or *UpBeet* postemergence. • Increase *Nortron* rate to 4 pt/A of SC on clay soils if weed pressure is heavy. • Rotation restrictions are based on the amount of ethofumesate applied. Restrictions are shorter when less than 0.375 lb a.i. is used. • Refer to label and Table 12 for crop rotation restrictions.

(Continued on next page)

Sugar Beets – Micro-Rate Postemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	desmedipham + phenmedipham *(Betamix)*	0.08	8 oz 1.3L	• Refer to Table 7B for weed control and crop tolerance ratings. • Micro-rate applications may be applied to sugar beets at any growth stage. TIME THE FIRST MICRO-RATE application when weeds are less than 0.125 inch tall. This can be as early as 14 days after sugar beet planting. • Make the second micro-rate application when emerging weeds are less than 0.125 inch tall. This will be 5-14 days later, depending on temperature and moisture. • Continue TIMELY micro-rate applications (usually every 7 days) as needed until beet canopy closure. • Reduce the number of micro-rate applications and minimize sugar beet injury by timing micro-rate applications using growing degree-days. See the next section on *TIMING MICRO-RATE APPLICATIONS USING GROWING DEGREE-DAYS (GDD).* • The *Betamix* rate may be increased up to 12 oz/A or the *Betamix Ultra* rate can be increased to 6 oz/A when sugarbeets are in the cotyledon to 4-leaf growth stage. The *Betamix* rate can be increased up to 16 oz/A or the *Betamix Ultra* rate can be increased to 8 oz/A if the smallest sugar beet plants in the field are in the 4-true-leaf stage. Use caution when using higher rates on sugarbeets in the early 2-leaf stage or injury may occur. • IF WEEDS EXCEED 0.25 inch, return to standard herbicide application rates. • *Select/Arrow* at 2 oz/A, *Select Max* at 3 oz/A, *Assure II/Targa* at 4 oz/A, or *Poast* at 5.3 oz/A can be *added to each* micro-rate application OR wait until grasses reach 2–3 inches tall and add one of these herbicides *at standard rates to one* of the micro-rate applications. • Apply micro-rates in 10–12 gal. water/A. The methylated seed oil concentration must be a minimum of 1 pt/A in spray volumes of 4–8 gal. water/A. • Micro-rates can be applied at any time of day. • DO NOT tank mix micro-rates with BOTH fungicides and insecticides. • DO NOT tank mix micro-rates with *Quadris* or *Amistar*. • Refer to label and Table 12 for crop rotation restrictions.
	OR		OR	
	(Betamix Ultra)		4 oz 2.6L	
	+	+	+	
	triflusulfuron methyl *(UpBeet)*	0.0039	0.125 oz 50DG	
	+	+	+	
	clopyralid *(Stinger)*	0.0235	1 oz 3L	
	+		+	
	methylated seed oil		1.5%	
		AND REPEAT		

(Continued on next page)

Sugar Beets – Micro-Rate Postemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	desmedipham + phenmedipham ethofumesame *(Progress)*	0.08	5.7 oz 1.8L	• Refer to Table 7B for weed control and crop tolerance ratings. • SEE ALL REMARKS IN THE *BETAMIX* MICRO-RATE SECTION. • Reduce the number of micro-rate applications and minimize sugar beet injury by timing micro-rate applications using growing degree-days. See the next section on *TIMING MICRO-RATE APPLICATIONS USING GROWING DEGREE-DAYS (GDD).* • Redroot pigweed will not be controlled by *Progress* or *Progress Ultra* micro-rate applications if pigweed exceeds 0.25 inch at the time of application. *Betamix* or *Betamix Ultra* micro-rate applications will provide more consistent pigweed control. • The *Progress* rate may be increased up to 8.7 oz/A or the *Progress Ultra* rate can be increased to 4.35 oz/A when sugarbeets are in the cotyledon to 4-leaf growth stage. The *Progress* rate can be increased up to 11.6 oz/A or the *Progress Ultra* rate can be increased to 5.8 oz/A if the smallest sugar beet plants in the field are in the 4-true-leaf stage. Use caution when using higher rates on sugarbeets in the early 2-leaf stage or injury may occur. • DO NOT tank mix micro-rates with *Quadris* or *Amistar*. • Refer to label and Table 12 for crop rotation restrictions.
	OR		OR	
	(Progress Ultra)		2.85 oz 3.6L	
	+	+	+	
	triflusulfuron methyl *(UpBeet)*	0.0039	0.125 oz 50DG	
	+	+	+	
	clopyralid *(Stinger)*	0.0235	1 oz 3L	
	+		+	
	methylated seed oil		1.5%	
		AND REPEAT		

Sugar beets - Timing Micro-Rate Applications Using Growing Degree Days (GDD)

$$\text{GDD Formula} = \frac{(\text{High Temp.} + \text{Low Temp.})}{2} - 34°\text{F}$$

EXAMPLE CALCULATION:

Day 1 = (75 + 55) / 2 - 34°F = 31 GDD
Day 2 = (80 + 60) / 2 - 34°F = 36 GDD
Two-day accumulation 67 GDD

- Timing micro-rate applications on GDD may reduce the number of herbicide applications during periods of cool weather.

GENERAL GUIDELINES:

- After the first micro-rate application, apply a micro-rate when 225 GDD have accumulated for average weed pressures on most soils. REPEAT.
- If soils are sandy, have high weed pressure, or are high in organic matter, adjust application timings to 175 GDD, particularly when pigweed is the target weed.
- Early in the season, when lambsquarters is the predominant species, micro-rate timings may be extended to 275 GDD. However, when pigweeds start to emerge, switch to 175 or 225 GDD.
- Delayed applications will result in reduced weed control.

Sugar Beets – Early Postemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	desmedipham + phenmedipham *(Betamix)* OR *(Betamix Ultra)* + triflusulfuron methyl *(UpBeet)* FOLLOWED BY: desmedipham + phenmedipham *(Betamix)* OR *(Betamix Ultra)* + triflusulfuron methyl *(UpBeet)*	0.5 + 0.0156 0.5 + 0.0156	3 pt 1.3L OR 1.5 pt 2.6L + 0.5 oz 50DG 3 pt 1.3L OR 1.5 pt 2.6L + 0.5 oz 50DG	• Refer to Table 7B for weed control and crop tolerance ratings. • Split low-rate applications of *Betamix* or *Betamix Ultra* + *UpBeet* may be applied to sugar beets at early growth stages (less than the 4-true-leaf stage) to control weed seedlings at the cotyledon stage. Weeds not completely controlled by the first treatment will be checked and controlled by the second application. • The second application MUST BE MADE AT LEAST 7 days but not more than 10 days AFTER the first application. • The rate of *Betamix* in the second application can be increased to 4.6 pt/A or the *Betamix Ultra* rate can be increased to 2.3 pt/A. • Add surfactant at 0.25% v/v (2 pt in 100 gal. water) to ONLY THE SECOND APPLICATION. • DISPERSE *UpBeet* thoroughly in the tank before adding other herbicides. • Apply in 10 gal. water/A at 20-40 psi. • The maximum amount of *UpBeet* that can be applied in one year is 2.5 oz/A. • Rainfall within 6 hours of application may reduce control. • Adding *UpBeet* to *Betamix* or *Betamix Ultra* results in velvetleaf control and more consistent lambsquarters, pigweed, smartweed and buckwheat control. • Refer to label and Table 12 for crop rotation restrictions.
	desmedipham phenmedipham *(Betamix)* OR *(Betamix Ultra)* + triflusulfuron methyl *(UpBeet)* FOLLOWED BY: desmedipham + phenmedipham *(Betamix)* OR *(Betamix Ultra)* + triflusulfuron methyl *(UpBeet)* + clopyralid *(Stinger)*	0.5 + 0.0156 0.5 + 0.0156 + 0.094	3 pt 1.3L OR 1.5 pt 2.6L + 0.5 oz 50DG 3 pt 1.3L OR 1.5 pt 2.6L + 0.5 oz 50DG + 0.25 pt 3L	• Refer to Table 7B for weed control and crop tolerance ratings. • Split low rates of *Betamix* or *Betamix Ultra* + *UpBeet* followed by *Betamix* or *Betamix Ultra* + *UpBeet* + *Stinger* may be applied to sugar beets at early growth stages (less than the 4- true-leaf stage) to control weed seedlings at the cotyledon stage. Weeds not completely controlled by the first treatment will be checked and controlled by the second application. • The second application MUST BE MADE AT LEAST *7* days but not more than 10 days AFTER the first application. • The rate of *Betamix* in the second application can be increased to 4.6 pt/A or *Betamix Ultra* rate can be increased to 2.3 pt/A. • Adding *Stinger* to the second application will control cocklebur and common and giant ragweed and improve lambsquarters control. • Add surfactant at 0.25% v/v (2 pt in 100 gal. water) to ONLY THE SECOND APPLICATION. • DISPERSE *UpBeet* thoroughly in the tank before adding other herbicides. • Apply in 10 gal. water/A at 20-40 psi. • DO NOT apply *Stinger* on sandy soils where water tables are shallow. • The maximum amount of *UpBeet* that can be applied in one year is 2.5 oz/A. • Rainfall within 6 hours of application may reduce control. • DO NOT plant dry beans for 18 months if organic matter is less than 2%. • Refer to label and Table 12 for crop rotation restrictions.

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Sugar Beets – Early Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	desmedipham + phenmedipham + ethofumesate *(Progress)* OR *(Progress Ultra)* + triflusulfuron methyl *(UpBeet)* FOLLOWED BY: desmedipham + phenmedipham + ethofumesate *(Progress)* OR *(Progress Ultra)* + triflusulfuron methyl *(UpBeet)*	0.25 + 0.0156 0.33 + 0.0156	1.13 pt 1.8L OR 9 oz 3.6L + 0.5 oz 50DG 1.5 pt 1.8L OR 12 oz 3.6L + 0.5 oz 50DG	• Refer to Table 7B for weed control and crop tolerance ratings. • DISPERSE *UpBeet* thoroughly in the tank before adding other herbicides. • DO NOT add crop oil concentrate or surfactant. • Split (low-rate) applications of *Progress* or *Progress Ultra* plus *UpBeet* may be applied to sugar beets at early growth stages (cotyledon to 4-true-leaf stage) to control weed seedlings at the cotyledon stage. • The second application MUST BE MADE AT LEAST 7 days but not more than 10 days AFTER the first application. • The rate of *Progress* in the second application can be increased to 2 pt/A (*Progress Ultra* at 1 pt/A) if sugar beets are at 2-leaf pairs or larger. • Adding *UpBeet* to *Progress* or *Progress Ultra* results in velvetleaf control and provides more consistent control of pigweed, mustard, smartweed and wild buckwheat. • *Stinger* can be added to the second application for control of cocklebur and common and giant ragweed. • Apply in a minimum of 10 gal. water/A at 20-40 psi. • The maximum amount of *UpBeet* that can be applied in 1 year is 2.5 oz/A. • Allow at least 60 days between *UpBeet* application and sugar beet harvest. • Rainfall within 6 hours of application may reduce control. • Refer to label and Table 12 for crop rotation restrictions.

Sugar Beets – Postemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses, Yellow nutsedge, Pigweed, E.B. nightshade	s-metolachlor *(Dual Magnum)*	1.27	1.33 pt 7.62 EC	• Refer to Table 7B for weed control and crop tolerance ratings. • *Dual Magnum* should be applied to sugar beets after they have **2 true leaves**. • Sugarbeets MUST HAVE 2-fully expanded true leaves before application; applications prior to this stage will result in significant crop injury and possible stand reduction. • Crop safety is greater when *Dual Magnum* applications are made after beets reach the 4-leaf stage. • *Dual Magnum* may be tank-mixed with micro-rate or standard-split herbicide applications. • *Dual Magnum* will not control emerged weeds, but will provide residual control of annual grasses and some broadleaf weeds. • MSU **does not** recommend preplant incorporated or premergence applications of *Dual Magnum* — severe stand reductions can occur. • More than one postemergence application can be made, but the total should not exceed 2.6 pt/A. • Refer to label and Table 12 for crop rotation restrictions.
	dimethenamid-P *(Outlook)*	0.75	16 oz 6L	• Refer to Table 7B for weed control and crop tolerance ratings. • Sugarbeets MUST HAVE 2-fully expanded true leaves before application; applications prior to this stage will result in significant crop injury and possible stand reduction. • Crop safety is greater when *Outlook* applications are made after beets reach the 4-leaf stage. • Apply *Outlook* before sugarbeets exceed the 8-leaf stage. • *Outlook* may be tank-mixed with micro-rate or standard-split herbicide applications. • *Outlook* will not control emerged weeds, but will provide residual control of annual grasses and some broadleaf weeds. • More than one application of *Outlook* can be made; maintain a minimum of 14 days between applications, and the total should not exceed 21 oz/A. • Refer to label and Table 12 for crop rotation restrictions.

Sugar Beets – Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Velvetleaf	triflusulfuron methyl *(UpBeet)* + surfactant	0.0156	0.5 oz 50DG + 0.25% AND REPEAT	• SEE TABLE 7C, "Guidelines for Velvetleaf Control with UpBeet." • *UpBeet* provides better velvetleaf control than *Pyramin* postemergence. • DISPERSE *UpBeet* thoroughly in the tank before adding surfactant. • A MINIMUM OF TWO APPLICATIONS ARE NEEDED FOR VELVETLEAF CONTROL. • Apply to velvetleaf at the 1-true-leaf stage. REPEAT application 7-10 days later. • Add 2 qt/A 28% liquid nitrogen in addition to surfactant if velvetleaf plants have 1 to 2 true leaves and beets are at 2-leaf-pair stage. • A third application of 0.5 oz/A of *UpBeet* + surfactant can be made. • The maximum amount of *UpBeet* that can be applied in 1 year is 2.5 oz/A. • *UpBeet* can be tank mixed with *Betamix, Betamix Ultra, Progress* or *Progress Ultra*. Never add surfactant with *Progress* or *Progress Ultra* unless you are applying micro-rates. Add surfactant with *UpBeet* + *Betamix* or *Betamix Ultra* if beets are at the 2-leaf-pair stage or larger for improved velvetleaf control. • Apply *UpBeet* in a minimum of 10 gal. water/A at 20-40 psi. • Rainfall within 6 hours of application may reduce control. • Allow at least 60 days between *UpBeet* application and sugar beet harvest. • Refer to label and Table 12 for crop rotation restrictions.
	pyrazon *(Pyramin)* + methylated seed oil	1	1.55 lb 67DF + 24 oz AND REPEAT	• TWO APPLICATIONS ARE NEEDED FOR BEST VELVETLEAF CONTROL. MAKE SECOND APPLICATION 5-7 DAYS FOLLOWING INITIAL TREATMENT. • Make first application when velvetleaf has cotyledonary leaves and one true leaf. • Application to velvetleaf at 2-true-leaf stage will NOT provide consistent control. • DO NOT TANK MIX with *Betamix, Betamix Ultra, Progress* or *Progress Ultra* — crop injury may occur. • *UpBeet* will provide better control than *Pyramin DF*. • Refer to label and Table 12 for crop rotation restrictions.

Sugar Beets – Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Cocklebur, Giant ragweed, Common ragweed, Jimsonweed, Volunteer sweet clover, Volunteer alfalfa	clopyralid *(Stinger)* + crop oil concentrate	0.094	0.25 pt 3L + 1 qt	• DO NOT use on sands, loamy sands, or permeable soils where water tables are shallow because of potential groundwater contamination. • Increase rate to 0.5 pt under drought conditions or dense weed infestations. • Controls cocklebur, giant ragweed, volunteer alfalfa, and sweet clover up to 6-leaf-stage, common ragweed, up to 5-leaf-stage. • 0.25 pt/A will suppress smartweed, wild buckwheat and nightshade if less than 3 leaf. • DO NOT cultivate for 7 days following application. • Tank mix with other postemergence herbicides such as *Betamix, Betamix Ultra, Progress* or *Progress Ultra* to control other broadleaf weeds. • Allow 105 days between application and sugar beet harvest. • DO NOT plant dry beans for 18 months if organic matter is less than 2%. • Refer to label and Table 12 for crop rotation restrictions.
Perennial sowthistle	clopyralid *(Stinger)* + crop oil concentrate OR ammonium sulfate	0.188	0.5 pt 3L + 1 qt OR 2.5 lb	• DO NOT use on sands or loamy sands or permeable soils where water tables are shallow because of potential groundwater contamination. • Increase rate to 0.67 pt under drought conditions. • Apply after sugar beets have reached the third leaf pair AND before thistles have reached the flowering stage. • DO NOT cultivate before OR for a minimum of 14 days after application. • DO NOT tank mix with other herbicides when applying for perennial sowthistle control. • Banded applications are NOT recommended. Instead, make a broadcast application over the thistle-infested area. • Allow 105 days between application and sugar beet harvest. • DO NOT plant dry beans for 18 months if soil organic matter is less than 2%. • Refer to label and Table 12 for crop rotation restrictions.
Canada thistle	clopyralid *(Stinger)* + crop oil concentrate OR ammonium sulfate	0.125	0.33 pt 3L + 1 qt OR 2.5 lb	• DO NOT use on sands or loamy sands or permeable soils where water tables are shallow because of potential groundwater contamination. • Increase rate to 0.5 pt under drought conditions. • Apply after sugar beets have reached the third leaf pair AND before thistles have reached the flowering stage. • DO NOT cultivate before OR for a minimum of 14 days after application. • Add COC when tank mixing 0.33 pt of *Stinger* with *Betamix* or *Betamix Ultra*. COC is not necessary when 0.5 pt/A of *Stinger* is applied. • Banded applications are NOT recommended. Instead make a broadcast application over the thistle-infested area. • Allow 105 days between application and sugar beet harvest. • DO NOT plant dry beans for 18 months if soil organic matter is less than 2%. • Refer to label and Table 12 for crop rotation restrictions.

