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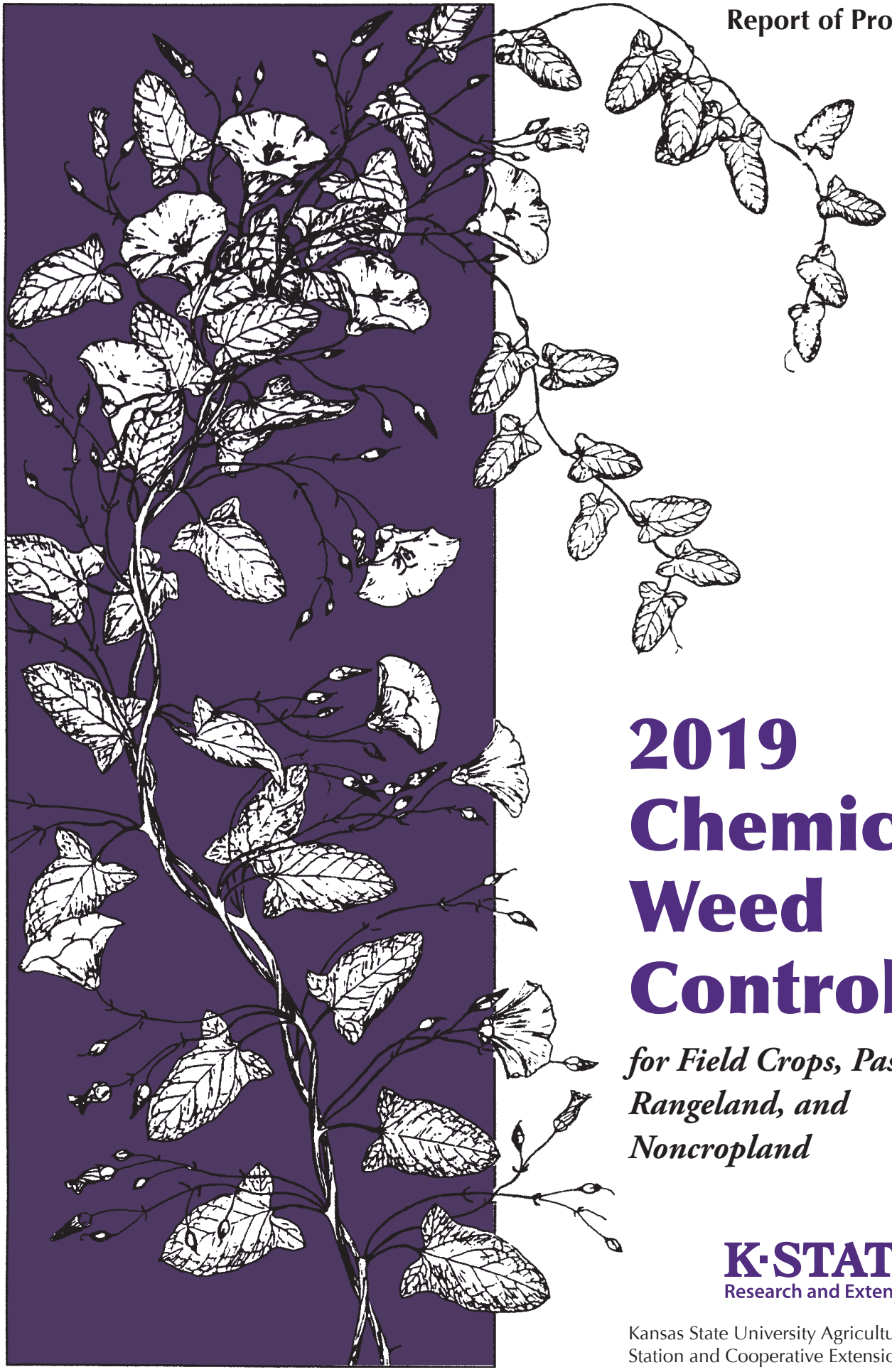


2019 Chemical Weed Control

for Field Crops, Pastures, Rangeland, and Noncropland

K-STATE Research and Extension

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

SELECTING AND APPLYING HERBICIDES

Protective Clothing and Equipment Guide

Pesticides kill. We wouldn't use them if they didn't. The problem is, chemicals that kill insects, diseases, and plants can cause illness in human beings in larger doses. Chemicals may not look all that harmful, but overexposure can be as dangerous as putting your arm into a hay baler. The damage may take longer to show up, which is what makes pesticide safety different from tractor or combine safety. Very few people die of acute pesticide poisoning, but it is possible to end up in a hospital emergency room because of a severe reaction that may suddenly occur after years of repeated exposure to a particular chemical.

Determining precisely the number of people who may suffer chronic, irreversible effects from pesticide exposure is impossible. These effects may include cancer, birth defects, and some types of nervous system disorders. Although cause and effect links between particular substances and cancer or birth defects are difficult to confirm, the sensible course of action is to give your health and that of your family the benefit of the doubt. Play it safe.

If you use pesticides, the best ways to minimize your exposure are to wear personal protective equipment and follow safe mixing, loading, application, and disposal procedures. Your risk of harmful health effects from pesticide exposure depends on two things: (1) the **toxicity** of the chemical and (2) how much of it you are **exposed** to. The National Agricultural Chemicals Association uses the formula: Risk = Toxicity + Exposure.

You can be exposed to chemicals in three ways. **Ingestion**, or swallowing, is the most common cause of acute poisonings. **Inhalation**, or breathing, is the most toxic of the ways that you can be exposed to pesticides because anything absorbed by the lungs goes directly into the bloodstream. **Dermal absorption,** or skin contact, is the route through which farmers get most of their exposure to pesticides.

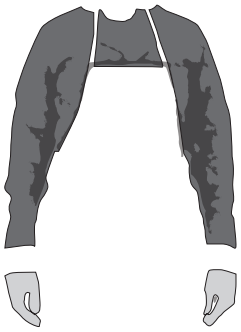
To avoid pesticide exposure, don't eat, drink, smoke, or go to the bathroom while working with pesticides—not until you have washed your face and hands thoroughly with detergent and water. **Wear personal protective equipment.**

Hat

Hats, especially wide-brimmed ones, help keep pesticide splashes off your scalp, neck, forehead, and ears, all of which absorb pesticides rapidly. The hat should be plastic with a plastic headband. A regular seed cap or an absorbent headband, such as elastic or leather, will absorb pesticides and recontaminate you every time you wear it.

Goggles or Full Face Shield

Get chemical splash goggles or a full face shield to protect your eyes from splashing. Never wear contact lenses when working with chemicals.



Clothes

Wear denim overalls and a long-sleeved work shirt. Wear coveralls over these clothes. Disposable garments are also available.

Gloves

The hands and forearms are contaminated by pesticides more often than any other part of the body. That's why you need chemical-resistant gloves, preferably ones that extend at least halfway to your elbow. **Avoid leather gloves** because leather absorbs pesticides and is impossible to decontaminate.

Use **unlined** gloves made of neoprene, nitrile, or natural rubber. Latex does not protect against concentrated chemicals. Avoid gloves with lining, because the lining can absorb the pesticide and re-expose you every time you use them. Unless you are working overhead, such as when spraying fruit trees, wear your sleeves outside the gloves.

Check gloves for leaks before you use them by filling them with water and squeezing. Wash them with water and detergent as soon as you're done. Wash the outsides while you still have them on, then take them off and turn them inside out to wash the insides.

NOTE:
All pesticide protective clothing should be used only for pesticide protection, not for rain protection or any other purposes. Wash every piece of protective equipment after every use, using heavy-duty liquid detergent and hot water, and rinse well.

Respirator

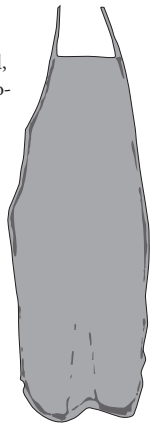
To prevent inhalation of pesticides, wear a chemical cartridge or canister respirator equipped with cartridges specially formulated to filter out pesticides. Dust masks are not effective. Chemical filters must be replaced every 8 hours of normal use, more frequently if you are working in high humidity or breathing heavily. Cartridge respirators can cost less than $25, and the replacement filters less than $15 a pair. Alternatively, you can use a full-face–shielded canister respirator. Canister filters are more expensive but last longer.

Respirators should be worn during mixing and loading of any pesticide and during application of highly toxic ("Danger – Poison") pesticides.

If you smell pesticide when you put on the respirator, throw the filters away, even if they are brand new. Then wash the respirator thoroughly with detergent and water, because it could be contaminated. Insert new filters and start over. Losing a few dollars is better than risking contamination. Your life is not worth the gamble.

For grain silo fumigation or other oxygen-poor environments, you must have a supplied-air respirator or self-contained breathing apparatus.

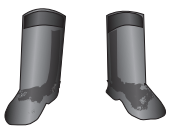
Rubber Apron



The area of the body that absorbs pesticides the most rapidly is not the palm of the hand, nor even your scalp or forehead, but the scrotum. For instance, parathion shows 11.8% absorption into the palm and 36.3% absorption into the forehead but is **absorbed 100%** by the scrotum if it comes into contact with it! At this rate, you suffer the same effect as if parathion were injected directly into your bloodstream. **This is why a rubber apron is critical.** You may prefer to use disposable Tyvek coveralls.

Rubber Boots

These should be neoprene, nitrile, or natural rubber. Leather absorbs pesticides! Wear boots, not overshoes, because pesticide can get inside overshoes and contaminate your shoes. Wear pant cuffs on the outside of the boots.



2019
Chemical Weed Control
for Field Crops, Pastures, Rangeland, and Noncropland

D.E. Peterson, W.H. Fick, R.S. Currie, V. Kumar, and J.W. Slocombe[1]

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Read The Label

Each herbicide used on raw agricultural products must be registered and must have a residue tolerance established by the Registration Division, Environmental Protection Agency. Check the label and select only herbicides that may be used legally.

[1] Extension Specialist-Weed Science, Extension Specialist-Range and Pasture Management, Department of Agronomy;
Research Weed Scientist, Southwest Research-Extension Center, Garden City;
Research Weed Scientist, Agricultural Research Center - Hays; and
Professor, Department of Biological and Agricultural Engineering;
Kansas State University, Manhattan, KS 66506.

Introduction

To control weeds effectively, select control methods carefully and use them properly. Chemicals, tillage, crop competition, cropping rotation, mowing, and fire are alternative weed control methods that may be used alone or in combination. Available time, labor, equipment, and other costs as well as types of weeds and areas infested need to be considered when planning a weed control program.

To increase efficiency of crop production, use weed control practices in conjunction with other crop and soil management practices such as planting high-quality seed, planting at the optimum rate and date, and maintaining optimum soil fertility.

This publication provides suggestions for chemical weed control in several major crops. For crops not listed, consult your local K-State Research and Extension agricultural agent.[1]

Proper Use of Herbicides

1. ***Selection –*** Choice of an herbicide depends on the crop being grown, expected weed infestation, soil type, desired duration of control, crop use, crop sequence, and cost. Be sure the herbicide selected has been registered for use on the crop to be grown. Rotation of crops and herbicides is recommended to avoid enhanced herbicide degradation, herbicide residue buildup, herbicide-resistant weed problems, and to manage troublesome weeds.

2. ***Label –*** READ AND FOLLOW DIRECTIONS AND PRECAUTIONS. The label designates the herbicide, lists the amount of active ingredient, and gives recommendations and precautions. By following recommendations and observing precautions, you minimize the danger of crop injury; reduce the hazards to people, animals, and susceptible plants; and increase the probability of satisfactory weed control.

3. ***Registered Uses –*** Do not use an herbicide unless directions for applying it to your crop are given on the label. At the time of printing, herbicides named in this publication were registered for uses suggested.

4. ***Herbicide Combinations –*** Some herbicides have been formulated in combination and are available as a "premix." Some herbicides can be mixed together by the applicator and applied as a "tank mix." More weed species can be controlled by using herbicides in combination than separately. Because the rate of each herbicide usually is reduced in the combination, crop injury and herbicide carryover can be reduced. NOTE: If a tank mix is used, follow all use limitations on labels of all products in the combination.

5. ***Application Rates –*** Use only the rate recommended for your soil. Do not exceed the rate specified on the label. A rate higher than the recommended rate is illegal and can result in illegal residues in the harvested crop. Excessive rates also can injure the crop or carry over to injure the following crop. Apply only at the recommended stage of crop and/or growth. When a combination of herbicides is being used, the lower rates may not control tolerant species (e.g., sunflower, velvetleaf, morningglory, or cocklebur).

6. ***Carrier –*** Water is the most commonly used carrier for herbicides. Liquid fertilizers can be used as carriers for most soil-applied herbicides and a few foliar-applied herbicides. Before mixing an herbicide with a liquid fertilizer (as recommended on some herbicide labels), **check the compatibility** of the herbicide with the carrier. Check by mixing a small amount of the herbicide and carrier in the approximate proportion to be used in the field. Shake or agitate the mixture vigorously. Allow it to stand for 5 minutes. If an initial separation or a settling out occurs in the herbicide-fertilizer mixture but disappears after vigorous shaking, the chemicals can be used in the same spray tank, if you maintain adequate agitation while spraying. If a precipitate forms, the mixture flakes, or the two chemicals will not stay mixed when agitated, the materials should not be mixed together in the same spray tank.

7. ***Drift –*** Minimize drift and possible damage to susceptible plants by applying chemicals when the wind is light (less than 10 mph). Check wind direction to avoid drift toward susceptible crops. Smoke can be a valuable tool to assist in determining wind characteristics and in checking for the presence of temperature inversions. Refer to the product label for specific environmental precautions.

8. ***2,4-D, Dicamba, and Other Auxin Herbicides –*** Susceptible plants and crops often are damaged by improper use of systemic, foliage-applied auxin herbicides. Each year, K-State Research and Extension agents, horticulturists, and weed control specialists receive questions and complaints regarding twisted and distorted plants. Misapplication and other misuse of auxin herbicides cause much of the plant damage. **Prevent damage from auxin herbicides to your own or your neighbor's susceptible plants by following these rules:**

   - Use auxin herbicides only when specifically needed. In some cases, other herbicides effectively control broadleaf weeds with fewer hazards.
   - Salt formulations have low volatility and present less risk of injury to nearby susceptible plants than ester formulations.
   - Volatility increases as temperature increases, especially when temperatures exceed 85°F.
   - Only apply auxin herbicides on days when the winds are less than 10 mph. Do not spray when wind is blowing in the direction of susceptible crops or areas.
   - Do not spray during a temperature inversion. Temperature inversions occur a majority of nights and generally start 1 to 2 hours before sunset and persist until about 1 hour after sunrise. Temperature inversions are most common with wind speeds less than 3 mph.
   - Spray drift from auxin herbicides can injure susceptible plants several miles away. Some of the most susceptible crops to auxin herbicides include soybean, cotton, grapes, and tomatoes.
   - Sprayer equipment contamination is a common source of auxin herbicide injury. Clean sprayers thoroughly after use according to product label guidelines. Consider using a dedicated sprayer for auxin herbicides if practical.

[1] In the following tables, common names are listed first, followed by trade names to help identify herbicides. No endorsement is intended, nor is any criticism implied of similar products not mentioned. The rate of application is given in pounds of active ingredient and amount of product.

9. ***Equipment –*** Clean equipment immediately after using. If a sprayer has been used for herbicides, clean it thoroughly before using it to spray insecticides or fungicides. Refer to page 10 for general directions for cleaning spray equipment and to product label for specific cleaning requirements.

10. ***Storage –*** Store herbicides in original containers — never in unmarked containers. If possible, store in a locked cabinet, room, or building away from food, feed, seed, and fertilizers. Follow label directions for storage conditions.

11. ***Disposal –*** Empty containers made of glass, metal, or plastic should be rinsed three times with water prior to disposal. Use the rinse water in the spray tank. After rinsing, containers should be punctured, broken, or crushed, then disposed of properly. Disposal in a sanitary landfill is permissible, if in accordance with local regulations.

    Large metal drums should be triple-rinsed and sent to a barrel-reconditioning company, if possible, or taken to a sanitary landfill. Consider the use of returnable, minibulk containers. Never reuse empty pesticide containers for any other purpose.

    Specific information on disposal can be obtained from your county Sanitary Landfill director or your K-State Research and Extension agricultural agent.

Factors Affecting Chemical Weed Control

A given herbicide may vary in effectiveness from year to year or place to place.

Factors affecting performance of soil-applied herbicides include:

- Kinds of weeds
- Rate of application
- Method and uniformity of application
- Solubility of herbicide
- Uniformity and depth of incorporation
- Rainfall
- Breakdown by light
- Soil type
- Soil organic matter
- Soil pH
- Calcium carbonate content of the soil
- Volatility of herbicide
- Herbicide resistance

Factors affecting performance of foliage-applied herbicides include:

- Kinds of weeds
- Rate of application
- Method and uniformity of application
- Spray retention on leaves
- Washing off of spray by rainfall
- Relative humidity and temperature
- Stage and rate of weed growth
- Spray adjuvants
- Tank mix partners
- Volatility of herbicides
- Drift-control agents
- Herbicide resistance

Knowledge of such factors will help to determine optimum plant, soil, and weather conditions for applying each herbicide. Such information usually can be obtained from the label, the dealer, or your K-State Research and Extension agricultural agent.

Herbicide Resistance

Weed species and different biotypes within species vary in susceptibility to herbicides. A weed population that initially is susceptible to an herbicide but contains a small percentage of resistant biotypes may develop gradually into a resistant population. Selection for resistance is most likely with the repeated use of long-residual herbicides that provide nearly complete control of the susceptible biotypes. Thus, the herbicide eliminates susceptible types, and the proportion of resistant plants increases until the weed population can no longer be controlled adequately with that herbicide. Kochia, waterhemp, and Palmer amaranth have developed resistance to atrazine, ALS-inhibiting herbicides, glyphosate, and other classes of herbicides in certain areas of Kansas. Selection for herbicide-resistant weed populations can be minimized by using crop rotations, herbicide rotations, mixtures of herbicides with different modes of action, and integrated pest management (IPM). Use of these practices reduces exposure to herbicides and the selective pressure favoring resistant biotypes. Failure to follow these guidelines and label recommendations in areas where resistance has occurred may lead eventually to loss of effectiveness of otherwise useful herbicides. Additional information on herbicide resistant weed management can be accessed at the Take Action Herbicide Resistance website (http://takeactiononweeds.com).

Herbicide Mode of Action

Herbicide *mode of action* refers to how herbicides work on plants and involves all the interactions from the time an herbicide is absorbed by the plant to the final effect. The specific process or site in a plant that an herbicide disrupts to interfere with plant growth and development is referred to as the herbicide *site of action*. Mode of action and site of action are often used interchangeably, usually in reference to site of action. Herbicides can be classified by site of action as well as by chemical families. Chemical families comprise herbicides with similar chemistries. Herbicides within the same chemical family usually have the same site of action; however, herbicides from different chemical families also may have the same site of action. Repeated use of the same herbicide or herbicides with the same site of action eventually can lead to herbicide resistance and other problems. Using herbicides with different sites of action in combination and in rotation will help prevent the development of herbicide resistance. The Weed Science Society of America (WSSA) has developed a numbered classification system based on the herbicide site of action to assist farmers and applicators in selecting herbicides with different sites of action. Most herbicide labels now prominently display the herbicide classification number at the beginning of the label. Herbicide premixes that contain multiple active ingredients with different sites of action will have all sites of action numbers listed. The following list presents herbicides by mode of action, chemical family, and the WSSA herbicide site of action number (in parentheses).

Amino Acid Inhibitors

ALS-AHAS inhibitors (2):

Imidazolinone family - Arsenal, Plateau, Pursuit, Raptor, Scepter, Contain, Beyond

Sulfonylurea family - Accent, Affinity, Ally, Amber, Basis, Beacon, Cimarron, Classic, Crusher, Escort, Express, Finesse, Glean, Harmony SG, Harmony Extra, Oust, Outrider, Peak, Permit, Steadfast, Synchrony, Telar

Triazolopyrimidine family - Python, FirstRate, PowerFlex

Sulfonylaminocarbonyl-triazolinone family - Olympus, Osprey, thiencarbazone

EPSP inhibitors (9):

Amino acid derivative family - glyphosate, Roundup, and others

Auxins-synthetic (4)

Arylpicolinate family - Quelex

Benzoic acid family - Dicamba, Banvel, Clarity, DiFlexx, Engenia, FeXapan, Status, Vision, Xtendimax, and others

Phenoxy family - 2,4-D, 2,4-DB, MCPA, MCPP, 2,4-DP

Pyridinecarboxylic acid family - Tordon, Stinger, Remedy, Garlon, Starane, Milestone, Trycera, StareDown

Quinoline carboxylic acid - Facet L, Paramount, Quinstar GT, Quinstar 4L

Picolinic Acid - Elevore, Quelex

Auxin Transport Inhibitor (19)

Semicarbazone family - diflufenzopyr

Cell Membrane Disrupters

Bipyridilium family (22) - Gramoxone, Diquat

Diphenylether family (14) - Ultra Blazer, Cobra, Phoenix, Reflex, Flexstar, ET, Vida, Dawn, Rhythm

N-Phenylphthalimide family (14) - Encompass, Resource, Valor

Aryl-Triazinone family (14) - Cadet, Spartan, Aim

Pyrimidinedione family (14) - Sharpen, Kixor

Lipid Synthesis Inhibitors (1)

Aryloxyphenoxypropionate family - Fusilade DX, Assure II, Fusion, Targa

Cyclohexanedione family - Poast, Poast Plus, Select, Volunteer, Section, Arrow, Tapout

Phenylpyrazolin family - Axial

Nitrogen Metabolism Inhibitors (10)

Organophosphorus family - Liberty

Photosynthetic Inhibitors

Triazine family (5) - atrazine, metribuzin, Princep, Evik, Pramitol

Phenylurea family (7) - Lorox, Karmex, Spike

Uracil family (5) - Sinbar, Hyvar

Nitrile family (6) - Buctril, Moxy, Bromox, Brox

Benzothiadiazole family (6) - Basagran

Pigment Inhibitors

Isoxazolidinone family (13) - Command

Isoxazole family (27) - Balance, Huskie

Triketone family (27) - Callisto, Impact, Laudis, Armezon, Talinor

Seedling Growth Inhibitors

Thiocarbamate family (8) - Eradicane, Eptam

Acetamide family (15) - Dual II Magnum, Outlook, Propel, Surpass, Harness, Degree, Topnotch, Warrant

Pyrazole family (15) - Zidua, Anthem

Dinitroanaline family (3) - Treflan, Trust, Prowl, Acumen, Sonalan, Balan

Unknown Mode of Action

Organic arsenical family (17) - MSMA, DSMA

Family not classified (NC) - sodium chlorate

For more information on herbicide families and modes of action, refer to K-State Research and Extension publication C-715, Herbicide Mode of Action.

Soil Residues

Some herbicides remain active in the soil for only a few days; others may persist for more than a year. Residual toxicity depends on (1) chemical structure, solubility, adsorption, and degradation; (2) texture, organic matter content, and pH of the soil; (3) rate applied; (4) environmental conditions, especially soil moisture and temperature; and (5) weed and crop species. **Read the label to determine residual toxicity and limitations, if any, on cropping sequence.**

Herbicide Application

Liquid and granular applications are the most common methods of applying herbicides. Sprayers are available in various types and sizes, each designed for a specific application. The types of sprayers used by applicators include hand-operated sprayers, low-pressure boom sprayers, and special sprayers for selective application of crop protection products. Granular applicators are also used to apply a variety of crop protection products to control weeds. Available units include row or band applicators for covering a variety of swath widths.

Better application equipment and new techniques that allow for smaller dosages of crop protection products and that reduce drift and residue have become increasingly important in minimizing harmful effects of crop protection products on the environment.

Low-Pressure Field Sprayers

Applicators typically use low-pressure sprayers more than any other kind of application equipment for applying crop protection products. Tractor-mounted, pull-type, and self-propelled sprayers are available in many models and for a large variety of prices. Spray pressures used typically range from 15 to 50 pounds per square inch (psi), and application rates can vary from less than 5 to more than 100 gallons per acre (GPA). All low-pressure sprayers have several basic components: a pump, tank, agitation system, flow-control assembly, and a distribution system. At the end of the distribution system is the spray nozzle.

Nozzle Types

Selection of the correct type and size of spray nozzle is essential for each application. The nozzle determines the amount of spray applied to an area, the uniformity of the application, the coverage of the sprayed surface, and the amount of drift. You can minimize the drift problem by selecting nozzles that give the largest droplet size while providing adequate coverage at the intended application rate and pressure. Although nozzles have been developed for practically every kind of spray application, only a few types – extended range flat-fans, Turbo flooding flat-fans, Turbo flat-fans, venturi flat-fans, and drift reduction pre-orifice flat-fans – are commonly used in the application of crop protection products. Emphasis on nozzle design in the past few years has resulted in a vast improvement in spray quality.

Spray nozzle assemblies consist of a body, cap, check valve, and nozzle tip. Various types of bodies and caps (including color-coded versions) and multiple nozzle bodies are available with threads as well as quick-attaching adapters. Nozzle tips are interchangeable in the nozzle cap and are available in a wide variety of materials, including hardened stainless steel, stainless steel, brass, ceramic, and various types of plastic. Hardened stainless steel and ceramic are the most wear-resistant materials, but they are also the most expensive. Stainless steel tips have excellent wear resistance with either corrosive or abrasive materials. Plastic tips are resistant to corrosion and abrasion and are proving to be very economical tips for applying crop protection products. Brass tips have been very common, but they wear rapidly when used to apply abrasive materials, such as wettable powders, and are corroded by some liquid fertilizers. Other types should be considered for more extensive use. See Table 1 for nozzle nomenclature information.

Variables Affecting Application Rate

Three variables affect the amount of spray material applied per acre: (1) nozzle flow rate, (2) ground speed of the sprayer, and (3) width sprayed per nozzle. To calibrate and operate a sprayer properly, you must understand how each of these variables affects sprayer output.

The nozzle flow rate varies with the size of the tip, the nozzle pressure, and the density of the spray liquid. Installing a nozzle tip with a larger orifice, increasing the pressure, and decreasing the density of the spray liquid all increase the flow rate. To increase the nozzle output, you must multiply the pressure by the square of the desired increase in flow rate. In other words, doubling the pressure will not double the nozzle flow rate. To double the flow rate, you must increase the pressure four times. For example, to double the flow rate of a nozzle from 0.2 gal/minute at 10 psi to 0.4 gal/minute, the pressure must be increased to 40 psi (4 × 10).

Pressure changes should not be used to make major adjustments in the application rate. To obtain a uniform spray pattern and minimize drift, you should maintain the operating pressure within the recommended range for each nozzle. The pressure can be changed, however, to correct for minor variations in flow rate resulting from nozzle wear.

The spray application rate varies inversely with the ground speed. Doubling the ground speed (mph) of the sprayer reduces the gallons of spray applied per acre (GPA) by one-half. For example, a sprayer applying 20 GPA at 4 mph would apply 10 GPA if the speed were increased to 8 mph while the pressure remained constant.

Many low-pressure field sprayers have a metering system that maintains a constant application rate while operating over a range of travel speeds. All metering systems now in use, such as ground-driven piston pumps, electronic feedback control systems, and various centrifugal pump arrangements, vary the nozzle pressure to compensate for changes in travel speed, keeping the application rate constant. Although all the systems work over a wide range of travel speeds, the spray nozzle limits the range of speeds at which precise application can be obtained. Because of the possibilities for dramatic pressure increases while using such systems, there is a serious potential for spray drift occurrence.

To regulate the flow in proportion to travel speed, the rate of increase in nozzle pressure must vary with the square of the rate of increase in speed. For example, if the sprayer is traveling at 4 mph at a nozzle pressure of 20 psi, increasing the speed to 8 mph will require increasing the nozzle pressure to 80 psi to maintain the same flow volume. Remember, a four-fold change in pressure drastically reduces the droplet size, which may result in increased drift. The pattern width and distribution pattern may also be affected. For uniform application, the travel speed should be held as nearly constant as possible, even when using controlled metering systems.

To apply crop protection products accurately, you must maintain the proper ground speed. Do not rely on a conventional speedometer as an accurate indicator of speed. Slippage of the drive wheels can result in speedometer errors of 20% or more. Electronic kits and radar guns give more accurate readings because they do not depend on the drive wheels for speed measurements. Changes in tire size also affect speedometer readings, and the accuracy of all speedometers should be checked periodically.

The effective width sprayed per nozzle also affects the spray application rate. Doubling the effective width sprayed per nozzle decreases the gallons per acre applied by one-half. For example, if you are applying 20 GPA with flat-fan nozzles on 20-inch spacings, changing to flooding nozzles with the same flow rate on 40-inch spacings will decrease the application rate from 20 GPA to 10 GPA.

Calibration

Accurate calibration is the only way to know how much chemical is applied. Even with the current widespread use of electronics to monitor and control the application of crop protection products, a thorough sprayer calibration procedure is essential to ensure against misapplication. Failure to calibrate a sprayer can injure your crop, cause pollution, and waste money. In addition to calibrating the sprayer at the start of the season, you should recalibrate regularly. Abrasive pesticide formulations can wear nozzle tips, resulting in an increased nozzle flow rate and the development of poor spray patterns.

To obtain uniform coverage, you must consider the spray angle, spacing, and height of the nozzle. The height must be readjusted for uniform coverage with various spray angles and nozzle spacings. Do

not use nozzles with different spray angles on the same boom for broadcast spraying. Be sure the nozzle tips are clean. If necessary, clean with a soft bristle brush. A nail, wire, or pocket knife can damage the tip and ruin the uniformity of the spray pattern. While the sprayer is running, observe each spray tip for any distortions in the patterns.

Worn or partially plugged nozzles produce nonuniform patterns. Misalignment of nozzle tips is a common cause of uneven coverage. The boom must be level at all times to maintain uniform coverage. Skips and uneven coverage will result if one end of the boom is allowed to droop. A good method for determining the exact nozzle height that will produce the most uniform coverage is to spray on a warm surface, such as a road, and observe the drying rate. Streaks in the spray pattern should be obvious. Replace nozzles that are not performing correctly.

When you are convinced that the sprayer is operating properly, you are ready to calibrate. There are many methods for calibrating low-pressure sprayers, but they all involve the use of the variables in the following equations. Any technique for calibration that provides accurate and uniform application is acceptable. No single method is best for everyone.

The calibration method described below has four advantages. First, it allows you to select the number of gallons to apply per acre and to complete most of the calibration before going to the field. Second, it provides a simple means for frequently adjusting the calibration to compensate for changes due to nozzle wear. Third, it can be used for broadcast, band, directed, and row crop spraying. This method requires a knowledge of nozzle types and sizes and the recommended operating pressure ranges for each type of nozzle used. Finally, when using the method below, the applicator will have a better understanding of how each variable will affect the application rate. As each of the variables change, the influence on the rate (GPA) is apparent.

The gallons of spray applied per acre can be determined using the following equation:

(Equation 1) $$GPA = \frac{GPM \times 5{,}940}{mph \times W}$$

GPM = output per nozzle in gallons per minute
mph = ground speed in miles per hour
W = effective width sprayed per nozzle in inches
5,940 = a constant to convert gallons per minute, miles per hour, and inches to gallons per acre

The size of the nozzle tip will depend on the application rate (GPA), ground speed (mph), and effective width sprayed (W) that you plan to use. Some manufacturers advertise "gallon-per-acre" nozzles, but this rating is useful only for standard conditions (usually 30 psi, 4 mph, and 20-inch spacing). The gallons-per-acre rating is useless if any one of your conditions varies from the standard.

A more exact method for choosing the correct nozzle tip is to determine the gallons per minute (GPM) required for your conditions. Then select nozzles that provide this flow rate when operated within the recommended pressure range. By following the five steps described below, you can select the nozzles required for each application well ahead of the spraying season.

1. Select the spray application rate in gallons per acre. Pesticide labels recommend ranges for various types of equipment. The spray application rate is the gallons of carrier (water, fertilizer, etc.) and pesticide applied per treated acre.

2. Select or measure an appropriate ground speed in miles per hour according to existing field conditions. Do not rely on speedometers as an accurate measure of speed. Slippage and variation in tire sizes can result in speedometer errors of 20% or more. If you do not know the actual ground speed, you can easily measure it. (Instructions for measuring ground speed are given below.)

3. Determine the effective width sprayed per nozzle (W) in inches.

   For broadcasting spraying, W = the nozzle spacing
   For band spraying, W = the band width
   For row-crop applications, such as spraying from drop pipes or directed spraying,

   $$W = \frac{\text{row spacing (or band width)}}{\text{number of nozzles per row (or band)}}$$

4. Determine the flow rate required from each nozzle in gallons per minute by using a nozzle catalog, tables, or the following equation. Using Equation 2 allows the applicator to determine flow rates for each application scenario needed for the application season. This can be done before the application season begins, thus not interfering with critical time available during the application time.

   (Equation 2) $$GPM = \frac{GPA \times mph \times W}{5{,}940}$$

   GPM = gallons per minute of output required from each nozzle
   GPA = gallons per acre from Step 1
   mph = miles per hour from Step 2
   W = inches sprayed per nozzle from Step 3
   5,940 = a constant to convert gallons per minute, miles per hour, and inches to gallons per acre

5. Select a nozzle that will give the flow rate determined in Step 4 when the nozzle is operated within the recommended pressure range. You should obtain a catalog of available nozzle tips. These catalogs can be obtained free of charge from equipment dealers or nozzle manufacturers. If you decide to use nozzles that you already have, return to Step 2 and select a speed that allows you to operate within the recommended pressure range.

Broadcast application:

Example 1. You want to broadcast a preplant incorporated herbicide at 15 GPA (Step 1) at a speed of 7 mph (Step 2), using TurboFlood nozzles spaced 40 inches apart on the boom (Step 3). What TurboFlood nozzle tip should you select?

The required flow rate for each nozzle (Step 4) is:

$$GPM = \frac{GPA \times mph \times W}{5{,}940}$$

$$GPM = \frac{15 \times 7 \times 40}{5{,}940} = \frac{4{,}200}{5{,}940} = 0.71$$

The nozzle that you select must have a flow rate of 0.71 GPM when operated within the recommended pressure range of 10 to 40 psi. Table 2 shows the GPM at various pressures for several Spraying Systems TF nozzles. For example, the Spraying Systems TF-5 nozzle has a rated output of 0.71 GPM at 20 psi (Step 5). This nozzle could be installed for this application.

Herbicide Band Applications for Cost-Effective Weed Control

Band applications of herbicides can reduce costs for postemergence and preemergence weed control treatments. In band applications, the treated acre is the acres actually sprayed and, depending on the row spacing and the band width, is some fraction of the total field acres. Remember, herbicides are applied in bands at the same rate of active ingredients per treated acre as in broadcast applications. Treating a field with 30-inch rows in 15-inch bands has the effect of reducing the herbicide cost by one-half.

When banding soil-applied herbicides to control weeds in row crops, use spray tips designed for band application. They are commonly referred to as "even flat spray" tips and are designated in the nozzle nomenclature with the letter 'E' (see Table 1). Even flat spray tips are designed to apply a uniform pattern on the target across the width of the angle. Extended range flat spray tips, on the other hand, are designed to apply a tapered edge pattern and thus would not uniformly cover the targeted band width. For even spray tips, the nozzle spray angle and height above the target will determine the spray width.

Band applications can also be used to apply postemergence materials. To obtain thorough coverage to all plant material, it may be necessary to direct the spray in a multi-nozzle arrangement around and over the top of the plant. Special band-application row kits or drops are available for this purpose. Special attention should be given when using a multiple nozzle kit to properly calibrate for the correct nozzle orifice size.

Band application—over the row:

Example 2. You want to apply a preemergence herbicide in a 15-inch band over each 30-inch corn row. The desired application rate is 15 GPA at 7.5 mph. Which even flat-fan nozzle should you select?

The required flow rate is:

$$GPM = \frac{GPA \times mph \times W}{5{,}940}$$

$$GPM = \frac{15 \times 7.5 \times 15}{5{,}940} = \frac{1{,}687.5}{5{,}940} = 0.28$$

The nozzle that you select must have a flow rate of 0.28 GPM when operated within the recommended pressure range. The Spraying Systems TP8003E or AI9503E nozzles shown in Table 3 have a rated output of 0.28 GPM at approximately 35 psi. Either of these nozzles could be used for this application.

Now that you have selected and installed the proper nozzle tips (Steps 1 to 5 above), you are ready to complete the calibration of your sprayer (Steps 6 to 10 below). Check the calibration every few days during the season or when changing the crop protection products being applied. New nozzles do not lessen the need to calibrate because some nozzles "wear in," increasing their flow rate more rapidly during the first few hours of use. Once you have learned the following method, you can check application rates quickly and easily.

6. Determine the required flow rate for each nozzle in ounces per minute (OPM). To convert gallons per minute (Step 4) to ounces per minute, use the following equation:

   (Equation 3) OPM = GPM × 128 (1 gal = 128 ounces)

   From Example 1, the required flow rate = 0.71 GPM
   OPM = 0.71 × 128 = 91

   From Example 2, the required flow rate = 0.28 GPM
   OPM = 0.28 × 128 = 36

7. Collect the output from one of the nozzles in a container marked in ounces. Adjust the pressure until the ounces per minute collected is the same as the amount that you determined in Step 6. Check several other or all of the nozzles to determine if their outputs fall within 5% of the desired ounces per minute.

   If it becomes impossible to obtain the desired output within the recommended range of operating pressures, select larger or smaller nozzle tips or a new ground speed, then recalibrate. It is important for spray nozzles to be operated within the recommended pressure range. The range of operating pressures is indicated at the nozzle tip. Line losses, nozzle check valves, and etc. may require the main pressure gauge at the boom or at the controls to read much higher.

8. Determine the amount of pesticide needed for each tankful or for the acreage to be sprayed. Add the pesticide to a partially filled tank of carrier (water, fertilizer, and etc.). Then add the carrier to the desired level with continuous agitation. Examples for determining the amount of pesticide to add to the tank are illustrated later.