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	sethoxydim *(Poast)* + crop oil concentrate OR methylated seed oil	0.19	1 pt 1.5SC + 1 qt OR 24 oz	• Refer to Table 7B for weed control and crop tolerance ratings. • Treat actively growing foxtails, fall panicum and barnyardgrass up to 8 inches and crabgrass up to 4 inches. • *Poast* can be reduced to 0.75 pt/A for 1-4 inch barnyardgrass, green and giant foxtails, and fall panicum. • Ammonium sulfate or 28% liquid nitrogen (urea ammonium nitrate) can be added at 2.5 lb/A to enhance crabgrass control. • DO NOT apply *Betamix, Betamix Ultra, Progress, Progress Ultra* or *Upbeet* within 5 days prior to applying *Poast* — reduced grass control may occur. • No soil activity from *Poast.* Controls only grasses present when sprayed. • Use a minimum of 5 gal. of water/A at 40 psi. • Rainfall within 1 hour of application will reduce control. • DO NOT apply *Poast* within 60 days of beet harvest. • Refer to label and Table 12 for crop rotation restrictions.
	clethodim *(Select/Arrow)* + crop oil concentrate OR *(Select Max)* + crop oil concentrate	0.094 0.068	6 oz 2EC + 1% 9 oz 0.97EC + 1%	• Refer to Table 7B for weed control and crop tolerance ratings. • Treat actively growing foxtails, fall panicum, and barnyardgrass up to 8 inches and crabgrass up to 4 inches tall. • *Select/Arrow* can be reduced to 4-5 oz/A and *Select Max* can be reduced to 6 oz/A for 1- to 4-inch grasses of some species. • DO NOT apply *Betamix, Betamix Ultra, Progress, Progress Ultra* or *UpBeet* within 5 days prior to applying *Select/Arrow* or *Select Max* — reduced grass control may occur. • *Select Max* offers greater adjuvant flexibility than *Select/Arrow.* Tank mixtures with *Betamix, Betamix Ultra, Progress* or *Progress Ultra* do not require an additional adjuvant. A non-ionic surfactant (0.25% v/v) should be added when *Select Max* is tank-mixed with *UpBeet* or *Stinger*. • Apply in 5-40 gal of water/A at 30-60 psi. • Rainfall within 1 hour of application will reduce control. • DO NOT apply *Select/Arrow* or *Select Max* within 40 days of beet harvest. • Refer to label and Table 12 for crop rotation restrictions.
	quizalofop-P-methyl *(Assure II/Targa)* + crop oil concentrate OR surfactant	0.044	7 oz 0.88L + 1% OR 0.25%	• Refer to Table 7B for weed control and crop tolerance ratings. • Treat actively growing grasses up to 4 inches tall. • 8 oz/A required for barnyardgrass and crabgrass control. • DO NOT apply *Betamix, Betamix Ultra, Progress, Progress Ultra* or *UpBeet* within 5 days prior to applying *Assure II/Targa* — reduced grass control may occur. • DO NOT cultivate for 7 days before or 7 days after treatment. • No soil activity from *Assure II/Targa.* Controls only grasses present when sprayed. • Apply in 10-20 gal. water/A with standard flat fan or hollow cone nozzles. • Rainfall within 1 hour of application will reduce control. • DO NOT apply *Assure II/Targa* within 45 days of beet harvest. • Refer to label and Table 12 for crop rotation restrictions.

Sugar Beets – Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses, Annual broadleaves	sethoxydim *(Poast)* + desmedipham + phenmedipham *(Betamix)* OR *(Betamix Ultra)*	0.29 + 0.5-1	1.5 pt 1.5SC + 3-6 pt 1.3L 1.5 – 3 pt 2.6L	• Treat actively growing barnyardgrass or foxtails up to 2 inches tall. • DO NOT ADD CROP OIL CONCENTRATE OR OTHER ADDITIVES. • Adjust *Betamix* and *Betamix Ultra* rates to size of broadleaf weeds. • No soil activity. Controls only grasses present when sprayed.
Volunteer corn	quizalofop-P-ethyl *(Assure II/Targa)* + crop oil concentrate OR surfactant	0.031	5 oz 0.88L + 1% OR 0.25%	• For volunteer corn up to 18 inches tall. • Rainfall within 1 hour of application will reduce control. • *Assure II/Targa* is more effective than *Poast.*
	sethoxydim *(Poast)* + crop oil concentrate OR methylated seed oil + ammonium sulfate	0.19	1 pt 1.5SC + 1 qt OR 24 oz + 2.5 lb	• For volunteer corn up to 20 inches tall. • If the volunteer corn is less than 12 inches, the application rate may be reduced. • Rainfall within 1 hour of application will reduce control.
	clethodim *(Select/Arrow)* + crop oil concentrate OR *(Select Max)* + crop oil concentrate	0.096 0.068	6 oz 2EC + 1% OR 9 oz 0.97EC + 1%	• For volunteer corn up to 18 inches tall. • Use 4 oz/A of Select/Arrow or 6oz/A of *Select Max* if volunteer corn is 4–12 inches tall. • Rainfall within 1 hour of application will reduce control. • *Select/Arrow* and *Select Max* are more effective than *Poast.*
Small grains	quizalofop-P-ethyl *(Assure II/Targa)* + crop oil concentrate OR surfactant	0.0625	10 oz 0.88L + 1% OR 0.25%	• Apply at 8 oz/A if cereals are less than 4 inches tall. • Spring-seeded cereals only. Control is less effective on fall-seeded cereals. Keep application rate at 10 oz/A. • *Assure II/Targa* is more effective than *Poast.*
	sethoxydim *(Poast)* + crop oil concentrate OR methylated seed oil + ammonium sulfate	0.29	1.5 pt 1.5SC + 1 qt OR 24 oz + 2.5 lb	• Apply before tillering (up to 4 inches tall). • Spring-seeded cereals only.
	clethodim *(Select/Arrow)* + crop oil concentrate + ammonium sulfate OR *(Select Max)* + crop oil concentrate + ammonium sulfate	0.125–0.25 0.09-0.18	8–16 oz 2EC + 1% + 2.5 lb OR 12–24 oz 0.97EC + 1% + 2.5 lb/A	• Oats can be controlled with 8 oz/A of *Select/Arrow* or 12 oz/A of *Select Max.* • Spring-seeded cereals are labeled for control at 8 oz/A of *Select/Arrow*. However, 16 oz/A of *Select/Arrow* or 24 oz/A of *Select Max* will provide better control. Apply 16 oz/A of *Select/Arrow* or 24 oz/A of *Select Max* on fall-seeded cereals. Control is less effective on fall-seeded cereals. • Apply before cereals exceed 6 inches tall. • *Select/Arrow* and *Select Max* are more effective than *Poast.*

Sugar Beets – Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Quackgrass	quizalofop-P-ethyl *(Assure II/Targa)* + crop oil concentrate OR surfactant	0.0625	10 oz 0.88L + 1% OR 0.25%	• Make application when quackgrass is 6-8 inches tall. • Two applications may be needed for best quackgrass control. Make a second application of 7 oz/A 14-21 days later when quackgrass has reached 4-8 inches tall. Cultivation may replace second application. • DO NOT TANK MIX. Reduced quackgrass control and/or crop injury may occur. • Use 10-20 gal water/A using standard flat fan or hollow cone nozzles. • Avoid drift onto corn, small grains, or turf. • DO NOT apply *Assure II/Targa* within 45 days of beet harvest.
	sethoxydim *(Poast)* + crop oil concentrate OR methylated seed oil + ammonium sulfate	0.29 + 0.19	1.5 + 1 pt 1.5SC + 1 + 1 qt OR 24 + 24 oz + 2.5 + 2.5 lb	• Two applications are needed for best quackgrass control. Make second application 14-21 days following initial treatment. Cultivation may replace second application. • DO NOT TANK MIX. Crop injury or reduced quackgrass control may occur, especially with nitrogen additives. • Addition of ammonium sulfate or liquid nitrogen is required. • Treat actively growing quackgrass 6-8 inches tall. • Use a minimum of 5 gal water/A at 40 psi. • Avoid drift onto corn, small grains, or turf. • Rainfall within 1 hr of application will reduce control. • DO NOT apply *Poast* within 60 days of beet harvest.
	clethodim *(Select/Arrow)* + crop oil concentrate + ammonium sulfate OR *(Select Max)* + crop oil concentrate + ammonium sulfate	0.125-0.25+ 0.125 0.09 + 0.09	8-16 + 8 oz 2EC + 1 + 1% + 2.5 + 2.5 lb 12 + 12 oz 0.97EC + 1 + 1% + 2.5 + 2.5 lb	• Make application when quackgrass is 4-12 inches tall. Use high rate when grasses are stressed or at maximum height. • Two applications may be needed for control. Make a second application 14-21 days later. • Cultivation may replace the second application. • DO NOT TANK MIX. Crop injury or reduced quackgrass control may occur. • Use 5-40 gal water/A at 30-60 psi. • Avoid drift onto corn, small grains or turf. • DO NOT apply *Select/Arrow* or *Select Max* within 40 days of beet harvest.

TABLE 7B – Weed Response to Herbicides in Sugar Beets*

			ANNUAL BROADLEAVES										ANNUAL GRASSES							PERENNIALS					
	SITE OF ACTION	CROP RESPONSE	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (BLACK)	PIGWEED	RAGWEED (COMMON)	SMARTWEED	VELVETLEAF	WILD MUSTARD	WILD BUCKWHEAT	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	BINDWEED (FIELD)	BINDWEED (HEDGE)	CANADA THISTLE	PERENNIAL SOWTHISTLE	QUACKGRASS	YELLOW NUTSEDGE
Preplant Incorporated																									
RO-NEET	O	2	P	P	F	F	**G**	F	P	**G**	P	F	**G**	**G**	**G**	**G**	**G**	**G**	**G**	N	N	N	N	F	**G**
Preemergence																									
NORTRON	O	2	F	F	**G**	**G**	**G**	P	**G**	F	**G**	**G**	P	F	**G**	F	F	P	P	N	N	N	N	N	P
PYRAMIN	O	2	P	P	**E**	**G**	**G**	**G**	**G**	F	**G**	**G**	P	P	P	P	P	P	P	N	N	N	N	N	N
Postemergence																									
BETAMIX/BETAMIX ULTRA	O	2	F	F	**E**	F	**G**	**G**	F	P	**G**	F	P	P	F	F	F	P	P	N	N	N	N	N	N
BETANEX	O	2	F	F	**G**	F	**E**	F	F	P	**G**	P	P	P	P	P	P	P	P	N	N	N	N	N	N
DUAL MAGNUM	O	2	N	N	P	F	**G**	P	P	N	P	N	**E**	**E**	**E**	**E**	**E**	**G**	**G**	N	N	N	N	N	P
OUTLOOK	O	2	N	N	P	**G**	**G**	P	P	N	P	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	N	N	N	N	N	P
NORTRON	O	2	P	P	F	**G**	F	P	**G**	P	**G**	**G**	P	P	F	F	F	P	P	N	N	N	N	N	P
UPBEET	B	2	F	–	P	F	F	F	F	**G**	**E**	F	P	P	F	F	F	P	P	N	N	P	N	N	P
PROGRESS/PROGRESS ULTRA	O/O	2	F	F	**E**	**G**	**G**	**G**	**G**	P	**G**	**G**	P	P	F	F	F	P	P	N	N	N	N	N	P
BETAMIX + UPBEET	O/B	2	F	F	**E**	F	**E**	**G**	**G**	**G**	**E**	**G**	P	P	**G**	F	F	P	P	N	N	P	P	N	P
BETAMIX + STINGER	O/O	2	**E**	**G**	**E**	F	**G**	**E**	**G**	P	**G**	**G**	P	P	F	F	F	P	P	N	N	F	F	N	N
BETAMIX + UPBEET + STINGER	O/B/O	2	**E**	**G**	**E**	**E**	**E**	**E**	**G**	**G**	**E**	**G**	P	P	**G**	F	F	P	P	N	N	F	F	N	P
PROGRESS + UPBEET	O/B	3	F	F	**E**	**G**	**E**	**G**	**G**	**G**	**E**	**G**	P	P	**G**	F	F	P	P	N	N	P	P	N	P
PROGRESS + STINGER	O/O/O	3	**E**	**G**	**E**	**G**	**E**	**E**	**G**	P	**G**	**G**	P	P	F	F	F	P	P	N	N	F	F	N	P
PROGRESS + UPBEET + STINGER	O/B/O	3	**E**	**G**	**E**	**E**	**E**	**E**	**G**	**G**	**E**	**E**	P	P	**G**	F	F	P	P	N	N	F	F	N	P
POAST	A	1	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	N	N	N	N	F	N
SELECT/ARROW/SELECT MAX	A	1	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	N	N	N	N	**G**	N
ASSURE II/TARGA	A	1	N	N	N	N	N	N	N	N	N	N	**G**	**G**	**E**	**E**	**G**	**E**	**E**	N	N	N	N	**E**	N
PYRAMIN	O	1	P	P	F	P	F	F	F	F	F	F	P	P	P	P	P	P	P	N	N	N	N	N	N
STINGER	O	1	**E**	**G**	P	F	P	**E**	F	P	P	F	N	N	N	N	N	N	N	P	P	**G**	**G**	N	N

Herbicide Site of Action: A = ACCase inhibitor; B = ALS inhibitor; C = Photosynthesis inhibitor; O = Other.
P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None

Crop Tolerance: 1 = Minimal risk of crop injury; 2 = Crop injury can occur under certain conditions (soil applied — cold, wet; foliar applied — hot, humid); 3 = Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4 = Risk of severe crop injury is high. Recommended only in rescue situations.

*The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.

TABLE 7C – Guidelines for Velvetleaf Control with UpBeet

Beet Size	Velvetleaf Size	Other Weeds?	UpBeet Application*
cotyledon	coty — 1st true leaf	No	UpBeet + NIS
> cotyledon	coty — 2nd true leaf	No	UpBeet + 28% N + NIS
coty — 1st leaf pair	coty — 1st true leaf	Yes	UpBeet + Betamix
coty — 1st leaf pair	coty — 1st true leaf	Yes	UpBeet + Progress[a]
≥ 2nd leaf pair	coty — 1st true leaf	Yes	UpBeet + Betamix + NIS
≥ 2nd leaf pair	coty — 1st true leaf	Yes	UpBeet + Progress[a]

*UpBeet at 0.5 oz/A. NIS—nonionic surfactant.
[a]DO NOT use if RoNeet was applied.

TABLE 8 –Chemical Weed Control in Forage Sorghum

Forage Sorghum, Sorghum/Sudangrass Hybrids – Preemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves **Annual grasses** (EXCEPT fall panicum, green foxtail, giant foxtail, witchgrass, and crabgrass)	atrazine (commercial product)	2	2 qt 4L OR 2.2 lb 90DG	• Do not use on sands, loamy sands, sandy clay loams or any soil with less than 1% organic matter. • Heavy rains following application may cause injury. • May be applied preplant incorporated. • Do not apply to sudangrass. • See label for details.

Forage Sorghum — Preemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves **Annual grasses**	atrazine (commercial product) + s-metolachlor (*Dual II Magnum*, *Cinch)*	1 + 1.27	1 qt 4L OR 1.1 lb 90DG + 1.33 pt 7.6L	• CAUTION: Seed must be treated with *(Concep II* or *Screen)* herbicide antidote. • See label for additional restrictions. • Commercial prepackaged mix *(Bicep II Magnum)* is available. See Table 1H. • May be applied preplant incorporated. • Do not apply to sudangrass or sorghum-sudangrass hybrids.
	atrazine (commercial product) + metolachlor (+ safener) (*Parallel*)	1.2 + 0.98	1.2 qt 4L OR 1.3 lb 90DG + 1 pt 7.8L	• This is a low rate of the active ingredient when compared to the rate of *Dual II Magnum* and *Cinch*. Level of weed control may be affected. • CAUTION: Seed must be treated with (*Concep II* or *Screen*) herbicide antidote. • See label for additional restrictions. • May be applied pre-plant incorporated. • Do not apply to sudangrass or sorghum-sudangrass. • Do not apply on medium soils with less than 1.5% organic matter.
	atrazine (commercial product) + metolachlor (Stalwart)	1 + 1.33	1 qt 4L OR 1.1 lb 90DG + 1.33 pt 8.0L	• This is a low rate of the active ingredient when compared to the rate of *Dual II Magnum* and *Cinch*. Level of weed control may be affected. • CAUTION: seed must be treated with (*Concep II* or *Screen*) herbicide antidote. • See label for additional restrictions. • May be applied pre-plant incorporated. • Do not apply to sudangrass or sorghum-sudangrass.

Forage Sorghum, Sorghum/Sudangrass Hybrids — Postemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	atrazine (commercial product) + crop oil concentrate	1.2	1.2 qt 4L OR 1.3 lb 90DG + 1 qt	• Apply after sorghum has reached the 3-leaf stage but before it exceeds 12 inches in height. • Apply before common lambsquarters and redroot pigweed reach 6 inches and other broadleaf weeds 4 inches • Heavy rainfall following application may cause injury. • Do not apply on sands or loamy sands. • Do not graze or cut for feed for 21 days following application. • Do not apply to sudangrass.
	2,4-D amine	0.5	1 pt 4L	• Apply when sorghum is 6-8 inches tall. • If sorghum is planted in rows, drop nozzles can be used when the crop is 8-15 inches tall. • Do not graze or harvest for forage for 14 days after treatment. • See remarks and limitations for 2,4-D under "Corn – Postemergence." • Do not apply to sudangrass or sorghum-sudangrass hybrids. • Consult the 2,4-D label for clearance on forage sorghum.
	bromoxynil *(Buctril, Moxy,* others*)*	0.375	1.5 pt 2L	• Apply to weeds less than 4 inches tall for effective control. • Do not mix with spray additives or liquid fertilizers. • Some leaf burn may occur, especially under cool and cloudy or hot and humid conditions. • Do not cut for feed or graze for 45 days after application. • Do not apply to sudangrass or sorghum-sudangrass hybrids.
	bentazon *(Basagran)* + atrazine (commercial product) + crop oil concentrate	0.75 + 0.75	0.75 qt 4L + 0.75 qt 4L OR 0.8 lb 90DG + 1 qt	• Do not apply to sorghum that is headed out. • Do not graze treated area or feed treated forage to livestock for 21 days following application. • Do not make more than one application per season. • Urea ammonium nitrate (28% liquid nitrogen) may be used at 1 gal/A instead of crop oil concentrate. Do not use urea ammonium nitrate if common lambsquarters is present. • Do not apply to sudangrass or sorghum-sudangrass hybrids.