9. Operate the sprayer in the field at the ground speed you measured in Step 2 and at the pressure you determined in Step 7. You will be spraying at the application rate you selected in Step 1. After spraying a known number of acres, check the liquid level in the tank to verify that the application rate is correct.

10. Check the nozzle flow rate frequently. Adjust the pressure to compensate for small changes in nozzle output due to nozzle wear or variations in other spraying components. Replace the nozzle tips and recalibrate when the output has changed 5% or more from that of a new nozzle, or when the pattern has become uneven.

Remember, to apply crop protection products accurately you must maintain the proper ground speed. Because speedometers do not always provide an accurate measure of speed, you may want to check the accuracy of the speedometer with an electronic kit or radar gun. If your sprayer does not have a speedometer or if your speedometer is not accurate, you must measure the speed at all of the settings that you plan to use in the field. By measuring and recording the ground speed at several gear and throttle settings, you will not have to remeasure speed each time you change settings.

To measure ground speed, lay out a known distance in the field you intend to spray or in another field with similar surface conditions. Suggested distances are 100 feet for speeds up to 5 mph, 200 feet for speeds from 5 to 10 mph, and at least 300 feet for speeds above 10 mph. At the engine throttle setting and in the gear you plan to use during spraying with a half-loaded sprayer, determine the travel time between the measured stakes in each direction. Average these speeds and use the following equation to determine ground speed.

$$Speed\ (mph) = \frac{distance\ (feet) \times 60}{time\ (seconds) \times 88}$$

1 mph = 88 feet per 60 seconds

Example: After measuring a 200-ft course – with the appropriate throttle settings, gear, and a half-loaded tank – you discover that 22 seconds are required for the first pass and 24 seconds for the return pass.

$$\text{Average time} = \frac{22 + 24}{2} = 23 \text{ seconds}$$

$$\text{mph} = \frac{200 \times 60}{23 \times 88} = \frac{12{,}000}{2{,}024} = 5.9$$

Once you have decided on a particular speed, record the throttle setting and drive gear used.

Mixing Pesticide Formulations

To determine how much pesticide to add to your spray tank, you must know (1) the recommended pesticide application rate, (2) the capacity of the spray tank, and (3) the calibrated output of the sprayer.

Follow the label instructions or university recommendations to determine the rate at which to apply the pesticide. The rate is usually indicated in pounds per acre for wettable powders, and in pints, quarts, or gallons per acre for liquids. Sometimes the recommended rate is given in pounds of active ingredient per acre (lb ai/acre) rather than the amount of product per acre. In these cases, you must convert the quantity of active ingredient to the corresponding quantity of the actual product.

You should verify that the sight gauge marks are accurate for your spray tank. Misapplication often occurs because tank capacities are measured inaccurately. To determine tank capacity, add measured volumes of water (5 to 50 gal) and mark the level on the gauge as you fill the tank. You can use flow meters to measure the quantity of water as it flows into the tank. Flow meters are much easier to use than containers when calibrating sight gauge marks on large tanks.

The calibrated output of your sprayer determines the number of gallons that will be applied per acre. Pesticide labels recommend ranges of application rates for various types of equipment. Sometimes crop protection products are applied in fertilizer solutions. In these cases, the desired fertilizer application rate determines the number of gallons per acre that must be applied. Also, most fertilizers are more dense than water and will have different flow characteristics. Adjustments for differences in flow rate are required to achieve the calibrated application rate.

Once you have figured out the exact capacity of your tank and have calibrated your sprayer accurately, you can determine how many acres you can spray with every tankful of spray solution. Divide the number of gallons the tank holds by the number of gallons you intend to apply to each acre. The amount of pesticide to add to the tank is determined by multiplying the number of acres sprayed per tankful by the recommended pesticide application rate. The following examples illustrate this procedure.

Example (Dry Formulation): An atrazine recommendation calls for 1.5 lb ai/acre. You have purchased AAtrex 90DF (90% dry flowable). Your sprayer has a 400-gal tank and is calibrated to apply 20 GPA. How much AAtrex should you add to the spray tank?

1. Determine the number of acres you can spray with each tankful.

   $$\frac{\text{tank capacity (gal/tank)}}{\text{spray rate (gal/tank)}} = \frac{400}{20} = 20 \text{ acres/tankful}$$

2. Determine the number of pounds of pesticide product needed per acre. Because not all of the atrazine in the bag is an active ingredient, you will obviously have to add more than 1.5 lb of the product to each "acre's worth" of water in your tank. To determine how much more, divide the percentage of active ingredient (in this case, 90) into the total (100).

   $$1.5 \text{ lb ai/a} \times \frac{100}{90} = 1.5 \times 1.11 = 1.66 \text{ lb product/acre}$$

   For each "acre's worth" of water in the tank, you will need 1.66 lb of product to apply 1.5 lb ai/acre.

3. Determine the amount of pesticide to add to each tankful. With each tankful you will cover 20 acres (Step 1), and you want to apply 1.66 lb of product per acre (Step 2).

   20 acre × 1.66 lb/a = 33.3 lb product per tankful

Example (Liquid Formulation): A trifluralin recommendation calls for 1 lb ai/acre. You have purchased Treflan 4E (4 lb/gal formulation). Your sprayer has a 500-gal tank and is calibrated to deliver 20 GPA. How much Treflan should you add to the spray tank?

1. Determine the number of acres that you can spray with each tankful.

   $$\frac{\text{tank capacity (gal/tank)}}{\text{spray rate (gal/acre)}} = \frac{500}{20} = 25 \text{ acres/tankful}$$

2. To determine the amount of product needed per acre, divide the recommended amount of active ingredient per acre by the concentration of the formulation.

   $$\frac{1 \text{ lb ai/a}}{4 \text{ lb ai/gal.}} = \text{¼ gal/acre}$$

3. Determine the amount of pesticide to add to each tankful. You will cover 25 acres with each tankful (Step 1), and want to apply ¼ gal (1 qt) of product per acre (Step 2).

   25 acre × 1 qt/a = 25 qt (6.25 gal) Treflan/tankful

Example (Adjuvant): It is often recommended that a small amount of an adjuvant, such as a spreader-sticker or a surfactant, be added to the chemical you plan to spray. The amount to be added is frequently given as percent concentration.

If you use an adjuvant at 0.5% concentration by volume, how much should you add to a 500-gal tank?

Solution 1:

1% of 100 gal = 1 gal (100 × 0.01 = 1)

0.5% of 100 gal = 0.5 gal

You will need 0.5 gal for 100 gal, or 2.5 gal for 500 gal (0.5 × 5 = 2.5).

Solution 2:

$$0.5\% = \frac{0.5}{100} = 0.005$$

0.005 × 500 gal = 2.5 gal adjuvant per 500-gal tank

Table 1. Explanation of Typical Nozzle Numbering Systems

Extended range flat-fan	XR 11004	XR - Extended range flat-fan
Turbo flat-fan	TT 11004	TT - Turbo flat-fan
Venturi flat-fan	AI 11004	AI - Air-induction/Venturi flat-fan 110 - 110 degree fan angle 04 - 0.4 GPM flow rate at 40 psi
Even-fan	TP8002E AI 9502E	E - Even spray pattern 80 - 80 degree fan angle, 95 degree fan angle 02 - 0.2 GPM flow rate at 40 psi
Turbo flooding	TF-4	TF - Turbo flood 4 - 0.4 GPM flow rate at 10 psi
Turf flood	TTJ04	TTJ - Turbo turf flood 4 - 0.4 GPM flow rate at 40 psi
Turbo flooding	QCTF 40	QCTF - Quick attach Turbo flood 40 - 4 GPM at 10 psi

Table 2. Turbo Flooding Flat-Fan Nozzle Chart

Spraying systems orifice designation	Liquid pressure (psi)	Capacity	
		gal/min (GPM)	oz/min (OPM)
TF-2	10	.20	26
	20	.28	36
	30	.35	45
	40	.40	51
TF-2.5	10	.25	32
	20	.35	45
	30	.43	55
	40	.50	64
TF-3	10	.30	38
	20	.42	54
	30	.52	67
	40	.60	77
TF-4	10	.40	51
	20	.57	73
	30	.69	88
	40	.80	102
TF-5	10	.50	64
	20	.71	91
	30	.87	111
	40	1.00	128
TF-7.5	10	.75	96
	20	1.1	136
	30	1.3	166
	40	1.5	192

Table 2. Turbo Flooding Flat-Fan Nozzle Chart

Spraying systems orifice designation	Liquid pressure (psi)	Capacity	
		gal/min (GPM)	oz/min (OPM)
TF-10	10	1.0	128
	20	1.4	180
	30	1.7	221
	40	2.0	256

Table 3. Banding and Directed Application Nozzle Chart

Spraying systems orifice designation	Liquid pressure (psi)	Capacity	
		gal/min (GPM)	oz/min (OPM)
TP8001E	30	0.087	11
	40	0.10	13
	50	0.11	15
	60	0.12	15
TP80015E, AI95015E	30	0.13	17
	40	0.15	19
	50	0.17	22
	60	0.18	23
	70	0.20	26
	80	0.21	27
TP8002E, AI9502E	30	0.17	22
	40	0.20	26
	50	0.22	28
	60	0.24	31
	70	0.26	33
	80	0.28	36
AI9525E	30	0.22	28
	40	0.25	42
	50	0.28	36
	60	0.32	41
	70	0.33	42
	80	0.35	45
TP8003E, AI9503E	30	0.26	33
	40	0.30	38
	50	0.34	44
	60	0.37	47
	70	0.40	51
	80	0.42	54
TP8004E, AI9504E	30	0.35	45
	40	0.40	51
	50	0.45	58
	60	0.49	63
	70	0.53	68
	80	0.57	73

Table 3. Banding and Directed Application Nozzle Chart

Spraying systems orifice designation	Liquid pressure (psi)	Capacity	
		gal/min (GPM)	oz/min (OPM)
TP8005E, AI9505E	30	0.43	55
	40	0.50	64
	50	0.56	72
	60	0.61	78
	70	0.66	84
	80	0.71	91
TP8006E, AI9506E	30	0.52	67
	40	0.60	77
	50	0.67	86
	60	0.73	93
TP8008E, AI9508E	30	0.69	88
	40	0.80	102
	50	0.89	114
	60	0.98	125
TP8010E	30	0.87	111
	40	1.00	128
	50	1.12	143
	60	1.22	156

Cleaning Spray Equipment

Clean your spray equipment immediately after use. Some crops can be damaged or killed by traces of herbicides that are left in the sprayer after cleaning. It usually is wise to have separate spray equipment for herbicides, insecticides, and fungicides.

You can clean spray equipment quickly with a suspension of activated charcoal in water. Triple-rinse the sprayer, then spray the water on a target area. Use at least a third of a tank of water. Then suspend activated charcoal in water for subsequent rinsing. For each 10 gal of water, add ¼ lb activated charcoal and ¼ to ⅓ lb laundry detergent. Agitate this mixture vigorously to distribute the charcoal throughout the water. Wash the equipment for 2 minutes by swirling the charcoal suspension around in the tank so that it reaches all parts. Pump some of the liquid through the hose and nozzles. Then drain the tank and rinse the equipment with clean water. Do this away from areas where rinse water might contaminate water supplies or animal feed.

For phenoxy herbicides, a 1% ammonia-water solution is effective. Follow the general instructions above, but soak the equipment for 24 hours. Refer to the product label for specific cleaning requirements. Some herbicides may require special procedures to prevent inadvertent contamination.

Pumps should be cleaned and lubricated after each use. They can be filled with oil to prevent rust or corrosion (use radiator rust inhibitor if the pump contains rubber parts or seals). Do not leave oil in hoses. Antifreeze should be used when winterizing to prevent freeze damage.

Protect Your Water Supply

1. Avoid contamination of wells and surface water sources by keeping pesticide storage, handling, mixing, and cleanup operations at least 300 feet away from them. Using a nurse tank for a water supply and mixing chemicals at the application site is recommended. When pesticide storage, handling, and mixing must be within 300 feet of wells and surface watercourses, anticipate accidents and provide protection. Have a lined collection and containment area for any spills and leaks that may occur.

2. Prevent back siphoning by keeping the end of the water supply hose above the sprayer tank water level at all times. Alternatively, anti-backflow devices of various types are available for installation in your water supply line.

3. Triple-rinse containers of liquid pesticide formulations, and use rinsings as diluents in subsequent spray applications. Puncture the container to render it useless. One way to dispose of small amounts of excess herbicide is to apply them at labelled rates to a set-aside field. Never drain leftover chemicals or rinses from equipment near or into ditches, streams, ponds, or other water sources.

4. In case of herbicide spillage, keep people away and confine the spill. If it starts to spread, dike it up with soil. Use absorbent material, such as soil, sawdust, or cat litter, to soak up the spill. Shovel all contaminated material into a leak-proof container and dispose of it as you would pesticide waste. Do not hose down the area, because this spreads the chemical. Contact the Kansas Department of Health and Environment or your K-State Research and Extension agricultural agent for more information.

5. For emergency assistance with major spills, call the toll-free CHEMTREC hotline at 1-800-424-9300, day or night. This number is for emergencies only.

6. Many herbicides adhere to soils. Protect watercourses with grass buffer strips at least 50 feet in width to trap soilborne herbicides.

7. Additional suggestions: Follow label directions; calibrate sprayer properly; use integrated weed management approaches (e.g., crop rotation, cultivation, competitive crops); and use short-residual herbicides. Also, identify high-risk areas, such as sandy soils, high pH soils, and areas where the water table is near the soil surface. Use pesticides with minimum potential for surface and groundwater contamination in these sensitive areas.

Herbicide Terms and Definitions

Acid equivalent (ae). The theoretical yield of parent acid from the active ingredient content of a formulation.

Active ingredient (ai). The agent in a product primarily responsible for the intended herbicidal effects and shown as the active ingredient on the herbicide label.

Adjuvant. Any substance added to the spray solution to aid or modify the action of an agrichemical.

Antagonism. Reduced activity of one or more pesticides when applied in combinations.

Antidote. A compound added to certain herbicides to increase their safety on certain crops (e.g., EPTC plus antidote makes Eradicane, which is safe to use on corn).

Band treatment. Application to a continuous restricted area such as on or along a crop row rather than over the entire field area.

Broadcast treatment. Application of an herbicide over an entire field area.

Carrier. A liquid or solid substance used to dilute or suspend an herbicide during its application.

Contact herbicide. An herbicide that causes localized injury where it contacts plant tissue. Not translocated.

Crop oil. A mixture of nonphytotoxic, paraffin-based petroleum oil with 2 to 5% emulsifier. Used as an adjuvant.

Crop oil concentrate (COC). A mixture of 80 to 85% nonphytotoxic, paraffin-based petroleum oil and 15 to 20% emulsifier. Used as an adjuvant to increase foliar uptake.

Defoliant. A chemical that causes the leaves to drop from a plant.

Desiccant. Any substance or mixture of substances used to accelerate the killing or drying of plant tissue.

Dry flowable (DF). A highly concentrated granule designed to break up and disperse in water in a manner similar to that of wettable powders. Requires agitation.

Dry soluble (DS). A dry formulation that forms a solution when added to water.

Emulsifiable concentrate (EC). A single-phase liquid system that forms an emulsion when mixed with water. Requires mild agitation to maintain the emulsion.

Emulsion. One liquid suspended as minute globules in another liquid (for example, oil dispersed in water).

Flowable formulation. A two-phase concentrate that contains solid herbicide suspended in liquid and is capable of suspension in water. Requires only moderate agitation.

Foliar application. Application of an herbicide to the foliage of plants.

Granule (G). An inert material with a low concentration (usually 5 to 15% active ingredient) of pesticide impregnated into it or on the surface and designed to be spread directly on the soil.

Growth stage for cereal crops.

(1) Tiller or Tillering—when additional shoots are developing from the crown.

(2) Joint or Jointing—when stem internodes begin elongating.

(3) Boot or Booting—when growth of the developing spike or panicle swells the upper leaf sheath.

(4) Head or Heading—when the seed head is emerging or has emerged from the sheath.

Growth stage for corn and sorghum. Three different measures are commonly used:

Plant height = height of freestanding plants.

Leaf number = total number of leaves, including the newest leaf that is at least half extended.

V-Stage = vegetative stage, according to the newest leaf whose leaf collar is visible.

Example: V3 = corn (or sorghum) plant with three leaf collars visible.

Herbicide. A chemical used to control, suppress, or kill plants or severely interrupt their normal growth processes.

High surfactant oil concentrate (HSOC). An emulsifiable oil-based product containing 25 to 50% surfactant and a minimum of 50% oil.

Incorporate. To mix or blend an herbicide into the soil.

LD_{50}. The dose (quantity) of a chemical calculated to be lethal to 50% of the organisms in a specific test situation. It is expressed in weight of the chemical (mg) per unit of body weight (kg). The toxicant may be fed (oral LD_{50}), applied to the skin (dermal LD_{50}), or administered in the form of vapors (inhalation LD_{50}). Measures acute, not chronic, exposure.

Low-volatile ester (LVE). Any ester with a high molecular weight (like butoxy-ethanol, iso-octyl, or propylene glycol butyl ester) that is less volatile than the low molecular weight esters (such as methyl, ethyl, propyl, isopropyl, butyl, amyl, and pentyl esters). Low-volatile esters are less likely than high-volatile esters to injure plants by vapor drift.

Methylated seed oil (MSO). Adjuvant containing a minimum of 80% methylated vegetable oil and 5 to 20% emulsifier.

Nonionic surfactant (NIS). A surface active agent having no ionizable polar end groups, but comprised of hydrophilic and lipophilic segments.

Persistent herbicide. See residual herbicide.

Pesticide. A chemical that destroys or suppresses pests (plants, pathogens, or animals).

Phytotoxic. Injurious or lethal to plants or seedlings.

Postemergence (POST). Applied after the specified weed or planted crop emerges.

Postplant incorporated. Applied and incorporated into the soil after the crop is planted.

Premix. A commercial product consisting of two or more herbicide active ingredients formulated for the convenience of the applicator.

Preemergence (PRE). Applied before the specified weed or crop emerges.

Preplant application. Applied on the soil surface before seeding or transplanting.

Preplant incorporated (PPI). Applied and tilled into the soil before seeding or transplanting.

Rate. The amount of active ingredient, acid equivalent, or product applied per unit area or other treatment unit.

Residue. That quantity of an herbicide remaining in or on the soil, plant parts, animal tissues, whole organisms, or surfaces.

Residual herbicide. A soil-applied herbicide that remains active over a period of time until broken down into compounds not toxic to seedlings or plants. Duration of activity (persistence) depends mainly on the chemistry of the herbicide but also can be influenced by rainfall, soil pH, and temperatures. Herbicide persistence must be taken into account when planning rotation of crops.

Seed safener. A chemical applied to crop seed to protect the seedling from injury caused by certain herbicides.

Selective herbicide. A chemical that is more toxic to some plant species than others.

Soil application. Application of an herbicide primarily to the soil surface rather than to vegetation.

Spot treatment. Application of an herbicide to localized area(s) of a whole unit (i.e., treating spots or patches of weeds in a larger field).

Spray drift. Movement of airborne spray from the intended area of application.

Surfactant. A material that favors or improves the emulsifying, dispersing, spreading, wetting, or other surface-modifying properties of liquids.

Susceptibility. Death or growth reduction of a plant in response to an herbicide treatment.

Synergism. A complementary action of two or more chemicals such that the total effect is greater than the sum of the independent effects. (Opposite of antagonism.)

Tank mix. Mixing of two or more pesticides or agricultural chemicals in a spray tank at application time.

Total vegetation control. Applying single or multiple herbicides at one time or in sequence to provide preemergence and/or postemergence control of all plants. The term usually refers to noncrop areas.

Toxicity. The degree to which a given substance injures plants or animals. Toxicity is classified as acute (immediate) or chronic (long-term). Toxicity varies with species, age, sex, nutritional state, method of administration, and chemical formulation. (See LD_{50}.)

Translocated herbicide. An herbicide that moves within the plant. Translocated herbicides can be either phloem-mobile or xylem-mobile, but the term frequently is used in a more restrictive sense to refer to herbicides that are moved in the phloem (e.g., from the foliage to the growing points of roots and shoots).

Vapor drift. The movement of chemical vapors from the area of application. Some herbicides, when applied at normal rates and normal temperatures, have vapor pressures that change them into vapor form, which may seriously injure susceptible plants away from the application site. Note: Injuries from vapor drift and spray drift often are difficult to distinguish.

Vegetable oil. A mixture of crop-origin oil plus emulsifier for use as an adjuvant to enhance herbicide absorption.

Volatility. The ability of a compound to evaporate or vaporize (change from a liquid to a gas) at ordinary temperatures when exposed to air.

Water dispersible or soluble film. Water-dissolvable film packaging that allows direct placement of an herbicide package into a spray tank.

Water dispersible granule (WDG). See dry flowable.

Wettable powder (WP). A finely divided dry formulation that can be suspended readily in water. Requires agitation.

Wetting agent. A substance that reduces interfacial tensions and causes spray solutions or suspensions to make better contact with treated surfaces. (See surfactant.)

Names, Toxicities, and Persistence of Herbicides in/on Soils

Common name	Trade name	Acute oral toxicity LD_{50} mg/kg[1]	Dermal toxicity[1]	Persistence in/on soils[2]
Acetochlor	Harness, Surpass NXT, Fultime NXT, Top-Notch, Volley, Keystone NXT, Confidence, SureStart II, Cadence, OverTime, Warrant	1,942	Moderately irritating	8 to 12 weeks
Acifluorfen	Ultra Blazer, Uproar, Avalanche Ultra, Levity, Pecos, Acifin	1,300	Moderately irritating	Half-life, 2 to 4 weeks
Ametryn	Evik	1,750	Mildly irritating	1 to 3 months
Aminocyclopyrachlor	Perspective, Streamline, Viewpoint	Above 5,000	LD_{50} > 5,000	114-433 days
Aminopyralid	Milestone	Above 5,000	Mildly irritating	Half-life, 25 to 35 days
Atrazine	AAtrex, Atrazine	5,100	Mildly irritating	About 1 year or more
Benefin	Balan	Above 10,000	Nonirritating	4 to 5 months
Bentazon	Basagran, Broadloom	1,100	LD_{50} > 2,500 mg/kg	Nonpersistent
Bromacil	Hyvar	5,200	Irritating	More than 1 season
Bromoxynil	Broclean, Buctril, Moxy, Bromox, Brox	440	Mildly irritating	No soil residue
Carfentrazone	Aim	5,143	LD_{50} > 4,000 mg/kg	2 to 4 weeks
Chlorimuron	Classic, Curio	Greater than 5,000	LD_{50} > 2,000 mg/kg	2 to 4 weeks
Chlorsulfuron	Glean, Telar DF, Report, Corsair	5,545	LD_{50} > 3,400 mg/kg	Half-life, 4 to 6 weeks
Clethodim	Select, Select Max, Volunteer, Arrow, Trigger, Section, Shadow, TapOut, IntensityOne	3,610	LD_{50} > 5,000 mg/kg	1 month
Clomazone	Command, Bombard	2,077	LD_{50} > 2,000 mg/kg	Half-life, 15 to 45 days

[1] LD_{50} is a statistical estimate of the dosage necessary to kill 50% of a large population of laboratory animals under stated conditions. The lower the LD_{50}, the more toxic the chemical. The acute oral toxicities of several substances to rats (approximate LD_{50}, mg/kg of body weight) are caffeine, 200; aspirin, 1,000; and table salt, 3,000.
Dermal toxicity refers to poison absorbed through the skin to produce toxic symptoms. The following are classifications of relative toxicity.

Degree of toxicity	Acute oral LD_{50}, mg/kg	Probable lethal dose for 150-pound person	Signal word on container
Highly toxic	Below 50	Few drops to 1 teaspoon	Danger, poison
Moderately toxic	50 to 500	1 teaspoon to 1 ounce	Warning
Slightly toxic	500 or greater	1 ounce to 1 pint or 1 pound	Caution

[2] Average persistence at recommended rates.

Names, Toxicities, and Persistence of Herbicides in/on Soils

Common name	Trade name	Acute oral toxicity LD_{50} mg/kg[1]	Dermal toxicity[1]	Persistence in/on soils[2]
Clopyralid	Stinger, Curtail, SureStart, Garrison	4,500	LD_{50} > 2,000 mg/kg	Half-life, 12 to 70 days
Cloransulam	FirstRate, Traject	Above 5,000	LD_{50} > 2,000 mg/kg	Half-life, 13 to 28 days
Dicamba	Banvel, Clarity, Sterling Blue, Oracle, Rifle, Distinct, Status, Diablo, Vanquish, Vision, Opti-OGA, Xtendimax	2,900	Mildly irritating	3 to 12 weeks
Dimethenamid-P	Outlook, Slider	1,570	Slightly irritating	Half-life, 2 to 5 weeks
Diquat	Reglone, Diquat, Verdure X	230	LD_{50} > 400 mg/kg	Persistent but biologically unavailable
Diuron	Karmex, Direx	3,400	Mildly irritating	About 1 season or more
Ethalfluralin	Sonalan	Above 10,000	Irritating	4 to 5 months
Florasulam	Orion	Above 5,000	LD_{50} > 2,000 mg/kg	Half-life, 4.5 days
Flucarbazone	Everest, Pre-Pare, Sierra	Above 5,000	LD_{50} > 2,000 mg/kg	Half-life, 17 days
Fluazifop-P	Fusilade DX	3,328	Mildly irritating	2 months
Flumetsulam	Python, Accolade, Sure Start II, TripleFLEX II, Trisidual	Above 5,000	LD_{50} > 2,000 mg/kg	Half-life, 1 to 2 months
Flumiclorac	Resource	3,600	Moderately irritating	Half-life, 1 to 6 days
Flumioxazin	Valor, Encompass, Chateau, Payload, Outflank, Panther, Tuscany	Above 5,000	LD_{50} > 2,000 mg/kg	Half-life, 18 days
Fluometuron	Cotoran	Above 1,500	LD_{50} > 2,000 mg/kg	Half-life, 85 days
Fluroxypyr	Starane Ultra, Vista, Spotlight, Obtain, StareDown, Comet	Above 5,000	LD_{50} > 2,000 mg/kg	Half-life, 13 to 36 days
Fluthiacet	Cadet	Above 5,000	Slightly irritating	Half-life, 1 to 2 days
Fomesafen	Reflex, Flexstar, Dawn, Rhythm, Rumble, TopGun, Sinister	1,499	Mildly irritating	2 to 3 months
Fosamine	Krenite S	Above 5,000	Nonirritating	Half-life, 8 days
Glufosinate	Liberty, Cheetah, Interline, Forfeit, Refer, Surmise	2,030	Slightly irritating	Nonpersistent
Glyphosate	see glyphosate table	5,600	Nonirritating	Nonpersistent
Halauxifen	Quelex, Elevore	Above 5,000	Mildly irritating	Half-life, 15 days
Halosulfuron	Permit, Sandea, Herbivore	8,865	Nonirritating	Half-life, 1 to 2 months
Hexazinone	Velpar L, Velossa, Pronone Power Pellets	4,120	LD_{50} > 5,278 mg/kg	Half-life, 1 to 6 months
Imazamox	Raptor, Beyond	Above 5,000	LD_{50} > 5,000 mg/kg	1 to 2 months
Imazapic	Plateau, Panoramic, Imazapic, Impose	Above 5,000	LD_{50} > 5,000 mg/kg	3 to 6 months
Imazapyr	Arsenal, Contain, Habitat	Above 5,000	LD_{50} > 2,148 mg/kg	3 to 12 months
Imazaquin	Scepter	Above 5,000	LD_{50} > 2,000 mg/kg	2 to 3 months
Imazethapyr	Pursuit, Thunder	Above 5,000	LD_{50} > 2,000 mg/kg	2 to 3 months
Iodosulfuron	Autumn Super	Above 5,000	LD_{50} > 5,000 mg/kg	1 to 1 months
Isoxaflutole	Balance Flexx, Corvus	5,000	LD_{50} > 2,000 mg/kg	2 months
Lactofen	Cobra, Phoenix	Above 5,000	Severely irritating	4 to 6 weeks
MCPA	Several	1,000	Moderately irritating	1 to 4 weeks
Mesosulfuron	Osprey	Above 2,000	LD_{50} > 2,000 mg/kg	Half-life, 11 to 17 days
Mesotrione	Callisto, Incinerate, Explorer, Motif	Above 5,000	LD_{50} > 2,000 mg/kg	Half-life, 12 days
Metolachlor	Me-Too-Lachlor, Parallel, Stalwart, Moccasin	2, 780	LD_{50} > 2,000 mg/kg	2 to 4 months
S-metolachlor	Dual II Magnum, Charger Basic, Brawl, EverpreX, Medal, Pennant Magnum, Moccasin II Plus	2,534	LD_{50} > 3,000 mg/kg	2 to 4 months
Metribuzin	Sencor, Dimetric, Tricor, Metribuzin, Glory, Metricor	1,090-1,206	Nonirritating	Half-life, 7 to 28 days

[1] LD_{50} is a statistical estimate of the dosage necessary to kill 50% of a large population of laboratory animals under stated conditions. The lower the LD_{50}, the more toxic the chemical. The acute oral toxicities of several substances to rats (approximate LD_{50}, mg/kg of body weight) are caffeine, 200; aspirin, 1,000; and table salt, 3,000.
Dermal toxicity refers to poison absorbed through the skin to produce toxic symptoms. The following are classifications of relative toxicity.

Degree of toxicity	Acute oral LD_{50}, mg/kg	Probable lethal dose for 150-pound person	Signal word on container
Highly toxic	Below 50	Few drops to 1 teaspoon	Danger, poison
Moderately toxic	50 to 500	1 teaspoon to 1 ounce	Warning
Slightly toxic	500 or greater	1 ounce to 1 pint or 1 pound	Caution

[2] Average persistence at recommended rates.

Names, Toxicities, and Persistence of Herbicides in/on Soils

Common name	Trade name	Acute oral toxicity LD_{50} mg/kg[1]	Dermal toxicity[1]	Persistence in/on soils[2]
Metsulfuron	Ally, Escort, Manor, Metgard, Valuron, Patriot, Plotter, Valuron, Purestand, Accurate	Above 5,000	LD_{50} > 5,000 mg/kg	2 to 4 weeks
Nicosulfuron	Accent, Nic-It, Primero, Zest	Above 5,000	Nonirritating	Half-life, 1 to 2 months
Norflurazon	Zorial	1,140	Slightly irritating	Half-life, 180 days
Oryzalin	Surflan A. S.	Above 500	LD_{50} > 2000 mg/kg	Half-life, 20 days
Paraquat	Gramoxone, Parazone, Helmquat	120	LD_{50} > 480 mg/kg	Persistent but biologically unavailable
Pendimethalin	Prowl, Acumen, Stealth, Framework, Satellite	3,277	LD_{50} > 2,260 mg/kg	No carryover to subsequent crop
Picloram	Tordon 22K, Trooper	8,200	Mildly irritating	Varies with rate, soils, climate
Primisulfuron	Beacon	Above 5,500	Nonirritating	Half-life, 1 month
Prometon	Pramitol	2,276	LD_{50} = 2,000 mg/kg	Several years
Prometryn	Caparol, Cotton Pro	Above 3,800	LD_{50} = 2,000 mg/kg	Half-life, 60 days
Propoxycarbazone	Olympus	Above 2,000	LD_{50} > 2,000 mg/kg	Half-life, 22 to 60 days
Prosulfuron	Peak, Spirit	4,360	Nonirritating	Half-life, 4 to 6 weeks
Pyraflufen	ET, Vida	Above 5,000	LD_{50} > 2,000 mg/kg	Nonpersistent
Pyrasulfotole	Huskie	Above 300	LD_{50} > 4,000 mg/kg	1 month
Pyrithiobac	Staple, Pyrimax	Above 1,600	LD_{50} > 2,000 mg/kg	Half-life, 60 days
Pyroxasulfone	Zidua, Fierce, Anthem Maxx, Anthem Flex	Above 2,000	Above 2,000 mg/kg	Half-life, 16 to 26 days
Pyroxsulam	PowerFlex HL	Above 5,000	Nonirritating	Half-life, 13 days
Quinclorac	Paramount, Facet L, QuinStar 4L, Quinstar GT, Drive	2,610	LD_{50} > 2,000 mg/kg	Up to 1 year
Quizalofop	Assure II, Targa, Aggressor	5,700	LD_{50} > 5,000 mg/kg	1 month
Rimsulfuron	Resolve Q, Basis, Basis Blend, Steadfast, Require Q, Pruvin, Solida	Above 5,000	Nonirritating	Half-life, 10 to 20 days
Saflufenacil	Sharpen, Kixor	Above 2,000	LD_{50} > 2,000 mg/kg	Half-life, 17 days
Sethoxydim	Poast Plus, Poast	2,676-3,125	Nontoxic	Half-life, 4 to 11 days
Simazine	Princep, Simtrol	Above 5,000	Mildly irritating	About 1 year or more
Sodium chlorate	Defol 6	5,000	Irritating	Half-life, 200 days
Sulfentrazone	Spartan, Blanket, Antares, Sulfin, Shutdown, Authority Brands	2,689	Nonirritating	Half-life, 4 to 6 months
Sulfometuron	Oust	Above 5,000	Mildly irritating	Half-life, about 4 weeks
Sulfosulfuron	Maverick, Outrider	Above 5,000	LD_{50} > 5,000 mg/kg	Half-life, 30 to 70 days
Tebuthiuron	Spike	644	Nonirritating	Half-life, more than 12 to 15 months
Tembotrione	Laudis, Capreno	1,750	LD_{50} > 5,000 mg/kg	Half-life, 23 days
Terbacil	Sinbar	Above 5,000	LD_{50} > 5,000 mg/kg	Half-life, 5 to 6 months
Thiencarbazone	Capreno, Corvus, Autumn Super	Above 2,000	LD_{50} > 2,000	Half-life, 3 to 55 days
Thifensulfuron	Harmony SG, Unity, Harass, Treaty, Thief	Above 5,000	Non or slightly irritating	Half-life, 12 days
Topramezone	Impact, Armezon	> 2,000	> 4,000 Nonirritating	Half-life, 14 days
Triasulfuron	Amber	Above 5,050	Nonirritating	Half-life, 4 to 12 weeks
Tribenuron	Express, Nuance, Victory	Above 5,000	LD_{50} > 2,000 mg/kg	Half-life, 10 days
Triclopyr	Garlon Ultra, Remedy Ultra, Relegate, Trycera	713	Nonirritating	Half-life, 46 days
Trifluralin	Treflan, Trust, Trilin, Trifluralin, Triflurex	Above 10,000	Nonirritating	4 to 6 months
2,4-D	Several	300-1,000	Irritating	1 to 4 weeks
2,4-DB	Butyrac, Butoxone	1,960	Nonirritating	Not for soil application

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[2] Average persistence at recommended rates.

Approximate 2019 Retail Costs of Herbicides, Harvest Aids, and Adjuvants

Formulated products	Company	Active ingredient (% or lb/gal)	Approximate cost ($/unit)
AAtrex Nine-O	Syngenta	90 DF	4.08/lb
Accent Q	Corteva	54.5 DF	20.76/oz
Acuron	Syngenta	3.44	77.35/gal
Acuron Flexi	Syngenta	3.26	92.75/gal
Affinity BroadSpec	FMC	50 DF	10.58/oz
Affinity TankMix	FMC	50 DF	8.70/oz
Afforia	Corteva	51 DF	5.80/oz
Agility SG	FMC	72.6 DG	2.48/oz
Aggressor	Albaugh	0.88	176.00/gal
Aim EC	FMC	2	6.00/oz
Ally Extra	FMC	7 DF	8.47/oz
Ally XP	FMC	60 DF	9.81/oz
Amber	Syngenta	75 WDG	11.23/oz
Anthem ATZ	FMC	4.51	111.50/gal
Anthem Flex	FMC	4	5.11/oz
Anthem Maxx	FMC	4.3	6.30/oz
Armezon	BASF	2.8	20.13/oz
Armezon PRO	BASF	5.35	166.00/gal
Arsenal	BASF	2	152.00/gal
Assure II	Corteva	0.88	96.80/gal
Atrazine 4L	Several	4	14.40/gal
Authority Assist	FMC	4	3.11/oz
Authority Elite	FMC	7	129.00/gal
Authority First	FMC	70 DF	90.20/lb
Authority Maxx	FMC	66 DF	64.15/lb
Authority MTZ	FMC	45 DF	27.15/lb
Authority Supreme	FMC	4.16	3.86/oz
Authority XL	FMC	70 DF	65.45/lb
Autumn Super	Bayer CS	51 WDG	24.50/oz
Avalanche Ultra	Winfield	2	71.35/gal
Axial XL	Syngenta	0.42	152.25/gal
Balance Flexx	Bayer CS	2	4.75/oz
Basagran	Winfield	4	56.10/gal
Basis Blend	Corteva	30 DF	7.95/oz
Beyond	BASF	1	4.54/oz
Bicep II Magnum	Syngenta	5.5	45.50/gal
Bicep Lite II Magnum	Syngenta	6	60.15/gal
Boundary	Syngenta	6.5	92.25/gal
Broadaxe	Syngenta	7	146.40/gal
Broadloom	UPI	4	65.25/gal
Bromoxynil	Several	2	59.55/gal
Bromoxynil+MCPA	Several	4	53.25/gal
Butyrac 200	Albaugh	2	29.94/gal
Cadet	FMC	0.91	9.67/oz
Callisto	Syngenta	4	2.58/oz
Callisto GT	Syngenta	4.18	51.90/gal
Callisto Xtra	Syngenta	3.7	52.50/gal
Canopy Blend	Corteva	58.3 DF	34.10/lb
CanopyEX	Corteva	29.5 DF	8.30/oz
Caparol	Syngenta	4	41.18/gal
Capreno	Bayer CS	3.45	5.65/oz
Capstone	Corteva	1.1	44.00/gal
Carnivore	Winfield	4	58.15/gal
Chaparral	Dow AS	0.62	5.94/oz
Chateau	Valent	51WDG	102.20/lb
Cimarron Plus	Bayer	63 DF	10.80/oz
Clarity	BASF	4	98.80/gal
Classic	Corteva	25 DF	17.53/oz
Cobra	Valent	2	239.50/gal
Colt	Loveland	1.5	63.35/gal
Colt+Salvo	Loveland	3.75	46.60/gal
Colt+Sword	Loveland	3.55	48.70/gal
Command	FMC	3	172.80/gal
Cornerstone Plus	Winfield	3 ae	14.06/gal
Corvus	Bayer CS	2.63	7.42/oz
Cotoran 4L	ADAMA	4	48.72/gal
Crossbow	Corteva	3	46.55/gal
Curtail	Corteva	2.4	65.32/gal
Degree Xtra	Bayer CS	4.04	48.95/gal
DiFlexx	Bayer	4	220.65/gal
DiFlexx Duo	Bayer	1.53	101.25/gal
Distinct	BASF	76.4 WDG	41.29/lb
Dual II Magnum	Syngenta	7.6	122.35/gal
Durango DMA	Corteva	4 ae	22.36/gal
Elevore	Corteva	0.57	8.18/oz
Engenia	BASF	5	133.40/gal
Enlist Duo	Corteva	3.3	30.33/gal
Enlist One	Corteva	3.8	43.76/gal
Enlite	Corteva	41 WDG	6.23/oz
Envive	Corteva	48 WDG	5.13/oz
Escort XP	Bayer	60 DF	9.90/oz
Esplanade	Bayer CS	1.67	49.95/gal
EverpreX	Corteva	7.62	90.75/gal
Express	FMC	50 SG	15.87/oz
Facet L	BASF	1.5	123.40/gal
FeXapan	Corteva	2.9	80.00/gal
Fierce	Valent	76 WDG	8.17/oz
Fierce XLT	Valent	62.4 WDG	6.69/oz
Finesse	FMC	75 DF	16.49/oz
FirstRate	Corteva	84 WDG	44.35/oz
Flexstar	Syngenta	1.88	73.53/gal
Flexstar GT 3.5	Syngenta	2.81	41.00/gal

[1] Approximate retail costs of herbicides and harvest aids on November 1, 2018, were based on estimated retail prices provided by major distribution companies. Retail cost will vary depending upon volume purchased, current price structure, and other factors. Retail prices from your dealer may be higher or lower than the approximate retail costs listed in this publication. Contact your local chemical supplier regarding current retail prices.

Approximate 2019 Retail Costs of Herbicides, Harvest Aids, and Adjuvants

Formulated products	Company	Active ingredient (% or lb/gal)	Approximate cost ($/unit)
Forefront HL	Corteva	3.74 ae	72.50/gal
FulTime NXT	Corteva	4	45.85/gal
Fusilade DX	Syngenta	2	141.25/gal
Fusion	Syngenta	2.66	232.50/gal
Garlon 4 Ultra	Corteva	4	108.25/gal
Glean FC	FMC	75 DF	22.50/oz
Gramoxone SL	Syngenta	2	26.30/gal
Graslan L	Corteva	3.81	42.22/gal
Grazon P+D	Corteva	2.54	31.10/gal
Grazon Next HL	Corteva	3.74	54.40/gal
Halex GT	Syngenta	4.39	64.40/gal
Harmony Extra SG	FMC	50 DF	12.39/oz
Harmony SG	FMC	50 SG	38.00/oz
Harness	Bayer CS	7	121.5/gal
Harness Max	Bayer CS	3.85	76.80/gal
Harness Xtra	Bayer CS	6	66.00/gal
Huskie	Bayer CS	2.06	116.50/gal
Hyvar XL	Bayer CS	2	107.50/gal
Impact	AMVAC	2.8	21.52/oz
Journey	BASF	2.25	140.00/gal
Karmex DF	ADAMA	80 DF	4.94/lb
Keystone LA NXT	Corteva	5.5	78.36/gal
Keystone NXT	Corteva	5.25	62.00/gal
Kochiavore	Winfield	4.0	63.30/gal
Laudis	Bayer CS	3.5	4.68/oz
Lexar EZ	Syngenta	3.7	66.30/gal
Liberty 280	BASF	2.34	77.90/gal
Linex 4L	NovaSource	4	92.15/gal
Lumax EZ	Syngenta	3.95	78.70/gal
Marvel	FMC	3	178.80/gal
MCPA ester	Several	4	22.26/gal
Metribuzin	Several	75 DF	20.00/lb
Milestone	Corteva	2	343.75/gal
Olympus	Bayer CS	70 WDG	15.43/oz
Orion	Syngenta	2.37	72.60/gal
Osprey	Bayer CS	4.5 WDG	3.63/oz
Oust XP	Bayer CS	75 WDG	3.25/oz
Outlook	BASF	6	151.40/gal
Outrider	Valent	75 DF	17.44/oz
Panoflex	FMC	50 DF	9.52/oz
Panoramic	Alligare	2	160.00/gal
Parallel	ADAMA	7.8	48.95/gal
Parallel Plus	ADAMA	5.5	31.90/gal
Pastora	Bayer	71.2 WDG	19.00/oz
Pasturall HL	Corteva	2.75	24.44/gal
Pasture Gard HL	Corteva	2	126.10/gal
Pathfinder II	Corteva	0.75 ae	49.50/gal
Peak	Syngenta	57 DF	18.27/oz
Permit	Gowan	75 DF	23.74/oz
Phoenix	Valent	2	237.25/gal
Plateau	BASF	1	171.35/gal
Poast	BASF	0.5	108.50/gal
PowerFlex HL	Corteva	13 WDG	7.27/oz
Pramitol 25E	Several	4	38.40/gal
Prefix	Syngenta	4.34	58.92/gal
Princep 4L	Syngenta	4	28.37/gal
Pronone Power Pellet	Pro-Serve	75%	4.68/oz
Prowl H2O	BASF	3.8	51.15/gal
Pursuit	BASF	2	3.55/oz
Python	Corteva	80 WDG	14.82/oz
Quelex	Corteva	20 WDG	8.17/oz
Range Star	Albaugh	3.87	34.70/gal
Raptor	BASF	1	4.54/oz
Rave	Syngenta	63.8 WDG	1.63/oz
Realm Q	Corteva	38.8 DF	5.08/oz
Reflex	Syngenta	2	58.18/gal
Reglone/Diquat	Syngenta	2	87.45/gal
Remedy Ultra	Corteva	4	75.55/gal
Resicore	Corteva	3.29	80.85/gal
Resolve Q	Corteva	22.4 DF	9.28/oz
Resource	Valent	0.86	251.70/gal
Revulin Q	Corteva	51.2 WDG	5.82/oz
Roundup PowerMax	Bayer CS	4.5 ae	28.41/gal
Roundup WeatherMax	Bayer CS	4.5 ae	33.71/gal
RT 3	Bayer CS	4.5 ae	19.56/gal
Sahara	BASF	70 DG	19.25/lb
Scoparia	Bayer CS	4	5.66/oz
Select Max	Valent	0.97	106.00/gal
Sentrallas	FMC	1.55	124.77/gal
Sequence	Syngenta	5.25	50.84/gal
Sharpen	BASF	2.85	6.72/oz
Sonalan	Gowan	3	55.00/gal
Sonic	Corteva	70 DF	90.31/lb
Spartan Charge	FMC	3.5	2.45/oz
Spartan Elite	FMC	7	129.45/gal
Spike	Corteva	20 P	15.76/lb
Staple LX	Corteva	3.2	7.80/oz
Starane Flex	Corteva	0.875	75.80/gal
Starane NXT	Corteva	2.91	91.50/gal
Starane Ultra	Corteva	2.8	285.80/gal
StareDown	Corteva	2.8	113.67/gal
Status	BASF	56 WDG	4.31/oz

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Formulated products	Company	Active ingredient (% or lb/gal)	Approximate cost ($/unit)
Steadfast Q	Corteva	37.7 DF	12.57/oz
Sterling Blue	Winfield	4	55.95/gal
Stinger	Corteva	3	540.50/gal
Storm	UPI	4	94.44/gal
SureStart II	Corteva	4.16	97.55/gal
Surmount	Corteva	1.33 ae	62.78/gal
Surpass NXT	Corteva	7.0	123.58/gal
Surveil	Corteva	48 WDG	6.37/oz
Synchrony XP	Corteva	28.4 DG	12.98/oz
Targa	Gowan	0.88	96.30/gal
Talinor	Syngenta	1.77	93.50/gal
Telar XP	Bayer CS	75 DF	20.34/oz
Threesidual	Winfield	4.25	66.24/gal
Tordon 22K	Corteva	2	72.20/gal
Tordon RTU	Corteva	0.4	59.52/gal
Trifluralin	Several	4	29.00/gal
TripleFLEX II	Bayer CS	4.16	88.75/gal
Trivence	Corteva	61.3 WDG	2.87/oz
Ultra Blazer	United Phos.	2	72.15/gal
Valor EZ	Valent	4	5.36/oz
Valor SX	Valent	51 WDG	4.89/oz
Valor XLT	Valent	40.3 WDG	5.88/oz
Velpar AlfaMax	TKI	78 DF	17.53/lb
Velpar AlfaMax Gold	TKI	78.5 WDG	13.98/lb
Velpar L	TKI	2	95.10/gal
Verdict	BASF	5.57	246.60/gal
Vista XRT	Corteva	2.8	251.75/gal
Warrant	Bayer CS	3	39.90/gal
Warrant Ultra	Bayer CS	3.45	58.88/gal
WideMatch	Corteva	1.5	78.76/gal
Xtendimax	Bayer CS	2.9	72.15/gal
Yukon	Gowan	67.5 WDG	4.17/oz
Zidua SC	BASF	4.17	6.02/oz
Zidua Pro	BASF	4.09	4.10/oz
2,4-D Amine		4	14.15/gal
2,4-D LV Ester		4	19.20/gal
Ammonium sulfate (AMS)			0.70/lb
Crop oil concentrates (COC)		15% emulsifiers	10.56/gal
Methylated seed oil (MSO)		25% emulsifier	41.60/gal
Nonionic surfactants (NIS)		90%	28.00/gal

[1] Approximate retail costs of herbicides and harvest aids on November 1, 2018, were based on estimated retail prices provided by major distribution companies. Retail cost will vary depending upon volume purchased, current price structure, and other factors. Retail prices from your dealer may be higher or lower than the approximate retail costs listed in this publication. Contact your local chemical supplier regarding current retail prices.

Herbicide Premixes

Product (Manufacturer)	Ingredients (Tradename, herbicide site of action number)
Accurate Extra (FMC)	37.5% thifensulfuron (Harmony, 2), 18.8% tribenuron (Express, 2), and 15% metsulfuron (Ally, 2)
Acuron (Syngenta)	2.14 lb *S*-metolachlor (Dual II Magnum, 15), 0.24 lb mesotrione (Callisto, 27), 0.06 lb bicyclopyrone (27), and 1 lb atrazine (5) per gal
Acuron Flexi (Syngenta)	2.86 lb *S*-metolachlor (Dual II Magnum, 15), 0.32 lb mesotrione (Callisto, 27), and 0.08 lb bicyclopyrone (27) per gal
Affinity BroadSpec (FMC)	25% thifensulfuron (Harmony, 2) and 25% tribenuron (Express, 2)
Affinity TankMix (FMC)	40% thifensulfuron (Harmony, 2) and 10% tribenuron (Express, 2)
Afforia (Corteva)	41% flumioxazin (Valor, 14), 5% thifensulfuron (Harmony, 2), and 5% tribenuron (Express, 2)
Agility SG (FMC)	4.7% thifensulfuron (Harmony, 2), 2.4% tribenuron (Express, 2), 1.9% metsulfuron (Ally, 2), and 58% ae dicamba (4)
Ally Extra SG (FMC)	27.3% thifensulfuron, 13.6% tribenuron (Harmony Extra, 2), and 10.9% metsulfuron (Ally, 2)
Anthem ATZ (FMC)	0.485 lb pyroxasulfone (Zidua, 15), 0.014 lb fluthiacet (Cadet, 14), and 4 lb atrazine (5) per gal
Anthem Flex (FMC)	3.73 lb pyroxasulfone (Zidua, 15) and 0.27 lb carfentrazone (Aim, 14) per gal
Anthem Maxx (FMC)	4.174 lb pyroxasulfone (Zidua, 15) and 0.126 lb fluthiacet (Cadet, 14) per gal
Armezon PRO (BASF)	0.1 lb topramazone (Armezon, 27) and 5.25 lb dimethenamid-P (Outlook, 15) per gal
Authority Assist (FMC)	3.33 lb sulfentrazone (Spartan, 14) and 0.67 lb ae imazethapyr (Pursuit, 2) per gal
Authority Elite (FMC)	0.7 lb sulfentrazone (Spartan, 14) and 6.3 lb *S*-metolachlor (Dual Magnum, 15) per gal
Authority First (FMC)	62.1% sulfentrazone (Spartan, 14) and 7.9% cloransulam (FirstRate, 2)
Authority Maxx (FMC)	62.1% sulfentrazone (Spartan, 14) and 3.9% chlorimuron (Classic, 2)
Authority MTZ (FMC)	18% sulfentrazone (Spartan, 14) and 27% metribuzin (Sencor, 5)
Authority Supreme (FMC)	2.08 lb suflentrazone (Spartan, 14) and 2.08 lb pyroxasulfone (Zidua, 15) per gal
Authority XL (FMC)	62% sulfentrazone (Spartan, 14) and 7.8% chlorimuron (Classic, 2)
Autumn Super (Bayer)	6% iodosulfuron (Autumn, 2) and 45% thiencarbazone (2)
Banvel K + Atrazine (Arysta)	1.1 lb ae dicamba (4) and 2.1 lb atrazine (5) per gal
Basis Blend (Corteva)	20% rimsulfuron (Resolve, 2) and 10% thifensulfuron (Harmony, 2)
Bicep II Magnum (Syngenta)	3.1 lb atrazine (5) and 2.4 lb *S*-metolachlor (Dual II Magnum, 15) per gal
Bicep Lite II Magnum (Syngenta)	2.67 lb atrazine (5) and 3.33 lb *S*-metolachlor (Dual II Magnum, 15) per gal
Bison (Winfield)	2 lb bromoxynil (Moxy, 6) and 2 lb ae MCPA (4) per gal
Boundary (Syngenta)	5.25 lb *S*-metolachlor (Dual II Magnum, 15) and 1.25 lb metribuzin (Sencor, 5) per gal
Brash (Winfield)	1 lb ae dicamba (4) and 2.87 lb ae 2,4-D amine (4) per gal
BroadAxe XC (Syngenta)	0.7 lb sulfentrazone (Spartan, 14) and 6.3 lb *S*-metolachlor (Dual II Magnum, 15) per gal
Bromox + Atrazine (MicroFlo)	1 lb bromoxynil (6) and 2 lb atrazine (5) per gal
Brozine (Loveland)	1 lb bromoxynil (6) and 2 lb atrazine (5) per gal
Cadence ATZ (Loveland)	4 lb acetochlor (15) and 2.25 lb atrazine (5) per gal
Cadence Lite ATZ (Loveland)	3 lb acetochlor (15) and 1.5 lb atrazine (5) per gal
Callisto GT (Syngenta)	0.38 lb mesotrione (Callisto, 27) and 3.8 lb ae glyphosate (9, Touchdown Total) per gal
Callisto Xtra (Syngenta)	0.5 lb mesotrione (Callisto, 27) and 3.2 lb atrazine (AAtrex 4L, 5) per gal
Canopy Blend (Corteva)	50% metribuzin (5) and 8.3% chlorimuron (Classic, 2)
Canopy EX (Corteva)	22.7% chlorimuron (Classic, 2) and 6.8% tribenuron (Express, 2)
Capreno (Bayer)	2.88 lb tembotrione (Laudis, 27) and 0.57 lb thiencarbazone (2) per gal
Capstone (Corteva)	0.1 lb ae aminopyralid (4) and 1 lb ae triclopyr (4) per gal
Carnivore (Winfield)	1.67 lb ae MCPA (4), 1.67 lb bromoxynil (Buctril, 6), and 0.67 lb ae fluroxypyr (Starane, 4) per gal
Chaparral (Corteva)	52.5% ae aminopyralid (Milestone, 2) and 9.45% metsulfuron (Ally, 2)
Charger Max ATZ (Winfield)	3.1 lb atrazine (5) and 2.4 lb *S*-metolachlor (Dual II Magnum, 15) per gal
Charger Max ATZ Lite (Winfield)	2.67 lb atrazine (5) and 3.33 lb *S*-metolachlor (Dual II Magnum, 15) per gal
Cimarron Max (Bayer)	1 lb ae dicamba (4), and 2.87 lb ae 2,4-D (4) per gal, 60% metsulfuron (Ally, 2) co-pack[1]
Cimarron Plus (Bayer)	48% metsulfuron (Ally, 2) and 15% chlorsulfuron (Glean, 2)
Colt (Loveland)	0.75 lb ae fluroxypyr (Starane, 4) and 0.75 lb ae clopyralid (Stinger, 4) per gal
Colt + Salvo (Loveland)	0.75 lb ae fluroxypyr (Starane, 4) and 3 lb ae 2,4-D (4) per gal
Colt + Sword (Loveland)	0.71 lb ae fluroxypyr (Starane, 4) and 2.84 lb ae MCPA (4) per gal

[1] Co-packs consist of individual components packaged in separate containers or compartments and sold together.
ae = acid equivalent

Herbicide Premixes

Product (Manufacturer)	Ingredients (Tradename, herbicide site of action number)
Confidence Xtra (Winfield)	4.3 lb acetochlor (Harness, 15) and 1.7 lb atrazine (5) per gal
Confidence Xtra 5.6L (Winfield)	3.1 lb acetochlor (Harness, 15) and 1.5 lb atrazine (5) per gal
Corvus (Bayer)	1.88 lb isoxaflutole (Balance Flexx, 27) and 0.75 lb thiencarbazone (2) per gal
Coyote (UPI)	3.34 lb *S*-metolachlor (15) and 0.33 lb mesotrione (Callisto, 27) per gal
Crossbow (Corteva)	2 lb ae 2,4-D (4) and 1 lb ae triclopyr (Remedy, 4) per gal
Crusher (FMC)	25% rimsulfuron (Resolve, 2) and 25% thifensulfuron (Harmony, 2)
Curtail (Corteva)	2 lb ae 2,4-D (4) and 0.38 lb ae clopyralid (Stinger, 4) per gal
Degree Xtra (Bayer CS)	2.7 lb acetochlor (Degree, 15) and 1.34 lb atrazine (5) per gal
DiFlexx DUO (Bayer)	1.26 lb ae dicamba (Clarity, 4) and 0.27 lb tembotrione (Laudis, 27) per gal
Display (FMC)	18% carfentrazone (Aim, 14) and 4.75% fluthiacet (Cadet, 14)
Distinct (BASF)	20% ae diflufenzopyr (19) and 50% ae dicamba (4)
Double Up B&D (Helena)	2 lb bromoxynil (Buctril, 6) and 1.9 lb ae 2,4-D ester (4) per gal
Enlist Duo (Corteva)	1.6 lb ae 2,4-D (4) and 1.7 lb ae glyphosate (9) per gal
Enlite (Corteva)	2.85% chlorimuron (Classic, 2), 36.2% flumioxazin (Valor, 14), and 8.8% thifensulfuron (Harmony, 2)
Envive (Corteva)	9.2% chlorimuron (Classic, 2), 29.2% flumioxazin (Valor, 14), and 2.9% thifensulfuron (Harmony, 2)
Expert (Syngenta)	1.74 lb *S*-metolachlor (Dual Magnum, 15), 2.14 lb atrazine (5), and 0.75 lb ae glyphosate (9) per gal
Fierce (Valent)	33.5% flumioxazin (Valor, 14) and 42.5% pyroxasulfone (Zidua, 15)
Fierce MTZ (Valent)	33.5% flumioxazin (Valor, 14) and 42.5% pyroxasulfone (Zidua, 15), and 4 lb metribuzin (5) per gal co-pack[1]
Fierce XLT (Valent)	6.7% chlorimuron (Classic, 2), 24.6% flumioxazin (Valor, 14), and 31.2% pyroxasulfone (Zidua, 15)
Finesse (FMC)	62.5% chlorsulfuron (Glean, 2) and 12.5% metsulfuron (Ally, 2)
Finesse Grass & Broadleaf (FMC)	25% chlorsulfuron (Glean, 2) and 47% flucarbazone (Everest, 2)
Flexstar GT 3.5 (Syngenta)	0.56 lb fomesafen (Flexstar, 15) and 2.26 lb ae glyphosate (9) per gal
ForeFront HL (Corteva)	0.41 lb ae aminopyralid (Milestone, 4) and 3.33 lb ae 2,4-D (4) per gal
Full Deck (Helena)	2.48 lb ae MCPA (4) ester, 0.66 lb ae fluroxypyr (Starane, 4), and 0.57 lb ae clopyralid (Stinger, 4) per gal
FulTime NXT (Corteva)	2.7 lb microencapsulated acetochlor (Surpass NXT, 15) and 1.34 lb atrazine (5) per gal
Fusion (Syngenta)	2 lb fluazifop (Fusilade, 1) and 0.66 lb fenoxaprop (Option II, 1) per gal
Graslan L (Corteva)	0.81 lb ae picloram (Tordon, 4) and 3 lb ae 2,4-D (4) per gal
GrazonNext HL (Corteva)	0.41 lb aminopyralid (Milestone, 4) and 3.33 lb ae 2,4-D amine (4) per gal
Grazon P+D (Corteva)	2 lb ae 2,4-D (4) and 0.54 lb ae picloram (Tordon, 4) per gal
Halex GT (Syngenta)	2.09 lb *S*-metolachlor (Dual Magnum, 15), 2.09 lb ae glyphosate (9), and 0.21 lb mesotrione (Callisto, 27) per gal
Harmony Extra SG (FMC)	33.3% thifensulfuron (Harmony, 2) and 16.7% tribenuron (Express, 2)
Harness Xtra (Bayer CS)	4.3 lb acetochlor (Harness, 15) and 1.7 lb atrazine (5) per gal
Harness Xtra 5.6L (Bayer CS)	3.1 lb acetochlor (Harness, 15) and 2.5 lb atrazine (5) per gal
Huskie (Bayer)	0.31 lb pyrasulfotole (27) and 1.75 lb bromoxynil (Buctril, 6) per gal
InterMoc (UPI)	2.5 lb *S*-metolachlor (15) and 1.07 lb glufosinate (Interline, 10) per gal
Intimidator (Loveland)	3.39 lb *S*-metolachlor (Dual Magnum, 15), 0.75 lb metribuzin (5), and 0.67 lb fomesafen (Reflex, 14) per gal
Journey (BASF)	8.13% ae imazapic (Plateau, 2) and 16.26% ae glyphosate (9)
Keystone LA NXT (Corteva)	4.3 lb acetochlor (Surpass, 15) and 1.7 lb atrazine (5) per gal
Keystone NXT (Corteva)	3.1 lb acetochlor (Surpass, 15) and 2.5 lb atrazine (5) per gal
Kochiavore (Winfield)	0.67 lb ae fluroxpyr (Starane, 4), 1.67 lb ae 2,4-D (4), and 1.67 lb promoxynil (Buctril, 16) per gal
Krovar (Bayer)	40% bromacil (Hyvar, 5) and 40% diuron (Karmex, 7)
Landmark (Bayer)	50% sulfometuron (Oust, 2) and 25% chlorsulfuron (Glean, 2)
Latigo (Helena)	2.4 lb ae 2,4-D (4) and 1.8 lb ae dicamba (4) per gal
Lexar EZ (Syngenta)	1.74 lb *S*-metolachlor (Dual II Magnum, 15), 1.74 lb atrazine (5), and 0.22 lb mesotrione (Callisto, 27) per gal
Lumax EZ (Syngenta)	2.49 lb *S*-metolachlor (Dual II Magnum, 15), 0.249 lb mesotrione (Callisto, 27), and 0.935 lb atrazine (5) per gal

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ae = acid equivalent

Herbicide Premixes

Product (Manufacturer)	Ingredients (Tradename, herbicide site of action number)
Marvel (FMC)	0.12 lb fluthiacet (Cadet, 14) and 2.88 lb fomesafen (Reflex, 14) per gal
Moccasin MTZ (UPI)	3.35 lb *S*-metoloachlor (15) and 1.1 lb metribuzin (5) per gal
Orion (Syngenta)	0.033 lb florasulam (2) and 2.34 lb ae MCPA (4) per gal
Outlaw (Helena)	1.45 lb ae 2,4-D ester (4) and 1.09 lb ae dicamba (4) per gal
Overdrive (BASF)	20% ae diflufenzopyr (16) and 50% ae dicamba (4)
Overtime ATZ (Helena)	3 lb acetochlor (15) and 2.25 lb atrazine (5) per gal
Overtime ATZ Lite (Helena)	4 lb acetochlor (15) and 1.5 lb atrazine (5) per gal
Panoflex (FMC)	40% tribenuron (Express, 2) and 10% thifensulfuron (Harmony, 2)
Panther Pro (NuFarm)	3 lb metribuzin (5), 0.67 lb flumioxazin (Valor, 14), and 0.56 lb imazethapyr (Pursuit, 2) per gal
Parallel Plus (ADAMA)	2.8 lb atrazine (5) and 2.7 lb metolachlor (Dual, 15) per gal
Pastora (Bayer)	56.2% nicosulfuron (Accent, 2) and 15% metsulfuron (Ally, 2)
PastureGard HL (Corteva)	3 lb ae triclopyr (Remedy, 4) and 1 lb ae fluroxypyr (Starane, 4) per gal
Perspective (Bayer)	39.5% ae aminocyclopyrachlor (4) and 15.8% chlorsulfuron (Glean, 2)
Prefix (Syngenta)	4.34 lb *S*-metolachlor (Dual Magnum, 15) and 0.95 lb fomesafen (Reflex, 14) per gal
Presidual (Winfield)	5.25 lb *S*-metolachlor (15) and 1.25 lb metribuzin (5) per gal
Pulsar (Syngenta)	0.73 lb ae dicamba (Banvel, 4) and 0.95 lb ae fluroxypyr (Starane, 4) per gal
Pummel (ADAMA)	5 lb metolachlor (Dual, 15) and 0.25 lb ae imazethapyr (Pursuit, 2) per gal
Quelex (Corteva)	10% halauxifen (Arylex, 4) and 10% florasulam (2)
Range Star (Albaugh)	1 lb ae dicamba (4) and 2.87 lb ae 2,4-D amine (4) per gal
Rave (Syngenta)	8.8% triasulfuron (Amber, 2) and 50% ae dicamba (4)
Ready Master ATZ (Monsanto)	1.5 lb ae glyphosate (9) and 2 lb atrazine (5) per gal
Realm Q (Corteva)	7.5% rimsulfuron (Resolve, 2) and 31.25% mesotrione (Callisto, 27)
Resicore (Corteva)	2.8 lb acetochlor (Surpass 15), 0.19 lb ae clopyralid (Stinger, 4) and 0.30 lb mesotrione (Callisto, 27) per gal
Resist (Tenkoz)	64.3% metribuzin (5) and 10.7% chlorimuron (Classic, 2)
Resolve Q (Corteva)	18.4% rimsulfuron (Resolve, 2) and 4% thifensulfuron (Harmony, 2)
Revulin Q (Corteva)	14.4% nicosulfuron (Accent, 2) and 36.8% mesotrione (Callisto, 27)
Rezult B&G (BASF)	4 lb bentazon (Basagran, 6) per gal and 1 lb sethoxydim (Poast Plus, 1) per gal co-pack[1]
Rifle-D (Loveland)	1 lb ae dicamba (4) and 2.88 lb ae 2,4-D amine (4) per gal
Rifle Plus (Loveland)	1.1 lb ae dicamba (4) and 2.1 lb atrazine (5) per gal
Sahara (BASF)	7.8% ae imazapyr (Arsenal, 2) and 62.2% diuron (Karmex, 7)
Scorch (NuFarm)	3 lb ae 2,4-D ester (4), 1 lb ae dicamba (4), and 0.75 lb ae fluroxypyr (4) per gal
Sentrallas (FMC)	0.25 lb thifensulfuron (Hamony, 2) and 1.3 lb ae fluroxypry (Starane, 4) per gal
Sequence (Syngenta)	3 lb *S*-metolachlor (Dual Magnum, 15) and 2.25 lb ae glyphosate (9) per gal
Solstice (FMC)	0.216 lb fluthiacet (Cadet, 14) and 3.784 lb mesotrione (Callisto, 27) per gal
Sonic (Corteva)	62.1 % sulfentrazone (Spartan, 14) and 7.9% cloransulam (FirstRate, 2)
Spartan Charge (FMC)	3.15 lb sulfentrazone (Spartan, 14) and 0.35 lb carfentrazone (Aim, 14) per gal
Spartan Elite (FMC)	0.7 lb sulfentrazone (Spartan, 14) and 6.3 lb *S*-metolachlor (Dual Magnum, 15) per gal
Starane Flex (Corteva)	0.83 lb ae fluroxypyr (Starane, 4) and 0.042 lb florasulam (2) per gal
Starane NXT (Corteva)	0.58 lb ae fluroxypyr (Starane, 4) and 2.33 lb bromoxynil (6) per gal
Status (BASF)	16% ae diflufenzopyr (19), 40% ae dicamba (4), and isoxadifen safener
Steadfast Q (Corteva)	25.2% nicosulfuron (Accent, 2) and 12.5% rimsulfuron (Resolve, 2)
Storm (United Phosphorus)	2.67 lb bentazon (Basagran, 6) and 1.33 lb acifluorfen (Blazer, 14) per gal
Stratos (Gharda)	1.1 lb ae dicamba (4) and 2.1 lb atrazine (5) per gal
Streamline (Bayer)	39.5% aminocyclopyrachlor (4) and 12.6% Metsulfuron (Ally, 2)
SureStart II (Corteva)	3.75 lb acetochlor (Surpass, 15), 0.12 lb flumetsulam (Python, 2), and 0.29 lb ae clopyralid (Stinger, 4) per gal
Surmount (Corteva)	0.67 lb ae picloram (Tordon, 4) and 0.67 lb ae fluroxypyr (Starane, 4) per gal
Surveil (Corteva)	36% flumioxazin (Valor, 14) and 12% cloransulam (FirstRate, 2)
Synchrony XP (Corteva)	21.5% chlorimuron (Classic, 2) and 6.9% thifensulfuron (Harmony, 2)
Tailspin (Loveland)	0.33 lb ae fluroxypyr (Starane, 4) and 1 lb ae triclopyr (Remedy, 4) per gal

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Herbicide Premixes

Product (Manufacturer)	Ingredients (Tradename, herbicide site of action number)
Tailwind (ADAMA)	5.25 lb metolachlor (Dual, 15) and 1.25 lb metribuzin (5) per gal
Threesidual (Winfield)	3.75 lb acetochlor (Harness, 15), 0.12 lb flumetsulam (Python, 2), and 0.29 lb ae clopyralid (Stinger, 4) per gal
ThunderMaster (Albaugh)	0.17 lb ae imazethapyr (Pursuit, 2) and 1.5 lb ae glyphosate (9) per gal
TNT Broadleaf (Gowan)	50% thifensulfuron (Harmony, 2) and 25% tribenuron (Express, 2)
Tordon RTU (Corteva)	3% ae picloram (Tordon, 4) and 11.2% ae 2,4-D (4) per gal
Torment (ADAMA)	2 lb fomesafen (Reflex, 14) and 0.5 lb ae imazethapyr (Pursuit, 2) per gal
TripleFLEX II (Bayer CS)	3.75 lb acetochlor (Harness, 15), 0.12 lb flumetsulam (Python, 2), and 0.29 lb ae clopyralid (Stinger, 4) per gal
Tripzin ZC (UPI)	2.9 lb pendimethalin (3) and 1.1 lb metribuzin (5) per gal
Trivence (Corteva)	3.9% chlorimuron (Classic, 2), 12.8% flumioxazin (Valor, 14), and 44.6% metribuzin (5)
Trump Card (Helena)	0.66 lb ae fluroxypyr (Starane, 4) and 2.65 lb ae 2,4-D (4) per gal
Valor XLT (Valent)	30% flumioxazin (Valor, 14) and 10.3% chlorimuron (Classic, 2)
Velpar AlfaMax (TKI)	35.3% hexazinone (Velpar, 5) and 42.4% diuron (Karmex, 7)
Velpar AlfaMax Gold (TKI)	23.1% hexazinone (Velpar, 5) and 55.4% diuron (Karmex, 7)
Verdict (BASF)	0.57 lb saflufenacil (Sharpen, 14) and 5 lb dimethenamid-P (Outlook, 15) per gal
Viewpoint (Bayer)	31.6% ae imazapyr (Arsenal, 2), 22.8% ae aminocyclopyrachlor (4), and 7.3% Metsulfuron (Ally, 2)
Vise (MANA)	4.45 lb metolachlor (Dual, 15) and 0.95 lb fomesafen (Reflex, 14) per gal
Volley ATZ (Tenkoz)	3 lb acetochlor (15) and 2.25 lb atrazine (5) per gal
Volley ATZ Lite (Tenkoz)	4 lb acetochlor (15) and 1.5 lb atrazine (5) per gal
Voucher (Helena)	0.64 lb ae fluroxypyr (Starane, 4) and 2.6 lb ae MCPA (4) per gal
Warrant Ultra (Bayer CS)	2.82 lb acetochlor (Warrant, 15) and 0.63 lb fomesaten (Reflex, 14) per gal
WeedMaster (NuFarm)	1 lb ae dicamba (4) and 2.87 lb ae 2,4-D amine (4) per gal
Weld (Winfield)	1.75 lb ae MCPA (4), 0.64 lb ae fluroxpyr (Starane, 4), and 0.5 lb ae clopyralid (Stinger, 4) per gal
WideMatch (Corteva)	0.75 lb ae clopyralid (Stinger, 4) and 0.75 lb ae fluroxypyr (Starane, 4) per gal
Wildcard Xtra (Helena)	2 lb bromoxynil (Moxy, 6) and 2 lb ae MCPA (4) per gal
Yukon (Gowan)	12.5% halosulfuron (Permit, 2) and 50% ae dicamba (4)
Zemax (Syngenta)	3.34 lb S-metoloachlor (Dual II Magnum, 15) and 0.33 lb mesotrione (Callisto, 27) per gal
Zidua Pro (BASF)	2.28 lb pyroxasulfone (Zidua, 5), 1.33 lb ae imazethapyr (Pursuit, 2), and 0.48 lb saflufenacil (Sharpen, 14) per gal
Zone (Helm)	62% sulfentrazone (Spartan, 14) and 7.8% chlorimuron (Classic, 2)

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Glyphosate Product Comparisons

Product[1]	Distributor	Salt[2]	Concentration[3] Salt ai (lb/gal)	Concentration[3] ae (lb/gal)	0.75 lb ae/acre Product rate (oz/acre)	Surfactant requirement	Labeled for RR[4] crops
Accord XRT II	Corteva	DMA	5	4	32	Not Required	No
Abundit Edge	Corteva	K	5.5	4.5	22	Not Required	Yes
Abundit Extra	Nufarm	IPA	4	3	32	Not Required	Yes
Alecto 41 HL	Ritter	IPA	4	3	32	Optional	Yes
Alecto 41 UL	Ritter	IPA	4	3	32	Optional	Yes
Alecto 41 S	Ritter	IPA	4	3	32	Not Required	Yes
Buccaneer	Tenkoz	IPA	4	3	32	Recommend	Yes
Buccaneer 5	Tenkoz	IPA	5	3.7	26	Not Required	Yes
Buccaneer Plus	Tenkoz	IPA	4	3	32	Not Required	Yes
Bullzeye	Growmark	IPA	4	3	32	Not Required	Yes
Cinco	Loveland	IPA	5.4	4	24	Recommend	Yes
Clearout 41	CPT-LLC	IPA	4	3	32	Recommend	Yes
Clearout 41 Plus	CPT-LLC	IPA	4	3	32	Not Required	Yes
Cornerstone Plus	Winfield	IPA	4	3	32	Not Required	Yes
Cornerstone 5 Plus	Winfield	IPA	5.4	4	24	Not Required	Yes
Credit	NuFarm	IPA	4	3	32	Recommend	Yes
Credit Extra	NuFarm	K+MA	3.4	3	32	Not Required	Yes
Credit 41	NuFarm	IPA	4	3	32	Not Required	Yes
Credit 41 Extra	NuFarm	IPA	4	3	32	Not Required	Yes
Credit Duo	NuFarm	IPA+MA	4	3	32	Recommend	Yes
Credit Duo Extra	NuFarm	IPA+MA	4	3	32	Not Required	Yes
Credit Xtreme	NuFarm	K/IPA	6	4.5	22	Not Required	Yes
Crop Smart Glyphosate 41 Plus	CropSmart	IPA	4	3	32	Not Required	Yes
Durango DMA	Corteva	DMA	5.4	4	24	Not Required	Yes
Envy	Invictis	IPA	4	3	32	Not Required	Yes
Envy Intense	Invictis	IPA	4	3	32	Not Required	Yes
Extra Credit 5	NuFarm	IPA	5	3.7	26	Not Required	Yes
Four Power Plus	Loveland	IPA	4	3	43	Not Required	Yes
Gly-4	UCPA	IPA	4	3	32	Recommend	Yes
Gly-4 Plus	UCPA	IPA	4	3	32	Not Required	Yes
Glyfine Plus	Aceto	IPA	4	3	32	Not Required	Yes
Glyfine 5 Plus	Aceto	IPA	5.4	4	24	Not Required	Yes
GlyFlo	Micro Flo	IPA	4	3	32	Recommend	Yes
Gly-N-Go	MEY	acid	95%	95%	0.8 lb	N-Go Required	Yes
Glyphogan	ADAMA	IPA	4	3	32	Recommend	Yes
Glyphogan Plus	ADAMA	IPA	4	3	32	Not Required	Yes
Glyphosate 4	FarmSaver	IPA	4	3	32	Required	Yes
Glyphosate 41%	Helm Agro	IPA	4	3	32	Recommend	Yes
Glyphosate Original	Griffin	IPA	4	3	32	Recommend	Yes
GlySupreme Plus	MEY	IPA	4	3	32	Not Required	Yes
Gly Star 5	Albaugh	IPA	5.4	4	24	Required	Yes
Gly Star Original	Albaugh	IPA	4	3	32	Recommend	Yes
Gly Star Plus	Albaugh	IPA	4	3	32	Not Required	Yes
Helosate Plus Advanced	Helm	IPA	4	3	32	Not Required	Yes

[1] Additional glyphosate products may be available, but this list contains many of the agricultural products.
[2] Glyphosate is generally formulated as one of the following salt molecules: IPA = isopropylamine, MA = monoammonium, K = potassium, DMA = dimethylamine, acid = glyphosate acid.
[3] The concentration of glyphosate salts can be expressed in terms of pounds of glyphosate salt/gallon or pounds of glyphosate acid per gallon. Because the various salts have different weights, comparing glyphosate on an acid equivalence (ae) basis provides a better comparison of the herbicidal component of the different salts.
[4] RR = Roundup Ready.