TABLE 9 – Weed Response to Herbicides in Forage Sorghum*

			ANNUAL BROADLEAVES											ANNUAL GRASSES								PERENNIALS				
Soil Applied	SITE OF ACTION	CORN TOLERANCE**	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	T-R LAMBSQUARTERS[a]	NIGHTSHADE (E. BLACK)	PIGWEED (REDROOT)	RAGWEED (COMMON)	RAGWEED (GIANT)	SMARTWEED	VELVETLEAF	WILD MUSTARD	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE	JOHNSONGRASS (seedling)	JOHNSONGRASS (rhizome)
Photosynthesis Inhibitors																										
ATRAZINE	**C**	1	F	F	**E**	N	**E**	**G**	**E**	**G**	**G**	F	**E**	**G**	P	F	F	**G**	P	P	P	F	F	F	N	N
Others																										
DUAL II MAGNUM/CINCH/ PARALLEL[c]/ STALWART[c]	O	1	N	N	P	P	F	**G**	P	N	P	N	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	F[b]	P	N
Postemergence																										
Photosynthesis Inhibitors																										
ATRAZINE	C	1	**G**	**G**	**E**	N	**G**	**E**	**E**	**G**	**G**	F	**E**	F	P	F	**G**	**G**	P	P	P	F	F	F	N	N
Others																										
2,4-D AMINE	O	3	**G**	F	**G**	**G**	**G**	**G**	**G**	**G**	P	F	**G**	N	N	N	N	N	N	N	N	F	N	N	N	N
BASAGRAN	O	1	**E**	**G**	F	F	P	P	F	P	**G**	F	**E**	N	N	N	N	N	N	N	N	**G**	N	**G**	N	N
BUCTRIL/MOXY/OTHERS	O	2	**G**	**G**	**E**	**E**	**G**	F	**G**	**G**	**G**	**G**	F	N	N	N	N	N	N	N	N	P	N	N	N	N

Herbicide Site of Action: C = Photosynthesis inhibitor; O = Other

Herbicide Effectiveness: P = Poor; F = Fair; G = Good; E = Excellent; N = None; - = Not enough information to rank

* The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.

**Crop Tolerance: 1=Minimal risk of crop injury; 2=Crop injury can occur under certain conditions (soil applied – cold, wet: foliar applied – hot, humid); 3=severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4=Risk of severe crop injury is high. Recommended only in rescue situations.

[a]Triazine-resistant lambsquarters

[b]Control of yellow nutsedge will be increased if the treatment is incorporated in the top 2-3 inches of soil.

[c]The recommended use rate of *Parallel* and *Stalwart* on forage sorghum is a low rate of the active ingredient when compared to the rate of *Dual II Magnum* and *Cinch*. Level of weed control may be affected.

TABLE 10 – Glyphosate Products Registered for Postemergence Application in *Roundup Ready* Crops.

			Product Rate Equivalent to:				
Trade Name	**Manufacturer**	**Glyphosate Formulation (lb/gal) [a]**	**0.56 lb a.e.**	**0.75 lb a.e.**	**1.13 lb a.e.**	**Surfactant is Needed?[b]**	**36 hr Preharvest Application on Alfalfa?[c]**
Buccaneer 4L	Tenkoz, Inc.	3 a.e.	24 fl oz	32 fl oz	48 fl oz	Y	No
Buccaneer Plus 4L	Tenkoz, Inc.	3 a.e.	24 fl oz	32 fl oz	48 fl oz	S	No
Clearout 41 Unloaded 4L	Chemical Product Technologies, LLC	3 a.e.	24 fl oz	32 fl oz	48 fl oz	Y	No
Clearout 41 Plus 4L	Chemical Product Technologies, LLC	3 a.e.	24 fl oz	32 fl oz	48 fl oz	S	No
Cornerstone 4L	Agriliance, LLC	3 a.e.	24 fl oz	32 fl oz	48 fl oz	Y	No
Cornerstone Plus 4L	Agriliance, LLC	3 a.e.	24 fl oz	32 fl oz	48 fl oz	S	No
Credit 4L	Nufarm	3 a.e.	24 fl oz	32 fl oz	48 fl oz	Y	No
Credit Duo 4L	Nufarm	3 a.e.	24 fl oz	32 fl oz	48 fl oz	Y	No
Credit Duo Extra 4L	Nufarm	3 a.e.	24 fl oz	32 fl oz	48 fl oz	S	No
Credit Extra 4L	Nufarm	3 a.e.	24 fl oz	32 fl oz	48 fl oz	S	No
Durango 5.4L	Dow Agro	4 a.e.	18 fl oz	24 fl oz	30 fl oz	N	Yes
Extra Credit 5	Nufarm	4 a.e.	18 fl oz	24 fl oz	30 fl oz	Y	Yes
Gly-4 4L	Universal Crop Protection	3 a.e.	24 fl oz	32 fl oz	48 fl oz	Y	No
Gly-4 Plus 4L	Universal Crop Protection	3 a.e.	24 fl oz	32 fl oz	48 fl oz	S	No
Gly Star Original 4L	Albaugh	3 a.e.	24 fl oz	32 fl oz	48 fl oz	Y	No
Gly Star Plus 4L	Albaugh	3 a.e.	24 fl oz	32 fl oz	48 fl oz	S	No
Gly-Flo 4L	Micro-Flo	3 a.e.	24 fl oz	32 fl oz	48 fl oz	Y	No
Glyfos 4L	Cheminova	3 a.e.	24 fl oz	32 fl oz	48 fl oz	Y	No
Glyfos X-tra 4L	Cheminova	3 a.e.	24 fl oz	32 fl oz	48 fl oz	S	No
Glyphogan	Makhteshim-Agan	3 a.e	24 fl oz	32 fl oz	48 fl oz	Y	Yes
Glyphomax 4L	Dow Agro	3 a.e.	24 fl oz	32 fl oz	48 fl oz	Y	No
Glyphomax Plus 4L	Dow Agro	3 a.e.	24 fl oz	32 fl oz	48 fl oz	N	Yes
Glyphomax XRT 5.4L	Dow Agro	4 a.e.	18 fl oz	24 fl oz	30 fl oz	N	Yes
Glyphosate 4 4L	Makhteshim-Agan	3 a.e.	24 fl oz	32 fl oz	48 fl oz	Y	No
Glyphosate 41% 4L	Helm Agro	3 a.e.	24 fl oz	32 fl oz	48 fl oz	Y	No
Glyphosate 41 Plus	Cropsmart	3 a.e	24 fl oz	32 fl oz	48 fl oz	N	Yes
Grandslam 4XS	Hide, LLC.	3 a.e.	24 fl oz	32 fl oz	48 fl oz	Y	No
Helosate Plus 4L	Helm Agro	3 a.e.	24 fl oz	32 fl oz	48 fl oz	S	No
Honcho 4L	Monsanto	3 a.e.	24 fl oz	32 fl oz	48 fl oz	Y	No
Honcho Plus 4L	Monsanto	3 a.e.	24 fl oz	32 fl oz	48 fl oz	S	No
Mirage 4L	UAP/Platte	3 a.e.	24 fl oz	32 fl oz	48 fl oz	Y	No
Mirage Plus 4L	UAP/Platte	3 a.e.	24 fl oz	32 fl oz	48 fl oz	S	No
Rattler 4L	Helena	3 a.e.	24 fl oz	32 fl oz	48 fl oz	Y	No
Rattler Plus 4L	Helena	3 a.e.	24 fl oz	32 fl oz	48 fl oz	S	No
Roundup Original 4L	Monsanto	3 a.e.	24 fl oz	32 fl oz	48 fl oz	Y	No
Roundup OriginalMax 5.5L	Monsanto	4.5 a.e.	16 fl oz	22 fl oz	32 fl oz	S	Yes
Roundup UltraDry 71.4WG	Monsanto	64.9% a.e.	0.9 lb	1.2 lb	1.8 lb	N	Yes
Roundup WeatherMax 5.5L	Monsanto	4.5 a.e.	16 fl oz	22 fl oz	32 fl oz	N	Yes
Touchdown HiTech	Syngenta	5 a.e.	14 fl oz	20 fl oz	30 fl oz	Y	Yes
Touchdown Total	Syngenta	4.17 a.e.	17 fl oz	24 fl oz	35 fl oz	N	Yes

[a] a.e. = acid equivalent, lb of glyphosate acid per gallon.

[b] Y = Yes, surfactant is needed; S = Sometimes under certain conditions additional surfactant may improve control; N = No surfactant is needed. For products that may need a surfactant, a non-ionic surfactant at 0.25 to 1.0% v/v is the typical recommendation. Consult the herbicide label to verify the type and rate of surfactant to include. AMS should be included at 17 lb/100 gal to improve glyphosate activity.

[c] Treated alfalfa and weeds can be harvested and fed to livestock after 36 hours.

TABLE 11 – Rain-free Period for Postemergence Herbicide Applications

HERBICIDE	RAIN-FREE PERIOD (in hours)	HERBICIDE	RAIN-FREE PERIOD (in hours)
Accent	4	Gramoxone Inteon	0.5
Affinity BroadSpec	several	Harmony Extra	Several
Aim EW	1	Harmony GT	1
Assure II/Targa	1	Hornet WDG	2
Atrazine	1–2**	Impact	1
Backdraft SL	NL	Laddok	NL*
Banvel	NL	Liberty	4
Basagran	4	Liberty ATZ	4
Basis	4	Lightning	1
Beacon	4	Marksman	4
Betamix/Betamix Ultra	6	MCPA	4
Betanex	6	Mirage	NL
Buctril	1	Moxy	1
Buctril/Atrazine	1	Northstar	4
Butoxone (2,4-DB)	NL	Option	2
Butyrac (2,4-DB)	NL	Osprey	4
Callisto	1	Permit	4
Canopy	1	Phoenix	2
Canopy EX	2	Poast	1
Celebrity	4	Poast Plus	1
Clarity	4	Progress/Progress Ultra	6
Classic	1	Puma	NL
ClearOut 41 Plus	NL	Pursuit	1
Credit Duo	2-6***	Raptor	1
Credit Extra	2-6***	Reflex	1
Cobra	0.5	Reglone	NL
Curtail	6	Resolve	NL
2,4-D Amine	6–8	Resource	1
2,4-D Ester	1	Roundup Original	NL
Distinct	4	Roundup Original II	NL
Equip	2	Roundup WeatherMax	NL
Express	Several	Scepter	NL
Extreme	NL	Select/Arrow/Select Max	1
FirstRate	2	Steadfast	4
Flexstar	1	Stinger	6
Fusion	1	Stout	4
Gly Star Original	2-6***	Synchrony XP	1
Gly Star Plus	NL	Touchdown	1–2‡
Gly-4	2-6***	Ultra Blazer	4
Gly-4 Plus	NL	UpBeet	4
Glyfos	2–6***	Valor	1
Glyfos X-tra	NL	WideMatch	6
Glyphomax	2–6***	Yukon	4
Glyphomax Plus	1–2‡		

NL – not listed on label.

* Basagran's rain-free period is 4 hours.

** Rainfall will improve control from root uptake.

*** Rainfall within 6 hr. after application may reduce effectiveness. Heavy rainfall within 2 hr. after application may wash the chemical off foliage and a repeat treatment may be required.

‡ Extended time interval (6 hr.) recommended with cool, cloudy conditions. Heavy rainfall within 2 hr. may wash chemical off of foliage.

TABLE 12 – Herbicide Crop Rotation Restrictions

		(in months)												
	SOIL pH RESTRICTIONS	SOYBEANS	FIELD CORN	SEED CORN	WHEAT	OATS	BARLEY	RYE	ALFALFA	DRY BEANS	SUGAR BEETS	POTATOES	CUCUMBERS	TOMATOES
2,4-D amine, 2,4-D ester	None	*	0*	0*	–	10	10	–	10	10	10	10	10	10
Accent	Yes*	0.5	0	0	4	8	8	4	10	10	10/18*	10/18*	10/18*	10/18*
Affinity BroadSpec	None	1.5	1.5	1.5	0	1.5	0	1.5	1.5	1.5	2	1.5	1.5	1.5
Aim	None	0	0	0	0	0	0	0	0	12	12	12	12	12
Assure II/Targa	None	0	4	4	4	4	4	4	4	0	0	4	4	4
Atrazine (1 lb a.i./A)	None	10	0	0	3	21	21	3	15	21	21	10	21	21
Atrazine (2 lb a.i./A)	None	18	0	0	15	21	21	15	21	21	33	18	33	33
Authority First/Sonic	None	0	10	10	4	12	12	12	12	12	30*	18	30*	30*
Axiom	None	0	0	0	12	12	12	12	12	12	18	1	12	12
Backdraft*	None	0	9.5/18*	9.5/18*	4	11/18*	11/18*	18	18	11	26	18	18	18
Basagran	None	0	0	0	0	0	0	0	0	0	0	0	0	0
Basis	> 9.0	0.5	0	0	4	8	8	4	10	8	10	0	18	1
Beacon	None	8	0.5	0.5	3	8	8	3	8	8	18	8	18	18
Betamix/Betamix Ultra	None	0	4	4	4	4	4	4	0	0	0	0	0	0
Betanex	None	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicep II Magnum/ Cinch ATZ/Parallel Plus	> 8.0	10	0	0	15	21	21	15	21	21	21	10	21	21
Bicep Lite II Magnum/ Cinch ATZ Lite	> 8.0	10	0	0	3	21	21	3	15	21	21	10	21	21
Boundary	None	0	8	8	4.5	12	4.5	12	4.5	12	18	8	12	12
Buctril + Atrazine	None	10	1	1	3	21	21	3	15	21	21	10	21	21
Buctril/Moxy	None	1	1	1	1	1	1	1	1	1	1	1	1	1
Bullet/Lariat	None	10	0	0	3	21	21	3	15	21	21	10	21	21
Butoxone 200/ Butyrac 200	None	–	–	–	–	–	–	–	–	–	–	–	–	–
Callisto	None	10	0	0	4	4	4	4	10	18	18	10	18	18
Camix	None	10	0	0	4.5	10	4.5	4.5	18	18	18	10	18	18
Canopy*	>7	0	10	10	4	4	4	4	10	12	30	30	18	10*
Canopy EX*	>7	0	10	10	4	4	4	4	10	12	30	30	18	10*
Celebrity	Yes*	1	0	0	4	8	4	4	12	10	10/18*	10/18*	10/18*	10/18*
Celebrity Plus	Yes*	4	0.25	0.25	4	8	4	4	12	10	10/18*	10/18*	10/18*	10/18*
Clarity/Banvel	None	4	4	4	1	1	1	1	4	4	4	4	4	4
Classic*	>7	0	9	9	3	3	3	3	12	9	30	30	18	9/15*
Cobra/Phoenix	None	0	0	0	0	0	0	0	0	0	0	0	0	0
Command*	<5.9	0	9	9	12	16	16	16	16	9	9	9	9	9/12*
Curtail*	None	10.5/18*	1	1	1	1	1	1	10.5	10.5/18*	12	18	18	18
Define	None	0	0	0	12	12	12	12	12	12	4	1	12	12
Degree Xtra/Harness Xtra/Keystone/ Volley ATZ	None	10	0	0	4	21	21	18	18	21	21	18	21	21
Distinct	None	1	0.25	0.25	1	1	1	1	1	1	1	1	1	1
Dual Magnum/Dual II Magnum/Cinch	None	0	0	0	4.5	4.5	4.5	4.5	6	0	10	0	10	6
Eptam	None	10	1	10	3	10	10	3	0	0	10	10	10	10
Equip	≥ 8.5	9	0.5	0.5	2	9	2	2	18	18	18	18	18*	18*
Expert	None	10	0	0	10	18	18	10	18	18	18	18	18	18

(continued on next page)

TABLE 12 – Herbicide Crop Rotation Restrictions (continued)