Glyphosate Product Comparisons

Product[1]	Distributor	Salt[2]	Concentration[3] Salt ai (lb/gal)	Concentration[3] ae (lb/gal)	0.75 lb ae/acre Product rate (oz/acre)	Surfactant requirement	Labeled for RR[4] crops
Honcho	Monsanto	IPA	4	3	32	Recommend	No
Honcho Plus	Monsanto	IPA	4	3	32	Optional	Yes
Imitator Plus	Drexel	IPA	4	3	32	Not Required	Yes
Mad Dog Plus	Loveland	IPA	4	3	32	Not Required	Yes
Makaze	Loveland	IPA	4	3	32	Not Required	Yes
Meychem 41	MEY	IPA	4	3	32	Not Required	Yes
Mirage	UAP	IPA	4	3	32	Recommend	Yes
Mirage Plus	UAP	IPA	4	3	32	Optional	Yes
Roundup Original Max	Bayer CS	K	5.5	4.5	22	Optional	Yes
Roundup PowerMax	Bayer CS	K	5.5	4.5	22	Not Required	Yes
Roundup WeatherMax	Bayer CS	K	5.5	4.5	22	Not Required	Yes
RT 3	Bayer CS	K	5.5	4.5	22	Optional	No
Shar-Max 41	Sharda	IPA	4	3	32	Not Required	Yes
Showdown	Helena	IPA+MA	4	3	32	Not Required	Yes
Top Dog Glycel 41% Plus	Repar	IPA	4	3	32	Not Required	Yes
Touchdown CT	Syngenta	K	5	4.2	24	Not Required	No
Touchdown Hitech	Syngenta	K	6	5	19	Required	Yes
Touchdown Total	Syngenta	K	5	4.2	24	Not Required	Yes
Traxion	Syngenta	K	5	4.2	24	Not Required	Yes
Wise Up Plus Glyphosate	MEY	IPA	4	3	32	Not Required	Yes

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Weed Response to Selected Corn Herbicides When Applied According to Label Directions[1]

		Annual grasses								Annual broadleaf weeds												Perennials	
Herbicide(s)	Crop tolerance	Barnyardgrass	Crabgrass	Fall panicum	Foxtail	Johnsongrass seedlings	Longspine sandbur	Shattercane	Witchgrass	Eastern black nightshade	Cocklebur	Devilsclaw	Jimsonweed	Kochia	Lambsquarters	Morningglory	Pigweed[2] + waterhemp	Common ragweed	Sunflower	Velvetleaf	Venice mallow	Field bindweed	Established johnsongrass
PREPLANT OR PREEMERGENCE																							
Acuron	G-E	E	E	E	E	F-G	F-G	F-G	E	E	G	E	E	E	E	G	E	G-E	G-E	E	E	—	—
Acuron Flexi	G-E	E	E	E	E	F-G	F-G	F-G	E	E	G	G-E	G-E	G	G-E	G	E	G-E	G	E	E	—	—
Anthem ATZ	E	E	E	E	E	F	F-G	F	E	E	F-G	—	G	E	E	G	E	G	F	G-E	F	—	—
Anthem Maxx	E	E	E	E	E	F	F-G	F	E	G-E	P	—	G	F-G	G	F	E	F	P	G	F	—	—
Atrazine	G-E	F-G	F	—	F-G	—	—	—	F	E	F-G	—	G	G[3]	G	G	G-E[3]	G	F	F	F	—	—
Balance Flexx	G	G	G	G	G	G	F-G	F	—	G	F	—	G	E	G	F-G	E	G	—	E	G	—	—
Basis Blend, Crusher	G	G-E	F	G-E	G-E	—	F	E	F	P	—	—	—	G[3]	E	—	E[3]	—	G	G	—	—	—
Corvus	G	G-E	G-E	E	G-E	G-E	G	G	G	G	F	—	G	E	G-E	F-G	E	G	G	E	E	—	—
Dual II Magnum and other *S*-metolachlor	G-E	E	E	E	E	P	F-G	—	E	G	—	—	—	—	F-G	—	F-G	—	—	—	—	—	—
Fierce	G	G-E	E	G-E	E	P	—	P	—	E	—	—	G-E	F	E	F-G	E	G	—	G	G-E	—	—
Outlook, Slider	G-E	E	E	E	E	P	F-G	—	E	G	—	—	—	—	—	—	F-G	—	—	—	—	—	—
Princep	G-E	F-G	F	—	F-G	—	—	P-F	F	G	—	—	F	—	G	G	G	G	F	F	F	—	—
Resolve	G-E	G	F	G	E	—	—	—	—	F	F	—	F	G[3]	G	F	G[3]	F	—	F	—	—	—
Sharpen	G	—	—	—	—	—	—	—	—	G	G	P-F	G	G	G	G	G	G	G	G	G	—	—
TopNotch, Surpass, Harness, Volley, Degree, Confidence	G-E	E	E	E	E	F	F-G	F	G-E	G	—	—	—	—	G	—	G	F	—	—	—	—	—
Bicep Lite II Magnum, Cinch ATZ Lite	G-E	E	E	E	E	P	F-G	P	E	E	F	F	F	F	G	F	E	F	F	P	P	—	—
Bicep II Magnum, Cinch ATZ	G-E	E	E	E	E	P	F-G	P	E	E	G	G	G	G	G	G	E	G	F	F	F	—	—
Harness Xtra, Cadence ATZ, Degree Xtra, Keystone NXT, Volley ATZ, FulTime NXT	G-E	E	E	E	E	F	F-G	F	E	E	G	G	G	G	G	G	E	G	F	F	F	—	—
Harness Max	G-E	E	E	E	E	F	F-G	F	E	E	G	G-E	E	E	G-E	G	E	G	F	E	E	—	—
Lumax EZ, Lexar EZ	G-E	E	E	E	E	F	F-G	F	E	E	G	E	E	E	G-E	F-G	E	G	G	E	E	—	—
Resicore	G	E	E	E	E	F	F	F	E	G	G	G	G	G	E	G	E	G-E	E	G-E	—	—	—
SureStart II, TripleFLEX II, Trisidual	F	E	E	E	E	—	P	P	E	G	G	—	—	G	E	F	E	G	E	F-G	—	—	—
Valor, Outflank, Panther, Tuscany	G-E	F	F	F-G	F-G	P	P	P	F	E	F	F-G	G-E	F	G-E	F-G	E	F	P	F	G-E	—	—
Verdict	G-E	E	E	E	E	P	F-G	P	E	G	G	P-F	G	G	G	G	G	G	G	G	G	—	—
Zemax, Coyote	E	E	E	E	E	F	F-G	P	E	G	G	G	G	G	G	F	E	G	F	G	G	—	—

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PREEMERGENCE ONLY																							
Prowl, Pendimax, Acumen	G	G-E	G	G	G	G	G	F	G-E	—	—	—	—	F-G	F-G	—	F-G	—	—	P-F	—	—	—
Zidua	E	E	E	E	E	F	F-G	F	E	G-E	P	—	G	F-G	G	F	E	F	P	F-G	F	—	—
Postemergence																							
Accent Q, NIC-IT	G-E	G-E	F	G	G-E	E	G	E	—	—	—	—	G	—	—	F	G[3]	—	—	—	—	—	G
Aim	G-E	—	—	—	—	—	—	—	—	E	F	F	E	F-G	E	E	F-G	F	F	E	G	—	—
Atrazine	G-E	F	F	—	G	—	—	—	G	G-E	G-E	—	E	E[3]	E	E	E[3]	E	E	E	E	—	—
Banvel K + Atrazine	G	—	—	—	—	—	—	—	—	G-E	E	—	G-E	E	E	E	E	E	E	G-E	G-E	F-G	—
Basis, Basis Blend	G	G-E	F	G-E	G-E	—	F	E	F	P	—	—	—	G[3]	E	—	E[3]	—	G	G	—	—	—
Beacon	F-G	—	—	F	—	E	—	E	—	G	G	G	G	G[3]	F	—	G[3]	E	G-E[3]	F-G	—	—	G
Broclean, Bromil, Buctril, Moxy	E	—	—	—	—	—	—	—	—	E	E	—	G	G	G	F-G	F	G	E	F-G	G	—	—
Brozine	G-E	—	—	—	—	—	—	—	—	E	E	—	E	E[3]	E	G-E	E	E	E	E	E	—	—
Cadet	G	—	—	—	—	—	—	—	—	G	G	—	—	G	G-E	G	F-G	F	F	E	—	—	—
Callisto and other mesotrione	E	—	G	—	—	—	—	—	—	E	G	G	E	G-E	E	F	G-E	G	G	G-E	G	—	—
Callisto Xtra	G-E	F	G	—	G	—	—	—	G	E	G-E	G	E	E	E	G-E	E	G-E	G-E	E	G-E	—	—
Capreno	G	G	G	G	G	G	G	G	—	E	G-E	—	E	G-E	E	G	E	E	E	E	G	—	—
Dicamba	F-G	—	—	—	—	—	—	—	—	G	G-E	—	G	G	G	G	G-E	G	G	G	F	F	—
DiFlexx	G	—	—	—	—	—	—	—	—	G	G-E	—	G	G	E	G-E	E	E	G	G	G	F	—
DiFlexx DUO	G	G	G	P	F	F	F	F	—	E	E	—	E	E	E	E	E	E	E	E	E	F	—
Distinct	G	F	—	F	F	F	—	F	F	G	G-E	—	G	G	E	E	E	E	G	G	E	G	—
Glyphosate *(resistant corn only)*	E	G	E	E	E	E	E	E	E	G	E	—	E	G	E	G	E	G	E	G	G	G	G
Halex GT *(resistant corn only)*	G-E	G	E	E	E	E	E	E	E	E	E	G	E	G	E	G	E	E	E	E	G	G	G

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POSTEMERGENCE																							
Impact/Armezon	E	G	G	F	F-G	F	—	F	—	E	G-E	—	E	G-E	E	F	G-E	G-E	G-E	G-E	F-G	—	—
Kochiavore	F	—	—	—	—	—	—	—	—	G-E	E	E	G-E	E	E	E	G-E	E	E	G	G	F	—
Laudis	E	G	G	P	F-G	G	F	G	—	E	G-E	—	E	G-E	E	F	G-E	E	G-E	E	G	—	—
Liberty and other glufosinate *(resistant corn only)*	E	G	G	G	E	F-G	F-G	G	G	G	E	—	E	F	G	G-E	G	E	G-E	G-E	G	F	F
Permit	G	—	—	—	—	—	—	—	—	—	E	—	—	G[2]	F	P	F[2]	G	E	G-E	G	—	—
Realm Q	F-G	G-E	F	G-E	G-E	—	F	E	F	G	G	G	G-E	G	G	F	G-E	G	G	G	G	—	—
Resolve Q	G	G-E	F	G-E	G-E	—	F	E	F	F	F	—	G	—	F	F	G[3]	F	—	F	—	—	F
Resource	G-E	—	—	—	—	—	—	—	—	—	F	—	G	—	—	F	F	G	—	E	—	—	—
Shieldex	E	G	G	—	G	—	—	F	—	F	G	—	—	G-E	E	F	E	E	E	G-E	P	—	—
Solstice	G	—	G	—	—	—	—	—	—	E	G	C	E	G	E	F-G	G	G	G	E	G	—	—
Steadfast Q	E	G-E	G	E	E	E	G	E	—	—	F	—	G	—	—	F	G[3]	—	—	—	—	—	G
Starane NXT	G	—	—	—	—	—	—	—	—	E	E	—	G	E	G	E	F	E	E	G	G	F-G	—
Starane Ultra	G	—	—	—	—	—	—	—	—	F	G	—	—	E	P	E	P	E	G	G	G	F-G	—
Status	G-E	F	—	F	F	F	—	F	F	G	G-E	—	G	G	E	E	E	E	G	G	E	G	—
Yukon	F-G	—	—	—	—	—	—	—	—	G	E	—	F-G	G	G	G	G	G	E	G-E	F-G	—	—
WideMatch	G	—	—	—	—	—	—	—	—	F	E	—	—	E	P	E	P	E	E	G	G	F-G	—
2,4-D	F	—	—	—	—	—	—	—	—	F	E	E	G	F	E	E	G	E	E	G	G	F-G	—

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Herbicides for Corn

Before using products containing atrazine, you may consult the Atrazine Watershed Information Center (AWIC) to determine whether the use of atrazine is prohibited in your watershed. The AWIC can be accessed by calling 1-866-365-3014.

Atrazine Rate Limitations

All atrazine uses on cropland must conform to the maximum rate limits shown below. The "Precautionary Statements" on atrazine labels indicate required setbacks from all wells, streams, ponds, or other water sources.

For Wheat Stubble Applications in Wheat-Corn-Fallow Rotations

Apply a maximum of 2.25 lb ai/a to stubble ground following wheat harvest. Treat only once during same fallow period. See "Chemical Fallow" section of atrazine label for additional instructions.

For Soil Applications in Spring, Before Crop Emergence

On highly erodible soils (as defined by the Natural Resources Conservation Service)

If plant residue cover at planting is 30% or more, apply a maximum of 2 lb ai/a as a broadcast spray.

If soil coverage is less than 30% at planting, apply a maximum of 1.6 lb ai/acre.

On soils not highly erodible

Apply a maximum of 2 lb ai/a as a broadcast spray.

For Postemergence Applications

If no atrazine was applied before corn emergence, apply a maximum of 2 lb ai/a broadcast. If a postemergence treatment is required following an earlier herbicide application, the total atrazine applied may not exceed 2.5 lb ai/a per calendar year. Postemergence applications over 1 lb ai/a are not considered best management practices. Runoff loss potential is very high from mid-April through July.

Practices to Reduce Atrazine Losses in Surface Water Runoff in Central and Eastern Kansas

Corn producers who no-till plant should consider split applications of herbicides, applying about two-thirds of the rate either the previous fall or early preplant in spring, and about one-third at planting time. The highest atrazine losses occur when intense rain storms follow atrazine application to high-residue, wet soils. Long-term weather records show that Kansas tends to have little winter precipitation, and that the probability of high-intensity storms occurring in March to mid-April is about half the probability of them occurring from mid-April through June. Therefore, fall and early spring application has less potential for loss in surface water runoff. In addition, such applications have the advantage of controlling winter annual weeds and tend to keep fields in plantable condition during wet spring weather, reducing the need for preplant burndown treatments.

Corn producers who till before planting should consider preplant incorporation of atrazine and companion herbicides, such as Dual II Magnum, Outlook, Harness, Zidua, and many others. Mechanically incorporating these herbicides in the top 2 inches of soil reduces potential atrazine loss in runoff by about two-thirds. Soil incorporation can be done with field cultivators, finishing disks, or spring tooth harrows at any time within 14 days before planting. Harrow attachments are recommended for the incorporation implement to avoid streaking. At planting, avoid furrowing that could move herbicide-treated soil out of the crop row.

Reduced-rate atrazine approaches for corn. Some soil-applied formulations, such as Bicep Lite II Magnum, Keystone LANXT, and Lumax, contain a lower proportion of atrazine than formulations, such as Bicep II Magnum, Keystone NXT, and Lexar. Also, banding preemergence herbicides reduces the amount applied per acre by one-half to two-thirds. Postemergence herbicides, such as Buctril/atrazine and dicamba + atrazine, and many postemergence tank mixtures contain only about 0.5 lb ai/a atrazine still provide good control of tough broadleaf weeds, such as velvetleaf, cocklebur, pigweed, morningglory, and sunflower.

Non-atrazine alternatives for corn. For certain soil types, soil-applied Resicore, Triple FLEX II, Sure Start II, Zemax, Balance Flexx, or Corvus can substitute for part or all of the atrazine. Postemergence herbicides for corn that control many weed species and do not contain atrazine include Liberty, Realm Q, Resolve Q, Status, glyphosate, and many other products. Caution: Some of these can be used only on genetically modified or other selected corn. Some have restrictions or cannot be used where Counter or Thimet insecticides have been used.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Acetochlor (15) 1.1 to 3	2.25 to 5 pt **Degree** or 1.5 to 3.75 pt **Cadence, Overtime,** or **Volley,** or 1.25 to 3 pt **Harness, Surpass NXT, Volley NXT,** or **Confidence***	TopNotch and Degree are microencapsulated formulations of acetochlor. Soil activity controls most annual grass and small-seeded broadleaf weeds. Rate depends on soil type and preplant or preemergence timing. Apply and incorporate into top 2 inches of soil within 2 weeks of planting, or apply after planting but before corn emerges. Contains a safener for corn. Do not apply through irrigation system. Do not apply aerially. Do not rotate to crops other than corn, sorghum, wheat, or soybean for 12 months. Can be tank mixed with atrazine, Hornet, dicamba, and several other herbicides to enlarge spectrum of weeds controlled. Note restrictions on label for depth to groundwater.
Acetochlor (15) + Atrazine (5) 1.3 to 3 + 1 to 2.0	2.9 to 4.4 qt **FulTime NXT**, or 2.9 to 3.7 qt **Degree Xtra** or 2.2 to 3.4 qt **Cadence ATZ, Overtime ATZ,** or **Volley ATZ** or 1.7 to 3 qt **Confidence Xtra 5.6L** or **Harness Xtra 5.6*,** or 1.4 to 3 qt **Keystone NXT** or **Volley ATZ NXT**	These herbicides are restricted-use pesticides. The addition of atrazine will enhance annual grass and broadleaf weed control. The ratio of acetochlor to atrazine varies in the products named. For sensitive watersheds, see K-State Research and Extension publication MF-2208 for atrazine best management practices. Follow atrazine rate limits and label directions. **No-Till:** If applied more than 30 days before planting, use split applications of 60% early preplant followed by 40% at planting. For single applications, apply within 30 days preplant up to planting time. Can be tank mixed with atrazine, Hornet, Gramoxone SL, glyphosate, dicamba, or 2,4-D and adjuvants to control emerged weeds. Follow atrazine rate limits and label directions.
Acetochlor (15) + Atrazine (5) 1.6 to 3 + 0.6 to 1.1	1.6 to 3 qt **Cadence Lite ATZ, Overtime ATZ Lite,** or **Volley ATZ Lite** or 1.8 to 2.3 qt **Confidence Xtra, Keystone LA NXT, Volley ATZ Lite NXT,** or **Harness Xtra***	These herbicides are restricted-use pesticides. These formulations are used by growers who want to reduce rates of soil-applied atrazine. Formulations vary in their ratio of acetochlor to atrazine, so follow label directions.
Acetochlor (15) + Clopyralid (4) + Flumetsulam (2) 0.7 to 1.4 + 0.07 to 0.14 + 0.023 to 0.046	1.5 to 3 pt **SureStart II, TripleFLEX II,** or **Trisidual**	These herbicides are for use in conventional or herbicide-tolerant field or silage corn. These herbicides may be used preemergence or early postemergence on corn up to 11 inches tall. The rate is dependent upon soil texture and organic matter. If soils are coarse-textured, use 1.5 to 2 pt/a; if medium-textured and less than 3% organic matter, use 1.5 to 2.5 pt; and if 3% organic matter or greater, use 1.75 to 3 pt/a. If soil textures are fine, use 2 to 3 pint/acre. The new formulations of these herbicides followed by II contain a safener allowing rates up to 3 pt.
Acetochlor (15) + Clopyralid (4) + Mesotrione (27) 1.6 to 2.1 + 0.107 to 0.142 + 0.169 to 0.225	2.25 to 3 qt **Resicore**	Resicore may be used on all field corn, grain, silage, or seed, and yellow popcorn from 28 days before planting prior to emergence. Resicore may be applied early postemergence to all field corn. See postemergence section for further discussion. When organic matter is less than 3% use Resicore at 2.25 qt on coarse soils, 2.5 qt on medium soils, and 2.75 qt on fine soils. When soils are 3% or more organic matter, use Resicore at 2.5 qt on coarse soils, 2.75 on medium soils, and 3 qt on fine soils. When applying Resicore as a split application, both pre and post, see label for restrictions and rates. A maximum of 3.25 qt can be used in the entire season. Weed control with Resicore will be enhanced when applied with atrazine. Rotational restrictions: wheat 4 months; alfalfa, barley, millet, oats rye, sorghum soybean, and sunflower 10.5 months. If applied with atrazine, restrictions to soybean is 18 months. If Resicore is applied after June 1, only corn or grain sorghum can be planted the following year.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Acetochlor (15) + Mesotrione (27) 1.51 to 2.42 + 0.142 to 0.227	1.72 to 2.75 qt **Harness Max**	Harness Max may be used on all field corn, grain, silage, or seed, and yellow popcorn from 29 days before planting prior to emergence. Harness Max may be applied early postemergence to corn. See postemergence section for further discussion. Use Harness Max at 55 to 64 fl oz on coarse soils, 64 to 75 fl oz on medium soils, and 64 to 75 fl oz on fine soils when organic matter is less than 3% and 75 to 88 fl oz when organic matter is 3% or greater. When applying Harness Max in a burndown situation, Harness Max may be tank mixed with Roundup brand glyphosate only, Gramoxone brands, dicamba and/or 2,4-D. Rotational restrictions: sorghum (concept treated immediately) wheat 4 months; alfalfa, soybean, and cotton 10 months; barley, oat, millet, and rye the spring following application; Cucurbits, drybeans, peas, and other crops 18 months.
Atrazine (5) 1.6 to 2	1.6 to 2 qt **Atrazine* 4L** or 1.8 or 2.2 lb **Atrazine* 90DF**	A restricted-use pesticide. Upper rate limits depend on soil texture, percentage plant residue cover, and NRCS soil erodibility classification. Controls small-seeded broadleaf weeds and helps suppress other broadleaf weeds and annual grasses. Apply preplant and incorporate or apply before corn emerges. Recropping options depend on soil pH, rate, and timing of application. Atrazine carryover is longer in higher pH soils. Caution: Because atrazine moves readily with water, surface runoff losses on fine-textured soils and leaching in coarse-textured soils can impair water quality. See K-State Research and Extension publication MF-2208 for atrazine best management practices. Follow label directions for rates, cropping, and feeding limitations. **No-till, fall application:** Atrazine can be applied to Kansas row-crop stubble from fall harvest to December 31 to control winter annual weeds and reduce or eliminate the need for burndown herbicide application or preplant tillage in spring. Apply with COC to enhance foliar activity. Tank mixing with 2,4-D LVE enhances control of dandelion and other broadleaf winter annual weeds. Can be tank mixed with Gramoxone SL to enhance control of cheat, downy brome, and Japanese brome. For highly erodible soils with less than 30% plant residue cover, limit fall application to a maximum of 1.6 lb. Total atrazine applications must not exceed 2.5 lb/a per calendar year. Do not apply to frozen ground or where soil surface conditions favor wind erosion. Do not plant any crops except corn, grain sorghum, or forage sorghum in the following spring. Follow directions on 24(C) Special Local Need label for Kansas. **No-till, early preplant application:** Atrazine can be applied in spring up to 45 days before planting. If weeds are present at time of treatment, but before crop emergence, atrazine may be tank mixed with Gramoxone SL or glyphosate. Apply with COC or NIS to enhance foliar uptake. Avoid tillage after application. Applying about two-thirds of the atrazine dose early preplant and one-third at planting time is a best management practice.
Carfentrazone (14) 0.0074 to 0.015	0.5 to 1 fl oz **Aim EC**	**No-till:** Can be applied alone or with other herbicides in fallow and preplant burndown applications to control or suppress annual broadleaf weeds. Can be tank mixed with glyphosate, 2,4-D, dicamba, or paraquat to broaden the spectrum of weeds controlled. Apply with NIS or COC. Aim is a contact herbicide requiring thorough spray coverage of foliage. Do not exceed 2 fl oz/a per season for all fallow, preplant, or in-crop applications to corn.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Dicamba (4) 0.25 to 0.5	0.5 to 1 pt **Dicamba*** or **DiFlexx** or 11 to 22 fl oz **FeXapan** or **Xtendimax** or 6.4 to 12.8 fl oz **Engenia**	Some dicamba formulations have differing dicamba concentrations. Review label for appropriate product rates. Following discussion assumes a 4 lb ae per gallon. After applying dicamba for weed burndown in no-till fields, it is recommended to delay corn planting 5 days for rates up to 4 fl oz/a and 7 days for rates from 4 to 8 fl oz/acre. Soil texture and organic matter content will also affect crop injury potential. If the DiFlexx formulation is used, there are no corn planting period restrictions. Can be applied immediately after corn is planted at least 1.5 inches deep, however, there is less potential for corn injury if application is delayed until near the spike stage. Do not apply to coarse-textured soils (sand, sandy loam, and loamy sand) until after crop emergence. Do not harvest or use corn for dairy or beef cattle feed before the milk stage. Avoid spray or vapor drift to sensitive crops. The addition of AMS to a spray mixture containing dicamba will increase the risk of volatility of dicamba and mitigate the benefits of lower volatility formulations. Do not apply AMS with Engenia.
Dicamba (4) + Atrazine (5) 0.28 to 0.48 + 0.5 to 0.9	2 to 3.5 pt **Stratos** or **Banvel K** + **Atrazine**	**No-till:** These are premixes of dicamba and atrazine (a restricted-use pesticide). They control many broadleaf weeds when applied before planting no-till corn. Do not apply to coarse-textured soils or soils with less than 2% organic matter. Contact your seed corn company before using this product on seed corn or specialty corn. Follow atrazine rate limits and label directions.
Dicamba (4) + 2,4-D (4) 0.25 to 0.5 + 1	0.5 to 1 pt **Dicamba*** or **Oracle** + 1 qt **2,4-D LV4, Latigo, Outlaw**	**No-till:** For control of established alfalfa and annual weeds, apply when alfalfa regrowth is 6 to 8 inches tall and growing actively. Fall treatment is preferred, provided that conditions favor vigorous alfalfa growth. If alfalfa escapes occur, apply only dicamba at rate recommended on label after corn emerges. See Latigo or Outlaw label for use rates.
Diflufenzopyr (19)+ Dicamba (4) 0.027 to 0.054 + 0.081 to 0.162	2 to 6 oz **Distinct**	Apply Distinct prior to but not sooner than 7 days before corn planting. Do not apply on coarse-textured soils. Distinct controls many broadleaf weeds and may suppress emerged annual grasses. Apply Distinct with NIS and UAN or AMS.
Dimethenamid-P (15) 0.56 to 0.98	12 to 21 oz **Outlook**	Controls most grasses and some broadleaf weeds, such as nightshade and pigweeds. Does not control emerged weeds. Rate depends on soil type. Apply preplant within 2 weeks of planting and incorporate shallowly, or apply after planting up to early postemergence. Can be tank mixed with atrazine, Pursuit (imidazolinone-tolerant corn only), and other herbicides. Can be used on sweet corn, popcorn, or seed corn. Fall cereals can be planted after 4 months.
Dimethenamid-P (15) + Saflufenacil (14) 0.39 to 0.70 + 0.044 to 0.079	10 to 18 fl oz **Verdict**	Verdict can be applied preplant surface, preplant incorporated, or preemergence to field corn, silage, or popcorn for broadleaf and grass weed control. Some popcorn hybrids may be sensitive to Verdict. Check with seed supplier. Do not apply Verdict to corn that has emerged, or significant crop injury may result. If broadleaf weeds are present at the time of application, to optimize burndown activity on broadleaf weeds, Verdict should be applied with MSO at 1% v/v (minimum of 1 pt/a) plus AMS 8.5 to 17 lb/100 gal or liquid nitrogen at 1.25 to 2.5 gal/100 gal. Apply with glyphosate to control emerged grasses. Verdict rate is affected by soil texture. Use 10 to 12 oz rate on coarse textured soils, 13 to 15 oz rate on medium textured soils, and 16 to 18 oz rate on fine-textured soils. Verdict may be tank mixed or applied sequentially with but not exclusively with Sharpen, Clarity, Status, atrazine, or glyphosate. Sequential applications with Sharpen or Verdict require 14 days between applications. Do not apply more than 0.134 lb/a saflufenacil per cropping season. Do not use if organophosphate or carbamate insecticides were used at planting.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Flumiclorac (14) 0.014 to 0.028	2 to 4 fl oz **Resource**	**No-till:** Resource can be tank mixed with glyphosate products to increase speed of burndown activity before planting field corn or soybean. Resource is a contact herbicide requiring thorough spray coverage of the foliage. West of U.S. Highway 75, always apply with 1 qt/a of COC plus AMS water conditioner for glyphosate.
Flumioxazin (14) 0.064 to 0.096	2 to 3 oz **Valor, Outflank, Panther,** or **Tuscany,** or 2 to 3 fl oz **Panther SC** or **Tuscany SC**	Apply to the soil surface 7 to 28 days prior to planting corn in a no-till or minimum-till system only. In conventional planted corn, 1 inch of precipitation must fall during the 30 day period between application and planting. Controls several broadleaf weeds including pigweeds and nightshade. Glyphosate, dicamba, or 2,4-D should be tank mixed to control emerged weeds. Valor can be tank mixed with atrazine or metribuzin. Do not rotate to wheat for 1 month or to alfalfa or oat for 8 months after application.
Flumioxazin (14) + Pyroxasulfone (15) 0.063 + 0.08	3 oz **Fierce**	Fierce is a premix of Valor and Zidua formulated as a dry product for early preplant preemergence broadleaf and grass control in field corn only. Fierce should be applied to the soil surface in a no-till or minimum-till system 7 to 30 days before corn planting and to conventional-till 30 days before corn planting. Fierce is activated with precipitation and effectively controls many grasses as well as small- and large-seeded broadleaf weeds. It may be tank mixed with glyphosate, 2,4-D, dicamba, atrazine, and others (see label) to control emerged weeds.
Glyphosate (9)	**Glyphosate*** (see glyphosate table)	**No-till:** Use to control annual weeds up to 6 inches tall and some perennial weeds in fallow fields or before corn emergence. Application in 3 to 10 gal/a spray is more effective than in higher gallonage. Condition spray water with 1 to 2%, by weight, of spray-grade AMS (9 to 17 lb/100 gal water) before adding glyphosate products to the tank. Some glyphosate products contain little or no adjuvant, so check label requirements carefully. Dust on plants can decrease performance. Usually applied with 2,4-D or dicamba to enhance control of certain broadleaf species.
Glyphosate (9) + 2,4-D choline (4) 0.74 to 1.01 + 0.70 to 0.95	3.5 to 4.75 pt **Enlist Duo**	Enlist Duo may be applied at 3.5 to 4.75 pt per acre pre-plant or preemergence to all types of corn including Enlist corn for burndown of broadleaf and grass weeds. Use the upper end of the rate range for less susceptible weeds, more mature weeds, or weeds under stress. Do not exceed 4.75 pts for any single application. See POSTEMERGENCE section for postemergence use on Enlist corn.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Iodosulfuron (2) + Thiencarbazone-methyl (2) 0.0011 to 0.008	0.3 oz **Autumn Super**	Autumn Super may be used for burndown/residual control anytime after fall harvest up to 1 month prior to planting field corn. For all other corn the rotational restriction is 9 months with 15 inches of precipitation. Use the 0.3 oz rate when soil pH is 7.0 to 8.0, it's after November 1, and you are located north of I-70. Do not use on soils with pH greater than 8 or on any soil that is frozen. Apply with COC or MSO and a nitrogen fertilizer, such as UAN or AMS. Autumn Super may be tank mixed with glyphosate, 2,4-D, dicamba, paraquat, and others to enhance control of emerged weeds. See label for rotational crop restrictions.
Isoxaflutole (27) 0.047 to 0.094	3 to 6 fl oz **Balance Flexx**	Balance Flexx is a restricted-use pesticide. It is prohibited on fields that contain vulnerable sandy loam, loamy sand, or sand soils if the water table is less than 25 feet below the soil surface. See 24(c) label for list of vulnerable soils. Rate depends on soil texture, organic matter, pH, and application timing. The addition of atrazine will improve control. Balance Flexx may be tank mixed with many grass and broadleaf herbicides. Do not apply aerially or through any type of irrigation system. Corn seed must be planted at least 1.5 inches deep, completely covered with soil, and the seed furrow firmed. The rotational interval is 4 months for wheat, 6 months for soybean, sorghum or sunflower, and 10 months for alfalfa. **No-till:** May be soil surface applied up to 21 days before planting field corn and up to 30 days before planting when used in a planned sequential application program. When applied with COC or MSO, Balance Flexx controls labeled weeds less than 3 inches in height. Tank mix with other burndown herbicides to control a broader spectrum of weeds or larger weeds. Tank mix with other residual herbicides to extend the spectrum and duration of control. **Early postemergence:** Balance Flexx can be applied postemergence to corn in a tank mixture with atrazine (only) from spiking through the 2-collar leaf stage of growth. Do not apply with other herbicides, insecticides, fertilizers, or adjuvants, or crop injury including bleaching, leaf necrosis, and stunting may result.
Isoxaflutole (27) + Thiencarbazone (2) 0.049 to 0.082 + 0.019 to 0.033	3.33 to 5.6 oz **Corvus**	Corvus is a restricted-use pesticide for use on field corn only. It is prohibited on fields that contain vulnerable sandy loam, loamy sand, or sand soils if the water table is less than 25 feet below the soil surface. Rate depends on soil texture, organic matter, pH, and application timing. The addition of atrazine will improve weed control. Corvus may be tank mixed with many grass and broadleaf herbicides. Do not apply aerially or through any type of irrigation system. Corn seed must be planted at least 1.5 inches deep, completely covered with soil, and the seed furrow firmed. The rotational interval is 4 months for wheat, 9 months for soybean, and 17 months for alfalfa, sorghum, and sunflower. Do not use Corvus in the same season that Counter 20 CR, Counter 15G, or Lorsban 15G insecticides are used. **No-till:** May be soil surface applied up to 21 days before planting field corn and up to 30 days before planting when used in a planned sequential application program. When applied with COC or MSO, Corvus controls labeled weeds less than 6 inches in height. Tank mix with other burndown herbicides to control a broader spectrum of weeds or larger weeds. Tank mix with other residual herbicides to extend the spectrum and duration of control. **Early postemergence:** Corvus can be applied postemergence to corn in a tank mixture with atrazine (only) from spiking through the 2-collar leaf stage of growth. Do not apply with other herbicides, insecticides, fertilizers, or adjuvants, or crop injury including bleaching, leaf necrosis, and stunting may result.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Mesotrione (27) 0.094 to 0.241	3 to 7.7 fl oz **Callisto, Incinerate, BL4, Bridle, Explorer, Tenacity, Willowood Mesotrione, Motif**	Mesotrione may be used on all field corn, yellow popcorn, or sweet corn at 5.3 to 7.7 fl oz/acre. Mesotrione can be tank mixed with atrazine or a premix or mixture of a chloracetamide (14) +atrazine for broad spectrum weed control. Not all tank mix partners shown on the label have registration for yellow popcorn and sweetcorn, see labels. If used in a burndown tank mix, mesotrione can be applied at 3 fl oz with Gramoxone brands, Roundup brands, Touchdown brands, dicamba or 2,4-D. Use the higher mesotrione rate structure to provide greater residual control. NOTE actual rate structure may vary slightly among mesotrione formulations, however, all are 4 lb ai/gallon of herbicide. When applying PRE to corn and POST to weeds use an adjuvant system that includes MSO or COC and a nitrogen based adjuvant to enhance foliar activity. NIS can be used but often is less effective than oils.
Metolachlor (15) 0.98 to 1.95	1 to 2 pt **Me-Too-Lachlor II** or **Parallel**	Controls annual grasses and small seeded broadleaf weeds in field corn, sweet corn, or popcorn. May be applied early preplant (see label for specific timing, rate, and soil restrictions) or preplant-incorporated or preemergence using 1 to 1.33 pt on coarse soils, 1.33 to 1.67 pt on medium soils, or 1.33 to 1.67 pt on fine soils with less than 3% organic matter and 1.67 to 2 pt on fine soils with 3% or higher organic matter. Research indicates that metolachlor formulations have approximately 1/3 less herbicidal activity than the *S*-metolachlor formulations when equal rates are compared.
Paraquat (22) 0.5 to 1.0	2 to 4 pt **Gramoxone SL**	Gramoxone SL is a formulation containing an alerting odor, emetic, and dye designed to reduce the amount of paraquat absorbed after accidental ingestion. Paraquat, a restricted-use pesticide, is a nonselective, nonresidual contact herbicide often used for preplant burndown of weeds. Apply in clean water or nitrogen fertilizer solutions to thoroughly cover actively growing weeds 1 to 6 inches tall. Rate depends on weed size. Dust on plants decreases paraquat activity. Tank mixing with triazine herbicides and COC in water carrier enhances weed burndown. When nitrogen fertilizer is the carrier, use NIS instead of COC.
Pendimethalin (3) 0.75 to 1.5	1.8 to 3.6 pt **Pendimax, Pendant, Acumen, Satellite,** or **Prowl 3.3EC** or 2 to 4 pt **Prowl H_2O,** or **Satellite Hydrocap**	Controls grasses more effectively than broadleaf weeds. Apply at planting or after planting but before weeds or corn emerge. Do not mechanically incorporate into soil because serious crop injury can occur. Corn must be planted at least 1.5 inches deep. Winter wheat can be planted in the fall, 4 months after application. Can be tank mixed with many grass herbicides and atrazine.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Pyroxasulfone (15) 0.08 to 0.21	1.5 to 4 oz **Zidua** or 2.5 to 6.5 fl oz **Zidua SC**	Zidua may be applied preplant or preemergence to field corn and some popcorn, or sweet corn cultivars. Verify cultivar sensitivity with your seed supplier. Zidua when activated in soil with rainfall will effectively control several grasses and small seeded broadleaf weeds. In addition, Zidua has activity on several large seeded broadleaf weeds including velvetleaf. See label for complete list. Does not control emerged weeds. Zidua is sensitive to soil texture. Use 1.5 to 2.75 oz dry or 2.5 to 4.5 fl oz on coarse soils, 2 to 3 oz dry or 3.25 to 5 fl oz on medium soils, and 2.5 to 4 oz dry or 4 to 6.5 fl oz on fine soils.
Pyroxosulfone (15) + Fluthiacet (14) + Atrazine 0.106 to 0.182 + 0.003 to 0.005 + 0.9 to 1.5	1.75 to 3 pt **Anthem ATZ**	Anthem ATZ (a restricted use herbicide) may be applied in the fall for residual weed control or from 45 days before planting to postemergence up to 4 visible collars to field corn, seed corn, sweetcorn, and popcorn for broadleaf and grass weed control. Apply Anthem ATZ at 1.75 to 2 pt on coarse soils, 2 to 2.5 pt on medium soils, and 2 to 3 pt on fine textured soils. If weeds are present at the time of application add COC or MSO at 1 to 2 pt/a or NIS at 0.25% V/V to enhance activity on emerged weeds. Anthem ATZ is compatible with liquid and dry fertilizers. Do not harvest all types of corn for forage within 60 days and for grain or fodder within 70 days of the final Anthem ATZ application. Do not harvest sweet corn forage or ears for human consumption within 45 days of Anthem ATZ application. The year after Anthem ATZ has been applied, rotation to soybean, cotton, or peanuts may occur depending on herbicide rate used, precipitation received, and timing of application. See label for details.
Pyroxosulfone (15) + Carfentrazone (14) 0.080 to 0.212 + 0.006 to 0.015	2.75 to 7.28 fl oz **Anthem Flex**	Anthem Flex may be applied early preplant 45 days before planting through preemergence following planting to field corn, seed corn, sweetcorn, and popcorn for grass and broadleaf weed control. Plant corn a minimum of 1.5 inches deep to reduce the risk of crop injury. Tank mixing with atrazine, Balance Flexx, or Hornet will broaden the spectrum of weeds controlled. To broaden the spectrum of foliar activity in a preplant burndown situation, Anthem Flex may be applied with glyphosate, paraquat, glufosinate, 2,4-D, dicamba, or Aim. When applying 15 to 45 days before planting use 3.5 to 4.5 fl oz on coarse textured soils, 4.5 to 5.5 on medium textured soils, and 5.5 to 7.28 fl oz on fine texture soils. When applying less than 15 days prior to corn planting use 2.75 to 5 fl oz on coarse soils, 3 to 6 fl oz on medium soils, and 3.5 to 7.28 on fine textured soils. See label for organic matter effect on Anthem Flex rates. Do not harvest sweet corn for human consumption with 37 days of Anthem Flex application.
Pyroxosulfone (15) + Fluthiacet (14) 0.082 to 0.212 + 0.002 to 0.006	2.5 to 6.5 fl oz **Anthem Maxx**	Anthem Maxx may be applied in the fall for residual weed control or from 45 days before planting to postemergence up to 4 visible collars to field corn, seed corn, sweetcorn, and popcorn for broadleaf and grass weed control. The addition of atrazine, Balance Flexx (preemergence only to corn), or Hornet to Anthem Maxx will improve control of additional broadleaf species. Apply Anthem Maxx at 2.5 to 4 fl oz on coarse soils, 2.5 to 5.5 fl oz on medium soils, and 3 to 6.5 fl oz on fine textured soils. See label for organic matter effect on Anthem Maxx rate with soil textures. If weeds are present at the time of application add COC or MSO at 1 to 2 pt/a or NIS at 0.25% V/V to enhance activity on emerged weeds. Anthem Maxx is compatible with liquid and dry fertilizers. Do not harvest field, pop, or seed corn for forage within 30 days and for grain or fodder within 70 days of the final Anthem Maxx application. Do not harvest sweet corn for forage or ears within 40 days of Anthem Maxx application. Rotation intervals vary based on Anthem Maxx rate used, soybean, 0 to 4 mo.; grain sorghum, 6 to 10 mo.; wheat, 1 to 6 mo.; sunflower, 4 mo.; and alfalfa 10 mo. See label for other crop rotation restrictions.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Rimsulfuron (2) + Thifensulfuron (2) 0.0104 to 0.0315 + 0.0052 to 0.0158	0.33 to 1 oz **Basis,** or 0.83 to 2.5 oz **Basis Blend**	Apply Basis in the fall (.033 to 0.5 oz) with 2,4-D ester before the ground freezes to control winter annual weeds and provide some residual weed control of later emerging winter annuals or early emerging spring annual weeds. Early spring applications up to 1 oz of Basis can be applied on heavy textured soils. Do not use on fields intended to be planted to popcorn, sweet corn, or field corn for seed production. Field corn can be planted in the spring following a fall application of Basis. Basis can be applied up to 7 days prior to planting corn for burndown of emerged weeds. To control emerged weeds, apply Basis with a COC or NIS and an ammonium nitrogen fertilizer. Tank mixing with herbicides registered for corn having a different mode of action may help control ALS-resistant weed species.
Rimsulfuron (2) + Thifensulfuron (2) 0.0156 to 0.0281 + 0.0156 to 0.0281	1 to 1.8 oz **Crusher**	Crusher may be applied following fall harvest in the previous year through winter and early spring but prior to corn emergence for preplant and preemergence weed control in field corn. Do not apply to frozen soil during the winter or early spring or postemergence to corn. If control of emergent weeds is anticipated with Crusher, add COC or MSO at 1% v/v. If tank mixed with a fully loaded glyphosate or Liberty 280 at recommended use rates, no additional adjuvants are required. Corn hybrids may vary in their sensitivity to Crusher; as a result, FMC is not responsible for crop injury observed from a Crusher application.
S-metolachlor (15) 1 to 1.9	1 to 2 pt **Dual II Magnum, EvarpreX, Charger Max,** or **Moccasin II Plus,** or 6 to 16 lb **Dual II Magnum**	Controls many annual grass and small-seeded broadleaf weeds. Preplant surface apply up to 45 days before planting corn, apply preplant and shallowly incorporate into the top 2 inches of soil within 14 days before planting, or apply before corn emerges. Small grains can be planted 4.5 months after treatment.
S-metolachlor (15) + Atrazine (5) 0.78 to 1.56 + 1 to 2	1.3 to 2.6 qt **Bicep II Magnum, Charger Max ATZ**	These are formulated mixtures of 3.1 lb atrazine (a restricted-use pesticide) and 2.4 lb *S*-metolachlor/gal. Use the lower rate for expected light weed infestations and the higher rate for heavy weed infestations. Use with shallow preplant incorporation or surface apply after planting and before grasses and broadleaf weeds are at 2-leaf stage and corn is 5 inches tall. For sensitive watersheds, see K-State Research and Extension publication MF-2208 for atrazine best management practices. Follow atrazine rate limits and label directions.
S-metolachlor (15) + Atrazine (5) 1.27 to 1.56 + 1.6 to 2	No-till: 2.1 to 2.6 qt **Bicep II Magnum**	**No-till:** Apply two-thirds the recommended rate as a split treatment 30 to 45 days before planting and the remainder at planting. Applications made less than 30 days before planting may be either a split or single treatment. May apply in fluid fertilizer with NIS to burn down labeled weeds up to 2-leaf stage. To control larger weeds, tank mix with Gramoxone SL, glyphosate, and etc. Follow atrazine rate limits and label directions.
S-metolachlor (15) + Atrazine (5) 0.8 to 1.58 + 0.63 to 1.27	0.95 to 1.9 qt **Bicep Lite II Magnum, Charger Max ATZ Lite**	These are formulated mixtures of 2.67 lb atrazine (a restricted-use pesticide) and 3.33 lb *S*-metolachlor/gal for use by growers wanting to reduce rates of soil-applied atrazine.
S-metolachlor (15) + Atrazine (5) + Glyphosate (9) 1.1 to 1.6 +1.3 to 2 + 0.47 to 0.70	2.5 to 3.75 qt **Expert**	**No-till:** Expert is a premix of the active ingredients in Bicep II Magnum (a restricted-use pesticide) and glyphosate. Typical use rate is 3 qt/acre. Use as a burndown of existing weeds and residual weed control.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
S-metolachlor (15) + glyphosate (9) 0.94 to 1.5 + 0.70 to 1.125	2.4 to 4 pt **Sequence**	Sequence is a premix of 3 lb *S*-metolachlor (Dual II Magnum) and 2.25 lb ae glyphosate and may be applied to all corn before, during, or after planting but before corn emerges if corn is not glyphosate-resistant. Apply with 8.5 to 17 lb AMS/100 gal spray solution to enhance foliar activity of the glyphosate on emerged weeds. The Dual II Mag component will provide early season residual of annual grasses and some small seeded broadleaf weed, but Sequence may be applied with several different tank mix partners listed on the label to broaden the spectrum of weeds controlled. Do not apply more than 3.5 pt of Sequence on coarse-textured soils.
S-metolachlor (15) + Mesotrione (27) 1.67 to 2 + 0.165 to 0.198	2 to 2.4 qt **Zemax** or **Coyote**	Zemax may be applied preplant up to 14 days before planting or preemergence for grass and broadleaf weed control in field corn, seed corn, popcorn, and sweet corn. See postemergence section for Zemax postemergence on field and seed corn. Any adjuvants may be used preplant or preemergence where corn has not emerged to increase burndown activity on existing weeds. Cereal crops (wheat, rye, barley, and oats) may be planted 4.5 months following application. Soybeans may be planted the following spring. All corn or Concep-treated sorghum may be planted anytime. Glyphosate, Gramoxone SL, atrazine, and several other herbicides (see label) may be tank mixed with Zemax to improve burndown of existing weeds or improve the spectrum of broadleaf and grass weed control.
S-metolachlor (15) + Mesotrione (27) + Atrazine (5) 1.68 to 2 + 0.17 to 0.2 + 0.63 to 0.76	2.7 to 3.25 qt **Lumax EZ**	Lumax EZ is a premix of 2.49 lb *S*-metolachlor (Dual II Magnum), 0.268 lb mesotrione (Callisto), and 0.935 lb atrazine (a restricted-use pesticide). Use the 2.7 qt rate when organic matter is less than 3% and 3.25 qt when organic matter is 3% or greater. Apply up to 14 days before planting or preemergence. Controls a wider spectrum of weeds than Bicep, especially velvetleaf, pigweed, and waterhemp, if properly activated. Can rotate to winter wheat 4.5 months after application and to cotton, soybean, or sorghum the following spring. Application to sands and loamy sands where the water table is near the surface may result in groundwater contamination. Follow atrazine rate limits and label directions. **No-till:** May be tank mixed with Gramoxone SL, glyphosate, or a 2,4-D product (see 2,4-D label for restrictions) for preplant burndown of existing weeds. May be applied in liquid fertilizer before corn emerges.
S-metolachlor (15) + Mesotrione (27) + Atrazine (5) 1.3 to 1.5 + 0.17 to 0.19 + 1.3 to 1.5	3 to 3.5 qt **Lexar EZ**	Lexar EZ is a premix of 1.74 lb *S*-metolachlor (Dual II Magnum), 1.74 lb atrazine (a restricted-use pesticide) and 0.22 lb mesotrione (Callisto)/gal. Use rate depends on soil organic matter content. Apply up to 14 days before planting. The higher atrazine content than Lumax EZ should give improved control of morningglory and cocklebur. Do not rotate to winter wheat following corn. Do not rotate to crops other than corn, cotton, soybean, or sorghum the spring following application. **No-till**: May be tank mixed with Gramoxone SL, glyphosate, or a 2,4-D product (see 2,4-D label for restrictions) for preplant burndown of existing weeds. May be applied in liquid fertilizer before corn emerges.
S-metolachlor (15) + Mesotrione (27) + Bicyclopyrone (27) + Atrazine (5) 1.34 to 1.61 + 0.15 to 0.18 + 0.038 to 0.045 + 0.63 to 0.75	2.5 to 3 qt **Acuron**	Acuron is a premix of 2.14 lb *S*-metolachlor, 0.06 lb bicyclopyrone, 0.24 lb mesotrione, and 1 lb atrazine (restricted use herbicide) for preemergence weed control in all corn types from 28 days before planting prior to corn emergence. Acuron may be applied early post to field, silage, and seed corn prior to corn attaining 12 inches tall. See Acuron in the Postemergence section of this weed guide for further discussion. Use rates are 2.5 qt when soil organic matter is less than 3% and 3 qt when organic matter is 3% or greater. The addition of bicyclopyrone will enhance control of large seeded broadleaf weeds. Rotational restrictions include wheat, rye, or barley 4 months; cotton, soybeans, sorghum 10 months; canola and alfalfa 18 months.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
S-metolachlor (15) + Mesotrione (27) + Bicyclopyrone (27) 1.43 to 1.60 + 0.16 to 0.18 + 0.040 to 0.045	2 to 2.25 qt **Acuron Flexi**	Acuron Flexi is a premix of 2.86 lb *S*-metolachlor, 0.32 lb mesotrione, and 0.08 lb bicyclopyrone for preemergence weed control in all corn types from 28 days before planting and through early postemergence to field, silage, and seed corn up to 30 inches tall or 8 leaf growth stage. Apply the 2 qt rate when soil organic matter is less than 3% and 2.25 qt when soil organic matter is 3% or greater. See the Postemergence section for further discussion. Acuron Flexi is best adapted for areas having atrazine restrictions. Acuron Flexi performance will be enhanced with the addition of atrazine. Rotational restrictions following Acuron Flexi application is wheat, rye, or barley, 4 months and alfalfa, cotton, drybeans, soybean, and sorghum 10 months.
Saflufenacil (14) 0.022 to 0.078	1 to 3.5 fl oz **Sharpen**	Sharpen can be applied preplant surface, preplant incorporated, or preemergence to field corn, silage, or popcorn for broadleaf weed control. Some popcorn hybrids may be sensitive to Sharpen. Check with seed supplier. Do not apply to corn that has emerged, or significant crop injury may result. The maximum rates of Sharpen that can be applied to a coarse soil is 2.5 fl oz, medium soil is 3 fl oz, and to a fine soil is 3.5 fl oz. Sharpen has excellent burndown activity of broadleaf weeds and must be applied with MSO at 1% v/v (minimum of 1 pt/a) plus AMS 8.5 to 17 lb/100 gal or liquid nitrogen at 1.25 to 2.5 gal/100 gal. Sharpen rate is affected by soil texture. Sharpen may be tank mixed or applied sequentially with but not exclusively with Clarity, Verdict, Outlook, Prowl H_2O, Status, Atrazine, glyphosate, Harness, or Harness Extra. Sequential applications with Sharpen or Verdict require 14 days between applications. Do not apply more than 0.134 lb/a saflufenacil (6 oz of Sharpen) per cropping season. Do not use if organophosphate or carbamate insecticides were used at planting.
Simazine (5) 1 to 2	1 to 2 qt **Princep 4L, Simtrol, Simazine 4L,** or 1.1 to 2.2 lb **Princep Caliber 90, Simazine 90DF**	Has more residual grass activity than atrazine and is less water soluble. Usually applied late preplant or preemergence at about 1 lb/acre. Do not soil incorporate. Does not have foliar activity. Can be used on sand, silt, and loam soils that are low in organic matter. Has longer carryover than atrazine.
Topramezone (27) + Dimethenamide (15) 0.011 to 0.019 + 0.57 to 0.98	14 to 24 fl oz **Armezon PRO**	Armezon PRO can be applied to all corn types preemergence to help control emerged weeds at planting. For burndown activity, apply Armezon PRO with COC or MSO at 1% v/v or HSOC at 0.5% v/v. If tank mix partner prohibits the use of oil additives use NIS at 0.25 to 0.5% V/V. The addition of UAN at 2.5% v/v or AMS at 8.5 to 17 lb/100 gallon spray solution is recommended. Use 14 to 16 fl oz on coarse textured soils having less than 3% organic matter and 16 to 20 when organic matter is 3% or greater. On medium and fine textured soils use 16 to 20 fl oz when soils have less than 3% organic matter and 20 to 24 when soil organic matter is 3% or greater. Can rotate to cereals after 4 months; sorghum, soybean, sunflower, alfalfa, canola, and cotton after 9 months; and peas and drybeans after 9 months when less than 20 fl oz are applied or 18 months if 20 fl oz. This preemergence application of Armezon PRO is based on a supplemental label that will expire August 1, 2019.
Thifensulfuron (2) 0.014 to 0.028	0.45 to 0.9 oz **Harmony SG**	Apply preplant until corn emergence for burndown of certain broadleaf weeds. Generally tank mixed with burndown herbicides for broader spectrum weed control. Apply with NIS or COC plus ammonium nitrogen fertilizer additives.
2,4-D (4) 1 to 1.5	2 to 3 pt of 4 lb/gal **2,4-D***	Application rates of 2,4-D, spray volumes, and timings differ with company and formulation. Apply 3 to 5 days after planting but before corn emerges. Can control broadleaf weeds for several weeks. Do not use on sandy soils. Avoid spray or vapor drift to sensitive crops. Enlist One herbicide (2,4-D choline) may be applied at 1.5 to 2 pt per acre PRE- or POST-plant and prior to emergence of all corn types, including Enlist corn hybrids.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Acetochlor (15) 1.1 to 3	3 to 6 pt **Warrant** or 2.25 to 5 pt **Degree** or 1.5 to 3.75 pt **Cadence, Overtime,** or **Volley** or 1.2 to 2.7 pt **Harness, Surpass NXT, Volley NXT,** or **Confidence***	Acetochlor and premixes containing acetochlor can be applied postemergence to corn up to 11 inches tall except Warrant may be applied on corn up to 30 inches tall. See labels for appropriate use rates on various soil types for each acetochlor formulation. It can be tank mixed with many postemergence herbicides. Follow label guidelines for all herbicides used. Acetochlor has no postemergence activity, so its role is to enhance residual weed control. Emerged weeds must be controlled with cultivation or the companion herbicide. Use only water as a carrier to avoid crop injury.
Acetochlor (15) + Atrazine (5) 0.8 to 3 + 0.6 to 2.0	1.5 to 3.7 qt **Degree Xtra** or **Fultime NXT,** or 1.8 to 3.4 qt **Cadence ATZ, Overtime ATZ,** or **Volley ATZ,** or 1 to 3 qt **Harness Xtra 5.6** or **Confidence Xtra 5.6,** or 1.4 to 3 qt **Keystone NXT** or V**olley ATZ NXT**	These herbicides are restricted-use pesticides. The ratio of acetochlor and atrazine varies in the products shown. These herbicides maybe applied to corn up to 11 inches tall. Use rates will vary based on soil texture. For fields in sensitive watersheds, please review K-State Extension Publication MF-2208 for atrazine best management practices. Total atrazine applied in a single crop season cannot exceed 2.5 lb. No more than 2 lb of atrazine can be applied in a single application. These herbicides are intended to extend residual control of weeds and are often tank mixed with additional herbicides to provide adequate control of emerged weeds. Review labels for tank mix partners. Restrictions apply to the herbicide with the most restrictive label in the mix.
Acetochlor (15) + Atrazine (5) 1.4 to 3 + 0.5 to 1.2	1.4 to 3 qt **Cadence ATZ Lite,** or **Overtime ATZ Lite,** or 1.8 to 3 qt **Volley ATZ Lite**, or 1.8 to 2.3 qt **Volley ATZ Lite NXT** or **Keystone LA NXT,** or 1 to 2.3 qt **Harness Xtra** or **Confidence Xtra**	These herbicides are restricted-use pesticides. The ratio of acetochlor and atrazine varies in the products shown. These herbicides maybe applied to corn up to 11 inches tall. Use rates will vary based on soil texture. Growers often use these products when reduced rates of atrazine are required. For fields in sensitive watersheds, please review K-State Extension Publication MF-2208 for atrazine best management practices. Total atrazine applied in a single crop season cannot exceed 2.5 lb. These herbicides are intended to extend residual control of weeds and are often tank mixed with additional herbicides to provide adequate control of emerged weeds. Review labels for tank mix partners. Restrictions apply to the herbicide with the most restrictive label in the mix.
Acetochlor (15) + Clopyralid (4) + Flumetsulam (2) 0.7 to 1.4 + 0.07 to 0.14 + 0.023 to 0.046	1.5 to 3 pt **SureStart II, TripleFLEX II,** or **Trisidual**	These herbicides maybe tank mixed with glyphosate (on glyphosate-tolerant) or Liberty (on Liberty Link) herbicide-tolerant field or silage corn from emergence up to 11 inches tall. The rate is dependent upon soil texture and organic matter. If soils are coarse-textured, use 1.5 to 2 pt/a; if medium-textured and less than 3% organic matter, use 1.5 to 2.5 pt; and if 3% organic matter or greater, use 1.75 to 3 pt/a. If soil textures are fine, use 2 to 3 pt/a. The new formulations of these herbicides followed by II contain a safener allowing rates up to 3 pt/a.
Acetochlor (15) + Clopyralid (4) + Mesotrione (27) 0.88 to 2.1 + 0.059 to 0.142 + 0.094 to 0.225	1.25 to 3 qt **Resicore**	Resicore may be applied to all field corn, grain, silage, or seed, early postemergence up to 11 inches tall and weeds less than 3 inches. When organic matter is less than 3% use Resicore at 2.25 qt on coarse soils, 2.5 qt on medium soils, and 2.75 qt on fine soils. When soils are 3% or more organic matter, use Resicore at 2.5 qt on coarse soils, 2.75 on medium soils, and 3 qt on fine soils. Include with these rates, NIS 0.25% v/v or COC not to exceed 1% v/v. Do not mix with MSO or adjuvants containing nitrogen. An exception is the 1.25 qt rate of Resicore may be applied postemergence when tank mixed with glyphosate or glufosinate to 1 to 2 inch weeds and corn 11 inches tall or less. In this tankmix, add 0.25% v/v NIS and AMS at 8.5 lb / 100 gallon spray solution. Do not use UAN or MSO. Rotational restrictions: wheat 4 months; alfalfa, barley, millet, oats rye, sorghum soybean, and sunflower 10.5 months. If applied with atrazine, restrictions to soybean is 18 months. If Resicore is applied after June 1, only corn or grain sorghum can be planted the following year.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Acetochlor (15) + Mesotrione (27) 1.10 to 2.06 + 0.103 to 0.193	1.25 to 2.34 qt **Harness Max**	Harness Max may be applied to all field corn, grain, silage, or seed, and yellow popcorn early postemergence to corn up to 11 inches tall and before weeds exceed 3 inches tall. Use Harness Max at 40 to 55 fl oz on coarse soils, 55 to 64 fl oz on medium soils, and 55 to 65 fl oz on fine soils when organic matter is less than 3% and 64 to 75 fl oz when organic matter is 3% or greater. Include with these rates, NIS 0.25% v/v or COC at 1% v/v and a nitrogen based adjuvant, UAN or AMS. Do not use COC or nitrogen based products when applying to yellow popcorn. Do not mix with MSO. Harness Max may be applied postemergence when tank mixed with Roundup brand only glyphosate on Roundup Ready 2 technology or Liberty herbicide on Liberty Link corn. Do not use MSO, COC, or a nitrogen based adjuvant when tank mixing with Liberty. Rotational restrictions: sorghum (concept treated immediately) wheat 4 months; alfalfa, soybean, and cotton 10 months; barley, oat, millet, and rye the spring following application; Cucurbits, drybeans, peas, and other crops 18 months. A maximum of 95 fl oz of Harness Max may be used during the season.
Atrazine (5) 1 to 2	1 to 2 qt **Atrazine* 4L** or 1.1 to 2.2 lb **Atrazine* 90 DF**	A restricted-use pesticide. The 2 lb/a rate is permissible only when no atrazine was applied before corn emergence. Apply with COC in water before grasses, broadleaf weeds, and corn exceed 1.5, 4, and 12 inches in height, respectively. Do not apply in liquid fertilizer carrier after corn emerges because injury can occur. Do not plant treated field to crops other than corn (or sorghum in northeastern Kansas) during the same season. Postemergence atrazine rates over 1 lb/a are not considered best management practices because of high runoff potential in surface water in sensitive watersheds (see K-State Research and Extension publication MF-2208). See label for directions, rates, recropping, and feeding limitations.
Bromoxynil (6) 0.25 to 0.38	1 to 1.5 pt **Broclean, Buctril, Bromox,** or **Moxy**	Apply bromoxynil when broadleaf weeds are small and growing actively but before they reach size limits listed on the label. Contact action requires thorough coverage. Bromoxynil is safer for corn than 2,4-D or dicamba. No residual activity. Can be tank mixed with atrazine, Callisto, dicamba, or 2,4-D. Do not feed forage or allow grazing within 30 days of treatment.
Bromoxynil (6) + Atrazine (5) 0.13 to 0.38 + 0.25 to 0.75	1 to 3 pt **Brozine, Buctril+Atrazine***	Atrazine is a restricted-use pesticide. These premixes of 1 lb bromoxynil and 2 lb atrazine/gal control many seedling broadleaf weeds. Use up to two applications per season when weeds are small and actively growing but before they reach size limits listed on the labels. Apply after 3- to 4-leaf stage but before corn exceeds 12 inches in height. Can be tank mixed with dicamba to increase control of pigweeds, kochia, and field bindweed. Tank mixing with up to 8 fl oz 2,4-D increases control of devilsclaw and field bindweed but increases potential for crop injury. Can be tank mixed with Accent for shattercane control. Bromoxynil plus atrazine application is considered an atrazine best management practice for use in sensitive watersheds because the low rate of atrazine reduces the potential for runoff loss. Do not feed forage or allow grazing within 30 days of treatment.
Carfentrazone (14) 0.008 to 0.016	0.5 to 1 fl oz **Aim EC**	Carfentrazone helps control black nightshade, velvetleaf, lambsquarter, pigweed, and morningglory when applied to actively growing plants 1 to 4 inches tall. Can be broadcast applied to corn with up to 8 leaf collars. For corn from 9 to 14 leaf collars, apply with drop nozzles. Always apply with NIS at 0.25% v/v. Substituting 1% v/v COC is permissible for very dry soil conditions, but leaf speckling on treated corn may increase. Can be tank mixed with other postemergence corn herbicides to broaden the weed spectrum and increase the level of control. For tank mixes, follow application and rotation guidelines of the more restrictive partner. Thorough and uniform spray coverage is needed for best results. Any crop can be planted after 30 days following application.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Clopyralid (4) 0.12 to 0.25	0.33 to 0.67 pt **Stinger**	Can be applied to corn from emergence until 24 inches tall, primarily for Canada thistle control. Apply to thistle plants at least 4 inches in diameter or tall but before the bud stage. Do not cultivate Canada thistle patches within 2 weeks before or after Stinger application. Can be tank mixed with 2,4-D.
Dicamba (4) 0.25 to 0.5	0.5 to 1 pt **Dicamba*** or 11 to 22 fl oz **FeXapan** or **Xtendimax** or 6.4 to 12.8 fl oz **Engenia**	Controls most broadleaf annual weeds. Best when applied before weeds are 3 inches tall. For corn from the spike stage through 8 inches, apply up to the 0.5 lb/a rate. Reduce the rate to 0.25 lb if corn is growing on coarse-textured soils. Apply up to 0.25 lb until corn is 36 inches tall or until 15 days before tassels emerge, whichever is earlier. Can be tank mixed with Exceed, Permit, and many other herbicides. Do not apply when temperature on the day of application is expected to exceed 85°F. Do not apply when soybean is growing nearby, if corn is more than 24 inches tall, soybean is more than 10 inches tall, or soybean has begun to bloom. Avoid spray or vapor drift to sensitive crops. See label for additional precautions. The addition of AMS to a spray mixture containing dicamba will increase the risk of volatility of dicamba and mitigate the benefits of lower volatility formulations. Do not use AMS with Engenia.
Dicamba (4) 0.25 to 0.5	0.5 to 1 pt **DiFlexx**	DiFlexx is a premix of Clarity and Bayers CSA safener. DiFlexx can be applied to all corn types from spike through 10 collar or 36 inches tall, which ever come first. The use of NIS at 0.25% v/v, COC or MSO at 1% v/v and a nitrogen source UAN at 2 to 4 qt/a or AMS 8.5 to 17 lb/100 gallon will enhance postemergence activity on emerged weeds. For the best control, apply to weeds that are less than 3 inches tall. The addition of AMS to a spray mixture containing DiFlexx will increase the risk of volatility of dicamba and mitigate the benefits of lower volatility of DiFlexx.
Dicamba (4) + Tembotrione (27) 0.23 to 0.39 + 0.050 to 0.084	24 to 40 fl oz **DiFlexx Duo**	DiFlexx Duo is a premix of Clarity 1.26 lb ae, Laudis 0.27 lb, and Bayer's CSA safener. DiFlexx Duo can be applied to field, silage, seed, and popcorn preplant, preemergence or postemergence on corn up through V6 or 36 inches tall, whichever comes first. It can be applied with a directed spray on 7 to 10 collar corn up to 36 inch tall corn. DiFlexx Duo applied sequentially, two applications only, must be separated by a minimum of two weeks and must not exceed a total of 78 fl oz. Use MSO or COC at 1% v/v when applied alone or tank mixed with atrazine. The use of 1.5 qt/a of UAN or 8.5 to 17 lb AMS/100 gallons spray solution with DiFlexx Duo will improved weed control when applied in conditions of low humidity. The addition of AMS to a spray mixture containing dicamba will increase the risk of volatility of dicamba and mitigate the benefits of lower volatility of products like Clarity or DiFlexx.
Dicamba (4) + Atrazine (5) 0.28 to 0.48 + 0.5 to 0.9	2 to 3.5 pt **Stratos** or **Banvel K + Atrazine**	These are mixtures of dicamba and atrazine (a restricted-use pesticide) that can be applied to corn from the spike stage until the 5-leaf stage. Use drop nozzles if corn is more than 8 inches tall. Do not apply to corn more than 12 inches tall. Use lower rate for coarse-textured soils. Do not use with adjuvants or liquid fertilizers, except as directed on labels. Can be tank mixed with Outlook, Harness, Surpass, or pendimethalin, but these residual herbicides have no foliar activity. When tank mixing with Accent, add 1 qt NIS/100 gal spray mixture and 1 gal/a UAN. Dicamba plus atrazine application is considered an atrazine best management practice for use in sensitive watersheds because the low rate of atrazine reduces the potential for runoff loss. Follow atrazine rate limits.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Diflufenzopyr (19) + Dicamba (4) 0.053 to 0.11 + 0.138 to 0.275	5 to 10 oz **Status**	Status combines diflufenzopyr and dicamba with isoxadifen, a safener. It may be broadcast applied over corn from 4 to 36 inches tall or the V8 stage. Always apply with NIS, MSO, or COC plus a nitrogen source, such as 5 qt/100 gal of UAN or 5 to 17 lb/100 gal of spray-grade AMS. When using AMS, dissolve Status in the tank before adding AMS. May be tank mixed with glyphosate for resistance management. May be aerially applied west and inclusive of Highway 81 in Kansas. Do not tank mix with growth regulator herbicides containing 2,4-D, dicamba, or clopyralid. Sequential treatment with these products must be separated by at least 15 days. Do not tank mix with emulsifiable concentrate formulations of chloroacetamide herbicides (which include actives: metolachlor, acetochlor, and dimethenamid).
Dimethenamid-P (15) 0.56-0.98	12 to 21 oz **Outlook**	Dimethenamid-P can be applied postemergence to corn up to 12 inches tall. Dimethenamid-P has no foliar activity, so its role is strictly to enhance residual weed control. Emerged weeds must be controlled with cultivation or the companion herbicide. Use only water as a carrier to avoid crop injury.
Flumiclorac (14) 0.013 to 0.040	2 to 6 oz **Resource**	Resource is used mainly in tank mixes to enhance velvetleaf control. It can be applied from the V2 to V10 stages (2 to 10 leaf collars visible) of corn. Use 2 oz for velvetleaf up to 4-leaf stage and 4 oz for velvetleaf at 6-leaf stage. Resource tank mixed with atrazine, Accent, Beacon, or similar products must be applied with 1 pt/a COC and AMS at 2.5 lb/a or UAN at 1 qt/a can be added. Resource mixed with 2,4-D amine, Stinger, or dicamba must be applied with 0.25% NIS. Resource mixed with Buctril, 2,4-D ester, or dicamba + atrazine must be applied without the addition of an adjuvant. See label for mixing order recommendations and directions for drop nozzle application.
Fluroxypyr (4) 0.14	0.4 pt **Comet, Starane Ultra, StareDown** or **Vista XRT**	Starane Ultra can be applied to field corn as a broadcast application by either ground or air. Use of a high quality adjuvant is recommended for improved weed control, especially in hot, dry conditions. Apply to field corn up to and including the V5 stage of growth. Starane Ultra can be tank mixed with other herbicides registered for postemergence application to corn.
Fluroxypyr (4) + Bromoxynil (6) 0.064 to 0.125 + 0.25 to 0.5	14 to 27.4 fl oz **Starane NXT**	Starane NXT can be applied to field corn as a broadcast application by either ground or air, from emergence (low use rates) through and including the V5 stage. May be tank mixed with other labeled corn herbicides, but spray mixtures that include spray additives or liquid fertilizers may cause excessive corn leaf burn.
Fluroxypyr (4) + Clopyralid (4) 0.125 + 0.125	1.33 pt **WideMatch**	WideMatch can be applied to field corn as a broadcast application by either ground or air. Apply to field corn up to and including the V5 stage of growth (5 leaf collars visible). Use of an adjuvant is not recommended when using WideMatch alone, as crop safety may be reduced. WideMatch can be tank mixed with other herbicides registered for postemergence application to corn. Do not apply WideMatch in combination with COC or MSO unless risk of crop injury is acceptable.
Fluroxypyr (4) + Bromoxynil (6) + 2,4-D (4) 0.084 to 0.126 + 0.21 to 0.31 + 0.21 to 0.31	1 to 1.5 pt **Kochiavore**	Kochiavore can be applied to burndown broadleaf weeds, preplant to corn. Wait a minimum of 7 days before planting corn or apply preemergence after corn is planted in a no-till system. The seed furrow must be completely closed at the time of application or severe crop injury may result. Kochiavore can be applied to corn from V3 through V5 growth stage and a directed spray only from V6 growth stage up to 2 weeks prior to tassel. Do not cultivate for 7 to 10 days following treatment to avoid stalk breakage. DO NOT tank mix with atrazine, crop oils, or other adjuvants, such as NIS.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Fluthiacet (14) 0.003 to 0.006	0.4 to 0.9 oz **Cadet**	Especially good for velvetleaf control and suppression of certain other small broadleaf weeds. The low rate is primarily to enhance velvetleaf control in tank mixes with other herbicides. Apply to field corn, seed corn, popcorn, or sweet corn up to 48 inches tall. There is a 90-day preharvest interval. Always apply in combination with 0.25% v/v NIS or 1 to 2 pt/a crop oil. Cadet is a PPO inhibitor and can cause leaf burning or speckling. New growth is unaffected.
Glufosinate (10) 0.40 to 0.78	22 to 43 oz **Liberty** and **others**	Liberty is a nonselective herbicide for use over corn designated as Liberty Link or corn warranted by BASF as being resistant to Liberty. Optimum weed control is achieved by applying with atrazine or Armezon when weed height is 1 to 4 inches and corn height is less than 12 inches. May be applied without atrazine to corn up through the V6 stage. Liberty is primarily a contact herbicide, so thorough spray coverage is important. For best results on crabgrass, sandbur, and yellow foxtail, apply before tillering. Always condition water carrier with spray-grade AMS at 3 lb/a before adding Liberty to the spray tank. Do not add surfactants. See label for rate guidelines, according to weed species and size. Liberty is foliar active and has no soil activity. Apply in a tank-mix with a residual herbicide for extended control. Liberty can be applied twice in-season. Maximum Liberty per season is 87 fl oz per acre.
Glyphosate (9)	**Glyphosate*** (see glyphosate table)	Most glyphosate products may be applied postemergence to corn with the Roundup Ready/GT gene only; however, RT3 and Touchdown CT are not labeled for in-crop use. Apply from emergence through the V8 stage (8 leaf collars visible) or until corn height reaches 30 inches (freestanding), whichever comes first. For corn with the RR2 event, glyphosate may be applied with drop nozzles to corn 30 to 48 inches tall. Some tank mixtures limit application to corn 5 or 11 inches tall. Condition spray water with 1 to 2%, by weight, of spray-grade AMS (8.5 to 17 lb/100 gal water) that is dissolved completely before adding glyphosate to the tank. Can be ground or aerially applied. Glyphosate has no soil residual activity. To reduce selection pressure for glyphosate resistance, a foundation treatment with a residual herbicide is recommended. Allow a minimum of 50 days between application and harvest of corn forage. There are no rotational crop restrictions.
Glyphosate (9) + 2,4-D choline (4) 0.74 to 1.01 + 0.70 to 0.95	3.5 to 4.75 pt **Enlist Duo**	Enlist Duo may be applied postemergence to Enlist Corn up to the V-8 stage of application or 30 inches tall, whichever comes first. Applications can be made to corn 30 to 48 inches tall if drop nozzles are used. Do not exceed 4.75 pts for any single application not to exceed 14.75 pt per crop season. Review details in label to comply with application requirements for spray drift management.
Glyphosate (9) + *S*-metolachlor (15) 0.7 + 0.94	2.5 pt **Sequence**	Sequence is a premix of glyphosate and Dual Magnum. Apply postemergence to corn with the Roundup Ready/GT gene only from emergence up to 30-inch corn. Apply in water preconditioned with AMS. (It may also be applied preplant or preemergence, but it does not contain the benoxacor safener that is in Dual II Magnum.)
Glyphosate (9) + *S*-metolachlor (15) + Atrazine (5) 0.47 to 0.70 + 1.1 to 1.6 + 1.3 to 2.0	2.5 to 3.75 qt **Expert**	Expert is a premix of the active ingredients in Bicep Magnum (a restricted-use pesticide) and glyphosate. Apply postemergence to corn with the Roundup Ready/GT gene only from emergence up to 12 inches in height. Do not tank mix with any other products. Apply in water preconditioned with AMS.
Halosulfuron (2) 0.031	0.67 oz **Permit**	Permit can be applied to corn over the top or with drop nozzles from the spike through layby stage of growth for control of many broadleaf weeds and suppression of yellow nutsedge. Use 0.25 to 0.5% v/v NIS or COC at 1% v/v. To enhance pigweed and morning glory control, an herbicide with improved activity on these species should be added to the mix.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Halosulfuron (2) + Dicamba (4) 0.03 to 0.06 + 0.125 to 0.25	4 to 8 oz **Yukon**	4 oz of Yukon premix is equivalent to ⅔ oz Permit and 4 fl oz dicamba. May be broadcast applied over field corn from spike stage through 36 inches tall. Apply to small weeds for best performance. Must be applied with 0.25 to 0.5% NIS or 1% (1 gal/100 gal spray mix) COC.
Mesotrione (27) 0.094	3 fl oz **Callisto, Incinerate, BL4, Bridle, Explorer, Tenacity, Willowood Mesotrione** or **Motif**	Apply mesotrione from emergence to 8-leaf stage of corn. Always add COC at 1% v/v (1 gal/100 gal spray). Note label for insecticide restrictions. Controls many annual broadleaf weeds. Mesotrione is rainfast after 1 hour. For corn up to 12 inches tall, mesotrione may be used in combination with atrazine at 0.25 to 0.75 lb/a or in combination with Bicep II Magnum or Lite Magnum. Can rotate to winter wheat 4.5 months after application and to cotton, soybean, or sorghum the following spring. See label for sprayer cleanup after application.
Mesotrione (27) + Fluthiacet (14) 0.059 to 0.093 + 0.003 + 0.005	2 to 3.15 fl oz **Solstice**	Solstice may be applied postemergence to field, silage, seed, pop, or sweet corn from emergence to the 8-leaf stage or to 30 inches tall. Apply with COC at 1% v/v. NIS at 0.25% is acceptable, but weed control may be reduced. Using MSO adjuvants or blends may cause unacceptable crop injury. Include AMS at 8.5 lb/100 gal spray solution or UAN at 2.5% v/v to field, silage, or seed control only. Do not use AMS or UAN when applying Solstice to sweetcorn or popcorn. When tank mixed with other herbicides follow the most restrictive label guidelines for adjuvant recommendations.
Mesotrione (27) + Glyphosate (9) 0.095 + 0.95	2 pt **Callisto GT**	Callisto GT may be applied at 2 pt/a to glyphosate-tolerant corn from emergence up to 30 inches tall showing 8 leaves or less, whichever is most restrictive. Apply Callisto GT with 0.25 to 0.5% v/v NIS and 8.5 to 17 lb of AMS/100 gal of spray solution. COC at 1% v/v may be substituted for the NIS, but, there is increased risk of temporary (<7 days) crop injury. Atrazine may be included in the tank mixture. Atrazine rate will depend on atrazine used preemergence as well as atrazine restrictions for the soil type or area.
Mesotrione (27) + Atrazine (5) 0.078 to 0.094 + 0.5 to 0.6	1.25 to 1.5 pt **Callisto Xtra**	Callisto Xtra is a restricted-use pesticide for use on field corn, silage corn, and yellow popcorn. Controls broadleaf weeds. Apply Callisto Xtra after crop emergence but before corn exceeds 12 inches in height. Apply with COC at 1% v/v (do not use MSO). You may add AMS at 8.5 to 17 lb/100 gal spray solution. Temporary crop response may occur under extreme weather conditions when crop is under stress. Can be applied with glyphosate in glyphosate-tolerant corn (refer to glyphosate label for proper adjuvant use). Do not apply to corn that has been treated with Counter or Lorsban (organophosphate) insecticides, as severe crop injury may occur. Can rotate to all corn or grain sorghum immediately and to alfalfa, barley, canola, cotton, potatoes, soybean, sunflower, and wheat the spring following application. All other crops can be planted after 18 months.
Mesotrione (27) + Atrazine (5)+ *S*-metolachlor (15) 0.17 to 0.2 + 1.3 to 1.5 + 1.3 to 1.5	3 to 3.5 qt **Lexar EZ**	Lexar EZ, a premix of Callisto, Dual II Magnum, and atrazine (a restricted-use pesticide) may be applied postemergence to corn up to 12 inches tall. See Callisto entry for adjuvants and restrictions.
Mesotrione (27) + Atrazine (5) + *S*-metolachlor (15) 0.17 to 0.2 + 0.63 to 0.76 + 1.68 to 2	2.7 to 3.25 qt **Lumax EZ**	Lumax EZ, a premix of Callisto, Dual II Magnum, and atrazine (a restricted-use pesticide), may be applied postemergence to corn up to 12 inches tall. See Callisto entry for adjuvants and restrictions.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
S-metolachlor (15) + Bicyclopyrone (27) + Mesotrione (27) + Atrazine (5) 1.34 to 1.61 + 0.038 to 0.045 + 0.15 to 0.18 + 0.63 to 0.75	2.5 to 3 qt **Acuron**	Acuron is a premix of 2.14 lb *S*-metolachlor, 0.06 lb bicyclopyrone, 0.24 lb mesotrione, and 1 lb atrazine (restricted use herbicide); and may be applied early post to field, silage, and seed corn prior to corn attaining 12 inches tall. The addition of NIS at 0.25% v/v is recommended. COC not to exceed 1% v/v can be used; however, crop injury may occur. When applying Acuron POST do not tank mix with MSO or nitrogen products including UAN or AMS. POST applications will not provide adequate control of emergence grasses thus an additional herbicide with grass activity should be tank mixed with the early post application. Use rates are 2.5 qt when soil organic matter is less than 3% and 3 qt when organic matter is 3% or greater. The addition of bicyclopyrone will enhance control of large seeded broadleaf weeds. Rotational restrictions include wheat, rye, or barley 4 months; cotton, soybeans, sorghum 10 months; canola and alfalfa 18 months.
S-metolachlor (15) + Mesotrione (27) + Bicyclopyrone (27) 0.89 to 1.60 + 0.10 to 0.18 + 0.025 to 0.045	1.25 to 2.25 qt **Acuron Flexi**	Acuron Flexi is a premix of 2.86 lb *S*-metolachlor, 0.32 lb mesotrione, and 0.08 lb bicyclopyrone and may be applied early postemergence to field, silage, and seed corn up to 30 inches tall up to 8 leaf growth stage. Apply the 1.25 to 2 qt rates when soil organic matter is less than 3% and 1.25 to 2.25 qt rates when soil organic matter is 3% or greater. Apply with NIS at 0.25% v/v. If COC is used, crop injury may be observed. Do not exceed 1.0% v/v COC. Do NOT use MSO or nitrogen based adjuvants, AMS OR UAN. Acuron Flexi is best adapted for areas having atrazine restrictions. Acuron Flexi performance will be enhanced with the addition of atrazine. When Acuron Flexi has been applied prior to June 1, the following Rotational restrictions apply: wheat, rye, or barley, 4 months and alfalfa, cotton, drybeans, soybean, and sorghum 10 months. If application is after June 1, rotate to corn the following spring.
Mesotrione (27) + *S*-metolachlor (15) 0.165 to 0.198 + 1.67 to 2.0	2 to 2.4 qt **Zemax** or **Coyote**	Zemax may be applied early postemergence to field and seed corn from emergence up to 30-inch-tall corn or up to the 8-leaf stage to control broadleaf weeds less than 3 inches in height. Use COC at 1% v/v or NIS at 0.25% v/v in combination with UAN or AMS to enhance foliar activity on the broadleaf weeds. DO NOT use methylated seed soil. Once incorporated with rainfall, Zemax will control germinating grass and broadleaf weeds. Several herbicides maybe tankmixed with Zemax including atrazine, Liberty (Liberty-Link corn), glyphosate (glyphosate tolerant corn), Status, and others (see label) to broaden the spectrum of weed species controlled. Zemax may be applied at 1.6 qt/a in combination with glyphosate or Liberty and use only AMS and the adjuvants recommended in the glyphosate product or Liberty label. Cereal crops (wheat, rye, barley, and oats) may be planted 4.5 months following application. Soybeans may be planted the following spring.
Mesotrione (27) + *S*-metolachlor (15) + Glyphosate (9) 0.094 + 0.94 + 0.94	3.6 pt **Halex GT**	Halex GT, a mixture of Callisto, Dual Magnum, and Touchdown, may be applied postemergence to glyphosate tolerant (GT or RR) corn from emergence to 30 inches in height. Condition water with 8.5 to 17 lb AMS per 100 gal spray mix before adding Halex GT. Always add 0.25% v/v (1 qt/100 gal) NIS. Best if applied to weeds before they become competitive. Tank mix with a product containing dicamba for increased control of kochia and Russian thistle. Halex GT can be applied with aerial application. Rotation restrictions: Corn (all types), sweet sorghum, grain sorghum (Concep treated sorghum only), anytime; barley, oats, rye, and wheat, 4 months; alfalfa, cotton, peas, potatoes, soybean, and sunflower, 10 months; canola and flax, 12 months; and all other crops, 18 months.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Nicosulfuron (2) 0.031	0.9 oz **Accent Q** or 2 fl oz **NIC-IT**	Controls 4- to 12-inch shattercane, 8- to 18-inch rhizome johnsongrass, and certain annual grasses and broadleaf weeds in field corn. Can be broadcast applied over corn up to 20 inches tall (freestanding). For corn 20 to 36 inches tall, apply with drop nozzles. Accent application to V7 to V10 corn (7 to 10 leaf collars visible) increases the potential for ear malformation (pinching). This risk may be reduced greatly, but not eliminated, by using drop nozzles adjusted so as to not apply Accent into the corn whorl. Do not apply to field corn taller than 36 inches or with more than 10 leaf collars visible, whichever is more restrictive. Do not apply to seed corn or popcorn taller than 20 inches. Apply with NIS or COC. In addition, UAN or spray-grade AMS can be added to enhance performance on certain weed species. Sequential treatments can improve rhizome johnsongrass control. Do not apply to corn that was treated with Counter 15G or Counter 20CR in-furrow. Can be applied following T-band applications of Counter 20CR, but injury potential still exists. Do not apply in irrigation water. Often tank mixed with dicamba or emulsified bromoxynil formulations to enhance broadleaf weed control. Use NIS rather than COC for these mixtures. Can be tank mixed with pendimethalin to provide late-season, residual grass control. A timely cultivation may be necessary to control suppressed weeds, weeds beyond maximum size at application, or weeds that emerge after Accent application. Optimum timing for cultivation is 7 to 14 days after application. See label for insecticide compatibility, sprayer cleanup, subsequent cropping, feeding restrictions, and other guidelines.
Nicosulfuron (2) + Mesotrione (27) 0.031 to 0.036 + 0.078 to 0.092	3.4 to 4 oz **Revulin Q**	Revulin Q contains 14.4% nicosulfuron and 36.8% mesotrione and may be applied postemergence to all types of corn for broadleaf and grass weed control. NOTE: not all corn inbreds, sweet corn hybrids, or popcorn hybrids have been evaluated for crop safety. Apply to corn up to 20 inches tall or 6 leaf collars whichever is more restrictive. With drop nozzles Revulin Q may be applied to corn up to 30 inches tall or 8 collars whichever is more restrictive. See label for growth restrictions when applying Revulin Q to field corn inbreds, popcorn, or sweet corn. Apply with COC 1 to 2% v/v or HSOC 0.5% v/v. NIS at 0.25% v/v may be used, however, reduced activity on weeds may be observed. Do not use MSO as unacceptable injury to corn may occur. UAN at 2 quarts per acre or AMS at 2 lb per acre is recommended. When Revulin Q is applied sequentially following preemergence herbicides a maximum of 3.85 oz ai mesotrione and 1 oz ai nicosulfuron can be applied in the crop year. Rotational restrictions include winter cereals 4 months; spring cereals 8 months; alfalfa, canola, cotton, sorghum, soybeans, and sunflower 10 months.
Nicosulfuron (2) + Rimsulfuron (2) 0.023 + 0.012	1.5 oz **Steadfast Q**	Steadfast contains 25.2% nicosulfuron and 12.5% rimsulfuron. Note grass and broadleaf size restrictions on label. It can be applied to field corn up to 12 inches tall or up to the V5 stage (5 leaf collars visible), whichever comes first. Must be applied with either COC or NIS and ammonium nitrogen fertilizer.
Pendimethalin (3) 0.95 to 1.43	2 to 3 pts **Prowl H_2O,** **Satellite Hydrocap** or **Satellite Flex**	Prowl H_2O may be applied postemergence to field corn up to 30 inches tall or to seed corn, popcorn or sweet corn up to 24 inches tall. Abide by the height restriction or the 8 leaf stage whichever is most restrictive. Use drop nozzles if the canopy prevents adequate soil coverage with herbicide. Use rate is 2 pt on coarse soils with <2% organic matter and 3 pt on all other soils. Prowl H_2O only has preemergence activity on the weeds and will require precipitation for activation and effective control.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Primisulfuron (2) 0.036	0.76 oz **Beacon** or split application of 0.38 oz + 0.38 oz **Beacon**	Controls 4- to 12-inch shattercane, 8- to 16-inch rhizome johnsongrass, and many annual broadleaf weeds 1 to 4 inches tall. Apply to approved field corn hybrids at 4- to 20-inch height or postdirected between the rows for corn from 20-inch height to tasseling. Apply with NIS or COC. Up to 1 gal/a of UAN can be added to improve control of velvetleaf and rhizome johnsongrass. Do not apply to corn treated with Counter 15G insecticide. Do not apply in irrigation water. Half rates of Beacon and Accent can be applied together as a sequential treatment to a preemergence grass-control herbicide. Can be tank mixed with dicamba, dicamba plus atrazine premix, bromoxynil plus atrazine premix, or 2,4-D for enhanced broadleaf weed control, but then do not use COC adjuvant. Can be tank mixed with pendimethalin for enhanced residual grass control. See label for insecticide compatibility, sprayer cleanup, subsequent cropping, feeding restrictions, and other guidelines.
Pyroxasulfone (15) 0.05 to 0.21	1 to 4 oz **Zidua** or 1.75 to 6.5 fl oz **Zidua SC**	Zidua may be applied preemergence to weeds and early postemergence to field corn, some popcorn, or sweet corn cultivars at the spike to V4 stage of growth. Zidua when activated in soil with rainfall will effectively control several grasses and small seeded broadleaf weeds. In addition, Zidua has excellent activity on several large seeded broadleaf weeds. See label for complete list. Zidua is sensitive to soil texture. Use 1 to 2.75 oz dry or 1.75 to 4.5 fl oz on coarse texture soils, 1.5 to 3 oz dry or 2.5 to 5 fl oz on medium soils, and 2 to 4 oz dry or 3.25 to 6.5 fl oz on fine soils.
Pyroxosulfone (15) + Fluthiacet (14) + Atrazine 0.091 to 0.182 + 0.0026 to 0.005 + 0.75 to 1.5	1.5 to 3 pt **Anthem ATZ**	Anthem ATZ (a restricted use herbicide) may be applied early postemergence from emergence up to 4 visible collars to field corn, seed corn, sweetcorn, and popcorn for broadleaf weed control and residual grass control. Check with your seed dealer to verify the hybrid selectivity to this herbicide. Additional tank mixtures are required to effectively control emerged grasses and certain resistant weeds. Can be tank mixed with glyphosate or glufosinate and other postemergence broadleaf herbicides approved for corn. Adding an adjuvant system, such as NIS, COC, or MSO, will enhance foliar activity of Anthem ATZ. The adjuvant system used may be limited or required by the tank mix partner. Use 1.5 to 2 pt on coarse soils, 1.75 to 2.25 pt on medium soils, and 2 to 3 pt on fine textured soils. Use highest rate for each soil type when weeds are large. Do not harvest sweet corn forage or ears for human consumption within 45 days of Anthem ATZ application. Do not harvest for forage within 60 days and grain or fodder within 70 days of the final Anthem ATZ application. The year after Anthem ATZ has been applied, rotation to soybean, cotton, or peanuts may occur depending on herbicide rate used, precipitation received, and timing of application. See label for details.
Pyroxosulfone (15) + Fluthiacet (14) 0.065 to 0.196 + 0.002 to 0.006	2 to 6 fl oz **Anthem Maxx**	Anthem Maxx may be applied early postemergence from emergence up to 4 visible collars to field corn, seed corn, sweetcorn, and popcorn for broadleaf weed control and residual grass control. Check with your seed dealer to verify the hybrid selectivity to this herbicide. Additional tank mixtures are required to effectively control emerged weeds. Can be tank mixed with glyphosate or glufosinate and other postemergence broadleaf herbicides approved for corn. Adding an adjuvant system, such as NIS, COC, or MSO, will enhance foliar activity of Anthem Maxx. The adjuvant system used may be limited or required by the tank mix partner. Use 2 to 3 (up to 3.5 on soil with 1% organic matter or more) fl oz on coarse soils, 2.5 to 4.5 fl oz on medium soils, and 3.5 to 6 fl oz on fine textured soils. Do not harvest sweet corn for forage or ears within 40 days of the last Anthem Maxx application. Do not harvest field, seed or popcorn for forage within 30 days and grain or fodder within 70 days of the last application of Anthem Maxx. Rotation intervals vary based on Anthem Maxx rate used, soybean, 0 to 4 mo.; grain, sorghum, 6 to 10 mo.; wheat, 1 to 6 mo.; sunflower, 4 mo.; and alfalfa 10 mo. See label for other crop rotation restrictions.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Rimsulfuron (2) 0.016	1 oz **Solida**	Solida at 1 oz/a may be applied to corn up to 12 inches tall exhibiting 5 leaf collars to control emerged annual grasses less than 2 inches tall and certain broadleaf weeds less than 3 inches tall. Do not use more than 2 oz of Solida in a single growing season. Apply with NIS at 0.25% v/v and an ammonium fertilizer, UAN at 2 qt/a or AMS at 2 lb/acre. Solida at 1.5 oz/a may be applied with COC or MSO for burndown of emerged weeds and preemergence to corn.
Rimsulfuron (2) + Mesotrione (27) 0.019 + 0.078	4 oz **Realm Q**	These herbicides are a premix of Resolve Q and a dry formulation of Callisto for postemergence broadleaf and grass weed control in field corn. Realm Q can be applied to corn up to 20 inches tall or to 7-leaf corn, whichever comes first. Apply Realm Q with NIS or COC and a nitrogen source, UAN or AMS. Best control will be obtained when Realm Q is applied to corn less than 12 inches tall, grass weeds less than 2 inches tall, and broadleaf weeds less than 5 inches tall. Realm Q may be tank mixed with glyphosate when applied to corn containing the Roundup Ready gene and may be tank mixed with Liberty when applied to corn with the Liberty Link gene. Do not apply more than 1 oz/ai rimsulfuron (an active ingredient in Basis, Prequel, Resolve SG, Resolve Q, or Steadfast Q) in a cropping season.
Rimsulfuron (2) + Thifensulfuron (2) 0.0104 +0.0052	0.83 oz **Basis Blend**	Controls emerged foxtail, fall panicum, and barnyardgrass that is less than 2 inches tall and provides short-term residual control if activated by rainfall or sprinkler irrigation. Apply to field corn that will have a lay-by cultivation 10 or more days after Basis application. Apply when corn is in the spike to 4-leaf (V2, or 2 leaf collars visible) stage (approximately 0.5 to 6 inches tall). Grass weeds must be less than 2 inches tall at treatment. Apply with NIS or COC and with UAN or spray-grade AMS. If dicamba is added, do not use COC. Do not tank mix with Basagran, Laddok S-12, Accent, Beacon, or other ALS-inhibiting herbicides. Do not apply to corn that was treated with Counter 15G or 20CR in-furrow. See label for insecticide compatibility, sprayer cleanup, rotational cropping, and feeding restrictions. Rotate to wheat after 4 months; and sorghum or sunflower after 10 months.
Rimsulfuron (2) + Thifensulfuron (2) 0.014 to 0.003	1.25 oz **Resolve Q**	Apply postemergence to field corn up to 20 inches tall or up to V7 (7 leaves or more), whichever is more restrictive. May be tank mixed with glyphosate products for application over glyphosate-tolerant corn. May be tank mixed with Starane and dicamba for kochia control. Precipitation is required for optimum activity. See label for tank mix precautions. Apply with 0.25% v/v of a good NIS plus either 2 qt/a UAN or 2 lb/a spray-grade AMS. Do not apply with liquid nitrogen fertilizer as the total carrier. Do not mix with Basagran, Lorsban, malathion, or parathion. May be applied aerially. Do not chemigate. Rotate to wheat after 4 months and to soybean, sorghum, or sunflower after 10 months.
S-metolachlor (15) 0.95 to 1.9	1 to 2 pt **Dual II Magnum, Charger Max,** or **Moccasin II Plus**	*S*-metolachlor alone or in premixes can be applied postemergence to corn up to 12 inches tall. Metolachlor has no postemergence activity. Its role is strictly to enhance residual weed control. Emerged weeds must be controlled with cultivation or the companion herbicide. Use only water as a carrier to avoid crop injury.
Tembotrione (27) 0.082	3 fl oz **Laudis**	Apply Laudis to field corn or popcorn from emergence up to V9 stage. Always apply with high-surfactant oil concentrate or MSO at 1% v/v and a nitrogen fertilizer source. Laudis controls many annual broadleaf and some grassy weeds. Atrazine is a recommended tank mix partner; however, corn must not exceed 12 inches tall. Laudis can be tank mixed with glyphosate or glufosinate. Laudis is rainfast in 1 hour. Can rotate to wheat in 4 months; and to cotton, sorghum, and soybean the following spring. Do not graze or harvest forage within 45 days of application. Do not apply by chemigation.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Tembotrione (27) + Thiencarbazone-methyl (2) 0.068 + 0.013	3 fl oz **Capreno**	Apply Capreno to all types of corn from emergence up through the 6-leaf stage. Apply with COC at 1% v/v and a nitrogen fertilizer source. Capreno controls many annual broadleaf and some grassy weeds. Capreno can be tank mixed with glyphosate, atrazine, or glufosinate. Capreno is rainfast in 1 hour. Can rotate to wheat in 4 months; cotton, soybean, and sorghum in 10 months; and alfalfa and sunflower in 18 months. Do not use in the same season as Lorsban 15G, Counter 15G, or Counter 20G. Apply Capreno spray mixtures within 24 hours of mixing to avoid product degradation. Do not graze or harvest forage within 45 days of application. Do not apply by chemigation.
Thifensulfuron (2) 0.004	0.125 oz **Harmony SG,** or 0.083 oz **Unity**	Apply to 1- to 5-collar field corn not exceeding 16 inches tall for control of selected broadleaf weed species. Tank mix with other herbicides for broader spectrum weed control. ALS-resistant broadleaf weeds will not be controlled unless tank mixed with other broadleaf herbicides. Always apply with NIS and nitrogen fertilizer additives. Do not feed forage from treated areas or allow livestock grazing within 7 days of application. Allow 30 days between application and feeding hay from treated areas to livestock.
Topramezone (27) 0.016 to 0.022	0.75 to 1 fl oz **Impact/Armezon**	These herbicides may be applied postemergence to all corn types and hybrids. Use the 1 fl oz Impact/Armezon applied as a single application on pop, sweet, and field corn hybrids to control certain grasses or large weeds. Apply with MSO or COC adjuvant and a nitrogen fertilizer source such as 1.25 to 2.5 gal of 28 to 32% nitrogen/100 gal of spray. MSO at 1% v/v is recommended for best performance. On corn up to 12 inches, a tank mix with 0.25 to 1 lb atrazine is recommended. Armezon can not be applied after the V8 stage of corn. Do not graze or feed treated corn for at least 45 days after application. Avoid cultivation for at least 7 days after application. These herbicides are rainfast after 1 hour. Can rotate to winter cereals after 3 months; and to alfalfa, canola, cotton, dry bean, sorghum, sunflower, or soybean after 9 months. If the 1 oz rate is used, canola and peas can be planted after 18 months.
Topramezone (27) + Dimethenamid-P (15) 0.011 to 0.019 + 0.57 to 0.98	14 to 24 fl oz **Armezon PRO**	Armezon PRO can be applied to all corn types. Preharvest interval for sweetcorn is 50 days. Can be applied on corn up to 30 inches tall or the V8 stage of growth. When applying Armezon PRO only include MSO at 1% v/v. When applying Armezon PRO with atrazine use COC at 1% v/v or HSOC at 0.5% v/v. Use NIS at 0.15% v/v when tank mix partners prohibit the use of oil based adjuvants. Use the higher rate of the adjuvants when hot and dry conditions exist. It is recommended that UAN at 1.25% to 2.5% v/v or AMS at 8.5 to 17 lb / 100 gallon be included in the tank mix. Use rates are based on soil texture and organic matter. Use 14 to 16 fl oz on coarse soils with less than 3% organic matter and 16 to 20 fl oz when organic matter is 3% or greater. On medium and fine texture soils use 16 to 20 fl oz on soils with less than 3% organic matter and 20 to 24 oz when soils are 3% organic matter or higher. If used sequentially following PRE applied Outlook or Verdict, do not exceed 1.125 lb dimethenamid-P. Do not apply with Status herbicide. Can rotate to cereals after 4 months; sorghum, soybean sunflower, alfalfa, and cotton after 9 months; and canola, peas, or drybeans after 9 months when 20 fl oz or less are used; and 18 months if 21 fl oz or more are used.
Topyralate (27) 0.026 to 0.035	1 to 1.35 oz **Shieldex**	Shieldex can be applied to all types of corn from emergence to V6 or 20 inches tall, for postemergence control of broadleaf weeds and grasses up to 5 inches tall, but prior to tillering. Apply with MSO at 0.5 to 1% v/v and a nitrogen fertilizer source such as UAN at 2.5 % v/v or AMS at 8.5 lb/100 gal of spray. On corn up to 12 inches tall, a tank mix with atrazine at 0.5 to 2 lb of atrazine is recommended. Do not graze or feed treated corn forage or silage for 21 days after application. Corn can be replanted any time. Do not rotate to cereal crops for 3 months; alfalfa, canola, cotton, sorghum, soybean, or sunflower for 9 months; or other crops for 12 months after application.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Corn