		(in months)												
	SOIL pH RESTRICTIONS	SOYBEANS	FIELD CORN	SEED CORN	WHEAT	OATS	BARLEY	RYE	ALFALFA	DRY BEANS	SUGAR BEETS	POTATOES	CUCUMBERS	TOMATOES
Express	None	1.5	1.5	1.5	0	1.5	0	1.5	1.5	1.5	2	1.5	1.5	1.5
Extreme	None	0	8.5	8.5	4	18	9.5	4	4	4	40*	26	40*	40*
Field Master	None	10	0	0	15	21	21	18	21	21	21	18	21	21
FirstRate	None	0	9	9	3	9	30*	30*	9	9	30	18	30*	30*
Flexstar/Reflex	None	0	10	10	4	4	4	4	18	10	18	18	18	18
Fultime	None	10	0	0	15	21	21	18	18	21	21	18	21	21
Fusion	None	0	2	2	2	2	2	2	0	0	0	0	0	0
Gangster	None	0	9	9	3	9	30*	30*	30*	9	30*	18	30*	30*
Glyphosate	None	0	0	0	0	0	0	0	0	0	0	0	0	0
G-Max Lite	None	10	0	0	3	21	21	3	15	21	21	10	21	21
Gramoxone Inteon	None	0	0	0	0	0	0	0	0	0	0	0	0	0
Guardsman Max	None	10	0	0	15	21	21	15	21	21	21	10	21	21
Harmony Extra	None	1.5	1.5	2.5	0	0	0	1.5	1.5	1.5	2	1.5	1.5	1.5
Harmony GT	None	0	0	1.5	0	0	0	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Harness/Volley/ Topnotch/Surpass/ Degree	None	10	0	0	4	18	18	18	18	18	18	18	18	18
Hornet WDG	> 7.8	10.5	0	0	4	4	4	4	10.5	10.5	26*	18	26*	26*
Impact (0.5 oz/A)	None	9	0	0	3	3	3	3	9	18	18	9	18	18
IntRRo/Micro-Tech	None	0	0	0	3	10	10	3	10	10	10	10	10	10
Kerb	None	12	12	12	12	12	12	12	12	12	12	12	12	12
Keystone LA/ Volley ATZ Lite	None	10	0	0	4	21	21	18	18	21	21	18	21	21
Laddock	None	10	0	0	3	21	21	3	15	21	21	10	21	21
Lexar	None	10	0	0	15	10	10	10	18	18	18	18	18	18
Liberty/Rely	None	0	0	0	2.5	2.5	2.5	2.5	4	4	4	4	4	4
Lightning	None	9	8.5	8.5	4	18	9.5	4	9.5	9.5	40*	26	40*	40*
Lorox/Linex	None	4	4	4	4	4	4	4	4	4	4	4	4	4
Lumax	None	10	0	0	4.5	10	4.5	4.5	18	18	18	18	18	18
Marksman	None	10	4	4	3	21	21	3	15	21	21	10	21	21
Matrix	None	4	0	0	4	9	9	4	18*	10	18*	0	18*	18*
MCPA	None	–	–	–	–	–	–	–	–	–	–	–	–	–
Northstar	None	8	0.5	0.5	3	8	8	3	8	8	18	8	18	18
Nortron*	None	6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/12	0	6/12	6/12	6/12
Option	None	0.5	0.25	0.25	2	2	2	2	2	2	2	2	2	2
Osprey	None	1	12	12	7d	10	1	10	10	3	10	10	10	10
Outlook	None	0	0	0	4	4	4	4	10	0	10	10	10	10
Permit/Sandea	None	9	1	2	2	2	2	2	9	9	21	9	9	8
Poast/Poast Plus*	None	0	1*	1*	1*	1*	1*	1*	0	0	0	0	0	0
Prefix	None	0	10	10	4.5	4.5	4.5	4.5	18	10	18	18	18	18
Priority	None	9	1	2	2	2	2	12	12	12	21	12	12	12
Progress/Progress Ultra	None	0	4	4	4	4	4	4	0	0	0	0	0	0
Prowl, Pendimax, Prowl H2O	None	0	10	10	4	10	4	10	10	0	12	10	10	10
Puma	None	0	0	0	0	0	0	0	0	0	0	0	0	0
Pursuit	None	0	8.5	8.5	4	18	9.5	4	4	4	40*	26	40*	40*
Pursuit Plus	None	0	8.5	8.5	4	18	9.5	9.5	9.5	4	40*	26	40*	40*

(continued on next page)

TABLE 12 – Herbicide Crop Rotation Restrictions (continued)

		(in months)												
	SOIL pH RESTRICTIONS	SOYBEANS	FIELD CORN	SEED CORN	WHEAT	OATS	BARLEY	RYE	ALFALFA	DRY BEANS	SUGAR BEETS	POTATOES	CUCUMBERS	TOMATOES
Pyramin*	None	10	10	10	10	10	10	10	10	10	0	10	10	10
Python	> 7.8	0	0	0	4	4	4	4	4	4	26*	12	26*	26*
Raptor	None	0	9	9	3	9	4	4	9	9	18	9	9	9
Resolve	None	4	0	0	4	9	9	4	18*	10	18*	0	18*	18*
Resource	None	0	0	0	4	4	4	4	1	1	1	1	1	1
Ro-Neet	None	–	–	–	–	–	–	–	–	–	–	–	–	–
Scepter*	None	0	9.5/18*	9.5/18*	4	11/18*	11/18*	18	18	11	26	18	18	18
Select/Arrow/ Select Max	None	0	1	1	1	1	1	1	0	0	0	0	0	0
Sencor	≥ 7.0	4	4	4	4	4	4	12	4	12	18	4	12	12
Shotgun	None	10	0*	0*	3	21	21	3	15	21	21	10	21	21
Sinbar	None	24	24	24	24	24	24	24	24	24	24	24	24	24
Sonalan	None	0	10	10	10	10	10	10	10	0	8/13*	10	10	10
Spartan	None	0	10	10	4	4	4	4	12	12	30	30	18	30
Stalwart/Stalwart C Parallel/Parallel PCS	None	10	0	0	4.5	4.5	4.5	4.5	4	10	10	10	10	6
Starane	None	10	4	4	4	4	4	4	4	10	10	10	10	10
Steadfast	Yes*	0.5	0	10	4	8	8	4	10	10	10/18*	10/18*	10/18*	10/18*
Steadfast ATZ	None	10	0	10	10	18	18	10	18	18	18	18	18	18
Stinger*	None	10.5	0	0	0	0	0	0	10.5	10.5	0	18	18	18
Stout	Yes*	0.5	0	0	4	8	8	4	10	10	10/18*	10/18*	10/18*	10/18*
Synchrony XP*	>7	0	9	9	3/4	3/4	3/4	3/4	12	9/12	30	30	18	9/15
Trifluralin	None	0	5	5	5	5	5	5	5	0	12*	5	5	5
Ultra Blazer	None	0	0	0	0	0	0	0	0	0	18	18	0	0
Upbeet	None	0.5	0.75	0.75	0.5	0.5	0.5	0.5	0.5	0.5	0	0.5	0.5	0.5
Valor	None	0	2	4	2	12	4	4	12*	4	12*	12*	12*	12*
Velpar	None	24	12	12	24	24	24	24	24	24	12	12	24	24
WideMatch	None	10.5	4	4	4	4	4	4	10.5	10.5	2	18	18	18
Yukon	None	9	1	2	2	2	2	2	9	9	21	9	9	8

This table contains general guidelines for crop rotation restrictions following herbicide application. Herbicide persistence and carry-over potential are variable and dependent upon soil and environmental characteristics.

– No information was given on the label.

* Consult the Remarks and Limitations sections in this guide and on the herbicide label for further information.

TABLE 13 – Toxicity, Solubility, Adsorptivity and Persistence of Herbicides

HERBICIDE	TOXICITY[1] LD_{50} mg/kg Oral	Dermal	WATER SOLUBILITY (ppm at 25°C)	ADSORPTIVITY TO SOIL	SOIL PERSISTENCE AT STANDARD RATE (months)	RUNOFF/[2] LEACHING POTENTIAL	RESTRICTED[3] ENTRY INTERVAL
Accent	>5000	>2000	70 (pH 7.0)	weak–moderate	1–10	3/1	4 hrs
Affinity BroadSpec	>5000	>2000	*	*	0.5	2/2	12 hrs
Aim EW	>5000	>5000	22	strong	–	–/–	12 hrs
Assure II/Targa	4100–5900	>2000	<1	moderate	0.5	1/2	12 hrs
Atrazine	1075–4346	>3100	33	strong	2–8	2/1	12 hrs
Axiom	1042–1308	>5000	56	moderate	2	2/1	12 hrs
Banvel/Clarity	2629-3512	>2000	4500	weak	1–6	3/1	24 hrs
Basagran	2063	>10,000	500	weak	0.5	3/1	4-8 hrs
Basis	>5000	>2000	–	–	–	–/–	4 hrs
Beacon	>5050	>2010	18,000 (pH 7.2)	weak	1–5	2/1	12 hrs
Betamix	4059	>1980	1	moderate	1	1/3	24 hrs
Betanex	3960	>9900	7	moderate	1	1/3	24 hrs
Buctril/Moxy	780	2000	50	moderate	0.5	2/3	12 hrs
Callisto	>5000	>5000	–	–	–	–	12 hrs
Canopy	>5000	>5000	300	strong	1-10	2/1	12 hrs
Canopy EX	>5000	>2000	286	strong	1-10	2/1	12 hrs
Classic	>5000	>2000	300	strong	1–10	2/1	12 hrs
Cobra	2400–2600	>2000	0.1	strong	0.5	2/3	12 hrs
Command	2084–5000	2000-5000	1100	v. strong	3–6	2/2	12 hrs
2,4-D	375–1492	>2000	900	weak	1	2/2	12–48 hrs
2,4-DB	>1706	2000	insoluble	weak	1	2/3	48 hrs
Define	1365	5000	56	moderate	–	–	12 hrs
Degree	2148	4166	223	moderate	1–2	2/2	12 hrs
DESICATE II	233	481	100,000	moderate	0.25	3/2	48 hrs
Reglone	600–810	260–315	infinite	v. strong	–	1/3	24 hrs
Distinct	>1800	>5000	–	–	–	–	12 hrs
Domain	1830–1920	>2000	56	moderate	2	2/1	12 hrs
Dual II Magnum/ Cinch/Stalwart/ Parallel	2672–2952	>2020	530	strong	1–3	2/1	24 hrs
Eptam	1325–5000	1500–5000	370	strong	1.5–2	2/3	12 hrs
Express	>5000	>2000	286	–	0.5	2/2	12 hrs
FirstRate	>5000	>2000	184	moderate	1–4	–/–	12 hrs
Fusion	3154	>2000	2 to 0.9	moderate	0.5	1/3	24 hrs
glyphosate***	>5000	>5000	900,000 (pH 7.0)	v. strong	1	1/3	SL
Gramoxone Inteon	310	>2000	infinite	v. strong	1	1/3	24 hrs
Harmony Extra	>5000	>2000	*	*	0.5	2/2	12 hrs
Harmony GT	>5000	>2000	2400	–	0.25	2/2	4 hrs
Harness	1249–2948	4166-5000	223	moderate	1–2	2/2	12 hrs
Hornet WDG	>5000	>5000	–	–	–	3/1	48 hrs
Impact	>2000	>4000	15,000 ppm@20° C	moderate	1-8	–/–	12 hrs
Kerb	>5000	>2000	15	strong	2–9	2/1	24 hrs
MicroTech/IntRRo	2000–5000	5000–7800	242	strong	1–2	2/2	12 hrs
Liberty	2119–2030	1390–5319	–	–	–	–	12 hrs
Lightning	>5000	>2000	–	–	–	2/1	12 hrs
Lorox	3600–4833	>2000	75	v. strong	2–4	1/2	24 hrs
Matrix	>5000	>2000	–	–		–/–	4 hrs
MCPA	800	1500	insoluble	v. weak	1–4	1/3	48 hrs
Nortron SC	>2100	>4100	110	strong	1–4	2/2	12 hrs
Option	>3881	>5000	–	–	–	–/–	12 hrs
Osprey	>2000	>2000		–		–/–	4 hrs
Outlook	695	>2000	1174	moderate	1–2	2/2	12 hrs

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TABLE 13 – Toxicity, Solubility, Adsorptivity and Persistence of Herbicides (continued)

HERBICIDE	TOXICITY[1] LD_{50} mg/kg Oral	Dermal	WATER SOLUBILITY (ppm at 25°C)	ADSORPTIVITY TO SOIL	SOIL PERSISTENCE AT STANDARD RATE (months)	RUNOFF/[2] LEACHING POTENTIAL	RESTRICTED[3] ENTRY INTERVAL
Permit	1287	>5000	15	–	–	2/2	12 hrs
Poast	2200–4100	2000–5000	48	moderate	0.25	2/3	12 hrs
Princep/Sim-Trol	>5000	2000–2500	5	strong	2–8	2/1	12 hrs
Prowl/Pendimax/ Prowl H_20	3956	>2200	<1	v. strong	3–6	1/3	24 hrs
Pursuit	3506–5000	>2000	1,400	weak	2–8	1/1	12–24 hrs
Pyramin	1160	>2000	1	strong	1–2	2/2	12 hrs
Python	>5000	>2000	49	moderate	2–8	3/1	12 hrs
Raptor	>5000	>4000	–	weak	1–2	–/–	4 hrs
Reflex/Flexstar	3683–8160	>1000	600,000	weak	6	2/1	24 hrs
Resolve	>5000	>2000	--	--		--/--	4 hrs
Resource	3200–4100	>2000	.189	strong		3/2	12 hrs
Ro-Neet	3160–3690	>4640	85	strong	1–3	2/2	12 hrs
Scepter	5000–6598	2000–5000	60	moderate	2–8	3/1	12–48 hrs
Select/Arrow	2920–3610	>5000	infinite	moderate	0.25	3/3	24 hrs
Sencor	1500–2794	>5000	1200	moderate	2–4	2/1	12 hrs
Sinbar	5000–7500	>5000	710	moderate	5–6	2/1	12 hrs
Sonalan	3300–5000	>5000	1	v. strong	3–5	1/3	24 hrs
Spartan	2416	>5000	110	moderate	2–8	–/–	12 hrs
Steadfast	>5000	>2000	–	–	–	–	4 hrs
Stinger	>5000	>5000	1000	moderate	1–10	3/1	12 hrs
Stout (mp)	>5000	>2000	70 (pH 7.0)	weak - moderate	1-10	2/1	4 hrs
Surpass	1426–1942	>2240	223	moderate	1–2	2/2	12 hrs
Synchrony XP	>5000	>2000	300	strong	1-10	2/1	12 hrs
Trifluralin	3738	>2000	<1	v. strong	3–6	1/3	12 hrs
Ultra Blazer	4790	3250	infinite	strong	1	2/2	48 hrs
Upbeet	>5000	>2000	110 (pH 7.0)	weak		–/–	4 hrs
Valor	>5000	>2000	1.78	–	–	–	12 hrs
Velpar	1100–4120	>5000	33,000	strong	4–6	2/1	24 hrs
WideMatch	>5000	>5000	1000	moderate	1-10	3/1	12 hrs
(Table Salt)	3320		360,000	–	–	–	
(Aspirin)	1200		2,500	–	–	–	

-– No information available.

Sources: *Herbicide Handbook*.

[1] The LD_{50} is a standard toxicological term which indicates the number of milligrams (mg) of pesticide per kilogram (kg) of test animal body weight required to kill 50% of a test animal population. Values less than 10 indicate extremely high toxicity to mammals. The LD_{50} data have been obtained from the Material Data Safety Sheets.

[2] The runoff/leaching potential ratings are from the ARS/NRCS pesticide properties database and were developed for use with the NRCS soils ratings for water quality in the NRCS "Soil-Pesticide Interaction Ratings." 1= high, 2=medium, 3= low.

[3] Read and follow label directions. Post areas or give oral warnings that areas have been treated to warn workers not to enter until the REI has elapsed as required by the label. SL=See Label.

* Combination of *Express* and the active ingredient in *Harmony GT.*

** Combination of *Lexone* plus chlorimuron.

*** Glyphosate IPA salt; active ingredient in products in Table 10.

Premixes: Refer to Tables 1H and 2E for components of herbicide premixes.

TABLE 14 – Glossary of Chemical Names

TRADE NAME** AND (MANUFACTURER)	COMMON NAME	CONCENTRATION COMMERCIAL FORMULATION†
ACCENT (DuPont)	NICOSULFURON	75% DF, SP
AFFINITY BROADSPEC (DuPont)	THIFENSULFURON METHYL + TRIBENURON METHYL	50% DS (25 + 25)
AIM EW (FMC)	CARFENTRAZONE	1.9 lb/gal L
ARROW 2EC (Makhteshim-Agan)	CLETHODIM	2.0 lb/gal L
ASSURE II (DuPont)	QUIZALOFOP-P-ETHYL	0.88 lb/gal L
* ATRAZINE (several)	ATRAZINE	4 lb/gal L; 90% DG
AUTHORITY FIRST (FMC)	SULFENTRAZONE + CLORANUSULAM	70% DF (62.1 + 7.9)
AXIOM (Bayer CropSciences)	FLUFENACET + METRIBUZIN	68% DF (54.4 + 13.6)
BACKDRAFT SL (BASF)	IMAZAQUIN + GLYPHOSATE	1.05 lb/gal (ae)
BANVEL (Micro Flo)	DICAMBA	4 lb/gal L
BASAGRAN (Micro Flo)	BENTAZON	4 lb/gal L
BASIS (DuPont)	RIMSULFURON + THIFENSULFURON	75% DG (50 + 25)
BEACON (Syngenta)	PRIMISULFURON	75% DG (in pouches)
BETAMIX (Bayer CropSciences)	DESMEDIPHAM+PHENMEDIPHAM	1.3 lb/gal L (0.65 + 0.65)
BETAMIX ULTRA (Bayer CropSciences)	DESMEDIPHAM + PHENMEDIPHAM	2.6 lb/gal L (1.3 + 1.3)
BETANEX (Bayer CropSciences)	DESMEDIPHAM	1.3 lb/gal L
* BICEP II MAGNUM (Syngenta)	ATRAZINE + S-METOLACHLOR (+ SAFENER)	5.5 lb/gal L (3.1 + 2.4)
* BICEP LITE II MAGNUM (Syngenta)	ATRAZINE + S-METOLACHLOR (+ SAFENER)	6 lb/gal L (2.67 + 3.33)
BOUNDARY 6.5EC (Syngenta)	S-METOLACHLOR + METRIBUZIN	6.5 lb/gal (5.25 + 1.25)
BUCTRIL (Bayer CropSciences)	BROMOXYNIL	2 lb/gal L
* BUCTRIL-ATRAZINE (Bayer CropSciences)	ATRAZINE + BROMOXYNIL	3 lb/gal L (2 + 1)
* BULLET (Monsanto)	ATRAZINE + ALACHLOR	4 lb/gal L (1.5 + 2.5)
BUTOXONE (Cedar)	2,4-DB	2 lb/gal L
BUTYRAC (Albaugh)	2,4-DB	2 lb/gal L
CALLISTO (Syngenta)	MESOTRIONE	4 lb/gal SC
CAMIX (Syngenta)	MESOTRIONE + S-METOLACHLOR (+ SAFENER)	3.67 lb/gal L (0.33 + 3.34)
CANOPY (DuPont)	CHLORIMURON + METRIBUZIN	75% DF (10.7 + 64.3)
CANOPY EX (DuPont)	CHLORIMURON + TRIBENURON	29.5%DG (22.7 + 6.8)
CELEBRITY (BASF)	NICOSULFURON + DICAMBA	Co-Pack
CELEBRITY PLUS (BASF)	DICAMBA + DIFLUFENZOPYR + NICOSULFURON	70% DG (42.4 + 17.0 + 10.6)
CINCH (DuPont)	S-METHOLACHLOR (+ SAFENER)	7.64 lb/gal L
* CINCH ATZ (DuPont)	ATRAZINE + S-METOLACHLOR (+ SAFENER)	5.5 lb/gal L (3.1 + 2.4)
* CINCH ATZ LITE (DuPont)	ATRAZINE + S-METOLACHLOR (+ SAFENER)	6.0 lb/gal L (2.67 + 3.33)
CLARITY (BASF)	DICAMBA	4 lb/gal L
CLASSIC (DuPont)	CHLORIMURON ETHYL	25% DF
COBRA (Valent)	LACTOFEN	2 lb/gal L
COMMAND (FMC)	CLOMAZONE	3 ME
CURTAIL (Dow AgroSciences)	CLOPYRALID + 2,4-D	2.38 lb/gal L (0.38 + 2.0)
2,4-D (Several)	2,4-D	various
DEFINE(Bayer CropSciences)	FLUFENACET	60% DF
DEFINE SC (Bayer CropSciences)	FLUFENACET	4 lb/gal SC
* DEGREE (Monsanto)	ACETOCHLOR (+ SAFENER)	3.8 lb/gal L
* DEGREE XTRA (Monsanto)	ACETOCHLOR (+ SAFENER) + ATRAZINE	4.0 lb/gal L (2.7 + 1.3)
DESICATE II (Cerexagri)	ENDOTHALL	2.0 lb/gal L
DISTINCT (BASF)	DICAMBA+DIFLUFENZOPYR	70% DS (50 + 20)
DOMAIN (BAYER CropSciences)	FLUFENACET + METRIBUZIN	60% DF (24 + 36)
DUAL MAGNUM (Syngenta)	S-METOLACHLOR	7.62 lb/gal L
DUAL II MAGNUM (Syngenta)	S-METOLACHLOR (+ SAFENER)	7.64 lb/gal L
EPTAM (Syngenta)	EPTC	7 lb/gal L; 10% G
EQUIP (Bayer CropSciences)	FORAMSULFURON + IODOSULFURON (+ SAFENER)	32% DG (30 + 2)
* EXPERT (Syngenta)	ATRAZINE + S-METOLACHLOR + GLYPHOSATE	4.88 lb/gal L (2.14 + 1.74 + 0.75ae)
EXPRESS (DuPont)	TRIBENURON METHYL	75% DF
EXTREME (BASF)	IMAZETHAPYR + GLYPHOSATE	2.17 lb/gal (ae)
* FIELDMASTER (Monsanto)	ACETOCHLOR (+ SAFENER) + ATRAZINE + GLYPHOSATE	4.06 lb/gal L (2 + 1.5 + 0.56 (ae))

(Continued on next page)

TABLE 14 – Glossary of Chemical Names (continued)

TRADE NAME** AND (MANUFACTURER)	COMMON NAME	CONCENTRATION COMMERCIAL FORMULATION†
FIRSTRATE (Dow AgroSciences)	CLORANSULAM METHYL	84% WDG
FLEXSTAR (Syngenta)	FOMESAFEN	1.88 lb/gal L
* FULTIME (Dow AgroSciences)	ACETOCHLOR (+ SAFENER) + ATRAZINE	4 lb/gal L (2.4 + 1.6)
FUSION (Syngenta)	FLUAZIFOP-P-BUTYL + FENOXAPROP	2.66 lb/gal L (2.0 + 0.66)
GANGSTER (Valent)	CLORANSULAM-METHYL + FLUMIOXAZIN	Co-pack
GLYPHOSATE (Several)	GLYPHOSATE	3, 4, 4.17, 4.5 lb/gal L (ae), 65% (ae)
* GRAMOXONE INTEON (Syngenta)	PARAQUAT	3 lb/gal L (ae)
* G-MAX LITE (BASF)	DIMETHENAMID-P + ATRAZINE	5 lb/gal L (2.25 + 2.75)
* GUARDSMAN MAX (BASF)	DIMETHENAMID-P + ATRAZINE	5 lb/gal L (1.7 + 3.3)
HARMONY EXTRA (DuPont)	THIFENSULFURON METHYL + TRIBENURON METHYL	75% DF
HARMONY GT (DuPont)	THIFENSULFURON METHYL	75% DF
* HARNESS (Monsanto)	ACETOCHLOR (+ SAFENER)	7 lb/gal L; 20% G
* HARNESS XTRA (Monsanto)	ACETOCHLOR (+ SAFENER) + ATRAZINE	6 lb/gal L (4.3 + 1.7)
* HARNESS XTRA 5.6L (Monsanto)	ACETOCHLOR (+ SAFENER) + ATRAZINE	5.6 lb/gal L (3.1 + 2.5)
HORNET WDG (Dow AgroSciences)	FLUMETSULAM + CLOPYRALID	68.5% WDG (18.5 + 50.0)
IMPACT (AMVAC)	TOPRAMEZONE	2.8 lb/gal SC
* INTRRO (Monsanto)	ALACHLOR	4.0 lb/gal L
* KERB (Dow AgroSciences)	PRONAMIDE	50% WP (in soluble pouches)
* KEYSTONE (Dow AgroSciences)	ACETOCHLOR (+ SAFENER) + ATRAZINE	5.25 lb/gal (3.0 + 2.25)
* KEYSTONE LA (Dow AgroSciences)	ACETOCHLOR (+ SAFENER) + ATRAZINE	5.5 lb/gal L (4 + 1.5)
* LADDOK (Sipcam Agro)	ATRAZINE + BENTAZON	3.3 lb/gal L (1.7 + 1.7)
* LARIAT (Monsanto)	ATRAZINE + ALACHLOR	4 lb/gal L (1.5 + 2.5)
* LEXAR (Syngenta)	S-METOLACHLOR (+ SAFENER) + ATRAZINE + MESOTRIONE	3.7 lb/gal L (1.74 + 1.74 + 0.224)
LIBERTY (Bayer CropSciences)	GLUFOSINATE	1.67 lb/gal L
* LIBERTY ATZ (Bayer CropSciences)	ATRAZINE + GLUFOSINATE	4.3 lb/gal L (3.3 + 1.0)
LIGHTNING (BASF)	IMAZETHAPYR + IMAZAPYR	70% DG (52.5 + 17.5)
LINEX (Griffin)	LINURON	4 lb/gal L
LOROX (Griffin)	LINURON	50% DF
* LUMAX (Syngenta)	MESOTRIONE + S-METOLACHLOR (+ SAFENER) + ATRAZINE	3.95 lb/gal L (0.268 + 2.68 + 1.0)
* MARKSMAN (BASF)	ATRAZINE + DICAMBA	3.2 lb/gal L (2.1 + 1.1)
MATRIX (DuPont)	RIMSULFURON	25% DF
MCPA (Several)	MCPA	Various L
* MICRO-TECH (Monsanto)	ALACHLOR	4 lb/gal L
MOXY (Agriliance)	BROMOXYNIL	2 lb/gal L
NORTHSTAR (Syngenta)	PRIMISULFURON + DICAMBA	43.8% DG (7.5 + 36.3)
NORTRON SC (Bayer CropSciences)	ETHOFUMESATE	1½ lb/gal L; 4 lb/gal SC
OPTION (Bayer CropSciences)	FORAMSULFURON (+ SAFENER)	35% WDG
OSPREY (Bayer CropSciences)	MESOSULFURON-METHYL	4.5% WDG
OUTLOOK (BASF)	DIMETHENAMID-P	6 lb/gal
PARALLEL (Makhteshim-Agan)	METOLACHLOR (+ SAFENER)	7.8 lb/gal L
PARALLEL PCS (Makhteshim-Agan)	METOLACHLOR	8.0 lb/gal L
PEAK (Syngenta)	PROSULFURON	57% DG
PENDIMAX (Dow AgroSciences)	PENDIMETHALIN	3.3 EC
PERMIT (Gowan)	HALOSULFURON	75% DS
PHOENIX (Valent)	LACTOFEN	2 lb/gal
POAST (Micro Flo)	SETHOXYDIM	1.53 lb/gal L
POAST PLUS (Micro Flo)	SETHOXYDIM + DASH	1.0 lb/gal L
PREFIX (Syngenta)	S-METOLACHLOR + FOMESAFEN	Co-pack
PRINCEP (Syngenta)	SIMAZINE	4 lb/gal L; 80% WP; 90% DG
PRIORITY (Tenkoz)	CARFENTRAZONE + HALOSULFURON-METHYL	62.5% DG (12.5 + 50)
PROGRESS (Bayer CropSciences)	DESMEDIPHAM + PHENMEDIPHAM + ETHOFUMESATE	1.8 lb/gal L (0.6 + 0.6 + 0.6)

(Continued on next page)

TABLE 14 – Glossary of Chemical Names (continued)

TRADE NAME** AND (MANUFACTURER)	COMMON NAME	CONCENTRATION COMMERCIAL FORMULATION†
PROGRESS ULTRA (Bayer CropSciences)	DESMEDIPHAM + PHENMEDIPHAM + ETHOFUMESATE	3.6 lb/gal L (1.2 + 1.2 + 1.2)
PROWL (BASF)	PENDIMETHALIN	3.3 EC
PROWL H_2O (BASF)	PENDIMETHALIN	3.8 lb/gal ACS
PUMA (Bayer CropSciences)	FENOXAPROP-P-ETHYL	1 lb/gal EC
PURSUIT (BASF)	IMAZETHAPYR	2 lb/gal L; 70% DG, ECO-PAK
PURSUIT PLUS (BASF)	IMAZETHAPYR+PENDIMETHALIN	3 lb/gal L (0.2 + 2.8)
PYRAMIN (Micro Flo)	PYRAZON	67% DF
PYTHON (Dow AgroSciences)	FLUMETSULAM	80% WDG
RAPTOR (BASF)	IMAZAMOX	1 lb/gal L
REFLEX (Syngenta)	FOMESAFEN	2 lb/gal L
REGLONE (Syngenta)	DIQUAT	2 lb/gal L
RESOLVE (DuPont)	RIMSULFURON	25% DF
RESOURCE (Valent)	FLUMICLORAC	0.86 lb/gal L
REZULT (BASF)	BENTAZON+SETHOXYDIM+DASH	Co-Pack
RO-NEET (Cedar)	CYCLOATE	6 lb/gal L; 10% G
SANDEA (Gowan)	HALOSULFURON	75% DG
SCEPTER (BASF)	IMAZAQUIN	1.5 lb/gal L; 70% DG, ECO-PAK
SELECT (Valent)	CLETHODIM	2 lb/gal L
SELECT MAX (Valent)	CLETHODIM	0.97 lb/gal EC
SENCOR (Bayer CropSciences)	METRIBUZIN	75% DF; 4 lb/gal L; Solupak
* SHOTGUN (United Agro Products)	ATRAZINE+2,4-D ESTER	3.25 lb/gal L (2.25 + 1)
SIM-TROL (Sipcam Agro)	SIMAZINE	4 lb/gal L; 90% DF
SINBAR (DuPont)	TERBACIL	80% WP
SONALAN (Dow AgroSciences)	ETHALFLURALIN	3 lb/gal L
SONIC (Dow AgroSciences)	SULFENTRAZONE + CLORANUSULAM	70% DF (62.1 + 7.9)
SPARTAN (FMC)	SULFENTRAZONE	4 lb/gal L
STALWART (Sipcam Agro)	METOLACHLOR	8.0 lb/gal L
STALWART C (Sipcam Agro)	METOLACHLOR (+ SAFENER)	7.8 lb/gal L
STALWART XTRA (Sipcam Agro)	METOLACHLOR (+ SAFENER) + ATRAZINE	5.5 lb/gal (2.4 + 3.1)
STARANE (Dow AgroSciences	FLUROXYPYR	1.5 lb/gal L
STEADFAST (DuPont)	NICOSULFURON+RIMSULFURON	75% WDG (50 + 25)
* STEADFAST ATZ (DuPont)	NICOSULFURON + RIMSULFURON + ATRAZINE	89.3% WDG (2.7 +1.3 +85.3)
STINGER (Dow AgroSciences)	CLOPYRALID	3 lb/gal L
STOUT (DuPont)	NICOSULFURON + THIFENSULFURON METHYL	62.5% (67.5 + 5.0)
* SURPASS (Dow AgroSciences)	ACETOCHLOR (+SAFENER)	6.4 lb/gal L
SYNCHRONY XP (DuPont)	CHLORIMURON ETHYL+THIFENSULFURON METHYL	28.4% DG (3:1)
TARGA (Gowan)	QUIZALOFOP-P-ETHYL	0.88 lb/gal L
* TOPNOTCH (Dow AgroSciences)	ACETOCHLOR (+SAFENER)	3.2 lb/gal L
TRIFLURALIN (Several)	TRIFLURALIN	4 lb/gal L; 10% G
ULTRA BLAZER (BASF)	ACIFLUORFEN	2 lb/gal
UPBEET (DuPont)	TRIFLUSULFURON METHYL	50% WDG
VALOR (Valent)	FLUMIOXAZIN	51% WDG
VELPAR (DuPont)	HEXAZINONE	2 lb/gal L; 90% SP, 75% DF
* VOLLEY (Tenkoz)	ACETOCHLOR (+ SAFENER)	6.4 lb/gal L
* VOLLEY ATZ (Tenkoz)	ACETOCHLOR (+ SAFENER) +ATRAZINE	5.25 lb/gal L (3.0 + 2.25)
* VOLLEY ATZ LITE (Tenkoz)	ACETOCHLOR (+ SAFENER) +ATRAZINE	5.5 lb/gal L (4.0 + 1.5)
WIDEMATCH (Dow AgroSciences)	CLOPYRALID + FLUROXYPYR	1.5 lb/gal L (0.75 + 0.75)
YUKON (Gowan)	HALOSULFURON+DICAMBA	67.5% WDG (12.5+55)

*Restricted use pesticides

**"Several" means there are numerous trade names for the chemical. The mention of trade names does not imply that they are endorsed or recommended over those of similar nature not listed.

† ACS – aqueous capsule suspension, DC – dry concentrate, DF – dry flowable, DG – dispersible granule, DS – dry soluble granule, EC – emulsifiable concentrate, EW – emulsifiable concentrate G – granular, L – liquid, WDG – water-dispersible granules, WP – wettable powder, WSP – wettable soluble powder.