Herbicide* and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
2,4-D (4) 0.25 to 0.5 amine or 0.25 to 0.38 LVE	0.5 to 1 pt **amine** or 0.5 to 0.75 pt **LVE** of 4 lb/gal **2,4-D***	Controls or suppresses annual broadleaf weeds. Apply in at least 10 gal of water/a from time corn emerges to tasseling. Do not apply from tasseling to dough stages. When corn is more than 8 inches tall, use drop nozzles to avoid application to corn leaves. Hybrids differ in response to 2,4-D; some are injured easily. Potential for injury is greater when corn is growing rapidly under high temperatures and high soil-moisture conditions. Low rates of 2,4-D in combination with other postemergence herbicides are safer to corn than higher rates of 2,4-D used alone. After application, delay cultivation for 8 to 10 days to allow corn to overcome temporary brittleness. Avoid spray or vapor drift to sensitive crops. Enlist One herbicide (2,4-D choline) may be applied at 1.5 to 2 pt per acre postemergence to Enlist corn up to the V-8 stage or 30 inches tall and up to 48 inches tall if drop nozzles are used.
DIRECTED POSTEMERGENCE		
Ametryn (5) 1.6 to 2	2 to 2.5 lb **Evik** 80W	Apply as a postemergence directed spray in corn at least 12 inches tall (freestanding). Apply with NIS at 0.5% v/v (2 qt/100 gal). Do not apply over-the-top to corn; injury will occur. Do not apply within 3 weeks of tasseling. This is a nonselective contact herbicide.
Carfentrazone (14) 0.0074 to 0.030	0.5 to 2 fl oz **Aim**	Apply as postdirected spray to target weeds, avoiding the corn whorl in corn up to the V14 leaf stage. Apply with NIS, COC, or MSO.
Paraquat (22) 0.25 to 0.5	1 to 2 pt **Gramoxone SL**	Apply as a postemergence directed spray when corn is at least 10 inches tall (freestanding). Adjust nozzle to spray no higher than the lower 3 inches of corn stems. Always add NIS. Do not tank mix with liquid fertilizer.
PREHARVEST		
Carfentrazone (14) 0.015 to 0.030	1 to 2 fl oz **Aim**	Apply as a preharvest treatment after corn reaches hard dough stage. Apply with NIS, COC, or MSO. No grazing restrictions apply, but the preharvest interval is 3 days. Follow label directions.
Glyphosate* (9)		Several glyphosate formulations are approved for preharvest application to control annual and perennial weeds listed on the labels. Apply after corn is physiologically mature, as indicated by black layer formation, and grain moisture is below 35%. Allow a minimum of 7 days between application and harvest. Do not apply to corn grown for seed.
2,4-D (4) 0.5 to 1 Amine or LVE	1 to 2 pt of 4 lb/gal **2,4-D***	Apply after corn reaches hard dough or dent stage. Apply by air or ground equipment to suppress perennial weeds, decrease weed seed production, and control tall weeds and vines that interfere with harvesting. Do not allow grazing or feed forage from treated areas for 7 days after application.
FOR SPOT TREATMENT ONLY		
Glyphosate* (9)	1 to 2 gal/100 gal or 1.33 to 2.67 fl oz/gal spray solution	Apply spot treatment to control annual and some perennial weeds. Apply at stage of weed growth recommended on glyphosate label but before corn silks. Corn that is not Roundup Ready will be killed. Avoid drift or spray outside target area.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Grain Sorghum

This publication primarily concerns chemical weed control. It is not intended to imply that cultivation, particularly in row crops, is undesirable. One or two cultivations can greatly improve weed control.

Weed Response to Selected Grain Sorghum Herbicides When Applied According to Label Directions[1]

		Annual grasses							Annual broadleaf weeds													Perennials
Herbicide(s)	Crop tolerance	Barnyardgrass	Crabgrass	Fall panicum	Foxtail	Longspine sandbur	Shattercane	Witchgrass	Eastern black nightshade	Cocklebur	Devilsclaw	Jimsonweed	Kochia	Lambsquarters	Morningglory	Pigweed	Puncturevine	Common ragweed	Sunflower	Velvetleaf	Venice mallow	Field bindweed
PREPLANT OR PREEMERGENCE																						
Atrazine	G-E	F	F	—	F	—	—	F	G-E	F	—	F	G[2]	G	G	G-E[2]	—	F	F	F	F	—
Bicep II Magnum[3]	G-E	G-E	E	G-E	E	F-G	P	G-E	G-E	F	F	F	F	G	F	G-E	—	F	F	F	F	—
Bicep Lite II Magnum[3]	G-E	G-E	E	G-E	E	F-G	P	G-E	G-E	F	F	F	F	G	F	G	—	F	F	P	F	—
Degree Xtra[3], Fultime NXT	G-E	E	E	E	E	F-G	F	E	G-E	F	—	F	F-G	G	F	E	—	F	F	F-P	F	—
Dual II Magnum[3] and other *S*-metolachlor	G-E	G-E	G-E	G-E	G-E	F-G	P	G	G	—	—	—	—	—	—	G	—	—	—	—	—	—
Lumax EZ[3], Lexar EZ[3]	G	E	E	E	E	F-G	P	E	E	G	E	E	E	G-E	F-G	E	G	G	G	E	E	—
Milo-Pro	G-E	—	—	—	—	—	—	—	—	F	F	—	F[2]	G	—	G-E[2]	—	F	—	—	—	—
Mesotrione	G	—	F	—	—	—	—	—	E	G	—	E	G	E	F-G	E	G-E	G	F	E	—	—
Outlook[3], Slider	G-E	G-E	G-E	G-E	G-E	F-G	P	G	E	—	—	—	—	F	—	G	—	—	—	—	—	—
Sharpen	G	—	—	—	—	—	—	—	G	G	P	G	G	G	G	G	G	G	G	G	G	—
Verdict	G	G	G-E	G	G-E	F	P	G	G-E	G	—	—	G	G	G	G	G	G	G	G	G	—
Zemax and Coyote	G	E	E	E	E	F-G	P	E	G	G	G	G	G	G	F	E	G	G	F	G	G	—
POSTEMERGENCE																						
Aim	G	—	—	—	—	—	—	—	E	F	F	F	F	E	F-G	G	F	F	F	G-E	G	F
Ally + 2,4-D	F	—	—	—	—	—	—	—	—	—	—	—	G[2]	E	E	G[2]	E	G-E	G-E	E	—	F
Atrazine	G	P	F	—	G	P	P	P	G-E	G	G	G	G-E[2]	E	G	E[2]	F-G	G	G	G	G	—
Banvel K + Atrazine	F-G	—	—	—	—	—	—	—	G-E	E	—	G-E	E	E	E	G	—	E	E	G-E	G-E	F
Broclean, Buctril, Moxy, Bromox	G	—	—	—	—	—	—	—	E	G-E	—	G	F-G	G	F-G	F	G	G	G	G	G	—
Brozine, Buctril + Atrazine	G	—	—	—	—	—	—	—	E	E	—	E	G-E	E	G-E	G	G-E	G-E	E	G-E	E	—

[1] Weed response ratings refer to application according to label directions and with favorable growing conditions:
E = Excellent, G = Good, F = Fair, P = Poor, and — = weed not listed on the herbicide label.

[2] Except for resistant weed populations.

[3] Apply only if field is planted with **Concep-treated sorghum seed**.

Caution: Disulfoton (Di-Syston) and phorate (Thimet), when applied separately on sandy and silt loam soils with preemergent herbicides commonly used on sorghum, may reduce crop stands. We do not know what causes the adverse interaction.

Herbicides for Grain Sorghum

This publication primarily concerns chemical weed control. It is not intended to imply that cultivation, particularly in row crops, is undesirable. One or two cultivations can greatly improve weed control.

Weed Response to Selected Grain Sorghum Herbicides When Applied According to Label Directions[1]

		Annual grasses							Annual broadleaf weeds													Perennials
Herbicide(s)	Crop tolerance	Barnyardgrass	Crabgrass	Fall panicum	Foxtail	Longspine sandbur	Shattercane	Witchgrass	Eastern black nightshade	Cocklebur	Devilsclaw	Jimsonweed	Kochia	Lambsquarters	Morningglory	Pigweed	Puncturevine	Common ragweed	Sunflower	Velvetleaf	Venice mallow	Field bindweed
POSTEMERGENCE																						
Dicamba	F	—	—	—	—	—	—	—	G	G-E	—	F	G-E	G	G-E	G	—	G	G	F-G	F	F
Facet L, Quinstar 4L, Quinstar GT	G	F	F	F	G	—	—	F	—	—	—	—	F	F	G	—	—	F	F	F	—	G-E
Huskie[2]	G	—	—	—	—	—	—	—	E	E	E	—	G	E	E	G-E	—	E	E	E	E	—
Peak	E	—	—	—	—	—	—	—	F	E	E	G	G[2]	G	F	G[2]	G-E	E	E	E	E	F
Kochiavore	P	—	—	—	—	—	—	—	G-E	E	E	G-E	E	E	E	G-E	G	E	E	G	G	F
Permit	G	—	—	—	—	—	—	—	—	E	—	—	G[2]	F	P	F[2]	G	E	E	G-E	G	—
RangeStar, Brash, WeedMaster, Outlaw, Latigo	P-F	—	—	—	—	—	—	—	G	G-E	E	F-G	G-E	E	E	G	G	G-E	G-E	G	G	F
Starane NXT	F	—	—	—	—	—	—	—	E	E	F	G	E	G	E	F	G	E	E	G	G	F-G
Starane Ultra	F-G	—	—	—	—	—	—	—	F	G	—	—	E	P	E	P	G	E	G	G	G	F-G
Yukon	F-G	—	—	—	—	—	—	—	G	E	—	F-G	G	G	G	G	G	G	E	G-E	F-G	—
Zest WDG *(Inzen sorghum only)*	F-G	G-E	F	G	G-E	F-G	E[2]	G	—	—	—	G	—	—	F	F-G[2]	—	—	—	—	—	—
2,4-D	P	—	—	—	—	—	—	—	G	E	E	G	G	E	E	G	G	G-E	E	G	G	F

[1] Weed response ratings refer to application according to label directions and with favorable growing conditions:
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[2] Except for resistant weed populations.
[3] Apply only if field is planted with **Concep-treated sorghum seed**.
Caution: Disulfoton (Di-Syston) and phorate (Thimet), when applied separately on sandy and silt loam soils with preemergent herbicides commonly used on sorghum, may reduce crop stands. We do not know what causes the adverse interaction.

Herbicides for Grain Sorghum

Before using products containing atrazine, you may consult the Atrazine Watershed Information Center (AWIC) to determine whether the use of atrazine is prohibited in your watershed. The AWIC can be accessed by calling 1-866-365-3014.

Atrazine Rate Limitations

All atrazine uses on cropland must conform to the maximum rate limits shown below. The "Precautionary Statements" on atrazine labels indicate required setbacks from all wells, streams, ponds, or other water sources.

For Wheat Stubble Applications in Wheat-Sorghum-Fallow Rotations

Apply a maximum of 2.25 lb ai/a to stubble ground following wheat harvest. Treat only once during same fallow period. See "Chemical Fallow" section of atrazine label for additional instructions.

For Soil Applications in Spring, Before Crop Emergence

On highly erodible soils (as defined by the Natural Resources Conservation Service)

If plant residue cover at planting is 30% or more, apply a maximum of 2 lb ai/a as a broadcast spray.

If soil coverage is less than 30% at planting, apply a maximum of 1.6 lb ai/acre.

On soils not highly erodible

Apply a maximum of 2 lb ai/a as a broadcast spray.

For Postemergence Applications

If no atrazine was applied before sorghum emergence, apply a maximum of 2 lb ai/a broadcast. If a postemergence treatment is required following an earlier herbicide application, the total atrazine applied may not exceed 2.5 lb ai/a per calendar year. Postemergence applications over 1 lb ai/a are not considered best management practices. Runoff loss potential is very high from mid-April through July.

Practices to Reduce Atrazine Losses in Surface Water Runoff in Central and Eastern Kansas

Sorghum producers who no-till plant should consider split applications of herbicides, applying about two-thirds of the rate either the previous fall or early preplant in spring, and about one-third at planting time. The highest atrazine losses occur when intense rain storms follow atrazine application to high-residue, wet soils. Long-term weather records show that Kansas tends to have little winter precipitation, and that the probability of high-intensity storms occurring in March to mid-April is about half the probability of them occurring from mid-April through June. Therefore, fall and early spring applications have less potential for loss in surface water runoff. In addition, such applications have the advantage of controlling winter annual weeds and tend to keep fields in plantable condition during wet spring weather, reducing the need for preplant burndown treatments.

Sorghum producers who till before planting should consider preplant incorporation of atrazine and companion herbicides such as Dual II Magnum, Outlook, and Warrant. Mechanically incorporating these herbicides in the top 2 inches of soil reduces atrazine losses in runoff by about two-thirds. Soil incorporation can be done with field cultivators, finishing disks, or spring tooth harrows at any time within 14 days before planting. Harrow attachments are recommended for the incorporation implement to avoid streaking. At planting, avoid furrowing that could move herbicide-treated soil out of the crop row.

Reduced-rate atrazine approaches for sorghum. Some soil-applied formulations, such as Bicep Lite II Magnum, Lumax EZ, Verdict, and Keystone LANXT, contain a lower proportion of atrazine than other formulations, such as Bicep II Magnum and Degree Xtra. Also, banding preemergence herbicides reduces the amount applied per acre by one-half to two-thirds. Postemergence herbicides such as Buctril + atrazine, dicamba + atrazine, and many postemergence tank mixtures contain only about 0.5 lb ai/a atrazine still provide good control of tough broadleaf weeds such as velvetleaf, cocklebur, pigweeds, morningglory, and sunflower.

Nonatrazine alternatives for sorghum. Peak, Permit, and Ally XP are sulfonylurea herbicides for weed control in sorghum. They often are tank mixed with dicamba or 2,4-D. Huskie also can be used without atrazine. All of the non-atrazine herbicides discussed are less effective when applied without atrazine.

Herbicides for Grain Sorghum

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Acetochlor (15) 1.13 to 2.25	1.5 to 3 qt **Warrant**	Warrant may be applied preplant incorporated or preemergence surface to forage or grain sorghum. Must use safened seed. Use 1.5 to 2.25 qt on coarse or medium textured soils with less than 3% organic matter or 2 to 3 qt on these soil textures with greater than 3% organic matter. Apply 1.5 to 2.5 qt on fine textured soils with less than 3% or 2.25 to 3 qt with greater than 3% organic matter. See postemergence section for Warrant postemergence applications. Do not graze or feed treated forage to livestock for 60 days following application.
Acetochlor (15) + Atrazine (5) 1.35 to 2.5 + 0.67 to 1.24	2 to 3.7 qt **Degree Xtra** or **Fultime NXT**	Degree Xtra and Fultime NXT are restricted-use herbicides. May be applied preplant incorporated, preplant surface, preemergence surface, or postemergence surface to grain sorghum (grain sorghum is a supplemental label and must use safened seed). The rate used in sorghum is dependent on soil texture and organic matter. If atrazine has been used early preplant, do not exceed a total of 2.5 lb atrazine active ingredient per calendar year. When applied to sorghum planted in alkali, eroded, or calcarious soils, crop injury may result. May be applied postemergence to sorghum up to 11 inches tall. Must be applied preemergence to emerging seedling grasses for adequate control.
Atrazine (5) 1.6 or 2	1.6 to 2 qt **Atrazine 4L** or 1.8 to 2.2 lb **Atrazine 90DF***	A restricted-use pesticide. It can injure sorghum on calcareous soils. Controls small-seeded broadleaf weeds best and suppresses annual grasses and large-seeded broadleaf weeds. Preplant incorporate or apply after planting but before sorghum emerges. In sensitive watersheds, atrazine best management practices suggest that soil surface applications at sorghum planting time should not exceed 1 lb/a because of high potential for runoff losses. Do not use on coarse-textured soils or other soils with less than 1% organic matter. Choice of rotational crops depends on atrazine rate, soil pH, and time of application. Follow atrazine rate limits and label directions. **No-till:** Atrazine can be applied to Kansas row-crop stubble from fall harvest to December 31 to control winter annual weeds and reduce the need for burndown herbicide application or preplant tillage in spring on fields to be planted to sorghum. Apply with COC to enhance foliar activity. Tank mixing with 2,4-D LVE and/or dicamba enhances control of dandelion and other broadleaf winter annual weeds. Can be tank mixed with Gramoxone SL to enhance control of cheat, downy brome, and Japanese brome. For highly erodible soils with less than 30% plant residue cover, limit fall application to a maximum of 1.6 lb. Total atrazine applications must not exceed 2.5 lb/a per calendar year. Do not apply to frozen ground or where soil surface conditions favor wind erosion. Do not plant any crops except corn, grain sorghum, or forage sorghum in the following spring. Follow directions on 24(c) Special Local Need label for Kansas.
Carfentrazone (14) 0.008 to 0.016	0.5 to 1 fl oz **Aim EC**	**No-till:** Can be applied alone or with other herbicides in fallow and preplant burndown applications to control or suppress annual broadleaf weeds. Combine with glyphosate, paraquat, or atrazine to broaden the burndown spectrum. Apply with NIS or COC. Aim is a contact herbicide requiring thorough spray coverage of the foliage. Do not exceed 1 fl oz/a per season for all fallow, preplant, or in-crop applications to sorghum.
Dicamba (4) up to 0.5	up to 1 pt **Dicamba*** or up to 11 fl oz **FeXapan** or **Xtendimax** or up to 6.4 fl oz **Engenia**	**No-till:** Apply up to 0.5 lb/a in fall for control of winter annual weeds. In spring, may apply up to 0.25 lb if applied at least 10 days before sorghum planting. Especially helpful to control certain weeds not very susceptible to 2,4-D and glyphosate, such as chickweed, smartweed, wild buckwheat, kochia, and Russian thistle. The addition of AMS to a spray mixture containing dicamba will increase the risk of volatility of dicamba and mitigate the benefits of lower volatility formulations. Do not apply AMS with Engenia.
Dicamba (4) + 2,4-D* (4) 0.25 + 1 amine or LVE	0.5 pt **Dicamba*** + 1 qt of 4 lb/gal **2,4-D*** or 1 qt **Range Star, Brash,** or **WeedMaster**	**No-till:** For control of established alfalfa and annual weeds, apply when alfalfa regrowth is 6 to 8 inches tall and growing actively. Most effective if applied to alfalfa regrowth in fall. If alfalfa escapes occur, apply only dicamba at rate recommended on label after sorghum emerges. Do not apply less than 15 days before planting sorghum.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Grain Sorghum

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Dimethenamid-P (15) 0.6 to 1.0	12 to 21 oz **Outlook**	Controls most annual grasses and small-seeded broadleaf weeds. For best weed control with Outlook, use 14 oz/a in coarse-textured soil, and use 18 oz/a for medium soils with less than 3% organic matter. Apply within 2 weeks before planting and shallowly incorporate, or apply after planting up to grain sorghum emergence. Use only Concep-safened grain sorghum seed. Not registered for use on forage sorghum. Grain sorghum treated with Outlook may be grazed or fed to livestock 60 days after treatment. Fall cereals can be planted after 4 months.
Flumioxazin (14) 0.064 to 0.096	2 to 3 oz **Valor SX, Outflank, Panther,** or **Tuscany** or 2 to 3 fl oz **Panther SC** or **Tuscany SC**	Apply flumioxazin to the soil surface at least 30 days before planting sorghum. A minimum of 1 inch of precipitation must be received between application and planting. Tank mix with glyphosate, dicamba, or 2,4-D to control emerged weeds. Flumioxazin can be tank mixed with atrazine to broaden the spectrum of weed control. Controls several broadleaf weeds including pigweed species. Do not rotate to wheat for 1 month, or to alfalfa or oats for 8 months.
Glyphosate (9)	**Glyphosate*** (see glyphosate table)	**No-till:** Use to control annual weeds up to 6 inches tall and some perennial weeds in fallow fields or before sorghum emergence. Application in 3 to 10 gal/a spray is more effective than in higher gallonage. Condition spray water with 1 to 2%, by weight, of spray-grade AMS (9 to 17 lb/100 gal water) before adding glyphosate products to the tank. Some glyphosate products contain little or no adjuvant, so check label requirements carefully. Dust on plants can decrease performance. Usually applied with 2,4-D or dicamba to enhance control of broadleaf species.
Mesotrione 0.188 to 0.2	6 to 6.4 oz **Callisto**, **Explorer, Incinerate, Motif,** or **Mesotrione**	Apply preplant unincorporated from 21 days before planting until prior to sorghum emergence for residual broadleaf weed control. If emerged weeds are present at the time of application, add NIS or COC. Tank-mix with atrazine and/or group 15 herbicides labeled for use on sorghum for improved activity and residual weed control. Do not apply to coarse textured soils. Do no not use on forage sorghum, sudangrass, or dual purpose sorghum.
Metolachlor (15) 0.98 to 1.67	1 to 1.67 pt **Me-Too-Lachlor II, Parallel, Parallel PCS,** or **Stalwart**	For use on grain or forage sorghum planted using safened seed. Controls annual grasses and small seeded broadleaf weeds. May be applied early preplant (see label for specific timing, rate, and soil restrictions) or preplant-incorporated or preemergence using 1 to 1.33 pt on coarse soils, 1.33 to 1.5 pt on medium soils, or 1.33 to 1.67 pt on fine soils. Research indicates that metolachlor formulations have approximately 1/3 less herbicidal activity than *S*-metolachlor formulations when equal rates are compared.
Paraquat (22) 0.5 to 1.0	2 to 4 pt **Gramoxone SL**	No-till: Gramoxone SL is a formulation designed to reduce the amount of paraquat absorbed after accidental ingestion. Paraquat is a restricted-use, nonselective, nonresidual, contact herbicide often used for preplant burndown. Apply in clean water or clear fertilizer solutions to thoroughly cover actively growing annual weeds 1 to 6 inches tall. Rate depends on weed size. Dust on plants reduces paraquat activity, but application with atrazine and/or nitrogen carrier enhances activity. Adjuvants are required for good performance. Use NIS at 0.25% v/v (1 qt/100 gal) when applying with atrazine in nitrogen fertilizer carrier. For all other applications, use either COC at 1% v/v or NIS.
Propazine (5) 0.75 to 1.2	0.75 to 1.2 qt **Milo-Pro**	Milo-Pro controls mainly small-seeded broadleaf weeds. It resembles atrazine in weed control performance but is safer than soil-applied atrazine, especially on lighter soils in central and western Kansas. Do not apply on sand or loamy sand soils. Milo-Pro may be applied to the soil surface 4 weeks before planting to after planting but prior to sorghum emergence. Do not apply more than 1.2 qt per growing season. The preharvest interval (PHI) is 70 days for forage sorghum and 90 days for grain sorghum. Do not use on sweet sorghum. Crop rotation restrictions are: small grains 4 months; corn 12 months; all other crops 18 months.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Grain Sorghum

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Prosulfuron (2) 0.018 to 0.036	0.5 to 1 oz **Peak**	In Kansas and Nebraska only, Peak can be applied after planting but before weed or sorghum emergence. See label for precautions. If applying with Dual II Magnum or Bicep Lite II Magnum, plant only Concep-treated seed. Preemergence application gives less control of velvetleaf, common cocklebur, and morningglory than postemergence application. No restrictions for rotation to wheat. Refer to most recent label before rotating Peak-treated fields to soybean in the next year. Do not rotate to sunflower for 24 months.
Quinclorac (4) 0.24 to 0.36	22 fl oz **Facet L** or 0.5 to 0.75 pt **Quinstar 4L** or 5.3 oz **Quinstar GT**	Facet L, Quinstar 4L, or Quinstar GT may be applied preplant or postplant preemergence to grain sorghum for control of annual grass and broadleaf weeds. The addition of atrazine at 0.5 to 1 lb will enhance the spectrum of broadleaf weed control. If 2,4-D or dicamba are added to the mix, follow the most restrictive plantback restrictions.
S-metolachlor (15) 1 to 1.6	1 to 1.66 pt **Dual II Magnum, Charger Max,** or **EverpreX**	Controls most annual grasses and small-seeded broadleaf weeds. Apply preplant and incorporate into the top 2 inches of soil, or apply after planting but before sorghum or weeds emerge. The benoxacor safener in these products is specific to corn and does not safen these herbicides for use on sorghum. Plant only Concep-safened forage or grain sorghum seed. Small grains can be planted 4.5 months after treatment.
S-metolachlor (15) + Atrazine (5) 0.96 to 1.26 + 1.24 to 1.6	1.6 to 2.1 qt **Bicep II Magnum, Charger Max ATZ,** or **Moccasin II Plus**	These are formulated mixtures of 3.1 lb atrazine (a restricted-use herbicide) and 2.4 lb *S*-metolachlor/gal. Apply preplant and incorporate into the top 2 inches of soil before planting, or apply after planting but before sorghum or weeds emerge. In sensitive watersheds, atrazine best management practices suggest that soil surface applications at sorghum planting time should not exceed 1 lb/a because of high potential for runoff losses. For a tank mix of Dual II Magnum and atrazine, follow directions on the Dual II Magnum label. Can injure sorghum on calcareous soils and should not be used on coarse-textured soils or other soils with less than 1% organic matter. The benoxacor safener in these products is specific to corn and does not safen these herbicides for use on sorghum. Use only Concep-safened forage or grain sorghum seed. **No-till:** Apply two-thirds of the recommended rate as a split treatment 30 to 45 days before planting and the remainder at planting. From 15 to 30 days preplant, a split application is preferred because it increases the chances of satisfactory activation by rainfall, but a single application is permissible. Can be tank mixed with paraquat or glyphosate.
S-metolachlor (15) + Atrazine (5) 0.92 to 1.25 + 0.73 to 1	1.1 to 1.5 qt **Bicep Lite II Magnum, Charger Max ATZ Lite**	These are mixtures of 2.67 lb atrazine (a restricted-use herbicide) and 3.33 lb *S*-metolachlor for use by growers wanting to reduce rates of soil-applied atrazine. This premix is recommended for sensitive watersheds, where atrazine best management practices suggest using no more than 1 lb atrazine/a for soil surface applications at planting time. Use only on sorghum with Concep seed treatment. Follow atrazine set-back guidelines and label directions.
S-metolachlor (15) + Atrazine (5) + Glyphosate (9) 1.1 to 1.6 + 1.3 to 2 + 0.47 to 0.70	2.5 to 3.75 qt **Expert**	**No-till:** This premix contains the active ingredients of Bicep Magnum (a restricted-use pesticide) and glyphosate. Use before crop emergence as a burndown when weeds are present. Use only on sorghum with Concep seed treatment.
S-metolachlor (15) + glyphosate (9) 0.94 to 1.5 + 0.70 to 1.125	2.4 to 4 pt **Sequence**	Sequence is a premix of 3 lb *S*-metolachlor (Dual II Magnum) and 2.25 lb ae glyphosate and may be applied to all Concep-treated sorghum before, during, or after planting but before sorghum emerges. Apply with 8.5 to 17 lb AMS/100 gal spray solution to enhance foliar activity of the glyphosate on emerged weeds. The Dual II Magnum component will provide early season residual of annual grasses and some small seeded broadleaf weeds; however, Sequence may be applied with a few different tank mix partners listed on the label to broaden the spectrum of weeds controlled. Do not exceed 3.5 pt when used on coarse-textured soils, 3.75 pt on medium soils with less than 3% organic matter, or 4 pt on all other soils.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Grain Sorghum

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
S-metolachlor (15) + Mesotrione (27) 1.67 + 0.165	2 qt **Zemax** or **Coyote**	Zemax may be applied preplant up to 21 days before planting and preemergence to grain sorghum for grass and broadleaf weed control. Sorghum must be treated with a safener (e.g., Concep III) that provides tolerance to *S*-metolachlor. Zemax applied 7 to 21 days before planting will reduce the risk of crop injury. Zemax may be applied as a split application with 1 to 1.25 qt/a 7 to 21 days before planting and 0.75 to 1 qt/a as a preemergence application not to exceed 2 qt/a. If weeds are present at the time of application COC at 1% v/v or NIS at 0.25% v/v + UAN or AMS should be added to enhance burn down activity of the emerged weeds. Do not apply Zemax to sorghum grown on sand, sandy loam, or loamy sand soils. Do not apply postemergence to grain sorghum. Do not use on forage sorghum, sweet sorghum, sudangrass, sorghum-sudan hybrids, or dual-purpose sorghum. Cereal crops (wheat, rye, barley, and oats) may be planted 4.5 months following application. Soybeans may be planted the following spring. All corns or Concep treated sorghum may be planted anytime.
S-metolachlor (15) + Mesotrione (27) + Glyphosate (9) 1.05 to 1.57 + 0.105 to 0.157 + 1.05 to 1.57	4 to 6 pt **Halex GT**	Halex GT may be applied from 21 days prior to planting to post planting but prior to sorghum emergence. Sorghum seed must be Concep III treated. Halex GT may be applied as a split application with the first application being made to the soil surface not incorporated and the second application being made post plant preemergence to the sorghum. The total maximum use rate of Halex GT is 6 pt. Do not apply to sorghum that has emerged as Halex GT will cause crop death. If weeds are emerged, Halex GT should be applied with NIS at 0.25 to 0.5% v/v and spray grade AMS at 8.5 to 17 lb/100 gallon of spray solution. Do not apply to sorghum grown on sandy soils (sand, sandy loam, or loamy sand). Do not use in production of forage sorghum, sweet sorghum, sudangrass, sorghum-sudan hybrids, or dual purpose sorghum. Label expires December 15, 2019.
S-metolachlor (15) + Atrazine (5) + Mesotrione (27) 1.3 + 1.3 + 0.17	3 qt **Lexar EZ**	Lexar EZ is a premix of 1.74 lb *S*-metolachlor, 0.22 lb mesotrione (Callisto), and 1.74 lb atrazine/gal (a restricted-use pesticide). Lexar EZ can be applied preplant nonincorporated from 21 days before planting through preemergence in sorghum for which the seed has been treated with Concep III. Applying Lexar EZ less than 7 days before planting may increase the risk of crop injury. Lexar may be applied in a split application to grain sorghum. Apply Lexar EZ 1.5 to 1.75 qt early preplant nonincorporated followed by 1.25 to 1.5 qt prior to sorghum emergence. Do not apply more than 3 qt Lexar EZ total in the split applications. Do not apply to sandy soils including sand, sandy loam, or loamy sand. Do not apply to emerged sorghum. Do not use on forage sorghum, sweet sorghum, sudangrass, or any dual-purpose sorghum.
S-metolachlor (15) + Atrazine (5) + Mesotrione (27) 1.68 + 0.63 + 0.168	2.7 qt **Lumax EZ**	Lumax EZ is a premix of 2.49 lb S-metolachlor (Dual II Magnum), 0.249 lb mesotrione (Callisto), and 0.935 lb atrazine (a restricted-use pesticide). Lumax EZ can be applied preplant nonincorporated (up to 21 days before planting) up through planting but prior to sorghum emergence. Plant Concep-treated seed only. Applying Lumax EZ less than 7 days before planting will increase the risk of crop injury. Lumax EZ also may be applied as a split application to grain sorghum. Apply Lumax EZ at 1.35 qt/a as a nonincorporated early preplant application (7 to 21 days before planting) followed by a second application of 1.35 qt/a preemergence prior to sorghum emergence. The total amount of Lumax EZ cannot exceed 2.7 qt/acre. Do not apply to sandy soils (sand, sandy loam, or loamy sand). Do not apply to emerged grain sorghum. Do not use on forage sorghum, sweet sorghum, sudangrass, or any dual-purpose sorghum.
S-metolachlor (15) + Glyphosate (9) 0.9 to 1.1 + 0.70 to 0.84	2.5 to 3 pt **Sequence**	**No-till:** Formulation of 2.25 lb ae glyphosate and 3 lb *S*-metolachlor/gal. Apply preplant to preemergence as burndown before crop emergence. Use only on sorghum with Concep seed treatment.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Grain Sorghum

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Saflufenacil (14) 0.022 to 0.044	1 to 2 fl oz **Sharpen**	Sharpen can be applied preplant surface, preplant incorporated, or preemergence to grain sorghum. Do not apply to sorghum that has emerged, or significant crop injury may result. Sharpen has excellent burndown activity of broadleaf weeds and should be applied with MSO at 1% v/v (minimum of 1 pt/a) plus AMS 8.5 to 17 lb/100 gal or liquid nitrogen at 1.25 to 2.5 gal/100 gal. Sharpen may be tank mixed or applied sequentially with but not exclusively with Clarity, Outlook, atrazine, or glyphosate. Sorghum forage can be harvested, fed, or grazed 70 days or more after application. Sequential applications with Sharpen or Verdict require 14 days between applications. Do not apply more than 0.111 lb/a saflufenacil per cropping season. Do not use if organophosphate or carbamate insecticides were used at planting.
Saflufenacil (14) + Dimethenamid-P (15) 0.044 + 0.39	10 fl oz **Verdict**	Apply Verdict at 10 fl oz in a tank mix with Outlook at 4 to 10 fl oz on coarse-textured soils or 6 to 12 fl oz on medium- or fine-textured soils. The addition of atrazine is required for full-season broad-spectrum weed control. Applications may be made preplant surface or preplant incorporated up to 14 days before planting or preemergence surface after planting. Do not treat emerged sorghum, as severe crop injury may result. When Verdict is used to burndown emerged broadleaf weeds, it must be applied with MSO at 1% v/v (minimum of 1 pt/a) plus AMS at 8.5 to 17 lb/100 gal spray solution or liquid nitrogen 1.25 to 2.5 gal/100 gal. Sequential applications with Sharpen or Verdict require 14 days between applications. Do not apply more than 0.111 lb ai/a per cropping season. Do not use Verdict if organophosphate or carbamate insecticides have been used at planting. Use Concep safened sorghum seed.
2,4-D LVE (4) 0.25 to 1	0.5 to 2 pt of 4 lb/gal **2,4-D* LVE**	**No-till:** Low volatile esters are preferred over amine formulations as components of preplant burndown applications. They are more effective in controlling weeds and are less water soluble than amine salts. These factors help reduce potential for crop injury. Sorghum can be injured by carryover from preplant 2,4-D. Observe the rate guidelines and preplant waiting periods on product labels. Including 2,4-D in the burndown mixture helps control winter annual weeds such as dandelion, prickly lettuce, horseweed, and evening primrose and early spring-germinating weeds such as ragweed and lambsquarters.
POSTEMERGENCE		
Acetochlor (15) 1.13 to 2.25	1.5 to 3 qt **Warrant**	Warrant may be applied to forage or grain sorghum. Must use safened seed. Use 1.5 to 2.25 qt on coarse or medium textured soils with less than 3% organic matter or 2 to 3 qt on these soil textures with greater than 3% organic matter. Apply 1.5 to 2.5 qt on fine textured soils with less than 3% or 2.25 to 3 qt with greater than 3% organic matter. Used primarily as a tank mix with postemergence herbicides to provide residual control of certain annual grasses and broadleaf weeds. Do not apply with fluid fertilizer as the carrier. Apply before sorghum reaches 11 inches tall. Do not graze or feed treated forage to livestock for 60 days following application.
Acetochlor (15) + Atrazine (5) 1.35 to 2.5 + 0.67 to 1.24	2 to 3.7 qt **Degree Xtra** or **Fultime NXT**	These herbicides are restricted-use pesticides. These herbicides may be applied to sorghum up to 11 inches tall. Use rates will vary based on soil texture. For fields in sensitive watersheds, please review K-State Extension Publication MF-2208 for atrazine best management practices. Total atrazine applied in a single crop season cannot exceed 2.5 lb. Restrictions apply to the herbicide with the most limiting restrictions in the mix.

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Herbicides for Grain Sorghum

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Atrazine (5) 2	2 qt **Atrazine 4L** or 2.2 lb **Atrazine 90DF***	A restricted-use pesticide. It can injure sorghum on calcareous soils. Controls broadleaf weeds more effectively than grasses. The 2 lb/a rate is permissible only when no atrazine was applied before sorghum emergence. Postemergence atrazine rates over 1 lb/a are not considered best management practices because of high potential for movement in surface water runoff. Apply before weeds are 1.5 inches tall and before sorghum exceeds 12 inches. Do not plant treated fields to any crop other than sorghum or corn for 18 months after application. Apply with 1% v/v COC or 0.25% v/v NIS to enhance foliar uptake. Follow atrazine rate limits and cropping, feeding, and grazing instructions on label.
Atrazine (5) 1.2	1.2 qt **Atrazine 4L** or 1.3 lb **Atrazine 90DF***	A restricted-use pesticide. It can injure sorghum on calcareous soils. Do not use on sands and loamy sands, or injury can occur. Controls broadleaf weeds in western Kansas. Apply when sorghum is 6 to 12 inches high. Add COC or NIS according to label. Follow atrazine rate limits and precautions on label.
Bromoxynil (6) 0.25 to 0.375	1 to 1.5 pt **Buctril*, DoubleUp*,** or **Moxy***	Apply bromoxynil when broadleaf weeds are small and growing actively but before they reach size limits listed on the label. Apply at 3- to 4-leaf stage up to boot stage of sorghum. Use a maximum of two applications per season. This is a contact herbicide, so thorough coverage is required. Bromoxynil is safer for sorghum than 2,4-D or dicamba. Pigweeds are somewhat tolerant and should be no larger than the 4-leaf stage. Can be tank mixed with low rates of 2,4-D or dicamba. Do not cut forage for feed or allow grazing within 30 days of treatment.
Bromoxynil (6) + Atrazine (5) 0.19 to 0.38 + 0.38 to 0.75	1.5 to 3 pt **Buctril + Atrazine**	Atrazine is a restricted-use pesticide. These premixes of 1 lb bromoxynil and 2 lb atrazine/gal control many broadleaf weeds. Use up to two applications per season when weeds are small and growing actively but before they reach size limits listed on the label. Apply after 2- to 4-leaf stage but before grain sorghum is 10 inches tall. Can be tank mixed with dicamba to increase control of pigweeds, kochia, and field bindweed. Tank mixing with up to 8 oz/a 2,4-D increases control of devilsclaw and field bindweed but also increases potential for sorghum injury. Bromoxynil plus atrazine application is considered an atrazine best management practice for use in sensitive watersheds because the low rate of atrazine reduces runoff loss potential. Do not cut forage for feed or allow grazing within 30 days of treatment. Follow atrazine rate limits and label directions.
Carfentrazone (14) 0.0074	0.5 fl oz **Aim EC**	Helps control black nightshade, lambsquarter, pigweeds, and morningglory when applied to actively growing plants 1 to 4 inches tall and velvetleaf up to 18 inches tall. Can be applied to grain sorghum from 4 inches tall to prior to boot stage. Always apply with NIS at 0.25% v/v. Application with COC may cause excessive sorghum leaf burn and is not recommended. Avoid spraying under high-moisture conditions (heavy dew, rain). Can be tank mixed with other postemergence sorghum herbicides to broaden the weed spectrum and increase the level of control. For tank mixes, follow application and rotation guidelines of the more restrictive partner. Aim is a contact herbicide requiring thorough and uniform spray coverage. Any crop can be planted after 30 days following application.

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Herbicides for Grain Sorghum

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Dicamba (4) 0.25	0.5 pt **Dicamba*** or up to 11 fl oz **FeXapan** or **Xtendimax** or up to 6.4 fl oz **Engenia**	Controls annual broadleaf weeds. Broadcast apply when weeds are small and growing actively and sorghum is in the 2- to 5-leaf stage but before it is 8 inches tall. On sorghum from 8 to 15 inches tall, apply with drop nozzles to keep dicamba off leaves and out of whorls. Failure to observe these height guidelines can result in damaged seed heads. Do not apply to sorghum grown for seed. Do not allow grazing of treated areas or feed treated forage or silage before mature grain stage. Do not apply when the temperature on the day of application is expected to exceed 85°F. Expect some crop response in the form of rolled-up leaves and leaning stems. The addition of AMS to a spray mixture containing dicamba will increase the risk of volatility of dicamba and mitigate the benefits of lower volatility formulations. Do not use AMS with Engenia.
Dicamba (4) + Atrazine (5) 0.28 + 0.53	2 pt **Banvel K + Atrazine**	This is a premix of dicamba and atrazine (a restricted-use pesticide) for control of many broadleaf weeds, including triazine-resistant species. For best performance and least crop injury, apply when sorghum has 2 to 5 leaves and weeds are less than 6 inches tall. Banvel-K + atrazine application is considered an atrazine best management practice for use in sensitive watersheds because the low rate of atrazine reduces potential for runoff loss. Follow atrazine rate limits and label directions.
Dicamba (4) + 2,4-D (4) 0.125 + 0.36	1 pt **Brash, Range Star**, or **WeedMaster**	Apply to sorghum in the 3- to 5-leaf stage (4 to 8 in tall). Performs best on weeds less than 3 inches tall. Expect injury symptoms on sorghum, such as leaning and brittle stems and rolled leaves. These symptoms may be outgrown within 2 weeks. Do not apply if potential for injury is not acceptable. Do not apply with surfactants and oils.
Dimethenamid-P (15) 0.6 to 1.0	12 to 21 oz **Outlook**	Outlook may be applied postemergence to grain sorghum up to 12 inches tall. Must use safened seed. Use 12 to 18 fl oz on coarse soils and 14 to 21 oz on medium and fine soils. Maximum rate depends on soil organic matter, refer to label for details. If Outlook is applied sequentially following preplant/preemerge applications of Outlook or Verdict, do not exceed 21 fl oz Outlook or 0.98 lb dimthenamid-P. per season. Outlook is intended to provide residual control of annual grasses and some broadleaf weed, however, it does not have postemergence activity on weeds, so tank mix with a postemergence herbicide that effectively controls emerged weeds.
Fluroxypyr (4) 0.14	0.4 pt **Comet, Starane Ultra, StareDown,** or **Vista XRT**	Starane Ultra can be applied to grain sorghum from the 3- to 7-leaf stage of growth as a broadcast application by either ground or air. Use drop nozzles and directed spray from the 8-leaf stage to boot stage. Do not make more than two applications or apply more than 0.7 pts per acre per year. Starane Ultra can be tank mixed with other herbicides registered for postemergence application to grain sorghum. Do not apply with Ally XP herbicide.
Fluroxypyr (4) + Bromoxynil (6) 0.10 + 0.38	21 fl oz **Starane NXT**	Starane NXT can be applied to grain or forage sorghum from the 4-through the 7-leaf stage or up to just prior to boot if using drop nozzles. Applications to sorghum later than just prior to boot can reduce grain yield. Starane NXT may be tank mixed with other broadleaf herbicides, however, tank mix partners or the addition of adjuvants may increase leaf burn. Do not graze or harvest fodder or forage for 45 days following the application.
Fluroxypyr (4) + Bromoxynil (6) + 2,4-D (4) 0.084 to 0.126 + 0.21 to 0.31 + 0.21 to 0.31	1 to 1.5 pt **Kochiavore**	Apply Kochiavore for broadleaf weed control to sorghum from the V4 to V8 stage. Drop nozzles should be used when treating at the V8 to pre-boot stage. DO NOT tank mix with atrazine, crop oils, or other adjuvants such as NIS. Some sorghum hybrids are sensitive to 2,4-D and will be injured. Consult your seed dealer. Do not allow the crop to be used as fodder, forage, or grazing for 45 days following application. Do not harvest within 70 days of the application. Only one application is allowed per growing season.

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Herbicides for Grain Sorghum

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Halosulfuron (2) 0.031	0.67 oz **Permit**	Controls several broadleaf weed species and suppresses yellow nutsedge. Apply to grain sorghum from the 2-leaf through lay-by stages (before grain head emergence). Usually used following a foundation application of Intrro or Lariat-type herbicide. To improve control of pigweed and morningglory species, tank mix with dicamba or 2,4-D. Always apply with a quality NIS at 0.25 to 0.5% v/v (1 to 2 qt/100 gal). To control velvetleaf up to 12 inches tall, add 4% (4 gal/100 gal) liquid nitrogen fertilizer.
Halosulfuron (2) + Dicamba (4) 0.03 to 0.05 + 0.125 to 0.19	4 to 6 oz **Yukon**	4 oz of Yukon premix is equivalent to ⅔ oz Permit and 4 fl oz dicamba. May be broadcast applied over grain sorghum from the 2-leaf stage up to 8 inches tall and with drop nozzles up to 15-inch-tall sorghum. May be applied with atrazine and COC.
Metsulfuron (2) + 2,4-D amine (4) 0.002 + 0.25	0.05 oz **Ally XP** or **Accurate** + 1/2 pt **2,4-D amine**	Broadcast apply to grain sorghum 3 to 10 inches in height. May be applied with drop nozzles to sorghum up to 15 inches tall, but only before the boot stage. Controls pigweeds, puncturevine, and velvetleaf less than 6 inches tall. Do not use surfactant or crop oil. May be ground or aerial applied. Prior cultivation to cover sorghum brace roots is recommended to minimize injury from 2,4-D.
Nicosulfuron (2) 0.031 to 0.062	0.67 to 1.33 oz **Zest WDG**	Apply Zest WDG to Inzen (ALS herbicide tolerant) Sorghum hybrids only. Conventional sorghum hybrids will be destroyed if treated with Zest. Zest may be applied up to 1.33 oz, not to exceed 1.8 oz/season to sorghum 4 to 20 inches tall. To ensure good control of the annual grasses, treat within label maximum size recommendations and when grass are small. See label for susceptible grass species. Apply with COC at 1 to 2% v/v using the higher rate in arid conditions. For aerial applications use COC at 0.5% v/v. NIS at 0.25% v/v may be used or 0.5% in arid conditions. Also include a nitrogen source, UAN at 2 quarts/a or 2 lb AMS/a. Double the quantity of the N source when applications are made under arid conditions. DO NOT apply Zest with fertilizer as the total carrier solution. Use this program in conjunction with an effective preemergence herbicide program and/or tank mix Zest with effective tank mix partners to assure effective control of broadleaf and difficult grass weeds. Zest may cause temporal yellowing to Inzen sorghum but will recover quickly. Do not apply with Huskie as significant antagonism of grass control and crop injury may occur. Crop rotational restrictions include corn, field and seed anytime; corn, pop, and sweet 10 months; soybean 15 days and 0.5 inches precipitation; winter cereals, wheat, barley, rye, and oats 4 months; cotton and drybeans 10 months; alfalfa and red clover 12 months; and all sorghum, including Inzen sorghum, 18 months. See zest.dupont.com for required Inzen Stewardship training to utilize Zest on Inzen sorghum.
Prosulfuron (2) 0.013 to 0.027	0.375 to 0.75 oz **Peak**	Controls or suppresses many broadleaf weed species. Usually used following a foundation application of Dual- or Bicep-type herbicide. Apply over-the-top to sorghum at least 5 inches tall. Refer to label for weed size limitations. If applied alone or tank mixed with atrazine, add COC at 1 qt/acre. Also add 2 to 4 qt/a UAN if velvetleaf is targeted. If tank mixed with 2,4-D, dicamba, or liquid formulations of bromoxynil, add NIS instead of COC. There are no restrictions for rotation to wheat. Sunflower and soybean are very sensitive to Peak carryover. See label for rotation restrictions that differ by field location, rate of Peak applied, and soil pH.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Grain Sorghum

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Pyrasulfotole (27) + bromoxynil (6) 0.031 to 0.039 + 0.175 to 0.219	12.8 to 16 oz **Huskie**	This premix controls broadleaf weeds when applied to grain or forage sorghum between the 3-leaf stage of growth and 30 inches tall and/or prior to flag leaf emergence, whichever comes first. The addition of 1 lb/a of AMS and 0.25% v/v NIS or 0.5% v/v high-surfactant oil concentrate may optimize Huskie activity. Huskie will perform best if applied with 0.25 to 1 lb of atrazine. Huskie must be applied in a minimum of 10 gpa spray solution. A maximum of 32 oz of Huskie may be applied in two applications per year. There must be an interval of 11 days between Huskie treatments. Transitory leaf burn and yellowing may occur following a Huskie application on sorghum. These symptoms generally dissipate within 21 days. Potential for increased injury exists when Huskie-treated sorghum has been previously treated with preemergence-applied herbicides containing mesotrione (Lexar, Lumax, and Zemax). Do not graze or cut for forage within 7 days following Huskie application. Do not harvest grain or stover within 60 days of Huskie application.
Quinclorac (4) 0.25 to 0.38	22 to 32 fl oz **Facet L,** or 0.5 to 0.75 pt **Quinstar 4L,** or 5.3 to 8 oz **Quinstar GT**	Facet L, Quinstar 4L, or Quinstar GT can be applied to grain sorghum from emergence to 12 inches for control of field bindweed, foxtail, barnyardgrass, and morningglory. Best annual grass control occurs when applied with 0.5 to 1 lb atrazine, grass density is moderate to low, and plants are less than 2 inches tall. Field bindweed should be growing actively with runners at least 4 inches long. Always apply with MSO when applying alone or tank mixing with atrazine. NIS should be used if tank mixed with growth regulator herbicides. UAN or AMS can be added. The addition of 8.5 lb AMS/100 gallon will help control bindweed. Because of root uptake, rainfall following Facet L or Quinstar GT application may improve weed control.
S-metolachlor (15) 0.95 to 1.59	1 to 1.67 pt **Dual II Magnum, Charger Max, EverpreX** or **Moccasin II Plus**	*S*-metolachlor alone or in certain tank mixes can be applied postemergence to grain or forage sorghum. The risk of injury increases when adjuvants (NIS or COC), nitrogen sources, or other fertilizer are applied with Dual II Magnum. Dual II Magnum has no foliar activity on weeds as it is intended for residual soil activity only. Thus, this application must be in conjunction with tillage or companion herbicides which provide good control of emerged weeds.
S-metolachlor (15) + atrazine (5) 0.78 to 1.5 + 1 to 2	1.3 to 2.58 qt **Bicep II Magnum FC**	Apply postemergence to sorghum from the V3 stage to 12 inches tall for residual control and control of small emerged weeds that haven't exceeded the 2 leaf stage. Use the lower rates on coarse textured soils and higher rates on fine textures soils. Apply with COC at 1% v/v for control of emerged weeds. The combined amount of Bicep II Magnum from all applications to sorghum must not exceed a total of 2.58 qt/a and the combined amount of atrazine from all sequential applications of atrazine containing products should not exceed 2.5/a per calendar year. Do not graze or feed forage for 60 days following application.
2,4-D (4) 0.33 to 0.5 amine or mixed amine, or 0.25 to 0.5 LVE	0.67 to 1 pt **amine** or **mixed amine,** or 0.5 to 1 pt **LVE** 4 lb/gal **2,4-D***	Numerous formulations of 2,4-D are available. Weedar 64 contains 3.8 lb/gal dimethylamine salt. Savage is a dry soluble formulation containing 95% dimethylamine salt. Weedone 638, Weedone LV4, and Weedone LV6 contain 2.8 lb, 3.8 lb, and 5.7 lb/gal, respectively, of the butoxyethyl ester. Hi-Dep contains 3.8 lb/gal of the dimethylamine and diethanolamine (mixed amine) salts. Salvo and SEE 2,4-D LV4 contain 5 lb and 3.8 lb/gal, respectively, of iso-octyl ester. Application rates, spray volumes, and timings differ with company and formulation. 2,4-D controls or suppresses annual and perennial broadleaf weeds. Most sorghum hybrids are injured by 2,4-D. High relative humidity and air temperature increase potential for sorghum injury. Sorghum is most tolerant to 2,4-D when 5 to 10 inches tall. Even then, expect crop response in the form of rolled leaves and brittle, spreading stems and tillers. When crop is more than 8 inches tall, use drop nozzles to reduce spray deposition on sorghum leaves. Do not apply during boot, flowering, or early dough stages. Very low rates of 2,4-D in combination with other postemergence herbicides are much safer to sorghum than higher rates of 2,4-D used alone. Yield-reducing sorghum injury can occur from over-the-top application rates as low as 0.125 lb and is common for rates of 0.25 lb and up. Producers should weigh potential sorghum injury from 2,4-D against potential loss of sorghum yield from weed competition.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Grain Sorghum

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
DIRECTED POSTEMERGENCE		
Paraquat (22) 0.25 to 0.5	1 to 2 pt **Gramoxone SL**	Apply when freestanding sorghum is at least 12 inches tall. Use precision-directed spray equipment adjusted so that no more than the lower 3 inches of sorghum stem is contacted by paraquat. Always add NIS, but do not tank mix with liquid fertilizer.
HOODED APPLICATIONS		
Glyphosate (9)	**Glyphosate*** (see glyphosate table)	Some glyphosate products are labeled for application under hooded sprayers between grain sorghum rows. Equipment must be operated in a manner that avoids bouncing or raising the hoods off the ground, or sorghum injury may occur. Use low-pressure/low-drift nozzles. Maximum sprayer speed is 5 mph, and maximum wind speed is 10 mph. See "Selective Equipment" section of label for further details.
FOR SPOT TREATMENT ONLY		
Glyphosate (9)	1 to 2 gal **Glyphosate** per 100 gal + surfactant or 1.28 to 2.56 fl oz/gal spray mix	Apply as spot treatment to control annual and some perennial weeds. Apply at stage of weed growth recommended on glyphosate label but before heading of sorghum. Sorghum in treated area will be killed. Avoid spray drift outside target areas.