TABLE 15 – Glossary of EPA Registration Numbers

Aatrex 4L	Syngenta	100-497
Aatrex 90	Syngenta	100-585
Accent	DuPont	352-560
Affinity BroadSpec	DuPont	352-661
Aim EW	FMC	279-3242
Alachlor-4EC	Micro Flo	524-314-51036
Arrow 2EC	Makhteshim-Agan	66222-60
Assure II	DuPont	352-541
Authority First	FMC	279-3246
Axiom	Bayer CropSciences	264-766
Backdraft SL	BASF	241-407
Banvel	Micro Flo	51036-289
Basagran	Micro Flo	7969-45
Basis	DuPont	352-571
Basis Gold	DuPont	352-585
Beacon	Syngenta	100-705
Betamix	Bayer CropSciences	264-621
Betamix Ultra	Bayer CropSciences	264-851
Betanex	Bayer CropSciences	264-620
Bicep II Magnum	Syngenta	100-817
Bicep Lite II Magnum	Syngenta	100-827
Boundary 6.5EC	Syngenta	100-1162
Buccaneer 4L	Tenkoz	524-445-55467
Buccaneer Plus 4L	Tenkoz	524-454-55467
Buctril	Bayer CropSciences	264-437
Buctril + Atrazine	Bayer CropSciences	264-477
Bullet	Monsanto	524-418
Butoxone 200	Nufarm	71368-46-81315
Butyrac 200	Albaugh	42 750-38
Callisto	Syngenta	100-1131
Camix	Syngenta	100-1148
Canopy	DuPont	352-444
Canopy EX	DuPont	352-635
Celebrity	BASF	7969-166
Celebrity Plus	BASF	7969-175
Cinch	DuPont	100-818-352
Cinch ATZ	DuPont	100-817-352
Cinch ATZ Lite	DuPont	100-827-352
Clarity	BASF	7969-137
Classic	DuPont	352-436
Clearout 41 4L	Chemical Product Technologies	70829-2
ClearOut 41 Plus	Chemical Products Technologies	70829-3
Cobra	Valent	59639-34
Command 3ME	FMC	279-3158
Cornerstone	Agriliance	42750-60-1381
Cornerstone Plus	Agriliance	524-454-1381
Credit	Nufarm	71368-20
Credit Duo	Nufarm	71368-25
Credit Duo Extra 4L	Nufarm	71368-25
Credit Extra	Nufarm	71368-20
Curtail	Dow AgroSciences	62719-48
2,4-D	many	many
Define	Bayer CropSciences	264-765
Define SC	Bayer CropSciences	264-819
Degree	Monsanto	524-496
Degree Xtra	Monsanto	524-511
Desicate II	Atochem/Cerexagri	4581-381
Distinct	BASF	7969-150
Domain	Bayer CropSciences	264-771
Dual Magnum	Syngenta	100-816
Dual II Magnum	Syngenta	100-818
Dual II Magnum SI	Syngenta	100-829
Dual IIG Magnum	Syngenta	100-910
Durango	Dow AgroSciences	62719-517
Eptam 7-E	Syngenta	10182-220
Eptam 20-G	Syngenta	10182-199
Equip	Bayer CropSciences	264-686
Expert	Syngenta	100-1161
Express	DuPont	352-509
Extra Credit 5	Nufarm	71368-43
Extreme	BASF	241-405
Field Master	Monsanto	524-497
FirstRate	Dow AgroSciences	62719-275
Flexstar	Syngenta	10182-418
FulTime	Dow AgroSciences	62719-371
Fusion	Syngenta	10182-343
Gangster	Valent	62719-275-59639
Gly-Flo	Micro-Flo	51036-312
Gly Star Original	Albaugh	42750-60
Gly Star Plus	Albaugh	42750-61
Gly-4	Universal Crop Protection	42750-60-72693
Gly-4 Plus	Universal Crop Protection	42780-61-72693
Glyfos	Cheminova	4787-31
Glyfos X-tra	Cheminova	4787-23
Glyphogan	Makhteshim-Agan	66222-105
Glyphomax	Dow AgroSciences	62719-323
Glyphomax Plus	Dow AgroSciences	62719-322
Glyphomax XRT	Dow AgroSciences	62719-517
Glyphosate 4	Makhteshim-Agan	72167-23-73220
Glyphosate 41 Plus	Cropsmart	42750-61-72693
Glyphosate 41%	Helm Agro U.S., Inc.	74530-4
Glyphosate Original	Griffin	352-607-1812
Gramoxone Inteon	Syngenta	100-1217
Grandslam	Hide, LLC.	75095-4
G-Max Lite	BASF	7969-200
Guardsman Max	BASF	7969-192
Harmony Extra	DuPont	352-538
Harmony GT	DuPont	352-446
Harness	Monsanto	524-473
Harness Xtra 5.6L	Monsanto	524-485
Harness Xtra	Monsanto	524-480
Helosate Plus	Helm Agro U.S., Inc.	74530-4
Honcho 4L	Monsanto	524-445
Honcho Plus 4L	Monsanto	524-454
Hornet WDG	Dow AgroSciences	62719-315
Impact	AMVAC	5481-524
IntRRo	Monsanto	524-314
Kerb 50-W	Dow AgroSciences	707-159
Keystone	Dow AgroSciences	62719-368
Keystone LA	Dow AgroSciences	62719-479
Laddok S-12	Sipcam Agro	7969-100
Lariat	Monsanto	524-329
Lexar	Syngenta	100-1201
Liberty	Bayer CropSciences	264-660
Lightning	BASF	241-377
Linex	Griffin	1812-245
Lorox DF	Griffin	352-394
Lumax	Syngenta	100-1152
Marksman	BASF	7969-136
MCPA Amine	many	many
Micro-Tech	Monsanto	524-344
Mirage	UAP	524-445-34704

(Continued on next page)

TABLE 15 – Glossary of EPA Registration Numbers (continued)

Mirage Plus 4L	UAP/Platte	524-454-34704
Moxy	Terra	51036-256-9779
Northstar	Syngenta	100-923
Nortron SC	Bayer CropSciences	264-613
Option	Bayer CropSciences	264-685
Osprey	Bayer CropSciences	264-802
Outlook	BASF	7969-156
Parallel	Makhteshim-Agan	66222-87
Parallel PCS	Makhteshim-Agan	66222-86
Partner	Monsanto	524-403
Pendimax 3.3	Dow AgroSciences	68156-6-62719
Permit	Gowan	81880-2-10163
Phoenix	Valent	59639-118
Poast	BASF	7969-58
Poast Plus	BASF	7969-88
Princep 4L	Syngenta	100-526
Princep Caliber 90	Syngenta	100-603
Priority	Tenkoz	33906-17-55467
Progress	Bayer CropSciences	264-815
Progress Ultra	Bayer CropSciences	264-854
Prowl 3.3EC	BASF	241-337
Prowl H2O	BASF	241-418
Puma	Bayer CropSciences	264-666
Pursuit DG	BASF	241-350
Pursuit Plus EC	BASF	241-331
Pyramin DF	BASF	7969-81
Python	Dow AgroSciences	62719-277
Raptor	BASF	241-379
Rattler	Helena	524-445-5905
Rattler Plus 4L	Helena	524-454-5905
Reflex	Syngenta	10182-83
Reglone	Syngenta	10182-353
Rely	Bayer CropSciences	264-652
Resolve	DuPont	352-556
Resource	Valent	59639-82
Ro-Neet 6-E	Syngenta	10182-178
Roundup Original	Monsanto	524-445
Roundup OriginalMax 5.5L	Monsanto	524-539
Roundup UltraDry	Monsanto	524-504
Roundup WeatherMax	Monsanto	524-537
Sandea	Gowan	10163-254
Scepter 70DG	BASF	241-306
Select 2EC	Valent	59639-3
Select Max	Valent	59639-132
Sencor DF	Bayer CropSciences	264-738
Shotgun	United Agri Products	34704-728
Sim-Trol 4L	Sipcam Agro	35915-11-60063
Sim-Trol 90DF	Sipcam Agro	35915-12-60063
Sinbar	DuPont	352-317
Sonalan HFP	Dow AgroSciences	62719-188
Sonic	Dow AgroSciences	279-3246-62719
Spartan	FMC	279-3189
Stalwart	Sipcam Agro	60063-24
Stalwart C	Sipcam Agro	60063-22
Stalwart Xtra	Sipcam Agro	60063-23
Starane	Dow Agrosciences	622719-286
Steadfast	DuPont	352-608
Steadfast ATZ	DuPont	352-619
Stinger	Dow AgroSciences	62719-73
Stout	DuPont	352-667
Surpass EC	Dow AgroSciences	10182-325
Synchrony XP	DuPont	352-648
Targa	Gowan	33906-9-81880
TopNotch	Dow AgroSciences	62719-369
Touchdown HiTech	Syngenta	100-1182
Touchdown Total	Syngenta	100-1169
Treflan TR-10	Dow AgroSciences	62719-131
Ultra Blazer	BASF	7969-79
Upbeet	DuPont	352-569
Valor	Valent	59639-99
Velpar DF	DuPont	352-581
Velpar L	DuPont	352-392
Volley	Tenkoz	55467-8
Volley ATZ	Tenkoz	55467-7
Volley ATZ Lite	Tenkoz	55467-6
WideMatch	Dow AgroSciences	62719-512
Yukon	Monsanto	33906-11-524

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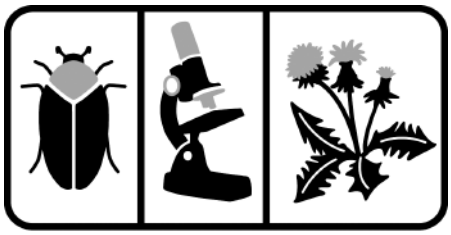
How to submit a sample to MSU Diagnostic Services



Diagnostic Services

Sample Submission

Accurate diagnosis depends on the rapid receipt of fresh and representative samples along with pertinent information relating to the problem. A completed submittal form should accompany all samples. Submittal forms are available at MSU Diagnostic Services or your local Extension office. Submittal forms can also be downloaded from **www.pestid.msu.edu**. Samples can be dropped off at our reception area between 8 a.m. and 5 p.m. or shipped overnight delivery by U.S. mail, FedEx, or UPS. To preserve the quality of the sample, do not package samples in envelopes. Also avoid mailing samples on Friday.

Submit samples to:

Michigan State University
Diagnostic Services
101 Center for Integrated Plant Systems
East Lansing, MI 48824-1311
Phone: (517) 355-4536 Fax: (517) 432-0899

Plant Health Analysis Samples:

Herbaceous Plants: Send whole plants, including roots and soil. Roots and soil should be in a plastic bag tied off at the soil line to prevent soil from touching foliage.

Tree Decline/Wilt: Send 6 to 12 branch sections .5 inch to 1 inch diameter and ~ 8 inches long. Samples should be taken from live areas of tree with symptoms, not from completely dead branches. Seal branches in plastic to retain moisture.

Seedlings: Leave plants in plug sheets or trays if possible. Send a minimum of 12 seedlings.

Turf: Include a 6" square of turf from the margin of the diseased area so that both healthy and diseased turf is included. An intact layer of soil should be included. Wrap sample in newspaper and pack in a box for shipment. Include a detailed description of cultural practices. Do not add moisture to the turf prior to shipment.

Leaf spot and Fruit Rot: Send several affected samples representing the early and moderate stages of the symptom progression.

Herbicide Injury: Submit both injured and apparently healthy crop plants. Plants should be dug carefully from the soil so roots, if injured, will remain intact. Roots and soil should be placed in a plastic bag, pot, or small bucket to prevent soil from touching the foliage. A pint of soil from both "good" and "bad" area should also be submitted. Any patterns in the field should be noted on the submittal form, along with past crop and pesticide history.

Weed/Plant Samples:

Herbaceous Plant Identification: Submit whole plants, including roots, vegetative structures, and flowers. Plants may be pressed flat between paper or cardboard to prevent leaf crinkling. For best results, plants should be submitted immediately after digging. Roots and soil should be in a plastic bag to prevent soil from touching the foliage.

Woody Plant Identification: Submit a large section of the terminal end of the stem or branch. Where possible, include any flower or fruiting structures, roots, and leaves. Leaves may be pressed flat between paper or cardboard to prevent crinkling. Woody plants may be wrapped in plastic to retain moisture.

Herbicide Resistance: Weeds will be screened for herbicide resistance using one of several techniques. Typically, a whole plant pot assay established from seed will be our standard test for resistance confirmation. Mature, high quality seed or seedheads should be collected from suspicious plants in late summer or fall and submitted in a paper bag. Do not seal in plastic. Screens will be designed by herbicide site of action (ie: ACCase inhibitors, ALS inhibitors, Photosynthesis inhibitors). Other resistance confirmation tests may be utilized but will depend upon weed species, herbicide, and mechanism of resistance. Extensive tests include but are not limited to: petri-dish germination, chlorophyll fluorescence, leaf disc flotation, and enzyme sensitivity assays, as well as molecular diagnostic testing.

How to submit a sample to MSU Diagnostic Services (continued)

Nematode Samples:

Refer to MSU Extension Bulletin E-2199, "Detecting and Avoiding Nematode Problems."

Always store nematode samples in plastic bags or other containers that retain moisture. Submit a pint to a quart of soil.

Problem Diagnosis: Collect soil & roots (or foliage) from the margins of diseased areas. Submit samples of diseased plants and apparently healthy ones.

Problem Avoidance: Collect soil & roots (if available) by walking a zigzag or w-shaped pattern. The more subsamples (soil, cores, probes, etc.) collected the "better" the sample.

Insect/Arthropod Samples:

Precise identification of insects or other arthropods requires specimens to be undamaged upon arrival. It is very important to kill and ship the specimens in a manner that will not damage the delicate structures that facilitate their identification. Dried and unprotected insects crumble easily during mail processing. Kill and ship specimens in a small, leak proof vial filled with rubbing alcohol.

Moths/Butterflies: Place specimens in the freezer for half an hour to kill them and gently pack in a small box or vial with tissue paper.

Ants/Other Adult Arthropods: Ant specimens should only include worker ants (i.e. those without wings). Submit all specimens in alcohol. Other adult and hard-bodied specimens: Submit in alcohol.

Larvae (Caterpillar, grub, maggot, etc.): Whenever possible, soft-bodied larvae should be lightly boiled for a few minutes before placing them in alcohol. This prevents the specimens from shriveling and becoming discolored, however it only works if the larvae are alive when dropped in the boiling water.

Pesticide Analysis Samples:

Soil, water, and plant vegetation can be tested for the presence of pesticides using appropriate analytical instruments and techniques. Pesticides will be tested on an individual basis or, if available, in multi-pesticide screens. Samples should be submitted in leak-proof, glass containers and kept cold or frozen until arrival.

Services and Fees for MSU Diagnostic Services

Note: Fees for out-of-state samples are higher. Contact laboratory for pricing.

Plant Health Analysis

- Visual inspection for infectious and non-infectious diseases, insect injury and herbicide injury; pathogen culturing; pH and soluble salts: $20.00
- INSV / TSWV ELISA tests: $20.00
- Bacterial ID (BIOLOG™): $25.00
- Special laboratory analysis: *

Weeds/Plants

- Common plant ID: N/C
- Keyout plant ID: $10.00
- Herbicide resistance in weeds
  Standard test:
  - Single site of action $50.00
  - Each additional site of action $20.00

  Extensive test: *
- Special identification/diagnosis *

Nematodes

- Basic nematode analysis: $20.00
- Total nematode community analysis: $50.00
- HG Type testing $50.00
- *Verticillium* analysis
  Wet sieving: $20.00
  Dilution plating: $15.00

Insects/Arthropods

- Common insect ID: N/C
- Keyout insect ID: $10.00
- Special identification/diagnosis *

Pesticide Analysis

- Individual pesticide tests/ multi-pesticide tests
  Water: $90.00 / $125.00
  Vegetation: $100.00 / $150.00
  Soil: $125.00 / $175.00

** Variable costs requiring client approval. Contact laboratory for pricing.*

DIAGNOSTIC SERVICES
101 Center for Integrated Plant Systems
East Lansing, MI 48824-1311
Office:517-355-4536 FAX:517-432-0899
www.pestid.msu.edu

Case No.: _____
Date Received: _____
Amount Paid: _____
Check/Receipt No.: _____
MSU Account #: _____
Diagnostic Fee: _____

Name: _____
Business Name: _____
Address: _____
City/State/Zip: _____
Work: ( ) FAX: ( ) Home: ( )
Email: _____ Cell: ( )
Sample Reference: _____

Plant Disease Diagnosis Fees	
Plant health analysis:	$20
INSV / TSWV ELISA tests:	$20
Bacterial ID (BIOLOG !"):	$25
Insect / Plant Identification Fees	
Common ID:	N/C
Keyout ID:	$10
Special ID /diagnosis (Per hour charge):	contact lab
Herbicide Resistance/ Pesticide Analysis:	contact lab
Nematode Sample Fees	(see below)

Out of State Fees Double
Fees subject to change

SEND RESULTS TO: CLIENT COUNTY AGENT KEEP RESULTS CONFIDENTIAL Fax: ( )
MSU Extension Agent: _____ County: _____ Email: _____

SAMPLE (ex. Tomato, Insect, Pine, etc.): _____

GENERAL INFORMATION (indicate all that apply)

PLANT PARTS AFFECTED
Entire Plant, Stems, Leaves/Needles, Twigs/Limbs, Roots, Trunk, Fruit, Flowers

NATURE OF THE INJURY
Poor or Abnormal Growth, Spots, Wilting, Yellowing, Plant Death, Boring, Leaf/Needle Drop, Cupping, Chewing, Dieback, Rot, Galls/Cankers

SOIL TYPE
Sandy, Clay, Muck, Silt Loam

TYPE OF PLANTING
Field, Garden, Nursery, House Plant, Greenhouse, Pasture, Orchard, Natural Area, Turf/Lawn, City/Recreation

PREVALENCE
Entire Planting, Single Localized Area, Several Localized Areas, Few Scattered Plants

EXTENT OF THE DAMAGE
Light Moderate Severe

DRAINAGE
Good Fair Poor

PROBLEM DISTRIBUTION
Upland, Near Drive/Road, Slopes, Edge of Field, Low Areas, Near a Residence

OTHER BACKGROUND
How long at site?
Height of plant?
How many plants affected?
How often watered?
How fertilized?
Sunny or Shaded?

HERBICIDE HISTORY
This year: _____
_____
Last year: _____
_____

INSECTICIDE HISTORY
This year: _____
_____

FUNGICIDE HISTORY
This year: _____
_____

CROP HISTORY
Last year: _____
This year: _____
Next year: _____

INSECT / ARTHROPOD ID SAMPLES ONLY (indicate all that apply)
Where was the insect found? _____ What was the insect doing there? _____
How many insects are there? One Few Several Hundreds Do you have small children living with you? _____

PLANT / WEED ID SAMPLES ONLY (indicate all that apply)

PLANT TYPE
Tree, Groundcover, Shrub, Herbaceous, Vine, Aquatic

PLANT SIZE
Height: _____
Width: _____
Few Leaves Many Leaves

GROWTH HABIT
Upright/Erect, Prostrate/Low-Growing, Climbing

FLOWERS
Color: _____
Size: _____
List any unique features: _____

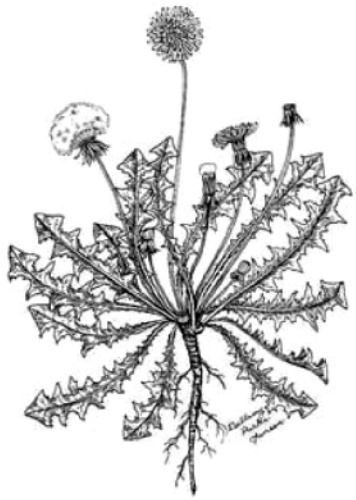
PLANT AGE
Annual: _____
Perennial: _____

NEMATODE SAMPLES ONLY (indicate type of analysis requested)
Soil and root analysis ($20/sample) Foliar nematode analysis ($20/sample)
Total nematode community structure analysis ($50/sample)
Hg Type test ($50/sample)
Verticillium dahliae analysis (potato soil / stem only) Dilution ($15/sample) Wet-sieving ($20/sample) Both ($35/sample)

No. of samples: _____
Sample/Field ID: _____

Controlling Dandelion

DANDELION is a simple perennial weed that is most often associated with undisturbed sites such as lawns and continuous no-till production fields. This species is most commonly recognized for its bright yellow flowers and mature seed heads that disperse seeds via the wind. Aboveground, the plant consists of leaves arranged in a rosette. Leaves vary in shape; their margins may either be smooth or toothed. Belowground, dandelion plants have a large taproot that allows the plant to over winter and to continue growing the following spring.



METHODS OF CONTROL

Mechanical Control

Dandelion is primarily a problem only in no-till production fields. Regular disturbance of the soil root zone by tillage will inhibit the establishment of dandelion plants. No-till fields that are infested with a dense population of dandelion may benefit from periodic cultivation.

Chemical Control

Herbicide applications of either glyphosate or 2,4-D ester are more effective in the fall than in the spring. Glyphosate applied at 0.75 a.e. lb/A plus ammonium sulfate (AMS) at 17 lb/100 gal effectively controlled dandelion when applied in the fall following crop removal. Spring applications were less effective. 2,4-D ester applied at 1 lb a.e./A was less effective than glyphosate. Because of plant regrowth and new seedling germination, sequential applications of glyphosate applied postemergence in Roundup Ready corn or soybean will be needed to further reduce populations of dandelion. The use of a residual herbicide is often needed to control seedling dandelions that may emerge after glyphosate or 2,4-D ester applications.

Corn Marketing Program of Michigan

MSPC

Project GREEEN

PREPLANT STRATEGIES

Herbicide Treatment	Timing	Effectiveness
glyphosate (0.75 lb ae)+ AMS[a] (17 lb/100 gal)	LFALL	**Good**
glyphosate (0.75 lb ae)+ AMS (17 lb/100 gal)	EFALL	Fair-**Good**
glyphosate (0.75 lb ae)+ AMS (17 lb/100 gal)	ESPRING	Fair
2,4-D ester[b] (1.0 lb ae)	EFALL	Fair
2,4-D ester[b] (1.0 lb ae)	LFALL	Fair
2,4-D ester[b] (1.0 lb ae)	ESPRING	Poor
glyphosate (0.75 lb ae)+ AMS (17 lb/100 gal)	LSPRING	Poor
2,4-D ester[b] (1.0 lb ae)	LSPRING	Poor

BEFORE SOYBEAN

Herbicide Treatment	Timing	Effectiveness
Canopy[c] (2.25-4.0 oz) + Express (0.17 oz) + 2,4-D[b] (0.5 lb ae) + COC (1% v/v)	FALL	**Good**
Canopy EX[c] (1.1-3.3 oz) 2,4-D[b] (0.5 lb ae) + + COC (1% v/v)	FALL	**Good**
Sencor (8 oz) + 2,4-D[b] (1.0 lb ae)	FALL	Poor
Valor (2 oz) + 2,4-D[b] (1.0 lb ae)	FALL	Poor

POSTEMERGENCE IN CORN

Herbicide Treatment	Effectiveness
Callisto (3 fl oz) + COC (1% v/v) + 28% UAN (2.5% v/v)	**Good**
Callisto (3 fl oz) + Atrazine (0.25 lb ai) + COC (1% v/v)+ 28% UAN (2.5% v/v)	**Good**
Distinct (6 oz) + NIS (0.25% v/v) + 28% UAN (1.25% v/v)	**Good**
Glyphosate[d] (0.75 lb ae) + AMS (17 lb/100 gal)	**Good**
Liberty[e] (24 fl oz) + AMS (17 lb/100 gal)	**Good**
Liberty[e] (24 fl oz) + Atrazine (0.25 lb ai) + AMS	**Good**
Marksman (3.5 pt)	Fair
Northstar (5 oz) + NIS (0.25% v/v) + 28% UAN (2.5% v/v)	Fair

[a] AMS = ammonium sulfate; COC = crop oil concentrate; 28% UAN = 28% liquid nitrogen; NIS = non-ionic surfactant.
[b] 2,4-D ester at (1 lb ae/A) wait a minimum of 30 d before planting soybean; 2,4-D ester at (0.5 lb ae/A) wait a minimum of 7 d before planting soybean
[c] DO NOT apply *Canopy* at rates higher than 2.25 oz or *Canopy EX* at rates higher than 1.1 oz to soils with a composite pH exceeding 7.0. DO NOT apply *Canopy* or *Canopy EX* to soils with a composite pH exceeding 7.6.
[d] Treatments containing glyphosate can be applied only to Roundup Ready corn hybrids.
[e] Treatments containing Liberty can be applied only to Liberty Link corn hybrids.

Controlling Grass Weeds in Winter Wheat

David Hillger[1], Steve Gower[2] and Jim Kells[1]
[1]Department of Crop and Soil Sciences, [2]MSU Diagnostic Services, Michigan State University

Annual grass weed control options in winter wheat are very limited. Grasses such as annual bluegrass, cheat and windgrass can have a severe impact on winter wheat yields and grain quality. Chemical control options for these grasses has expanded in recent years; however correct identification and early management is critical in achieving the best control success while limiting potential crop injury.

Annual Bluegrass (*Poa annua*) is a clump-forming winter annual grass. It reproduces by seed and the clumps enlarge by aggressive tillering. Annual bluegrass has linear leaves (sides parallel) with boat-shaped leaf tips. This boat-shaped leaf tip is characteristic of the bluegrasses. It has long, pointed, membranous ligules (Figure 1). Annual bluegrass appears to be light green in color, compared to the other grasses.

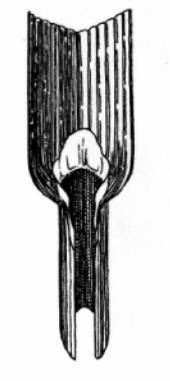


Figure 1. Annual bluegrass ligule and sheath (Ciba-Geigy Corporation)

Annual bluegrass's seedhead is an open-branched, greenish white panicle with a pyramid-like shape (Figure 2). Annual bluegrass has traditionally been a problem in turf; however it can be present in row crops and winter-seeded small grains like wheat. It grows best in a cool, moist environment; however it can tolerate a variety of conditions. The spikelets will have 3 to 6 flowers each.

Figure 2. Annual bluegrass seedhead (Ciba-Geigy Corporation)

Cheat (*Bromus secalinus*) is an annual grass species that reproduces by seed. It is similar in appearance and growth habit as winter wheat. Cheat normally germinates in the fall, over winters, grows in the spring and reaches maturity in early summer. The leaves of cheat may be smooth to softly hairy. Stems are smooth but with characteristically dense, hairy nodes. The lower leaf sheaths may be closed while upper sheaths are split with overlapping margins. Cheat has membranous, 1 to 2-mm tall ligules (Figure 3).

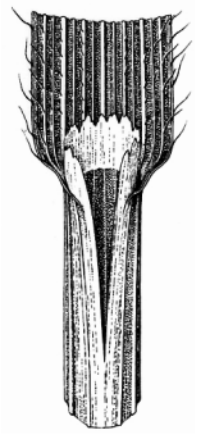


Figure 3. Cheat ligule and sheath (Ciba-Geigy Corporation)

The seedhead of cheat is an erect, branched panicle (Figure 4). Spikelets contain 5-15 seeds that have 3.0 to 6.5 mm awns or can be without awns. At maturity, the lemmas will distinctively roll inwards.

Figure 4. Cheat seedhead (Ciba-Geigy Corporation)

Windgrass (*Apera spica-venti*) is a winter or summer annual plant that only reproduces by seed. Stems can be up to 1.5 m tall, unbranched, and produce several tillers, like wheat. Windgrass has short, pointed membranous ligules as a seedling but become somewhat torn or toothed with maturity (Figure 5). The ligules can be short but lengthen with age. Margins of the ligules are continuous with the sheath margins. Leaf sheaths and leaves are smooth.

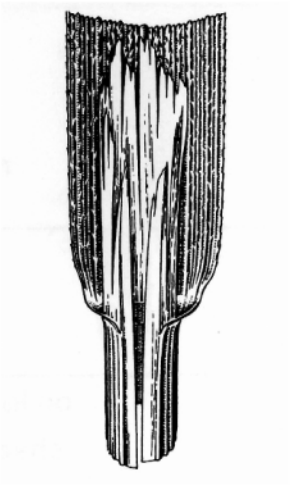


Figure 5. Windgrass ligule and sheath (Ciba-Geigy Corporation)

Windgrass has rather large nodes that are much darker than the stem and sheath. These nodes sometimes appear brown to black in color. Upon maturity, windgrass has a loose, open-branched, reddish panicle with numerous fine branches (Figure 6). Each branch ends with a single spikelet that has a long, straight awn.

Figure 6. Windgrass seedhead (Ciba-Geigy Corporation)

Management with Herbicides Management of these grass species in wheat can be accomplished with herbicides. The products registered for use in Michigan for control of grasses in wheat are: *Osprey* (mesosulfuron), *Puma* (fenoxaprop) and trifluralin. MSU has conducted limited research with these products. The spectrum of species controlled varies with these products (see Table 1) and correct identification is important.

Table 1. Weed Species Controlled, Use Rate and Adjuvants Needed

Herbicide	Species labeled as controlled: Bluegrass	Cheat	Windgrass	Rate (prod/A)	Adjuvant[A]
Osprey	yes	++[B]	yes	4.75 oz	NIS & AMS
Puma	no	no	yes	10.6 fl oz	none

[A]NIS = non-ionic surfactant; AMS = ammonium sulfate
[B] MSU research has found good suppression of cheat at the labeled use rate of this product.

Osprey and *Puma* are applied to wheat prior to the jointing stage (Feeke's Stage 6). The crop rotation restrictions should be considered before choosing an herbicide. The crop rotation restriction for *Osprey* is: 12 months to corn, 3 months to soybean and 10 months to sugarbeet. *Puma* has little soil activity therefore there is no crop rotation restrictions following application. Product labels should always be consulted before using.

Trifluralin can be used post-plant, soil incorporated in the fall to control windgrass. This application must be made no later than two days after planting and should be incorporated into the top 1 inch with tillage without disturbing the planted wheat (read product label for more details).

In addition to these herbicides, four other products (flucarbazone, pinoxaden, propoxycarbazone and sulfosulfuron) are registered for use in Michigan for control of one or more of these grass species postemergence in winter wheat. MSU has little or no data for these products. These herbicides contain crop rotation restrictions that may limit rotation options in Michigan.

Keys to Management Success The most important key to controlling these grasses in wheat is to prevent them from becoming a problem. Proper identification and early detection will improve the opportunity for successful control. If a field has a large infestation, changes in the crop rotation may offer an opportunity to aggressively target these weeds with control practices not available within wheat. Growers should also avoid spreading weed seeds from field to field by cleaning their tillage and harvest equipment before entering fields where these species are not a problem. Weed free seed should be used. If saved seed is used, do not use seed from a field where these grasses are present. Using multiple tactics will provide greater control success and prevent the increase of these problematic species.

Controlling White Campion in No-Tillage Systems

Christy Sprague, Karen Renner, and Gary Powell
Department of Crop and Soil Sciences, Michigan State University

Description of White Campion

White campion (*Silene alba*) or more commonly referred to as white cockle is a biennial or short-lived perennial weed. White campion is commonly found along roadsides, and is a weed of small grains and legume forage crops. However, with the general increase in no-tillage production systems white campion has more recently become a problem in no-tillage soybean and corn production. White campion grows from roots that overwinter, but only reproduces by seed. Seedlings can emerge in mid- to late spring and again in late summer. Since white campion is usually a biennial it produces only leaves its first year, then overwinters and produces flowers and seed the following year.

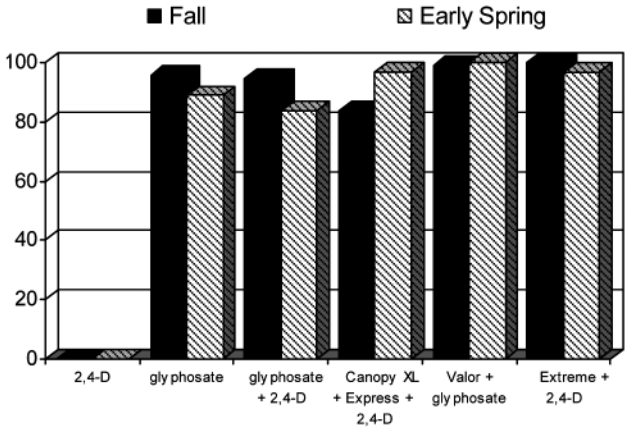
Key Identifying Characteristics

- Cotyledons are narrow to egg-shaped
- Young plants are hairy and form a rosette
- Leaves are soft, hairy and opposite
- Stems are hairy and swollen where the leaves are attached
- Flowers are generally white, but can also be light pink and appear from June to October

Control of White Campion

Since white campion is primarily a problem in no-tillage productions fields, frequent tillage will stop the establishment of white campion. However, this strategy doesn't work in no-tillage production systems. To control white campion apply glyphosate at 0.75 lb a.e./A + ammonium sulfate (AMS) at 17 lb/100 gal in the late fall (late October – November) or early spring (Figure 1). These applications need to be made before white campion is much greater than 4 inches tall in the spring or control may be reduced. Late fall applications of Canopy XL (3.5 oz/A) + Express (1/6 oz/A) + 2,4-D ester (1 pt/A) + crop oil concentrate (1.0% v/v) also provided good to excellent control of white campion. 2,4-D ester alone will *NOT* control white campion.

Figure 1. White campion control in early June with fall and early spring applications of various herbicide programs.



Acknowledgments

Research supported by the Michigan Soybean Promotion Committee.

Controlling Horseweed (Marestail)

HORSEWEED (A.K.A. MARESTAIL) is an annual weed that can follow a winter or summer annual life cycle. While the majority of horseweed emerges in the fall, it can also emerge in the spring and summer. Unlike other winter annuals horseweed does not mature until late summer, allowing for greater competition with crops compared with other winter annual weeds. Horseweed plants start out as a rosette, generally bolt in April/May, flower in July, and set and disperse seed from August to October. Each plant can produce up to 200,000 seeds that travel long distances in the wind. Up to 86% of seeds produced can germinate right off the plant. Of fall emerging seedlings 59 to 91% can survive the winter, causing problems in the next spring's crop.

HORSEWEED MANAGEMENT

Horseweed can be a problem in no-till or reduced tillage production systems. Therefore, herbicides are a major component for horseweed management. Many corn herbicides (e.g., atrazine and growth regulators) are very effective in controlling horseweed; as a result horseweed is generally not a problem in corn. However, control in soybeans can be difficult, especially with several populations of horseweed resistant to ALS-inhibiting herbicides in Michigan. Also there are concerns of glyphosate-resistant horseweed since there have been populations confirmed in Indiana and Ohio. To effectively manage horseweed it is important to control horseweed prior to soybean planting. This can be done with fall or early-spring herbicide applications. Fall applications will only control emerged horseweed, unless a residual herbicide is included. If soybeans are planted early in the season a residual herbicide should also be used to control later-emerging horseweed. Control of horseweed is more effective when plants are in the rosette stage or less than 2 inches tall.

BURNDOWN[a] (SOYBEANS)

CONTROL OF EMERGED HORSEWEED (ROSETTE STAGE ONLY)

ALL POPULATIONS (INCLUDING SUSPECTED ALS- AND GLYPHOSATE-RESISTANT POPULATIONS)

Herbicide Treatment[b]	Effectiveness
2,4-D ester (0.5 lb ai)[c,d]	**Good-Excel.**
glyphosate + 2,4-D ester (0.5 lb ai)[c,d]	**Good-Excel.**
Sencor + 2,4-D ester (0.5 lb ai)[c]	**Good-Excel.**
Sencor + Gramoxone	**Good**

CONTROL OF EMERGED HORSEWEED ROSETTE UP TO 6 INCHES

ALL POPULATIONS (INCLUDING SUSPECTED ALS- AND GLYPHOSATE-RESISTANT POPULATIONS)

Herbicide Treatment[b]	Effectiveness
glyphosate (0.75 lb ae) + 2,4-D + FirstRate[c]	**Good-Excel.**
glyphosate (0.75 lb ae) + 2,4-D + Canopy[c]	**Good-Excel.**
glyphosate (0.75 lb ae) + 2,4-D + Gangster[c]	**Good-Excel.**
glyphosate (0.75 lb ae) + 2,4-D ester[c,d]	**Good**
Sencor + Gramoxone Max + 2,4-D ester[c]	**Good**

NON-RESISTANT POPULATIONS (INCLUDING ABOVE TREATMENTS)

Herbicide Treatment[b]	Effectiveness
glyphosate (0.75 lb ae)[d]	**Good-Excel.**
glyphosate (0.75 lb ae) + FirstRate	**Good-Excel.**
glyphosate (0.75 lb ae) + Canopy	**Good-Excel.**
glyphosate (0.75 lb ae) + Gangster	**Good-Excel.**

CONTROL OF EMERGED HORSEWEED > 6 INCHES

Herbicide Treatment[b]	Effectiveness
glyphosate (1.5 lb ae) + 2,4-D + FirstRate[c]	Fair-**Good**
glyphosate (1.5 lb ae) + 2,4-D + Canopy[c]	Fair-**Good**
glyphosate (1.5 lb ae) + 2,4-D + Gangster[c]	Fair-**Good**

RESIDUAL HORSEWEED CONTROL (SOYBEANS)

HERBICIDES WITH ACTIVITY ON NON-EMERGED HORSEWEED

Herbicide[b]	Effectiveness
ALS- AND GLYPHOSATE-RESISTANT POPULATIONS	
Sencor, Valor, and Gangster	**Good**
NON-ALS-RESISTANT POPULATIONS	
Canopy, FirstRate, and Python	**Good**

POST HORSEWEED CONTROL (SOYBEANS)

Herbicide[b]	Effectiveness
ALS-RESISTANT POPULATIONS	
glyphosate (0.75 lb ae)[d]	**Excellent**
GLYPHOSATE-RESISTANT POPULATIONS	
Classic and FirstRate	**Good**

[a] Applications should be made to control all horseweed prior to planting.
[b] Refer to herbicide labels for application rates and additives.
[c] 7 day restriction prior to planting soybeans.
[d] This treatment can be used prior to planting corn.

Project GREEEN

Controlling Wild Carrot

WILD CARROT, otherwise known as Queen Anne's lace, is a deep-rooted biennial. Wild carrot usually becomes a problem in continuous no-till production systems. Similar in appearance to cultivated carrots, leaves of wild carrot are finely divided and arranged in a rosette. Keeping with its name, when any part of the plant is crushed the characteristic odor of carrot is present. Seedlings of wild carrot may emerge as early as April and continue to emerge until mid-October if conditions are favorable. Since wild carrot is a biennial it overwinters as a rosette, starts to produce new leaves as early as March, and will bolt as early as June the following season. In order to survive the winter, wild carrot's root diameter must be at least 1/8 inch. After bolting, flowering may begin as early as late-June and continue through August. Flowering wild carrot plants may grow to 4 ft tall. The umbel or seedhead of wild carrot is made up of numerous individual white flowers. Cross-pollination by insects is the primary method of fertilizing wild carrot flowers, but some self-pollination can occur. One wild carrot umbel can produce as many as 1000 seeds. Seeds are light in weight and are primarily dispersed by wind. However, wild carrot seeds have hooked spines that easily attach to animal fur and clothing that lead to other methods of dispersal. Most seeds germinate within the first two years after dispersal, but they may persist in the soil for up to seven years.

CULTURAL CONTROL

- Including fall-planted cereals, like wheat, in the rotation will reduce wild carrot seed production because wheat harvest occurs when wild carrot plants are flowering but before seed is produced.

MECHANICAL CONTROL

- Tillage effectively and consistently controls wild carrot.
- Mowing wheat stubble, roadsides, and fence rows in late August will cut off wild carrot flowers and stop seed production.

CHEMICAL CONTROL*

Wild carrot may be controlled by herbicides at three stages of growth: seedling, over-wintered, and established plants. Over-wintered and established plants are generally more difficult to control. This coupled with the frequency of 2,4-D resistant wild carrot populations in Michigan limits the options for wild carrot control. Below are herbicides options for controlling wild carrot.

BURNDOWN *(Early Preplant)*[a]

Herbicide[b,c]	Rate	Effectiveness
glyphosate + AMS	0.75 lb a.e.	Fair-**Good**
SOYBEAN ONLY		
Canopy + 2,4-D + COC	3 oz + 1 pt	Fair

SOYBEANS

Herbicide[b,c]	Rate	Effectiveness
Classic + COC	0.67 oz	Fair-**Good**
Pursuit DG + NIS + N	1.4 oz	Poor-Fair
STS SOYBEAN ONLY		
Synchrony XP + COC + N	0.75 oz	Fair-**Good**

CORN

Herbicide[b,c]	Rate	Effectiveness
Atrazine + COC	2 lb a.i.	**Good-Excel.**
Beacon + COC + N	0.76 oz	**Good**
Northstar + NIS + N	5 oz	**Good**
Accent + COC +N	0.67 oz	Fair-**Good**
Permit + NIS	0.67 oz	Fair-**Good**

ROUNDUP READY CROPS

Herbicide[b,c]	Rate	Effectiveness
glyphosate + AMS	0.75 lb a.e.	Fair

TREATMENT BETWEEN CROPS *(FALL)*[d]

Herbicide[c]	Rate	Effectiveness
glyphosate + AMS	1.5 lb a.e.	**Good-Excel.**
glyphosate + AMS	0.75 lb a.e.	**Good**

* Research supported by the Michigan Soybean Promotion Committee.

[a] Control will be greater when application is made during the first warm period in the spring following green-up.

[b] Refer to herbicide label for maximum application heights and stages.

[c] NIS = non-ionic surfactant; COC = crop oil concentrate; N = 28% UAN or AMS (ammonium sulfate).

[d] Apply in late-September or early-October. Light frosts that do not injure wild carrot will not reduce the effectiveness of the herbicide treatments.

Project GREEEN

Controlling Canada Thistle

CANADA THISTLE is a perennial weed. Infestations can start from seed but plants primarily regrow and spread each year from Canada thistle's creeping root system. The roots have adventitious buds that form new shoots each spring and summer. This extensive root system can run 15 ft or more horizontally and may penetrate up to 20 ft deep. Canada thistle plants can grow 2 to 5 ft tall and branch only at the top. Leaves are slender, smooth, and have crinkled edges with spiny margins. Canada thistle has male and female flowers on separate plants (dioecious) and seed production requires the presence of both plants. Flowers are about ¾ inch in diameter, are rose to purple in color, and are produced between July and August. Individual flower heads have about 100 florets and vigorous stems can produce 50 to 100 flower heads, with each producing 80 to 90 seeds. Viable seeds are formed 8 to 10 days after flowering and single plants can release more than 5,000 seeds. Long distance dispersal by wind is unlikely since the seeds often remain in the flower head while the pappus detaches and floats away. However, seed that remains attached to the pappus may move several feet from the parent plant. Seeds may remain viable in the soil for up to 4 years.

CULTURAL CONTROL

Including a forage or small grain in the rotation can help manage Canada thistle.

- Repeated mowing suppresses Canada thistle in forages.
- Small grains are competitive with Canada thistle, and provide an opportunity for mechanical and chemical control after harvest.

MECHANICAL CONTROL

- Tillage of established patches may spread and chop up rootstock; breaking apical dominance that leads to emergence of more shoots.

CHEMICAL CONTROL

Canada thistle is most susceptible to certain herbicides between the bud and flower stages. However, most herbicides have maximum crop height or stage restrictions for application; refer to the herbicide label for these restrictions.

SOYBEANS

Herbicide[a,b]	Rate	Effectiveness
Basagran + COC	1 qt	**Good**
Classic + NIS[c]	0.5-0.75 oz	Fair-**Good**
Pursuit DG + NIS + N[c]	1.4 oz	Fair-**Good**
FirstRate + NIS or COC + N[c]	0.3 oz	Fair
Ultra Blazer + NIS + N	1.5 pt	Poor
Cobra + COC	12 oz	Poor

CORN[d]

Herbicide[a,b]	Rate	Effectiveness
Stinger	0.5 pt	**Good**
Hornet + Stinger + NIS + N	4 oz + 4 oz	**Good**
Basagran + COC	1 qt	Fair-**Good**
Clarity	0.5 pt	Fair-**Good**
Beacon + 2,4-D + NIS	0.38 oz + 1 pt	Fair-**Good**
Beacon + Clarity + NIS + N	0.38 oz + 0.5 pt	Fair-**Good**
Northstar + NIS + N	5 oz	Fair-**Good**
Distinct + NIS + N	4 oz	Fair-**Good**
Clarity + 2,4-D amine	0.25 pt + 0.5 pt	Fair
Beacon + COC or NIS + N	0.76 oz	Fair
2,4-D amine	1 pt	Poor

ROUNDUP READY CROPS

Herbicide[a,b]	Rate	Effectiveness
glyphosate + AMS	0.75 lb a.e.	**Good-Excel.**
fb.		
glyphosate + AMS *(if needed)*	0.75 lb a.e.	
SOYBEANS ONLY		
Extreme + NIS + AMS	3 pt	**Good**

TREATMENT BETWEEN CROPS (WHEAT STUBBLE)[e]

Herbicide[b]	Rate	Effectiveness
glyphosate + AMS	1.5-2.25 lb a.e.	**Good-Excel.**
Clarity	1-2 qt	**Good-Excel.**
2,4-D ester	1-2 qt	Fair-**Good**

[a] Refer to herbicide label for maximum application heights and stages.
[b] NIS = non-ionic surfactant; COC = crop oil concentrate; N = 28% UAN or AMS (ammonium sulfate).
[c] Apply when Canada thistle is between 2 and 4 inches tall.
[d] Applications should be made when Canada thistle is 8 inches tall.
[e] Apply when Canada thistle is in the bud stage for Clarity and 2,4-D; bud to bloom stage for glyphosate; **Fall applications** are most effective.

Project GREEEN

Controlling Common Pokeweed

COMMON POKEWEED is a deep-rooted perennial that reproduces from buds on the root or from seeds. Aboveground shoots of this plant arise from the taproot and consist of diffusely branched, fleshy stems (resembling a small tree) that can reach heights of 6 to 8 ft under fertile conditions. In older plants the taproot can be up to 6 inches in diameter and can grow to depths of more than 12 inches. The fruit produced in late summer are clusters of green berries that turn purple to black at maturity and contain a profuse amount of red juice. The green leaves, fleshy stem, and purple berries of common pokeweed can inhibit the harvesting process and lead to discounts at the elevator for high moisture and stained seed. In addition, areas with heavy infestations of common pokeweed have been known to compete and reduce yield in both corn and soybeans. Numerous bird species are known to feed on the berries and are capable of randomly dispersing pokeweed seeds over sizeable areas. Seedlings can emerge from mid-spring through early summer. Within 5 to 9 weeks after emergence, seedlings of common pokeweed develop the taproot that is capable of regrowth (becomes perennial). New plants from seed dispersed over undisturbed sites, such as no-till crop fields, are capable of becoming more entrenched as their taproots develop.

CULTURAL CONTROL

- Common pokeweed establishment often begins in fence rows or under power lines (dispersal by birds), monitor and control pokeweed in these areas to prevent spread.

MECHANICAL CONTROL

- Common pokeweed does not become a problem in fields with intensive tillage.
- Tillage will control true seedlings within 5-6 weeks after emergence.
- After pokeweed establishment reduced tillage will only suppress common pokeweed.

CHEMICAL CONTROL

Several herbicides with residual activity are effective at controlling seedling common pokeweed. However, common pokeweed is more difficult to control once it has developed its taproot and becomes perennial. Because of the variable size of common pokeweed populations in a field, application timing is critical. For in-crop applications time herbicide applications when common pokeweed is at least 8 inches tall and preferably less than 12 inches tall. Below are effectiveness ratings for several herbicides for common pokeweed control. Refer to the herbicide labels for maximum crop height and stage application restrictions for individual herbicides.

SOYBEANS

Herbicide[a,b]	Rate	Effectiveness
Raptor + NIS + N	5 oz	Fair
Classic[c] + NIS	0.67 oz	Poor-Fair
FirstRate + NIS or COC + N	0.3 oz	Poor
STS SOYBEAN ONLY		
Synchrony XP + COC + N	0.75 oz	Fair

CORN

Herbicide[a,b]	Rate	Effectiveness
Callisto + COC + N	3 oz	**Good**
Distinct + NIS + N	4 oz	Fair-**Good**
Clarity	0.5 pt	Fair-**Good**
Northstar + NIS + N	5 oz	Fair-**Good**
Beacon + COC or NIS + N	0.76 oz	Fair
2,4-D amine	1 pt	Poor
CLEARFIELD CORN ONLY		
Lightning + NIS + N	1.28 oz	Fair-**Good**

ROUNDUP READY CROPS

Herbicide[a,b]	Rate	Effectiveness
glyphosate + AMS	0.75 lb a.e.	**Good**
fb.		
glyphosate + AMS *(if needed)*	0.75 lb a.e.	

NONCROP/FALLOW (FALL)[c]

Herbicide[b]	Rate	Effectiveness
glyphosate + AMS	1.5 lb a.e.	**Good-Excel.**

[a] Refer to herbicide label for maximum application heights and stages.
[b] NIS = non-ionic surfactant; COC = crop oil concentrate; N = 28% UAN or AMS (ammonium sulfate).
[c] Apply in late-September or early-October when common pokeweed is 8 to 24 inches tall, but before a frost.

Project GREEEN

Controlling Hemp Dogbane

HEMP DOGBANE is a perennial weed that reproduces by seed, by crown buds, or by over-wintering rootstocks. Similar in appearance to common milkweed, hemp dogbane plants grow to be 3 to 5 ft tall, and all plant parts when broken exude a white milky sap. However, hemp dogbane leaves are smaller, lighter-green in color, and generally are more pointed than common milkweed. Additionally, the stem branches near the top of the plant, giving hemp dogbane a 'bushy' appearance. Flowers of hemp dogbane each produce two seed pods that are slender, sickle-shaped, and produce 80 to 200 seeds per pod.

Seeds of hemp dogbane are dispersed by wind and are not persistent (less than 6 months survival in the soil). Seeds have very little dormancy and more than 75% of the seeds germinate the year they are produced. True seedlings are susceptible to soil disturbance from cultivation before becoming perennial, which happens within 5 to 6 weeks after emergence. Plants do not flower the year they start from seed.

Rootstock of hemp dogbane is persistent and can grow to a depth of 6 ft in the soil and spread up to 10 ft in length in one season. Because of this reproductive characteristic, hemp dogbane is often found in patches. In two seasons one hemp dogbane plant can invade an area nearly 40 ft in diameter if not adequately controlled.

CULTURAL CONTROL

Including a forage or small grain in the rotation can help manage hemp dogbane.

- Repeated mowing suppresses hemp dogbane in forages.
- Small grains are competitive with hemp dogbane, and provide an opportunity for mechanical and chemical control after harvest.

MECHANICAL CONTROL

- Tillage will control true seedlings within 6 weeks after emergence.
- Tillage of established patches may spread and chop up rootstock; breaking apical dominance that leads to emergence of more shoots.
- Herbicide treatments are generally more effective if the soil is undisturbed.

CHEMICAL CONTROL

Herbicides are more effective for control of hemp dogbane on larger plants. Hemp dogbane is most susceptible to herbicides between the late bud and flower stages. However, most herbicides have maximum crop height or stage restrictions for application; refer to the herbicide label for these restrictions.

SOYBEANS

- There are no effective herbicides for control of hemp dogbane in conventional soybeans.

CORN*

Herbicide[a,b]	Rate	Effectiveness
Starane	2/3 pt	**Good-Excel.**
Beacon + 2,4-D + NIS	0.38 oz + 1 pt	**Good**
Accent + Clarity + NIS	0.67 oz + 0.5 pt	Fair-**Good**
Beacon + Clarity + NIS + N	0.38 oz + 0.5 pt	Fair-**Good**
Northstar + NIS + N	5 oz	Fair-**Good**
Distinct + NIS + N	4 oz	Fair-**Good**
Clarity + 2,4-D amine	0.25 pt + 0.5 pt	Poor-Fair
2,4-D amine	1 pt	Poor-Fair
Clarity	0.5 pt	Poor

ROUNDUP READY CROPS

Herbicide[a,b]	Rate	Effectiveness
glyphosate + AMS fb.	0.75 lb a.e.	**Good-Excel.**
glyphosate + AMS *(if needed)*	0.75 lb a.e.	

TREATMENT BETWEEN CROPS (WHEAT STUBBLE)[c]

Herbicide[b]	Rate	Effectiveness
glyphosate + AMS	3 lb a.e.	**Excellent**
Clarity	1 qt	**Good**
Clarity + 2,4-D	0.5 pt + 1 pt	Fair-**Good**

* Research supported by the Corn Marketing Program of Michigan.
[a] Refer to herbicide label for maximum application heights and stages.
[b] NIS = non-ionic surfactant; N = 28% UAN or AMS (ammonium sulfate).
[c] Apply when hemp dogbane is late bud to flower stage.

Project GREEEN

PESTICIDE EMERGENCY INFORMATION

For any type of an emergency involving a pesticide, immediately contact the following emergency information centers for assistance.

Current as of November 2006

Human Pesticide Poisoning

POISON CONTROL

From anywhere in the United States, call

1-800-222-1222

Special Pesticide Emergencies

Animal Poisoning

Your veterinarian:

_____
Phone No.

or

Animal Poison Control Center ($55 consultation fee per case)

****1-888-426-4435***

www.aspca.org

Pesticide Fire

Local fire department:

_____
Phone No.

and

****911***

Traffic Accident

Local police department or sheriff's department:

_____
Phone No.

and

Operations Division, Michigan State Police:

****(517) 336-6605***

Environmental Pollution

District Michigan Department of Environmental Quality (MDEQ) Office Phone No.

_____
Phone No.

and

MDEQ Pollution Emergency Alerting System (PEAS):

****1-800-292-4706***

also

****1-800-405-0101***

Michigan Department of Agriculture Spill Response

(for fertilizer, pesticide, and manure spills)

Pesticide Disposal Information

Michigan Clean Sweep, Michigan Department of Agriculture Environmental Stewardship Division.

Monday– Friday: 8 a.m.–5 p.m.

(517) 335-2874

National Pesticide Information Center

Provides advice on recognizing and managing pesticide poisoning, toxicology, general pesticide information and emergency response assistance. Funded by EPA, based at Oregon State University

7 days a week; excluding holidays

6:30 a.m. – 4:30 p.m. Pacific Time Zone

1-800-858-7378

FAX: 1-541-737-0761

Web: npic.orst.edu

**** Telephone Number Operated 24 Hours***

Revised by Carolyn J. Randall, *Pesticide Education Program, Michigan State University Extension*

This publication contains pesticide recommendations based on research and pesticide regulations. However, changes in pesticide regulations occur constantly. Some pesticides mentioned may no longer be available, and some uses may no longer be legal. If you have questions about the legality and/or registration status for using pesticides, contact your county MSU Extension office.

To protect yourself and others and the environment, always read the label before applying any pesticide.