ROLLER OR WICK-TYPE APPLICATORS

Note: Expect best results when target weeds are 8 to 12 inches taller than grain sorghum. Two applications made in opposite directions give better coverage. Operate at ground speeds of less than 5 mph. See glyphosate label for application directions and precautions.

Herbicide/method	Mixing Ratio herbicide: water	Comments and limitations
Glyphosate (9)/Roller	1:19	A 5% solution for control of volunteer corn and shattercane.
	1:9	A 10% solution to control volunteer corn and shattercane and suppress johnsongrass, redroot pigweed, giant ragweed, sunflower, velvetleaf, common milkweed, and hemp dogbane. Roller speed should be maintained at 40 to 60 rpm.
Glyphosate (9)/Wick	1:2	This 33% solution in a rope wick should perform like the 10% solution in the roller.
HARVEST AIDS		
Diquat (22) 0.38 to 0.5	1.5 to 2 pt **Reglone/Diquat**	**Use for seed production only.** For preharvest desiccation of foliage, apply 1 to 2 weeks before harvest and when seed moisture is 30% or less. This coincides with black layer on kernels in the lower part of the heads. Do not allow grazing of treated areas or feed treated forage. Do not use seed from treated plants for food or feed purposes.
Carfentrazone (14) 0.015	Up to 1 fl oz **Aim EC**	May be applied, alone or tank mixed with other desiccants, to physiologically mature sorghum. Apply with 1% v/v COC. Good spray coverage is essential. Allow at least 3 days between application and harvest.
Glyphosate (9)	**Glyphosate*** (see glyphosate table)	Use for feed grain production only. For preharvest desiccation of sorghum foliage and grain, apply when grain moisture is 30% or less. This coincides with black layer on kernels in the lower part of the heads. After application, a 7-day harvest delay is required, and a 2-week delay is recommended to give glyphosate time to work. Apply aerially or by ground.
Sodium chlorate (NC) 4.5 to 6.0	3.6 to 4.8 qt **Defol 5** or 2.4 to 3.2 qt **Defol 750**	Can be used to reduce moisture content in sorghum grain. Apply at physiological maturity, when kernels at the base of the sorghum head show black-layer formation. Most effective when application is followed by dry, sunny weather. Apply by aircraft or ground equipment 7 to 10 days before harvest. Use spray adjuvants as recommended on the label. Can be applied in 28% UAN carrier to enhance foliar desiccation and to apply nitrogen for the succeeding crop.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Soybean

This publication primarily concerns chemical weed control. It is not intended to imply that cultivation, particularly in row crops, is undesirable. One or two cultivations can greatly improve weed control.

Weed Response to Selected Soybean Herbicides When Applied According to Label Directions[1]

		Annual grasses							Annual broadleaf weeds															Perennials	
Herbicide(s)	Crop tolerance	Barnyardgrass	Crabgrass	Fall panicum	Foxtail	Longspine sandbur	Shattercane	Witchgrass	Eastern black nightshade	Cocklebur	Devilsclaw	Horseweed/Marestail	Kochia	Lambsquarters	Morningglory	Pigweed[2]	Prickly sida	Common ragweed	Pennsylvania smartweed	Sunflower	Velvetleaf	Venice mallow	Rhizome johnsongrass	Yellow nutsedge
PREPLANT INCORPORATED																								
Trifluralin, Sonalan	G-E	G-E	E	G-E	E	E	G-E	G-E	F	—	—	—	F-G	F-G	—	G	—	P	P	—	—	—	F	—
PREPLANT OR PREEMERGENCE																								
Authority Assist	G-E	F-G	F-G	F-G	G	F	F-G	F-G	E	G	—	—	E	E	E	E	G	F	E	F-G[3]	G-E	G	F	G
Authority Elite	G-E	G-E	G-E	G-E	G-E	—	—	G-E	E	—	—	—	E	E	G-E	E	G	—	G	—	—	—	—	G
Authority First/Sonic	G-E	F	F	F	F	—	—	—	E	G-E	—	G[3]	E	E	E	E	G	E[3]	G	G-E[3]	E	E	—	G
Authority Maxx	G-E	F	F	F	F	—	—	—	G-E	G	—	G[3]	E	E	E	E	E	—	G	G[3]	G	—	—	G
Authority MTZ	G	F	F	F	F	—	—	F	G-E	G	—	F[3]	E	E	E	E	G	G	G-E	F	F-G	E	—	G
Authority Supreme	G	G-E	E	G-E	E	F-G	F	G-E	E	—	—	F	E	E	E	E	G	F	G	—	F-G	—	—	G
Authority XL	G-E	F	F	F	F-G	—	—	—	G-E	G-E	—	G[3]	E	E	E	E	E	G-E	G-E	G	G	G	—	G
Boundary, Moccasin MTZ	G	G	G	G	G	—	—	G	G	—	—	F	—	G	—	G	G	G	F	G	—	—	—	F
Command	E	E	G-E	E	E	F	F-G	—	P	F	—	—	G	E	P	P	E	G	G	P	E	E	—	—
Canopy	G-E	F	F	F	F	—	—	—	—	G-E	—	G[3]	—	G	G-E	E	G	G	G	E	G-E	—	—	F
Canopy EX	G-E	F	F	F	F	—	—	—	—	G[3]	—	G[3]	—	E	F	G[3]	F	G	G	G[3]	F-G	—	—	F
Dual II Magnum and other S-metolachlor	E	G	G-E	G	G-E	F-G	—	G-E	G	—	—	—	—	—	—	G	—	—	—	—	—	—	—	F
Envive/Enlite	G	F	F	F	F	—	—	—	E	G-E	—	G	G	E	E	E	G	G	G	E	G-E	G-E	—	—
Fierce	G	G-E	E	G-E	E	—	—	—	E	—	—	G	F-G	E	G	E	E	G	F	—	G-E	E	—	—
Fierce MTZ	G	G-E	E	G-E	E	—	—	—	E	—	—	G-E	G	E	G	E	E	G	F	—	G-E	E	—	—
Fierce XLT	G	G-E	E	G-E	E	F	F	E	E	G[3]	—	G-E	G	E	G	E	E	E	G	G[3]	G-E	E	—	—
FirstRate	E	—	—	—	—	—	—	—	—	E	—	G[3]	—	E	G	E[3]	G	G	G	E[3]	G-E	E	—	—
Metribuzin	F-G	P-F	P-F	P-F	—	—	—	—	P-F	G	—	—	G	E	—	G	G-E	G	G	G	G	G	—	—
Outlook	E	G	G-E	G-E	G-E	—	P-F	G-E	G	—	—	—	—	G	—	G	—	—	—	—	—	—	—	F
Pendimethalin	G	G-E	G-E	G-E	G-E	G	G	G	—	—	—	—	F-G	F-G	—	F-G	—	—	F	—	F	—	—	—
Prefix	E	G	G-E	G	G-E	F-G	F	G-E	E	P-F	—	—	—	E	P	E	P	G	G	F	F	—	—	F
Pursuit	E	F	F	F	G	—	F	—	E	F[3]	—	—	G[3]	G	F	E[3]	G	F	G	G	G	F	—	—
Python	E	—	—	—	—	—	—	—	G	F-G[3]	—	F[3]	G[3]	G	F	G[3]	G	G	G	G	G-E	E	—	—
Scepter	G-E	F	—	—	G	—	F	—	E	E[3]	—	—	—	G	F	E[3]	G	G	G	E	G	G	—	—
Sharpen[4]	G	—	—	—	—	—	—	—	E	E	—	E	G	G-E	G-E	E	G-E	G-E	G-E	E	E	E	—	—
Spartan and other sulfentrazone	G-E	—	—	—	—	—	—	—	E	—	—	—	G	G	E	E	G	—	F	—	F	F	—	G
Surveil	G-E	F	F	F	F	—	—	—	E	E	—	G	E	E	E	E	G	E	G	E[3]	E	E	—	G
Trivence	G	F	F	F	F	—	—	—	G	G-E	—	G-E	G	E	E	E	G-E	E	G	E	G-E	G-E	—	—
Tripzin ZC	F-G	G-E	G-E	G-E	G-E	G	F	G	—	F-G	—	F	G	E	F	G	G-E	G	G	G	G	G	—	—

[1] Weed response ratings refer to application according to label directions and with favorable growing conditions:
E = Excellent, G = Good, F = Fair, P = Poor, and — = weed not listed on the herbicide label.

[2] Pigweed species may vary in response to herbicides. Common waterhemp and Palmer amaranth tend to be less susceptible than other pigweeds to postemergence herbicides.

[3] Except where resistant weed populations have developed.

[4] Primarily burndown weed control with only a short period of residual activity.

Herbicides for Soybean

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		Annual grasses							Annual broadleaf weeds														Perennials	
Herbicide(s)	Crop tolerance	Barnyardgrass	Crabgrass	Fall panicum	Foxtail	Longspine sandbur	Shattercane	Witchgrass	Eastern black nightshade	Cocklebur	Devilsclaw	Horseweed/Marestail	Kochia	Lambsquarters	Morningglory	Pigweed[2]	Prickly sida	Common ragweed	Pennsylvania smartweed	Sunflower	Velvetleaf	Venice mallow	Rhizome johnsongrass	Yellow nutsedge
PREPLANT OR PREEMERGENCE																								
Valor, Encompass, Outflank	G	F	F	F	F	—	—	—	E	—	F	G	F	E	G	E	G	G	F	—	G-E	G-E	—	—
Valor XLT	G	F	F	F	F	—	—	—	E	G	—	G	F	E	E	E	G-E	G-E	G	E	G-E	E	—	—
Warrant	E	G	G-E	G-E	E	F	F	G	G	—	—	—	—	G	—	G	—	—	—	—	—	—	—	F
Zidua, Anthem Maxx	G-E	G-E	E	G-E	E	F-G	F	G-E	G	—	—	—	F	F-G	F	G-E	G	F	—	—	F	—	—	F
Zidua Pro	G	G-E	E	G-E	E	F-G	G	—	G	G	—	—	G	G-E	G	G-E	G-E	G	G-E	G-E	G-E	G-E	—	F
POSTEMERGENCE																								
Acifluorfen, Blazer	G	—	—	F	F	—	F	—	G-E	F	F-G	—	—	F-G	G	G-E	—	F	G-E	—	—	—	—	—
Assure II, Targa	E	G-E	G-E	E	E	G-E	E	G-E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	G-E	—
Basagran, Broadloom	G-E	—	—	—	—	—	—	—	—	E	G-E	—	—	F	P	—	F-G	F	G-E	G-E	G-E	G-E	—	G
Basagran + Blazer (Storm)	G	—	—	—	—	—	—	—	G-E	G-E	G-E	—	—	F-G	G	G-E	G	G-E	G-E	G	G-E	G	—	F
Cadet	G	—	—	—	—	—	—	—	F	—	—	—	F	F-G	F-G	F	—	—	F	—	E	—	—	—
Classic	G-E	—	—	—	—	—	—	—	—	E	—	G[3]	—	—	G	G[3]	—	G	G	E	F	—	—	G
Clethodim	E	G-E	G-E	G-E	E	G-E	E	G-E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	G-E	—
Cobra, Phoenix	G	—	—	—	—	—	—	—	E	F-G	G-E	—	F-P	F-P	G	E	G	E	F	F	F	F-G	—	—
FirstRate	E	—	—	—	—	—	—	—	—	E[3]	—	G[3]	—	—	G	—	—	G	G	E	E	E	—	—
Fomesafen, Flexstar	G	—	—	—	—	—	—	—	G-E	F	F-G	—	—	F	G	G-E	—	F	G-E	—	—	—	—	—
Fusilade DX	E	G-E	G-E	G-E	G	G-E	E	G-E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	G-E	—
Fusion	E	G-E	G-E	E	E	G-E	E	G-E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	G	—
Glyphosate *(resistant soybean only)*	E	E	E	E	E	E	E	E	G	E	G	G[3]	G[3]	G	G	E[3]	E	G[3]	E	E	G	E	E	F
Harmony SG	G	—	—	—	—	—	—	—	—	F	—	—	—	G	—	E[3]	—	—	E	F	G	—	—	—
Liberty and other glufosinate *(resistant soybean only)*	E	G	G	G	E	F-G	G	G	G	E	—	G-E	G	G	G	G	G	E	E	G	G	E	F	F
Marvel	G	—	—	—	—	—	—	—	E	F	—	—	F	G	G	G-E	F	F	G-E	—	E	G-E	—	—
Poast Plus	E	G-E	G-E	G-E	E	G-E	E	G-E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	G-E	—
Pursuit	E	G	F	—	G	—	E	—	E	E[3]	—	—	G[3]	F	G	E[3]	—	F	G	G[3]	G	—	F	—
Raptor	G-E	G	G	—	G	—	E	—	E	E[3]	—	—	G[3]	G	G	E[3]	—	G	E	E[3]	G-E	—	F	—
Resource	G	—	—	—	—	—	—	—	—	F	—	—	—	F-G	—	F	G	G	—	—	E	—	—	—
Synchrony XP	E	—	—	—	—	—	—	—	—	E[3]	—	G[3]	—	G-E	G-E	E[3]	—	G	E	E[3]	E	—	—	G
Thunder Master *(resistant soybean only)*	E	E	E	E	E	E	E	E	E	E	G	G-E[3]	G	E	E	E	G-E	G	E	E[3]	E	E	E	F
Torment	G	F	F	F	F-G	—	G	—	E	E[3]	—	F	—	F	G	G-E	G	G	G	G[3]	G	—	F	F
Xtendimax, FeXapan, Engenia *(resistant soybean only)*	E	—	—	—	—	—	—	—	G	E	—	E	E	G	E	G-E	G	E	E	E	G	G	—	—

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E = Excellent, G = Good, F = Fair, P = Poor, and — = weed not listed on the herbicide label.
[2] Pigweed species may vary in response to herbicides. Common waterhemp and Palmer amaranth tend to be less susceptible than other pigweeds to postemergence herbicides.
[3] Except where resistant weed populations have developed.
[4] Primarily burndown weed control with only a short period of residual activity.

Herbicides for Soybean

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Acetochlor (15) 0.94 to 1.5	2.5 to 4 pt **Warrant**	Warrant is an encapsulated formulation of acetochlor. It provides early season residual control of small seeded grasses and some small seeded broadleaf weeds, but it does not control emerged weeds. Do not graze or feed treated forage to livestock.
Acetochlor (15) + Fomesafen (14) 1.06 to .24	3 pt **Warrant Ultra**	Warrant Ultra is a premix of 2.82 lb acetochlor (Warrant) and 0.63 lb fomesafen (Reflex)/gal. Apply preplant or preemergence for residual control of small-seeded grasses and pigweeds. Apply with oil concentrate or NIS for control of emerged broadleaf weeds. Weak on large-seeded broadleaf weeds. May be tank mixed with glyphosate, paraquat, or 2,4-D for enhanced burndown control in no-till. Do not apply in counties west of U.S. Highway 281. Do not rotate to wheat for 4 months; corn for 10 months; or alfalfa, grain sorghum, or sunflower for 18 months after application.
Carfentrazone (14) 0.0074 to 0.023	0.5 to 1.5 oz **Aim EC**	Apply as part of a burndown application prior to emergence of soybeans for improved control of certain broadleaf weeds including velvetleaf, pigweeds, and kochia. Always apply with COC or MSO for optimal weed control. Generally tank-mixed with other herbicides for broader spectrum weed control.
Chlorimuron (2) + Tribenuron (2) 0.0156 to 0.046 + 0.0046 to 0.014	1.1 to 3.3 oz **Canopy EX**	Canopy EX is a premix of 22.7% chlorimuron (Classic) and 6.8% tribenuron (Express) for fall and early preplant application up to 45 days before planting soybean. Provides foliar and residual control of certain broadleaf weeds including chickweed, field pansy, henbit, and most winter annual mustard species. Apply with COC at 1% v/v or NIS at 0.25% v/v. Only use the 1.1 oz rate on soils with pH greater than 7. The addition of 2,4-D at 1 pt/a is required at the 1.1 oz rate and is recommended for all Canopy EX applications. Can be tank mixed with various herbicides for enhanced burndown and residual weed control. On soils with a composite pH greater than 7.0, do not exceed 2.2 oz/acre. Do not allow grazing in treated fields or harvest for forage or hay. Wheat can be planted after 4 months; alfalfa or field corn after 10 months; sorghum or sunflower after 12 months.
Chlorimuron (2) + Metribuzin (5) 0.015 to 0.047 + 0.09 to 0.28	2.9 to 9 oz **Canopy Blend**	Canopy is a premix of 8.3% chlorimuron (Classic) and 50% metribuzin (Sencor) recommended mainly for eastern Kansas. Can be applied in the fall, early preplant, preplant, or preemergence. Provides residual and burndown control of many broadleaf weeds. If emerged weeds are present at treatment time, add COC to enhance foliar activity. Can be tank mixed with various herbicides for enhanced burndown and residual weed control. On soils with a composite pH greater than 7.0, do not exceed 2.9 oz/acre. Do not allow grazing in treated fields or harvest for forage or hay. Wheat can be planted after 4 months; alfalfa or field corn after 10 months; sorghum, sunflower, cotton, or canola after 18 months.
Chlorimuron (2) + Flumioxazin (14) 0.0194 to 0.033 + 0.0561 to 0.0935	3 to 5 oz **Valor XLT**	Valor XLT is a premix of 10.3% chlorimuron (Classic) and 30% flumioxazin (Valor). Recommended mainly for eastern Kansas. Provides residual and burndown control of many broadleaf weeds. Can be applied preplant in the fall or spring or preemergence until 3 days after planting. If emerged weeds are present at the time of treatment, add COC to enhance foliar activity. The addition of glyphosate and/or 2,4-D is recommended for more broad-spectrum burndown weed control. If the soil pH is greater than 6.8, do not use more than 2.5 oz/a of Valor XLT. Do not apply Valor XLT in fields treated with products containing flufenacet, alachlor, metolachlor, or dimethenamid. Do not allow grazing in treated fields or harvest for hay or forage. Do not rotate to wheat for 4 months; field corn, cotton, or sorghum for 10 months; alfalfa for 12 months; sunflower for 18 months; or canola for 30 months after application.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Soybean

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Chlorimuron (2) + Flumioxazin (14) + Metribuzin (5) 0.015 to 0.024 + 0.048 to 0.08 + 0.17 to 0.28	6 to 10 oz **Trivence**	Trivence is a premix containing 3.9% chlorimuron (Classic), 12.8% flumioxazin (Valor), and 44.6% metribuzin for burndown and residual control of broadleaf weeds. Recommended mainly for eastern Kansas; can be applied preplant in the fall or spring or preemergence until 3 days after planting. Do not apply more than 6 oz/a if soil pH is greater than 7.0. Apply with oil concentrate or NIS for control of emerged weeds. Often applied as a tank-mix with 2,4-D, glyphosate, or other herbicides for enhanced control of certain weed species. Do not apply in fields also treated preemergence with products containing flufenacet, alachlor, metolachlor, or dimethenamid. Do not rotate to wheat for 4 months; alfalfa or field corn for 10 months; sunflower, cotton, sorghum, or oats for 18 months; or canola for 30 months after application. Refer to label for crop rotation guidelines.
Chlorimuron (2) + Flumioxazin (14) + Thifensulfuron (2) 0.014 to 0.03 + 0.046 to 0.097 + 0.0045 to 0.0094 or 0.005 + 0.064 + 0.015	2.5 to 5.3 oz **Envive** or 2.8 oz **Enlite**	Envive is a premix of 9.2% chlorimuron (Classic), 29.2% flumioxazin (Valor), and 2.9% thifensulfuron (Harmony SG) for residual and burndown control of many broadleaf weeds. Enlite is a premix of 2.85% chlorimuron, 36.2% flumioxazin, and 8.8% thifensulfuron. Enlite is a better option than Envive on high pH soils. Can be applied preplant in the fall or spring or preemergence until 3 days after planting. If emerged weeds are present at the time of treatment, add COC or NIS to enhance foliar activity. The addition of glyphosate, 2,4-D, and/or dicamba is recommended for more broad-spectrum burndown weed control. If the soil pH is greater than 7.0, do not use more than 2.5 oz/a of Envive. Do not apply Envive in fields treated with products containing flufenacet, alachlor, metolachlor, or dimethenamid. Do not allow grazing in treated fields or harvest for hay or forage. Do not rotate to wheat for 4 months; field corn, cotton, or sorghum for 10 months; alfalfa for 12 months; sunflower for 18 months; or canola for 30 months after Envive application. Do not rotate to wheat for 4 months; field corn, cotton, or sorghum for 9 months; alfalfa for 12 months; or sunflower or canola for 18 months after Enlite application.
Clomazone (13) 0.5 to 0.75	1.33 to 2 pt **Command**	Controls velvetleaf, many annual grasses, and some broadleaf weeds. Can be applied preemergence or incorporated with one or two passes to a maximum depth of 3 inches. Can be tank mixed with trifluralin, Scepter, Sencor, pendimethalin, or Dual II Magnum. Susceptible nearby plants can show symptoms of foliar whitening or yellowing from spray or vapor drift of Command. Rotation to soybean, corn, and sorghum can be done after 9 months, to wheat after 12 months, and to other crops after 16 months. Do not allow grazing or feed soybean plants from treated fields. See label restrictions for preemergence use.
Cloransulam (2) 0.032 to 0.04	0.6 to 0.75 oz **FirstRate**	Controls many broadleaf weeds as a preplant incorporated, preplant, or preemergence treatment. Can be applied up to 30 days before planting. Apply with NIS, MSO, or COC plus UAN fertilizer solution for control of emerged weeds in no-till. Wheat can be planted after 4 months; alfalfa, corn, sorghum, or cotton can be planted 9 months; and sunflowers 30 months after application. Do not plant any other crop not listed on the label until 18 months after application and completion of a field bioassay. Do not apply through a chemigation system. Refer to supplemental label for aerial application.
Cloransulam (2) + Flumioxazin (14) 0.026 to 0.032 + 0.079 to 0.095	3.5 to 4.2 oz **Surveil**	Surveil is a premix containing 12% cloransulam (FirstRate) and 36% flumioxazin (Valor). Can be applied in the fall or spring from prior to 3 days after soybean planting. Apply with oil concentrate for enhanced burndown control of emerged weeds in no-till. Do not tank mix Surveil with Group 15 herbicides such as acetochlor, dimethenamid-P, or pyroxasulfone within 14 days of planting soybeans unless planted no-till on wheat or corn stubble. Do not rotate to wheat for 3 months; corn, cotton, sorghum, or oats for 9 months; alfalfa for 10 months; sunflowers for 30 months; or alfalfa, canola, or other crops not listed on the label until successful completion of a field bioassay.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Soybean

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Cloransulam (2) + Sulfentrazone (14) 0.015 to 0.04 + 0.12 to 0.31	3 to 8 oz **Authority First** or **Sonic**	Authority First and Sonic are premixes of 7.9% cloransulam and 62.1% sulfentrazone. Can be applied preplant or preemergence until 3 days after planting. Primarily controls yellow nutsedge and broadleaf weeds, including waterhemp, Palmer amaranth, morningglory, velvetleaf, and black nightshade. The low rates are recommended primarily as a foundation treatment ahead of glyphosate in glyphosate-resistant soybean unless glyphosate-resistant weeds are present. Higher rates are recommended for use on conventional soybean varieties or where glyphosate-resistant weeds are present. Do not use on sandy soils with less than 1% organic matter. Do not rotate to wheat for 4 months; corn for 10 months; alfalfa or sorghum for 12 months; cotton for 12 to 18 months; canola for 24 months; or sunflower for 30 months after application.
Dicamba (4) 0.125 to 0.5	4 to 16 oz **Clarity, Sterling Blue,** or **Vision**	Apply as a fall or spring application with the appropriate preplant interval to control emerged broadleaf weeds. Following application and accumulation of 1 inch of rain or overhead irrigation, a minimum waiting interval of 14 days is required before planting soybeans for rates up to 8 oz/acre, and a minimum waiting interval of 28 days is required before planting soybeans for rates between 8 and 16 oz/acre. Do not make preplant applications to soybeans in geographic areas with less than 25 inches of annual precipitation. Other dicamba products also can be used, but they may have different waiting intervals.
Dicamba (4) 0.5 to 1	22 to 44 oz **Xtendimax or FeXapan,** or 12.8 oz **Engenia**	Restricted use pesticides. Apply only where Xtend soybeans will be planted if applied within 28 days prior to planting or preemergence. Provides burndown and some residual control of susceptible broadleaf weeds. Some crops, such as non-Xtend soybeans, are extremely susceptible to off-site movement of dicamba, so follow label guidelines near susceptible crops and sensitive areas. Do not spray when wind is blowing in direction of neighboring susceptible crops, including non-Xtend soybeans, and observe buffer guidelines. Only spray between 1 hour after sunrise and 2 hours before sunset when wind speed is between 3 and 10 mph. Do not spray during a temperature inversion. Do not apply with ammonium sulfate, which greatly increases the risk of volatility and vapor drift. Consult labels and respective websites for additional application guidelines and approved tank-mix combinations: xtendimaxapplicationrequirements.com for Xtendimax; fexapanapplicationrequirements.dupont.com for FeXapan; or engeniatankmix.com for Engenia.
Dimethenamid-P (15) 0.5 to 0.98	12 to 21 oz **Outlook**	For preemergence control of weeds, apply to soybean preplant, preplant incorporated into the surface 1 to 2 inches, preemergence, or postemergence. Controls grasses and small seeded broadleaf weeds. Rate depends on soil texture and organic matter. Often tank mixed with other herbicides for enhanced broadleaf weed control. Fall cereals can be planted 4 months after application, and any crop can be planted in the following season.
Ethalfluralin (3) 0.56 to 1.125	1.5 to 3 pt **Sonalan**	Apply up to 3 weeks before planting and incorporate uniformly into the top 2 to 3 inches of soil for partial control of black nightshade. Often tank mixed with other herbicides for enhanced broadleaf weed control. Do not allow grazing or cut hay.
Flumetsulam (2) 0.04 to 0.07	0.8 to 1.33 oz **Python**	Controls annual broadleaf weeds as a preplant incorporated or preemergence application. Preemergence treatments can be tank mixed with glyphosate, Gramoxone SL, or 2,4-D to help control emerged weeds in no-till. Do not apply if soil pH is greater than 7.8. Corn and soybean can be planted anytime after application. Do not rotate to alfalfa for 4 months; wheat and oat for 4.5 months; grain sorghum for 12 months; sunflower for 18 months; or any other crop until a field bioassay has been completed. Do not apply aerially or through a chemigation system.
Flumioxazin (14) 0.064 to 0.096	2 to 3 oz **Valor SX** or **EZ, Encompass, Outflank,** or **Panther SC**	Apply in the fall, preplant, or preemergence to soybean. Add COC to enhance burndown activity on emerged weeds in no-till. Controls several broadleaf weeds, including pigweeds and black nightshade. Tank mixes of Valor with flufenacet, metolachlor, dimethenamid, or alachlor products may result in severe soybean injury. Do not rotate to wheat for 1 month, or to alfalfa or oat for 8 months after application.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Soybean

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Flumioxazin (14) + metribuzin (5) + imazethapyr (2) 0.063 to 0.079 + 0.28 to 0.35 + 0.053 to 0.066	12 to 15 oz **Panther Pro**	Panther Pro is a premix containing 0.67 lb flumioxazin, 3 lb metribuzin, and 0.56 lb imazethapyr/gal. Apply preplant or preemergence for burndown and residual control of broadleaf and certain grass weeds. Apply with COC, MSO or NIS plus a spray grade nitrogen source for enhanced control of emerged weeds. Do not apply to sand soils or sandy loam soils with less than 2% organic matter. Do not tank-mix with acetochlor, metolachlor or dimethenamid products within 14 day of planting soybeans, unless no-till planted. Do plant wheat for 4 months; alfalfa for 4 to 8 months; corn for 8.5 months; or cotton, sorghum, sunflower, canola, or oats for 18 months after application.
Flumioxazin (14) + Pyroxasulfone (15) 0.063 to 0.079 + 0.08 to 0.1	3 to 3.75 oz **Fierce**	Fierce is a premix containing 33.5% flumioxazin (Valor) and 42.5% pyroxasulfone (Zidua) for partial burndown and residual control of grass and broadleaf weeds. Can be applied in the fall, preplant, or preemergence to soybeans, but the best in-crop residual control of summer annual weeds will occur with application close to planting time. Apply with COC and tank mix with glyphosate or other herbicides for enhanced burndown control in no-till. Do not apply in conjunction with products containing dimethenamid or metolachlor or severe soybean injury may occur. Do not plant field corn for 7 to 30 days; wheat or cotton for 1 to 2 months; sunflower for 4 months; alfalfa for 10 months; oats or barley for 11 to 12 months; or any other crops for 18 months after Fierce application.
Flumioxazin (14) + Pyroxasulfone (15) + Chlorimuron (2) 0.058 to 0.081 + 0.073 to 0.1 + 0.0156 to 0.022	3.75 to 5.25 oz **Fierce XLT**	Fierce XLT is a premix containing 24.6% flumioxazin (Valor), 31.2% pyroxasulfone (Zidua), and 6.7% chlorimuron (Classic) for partial burndown and residual control of grass and broadleaf weeds. Can be applied in the fall, preplant, or preemergence to soybeans, but the best in-crop residual control of summer annual weeds will occur with application close to planting time. Apply with COC and tank-mix with glyphosate or other herbicides for enhanced burndown control in no-till. Do not apply in conjunction with products containing dimethenamid or metolachlor, or severe soybean injury may occur. Do not plant field corn or wheat for 10 months; alfalfa, cotton or sorghum for 18 months; or canola or any other crops not listed on the label for 30 months after Fierce XLT application.
Flumioxazin (14) + Pyroxasulfone (15) + metribuzin (5) 0.063 to 0.079 + 0.08 to 0.1 + 0.19	3 to 3.75 oz **Fierce** + 6 oz **MTZ**	Fierce MTZ is a co-pack of Fierce and metribuzin for partial burndown and residual control of many grass and broadleaf weeds. Can be applied in the fall, preplant, or preemergence to soybeans, but the best in-crop residual control of summer annual weeds will occur with application close to planting time. Apply with COC and tank mix with glyphosate or other herbicides for enhanced burndown control in no-till. Do not apply in conjunction with products containing dimethenamid or metolachlor or severe soybean injury may occur. Do not plant field corn or wheat for 4 months; alfalfa for 10 months; or any other crop not listed on the label for 18 months after application.
Flumioxazin (14) + Thifensulfuron (2) + Tribenuron (2) 0.07 to 0.096 + 0.0086 to 0.012 + 0.0086 to 0.012	2.75 to 3.75 oz **Afforia**	Afforia is a premix containing 40.8% flumioxazin (Valor), 5% thifensulfuron (Harmony), and 5% tribenuron (Express) for burndown and residual control of broadleaf weeds. Can be applied from fall through spring prior to soybean emergence. Do not apply more than 2.75 oz/a less than 7 days prior to planting soybeans. Apply with oil concentrate or NIS for control of emerged weeds. Often applied as a tank-mix with 2,4-D, glyphosate, or other herbicides for enhanced control of certain weed species. Do not apply in fields also treated preemergence with products containing metolachlor or dimethenamid. Refer to label for crop rotation guidelines.
Fomesafen (14) 0.25	1 pt **Reflex** or **FlexStar**, or 0.7 pt **Sinister**	Primarily for residual and burndown of small pigweeds. Weak on large seeded broadleaf weeds and grasses. May be tank-mixed with other herbicides for additional burndown and residual weed control. Do not Sinister apply in counties west of highway 281. Do not apply Reflex or Flexstar after June 20 in counties west of highway 281. Do not rotate to wheat for 4 months; corn for 10 months; or alfalfa, canola, sorghum, or sunflower for 18 months after application. Do not apply any additional fomesafen products to soybeans in the same season and use only in alternate years.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Soybean

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Glufosinate (10) 0.53 to 0.79	29 to 43 oz **Liberty, Interline, Cheetah, Forfeit, Refer,** or **Surmise**	Liberty is a broad-spectrum herbicide for burndown control of emerged weeds prior to crop emergence. Provides no residual weed control. Always condition spray water with AMS at 3 lb/a before adding Liberty to the spray solution. Liberty is most effective with warm temperatures, high relative humidity, and bright sunlight. Application to large or stressed plants or late in the day may result in reduced weed control. Do not apply more than 87 oz/a of Liberty per growing season. Do not graze or harvest the treated crop for hay.
Glyphosate (9) 0.38 to 1.12 lb ae	1 to 3 pt of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	Apply to control emerged weeds before or after soybean planting but before crop emergence. Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. Condition spray solution with 1 to 2% spray-grade AMS by weight (8.5 to 17 lb/100 gal water) before adding glyphosate to the tank. Can be tank mixed with residual herbicides for extended weed control. Follow label directions. Fall treatments can be especially effective for control of emerged winter annual weeds and reduce the need for intensive spring burndown treatments.
Glyphosate (9) + *S*-metolachlor (15) 0.68 to 0.87 lb ae + 1 to 1.2	2.5 to 3 pt **Sequence**	Sequence is a premix of 2.25 lb glyphosate and 3 lb *S*-metolachlor (Dual Magnum)/gal. Apply preplant up to 14 days before planting or preemergence. Provides burndown control of most existing weeds and early season residual control of small-seeded grasses and some small-seeded broadleaf weeds. The addition of 2% AMS by weight or 17 lb/100 gal water can improve control of emerged weeds.
Halauxifen (4) 0.0045	1 oz **Elevore**	Apply at least 14 days prior to planting soybeans for control of emerged marestail, henbit, wild garlic, and other broadleaf weeds listed on the label. Often tank-mixed with other herbicides for broader spectrum weed control. Apply with COC or MSO at 0.5 to 1 % v/v. Do not plant corn, sorghum, soybeans, sunflowers, wheat or canola for 14 days; cotton for 30 days; alfalfa for 8 months; or other crops not listed on the label for 15 months after application.
Imazaquin (2) 0.125	2.8 oz **Scepter DG**	Controls many annual weeds in soybean in and east of Jewell, Mitchell, Lincoln, Ellsworth, McPherson, Harvey, Sedgwick, and Sumner counties. Apply preplant (up to 45 days before planting) and incorporate with two passes in top 2 inches of soil. Preemergence application can be effective if enough rainfall to wet the soil to a depth of 2 inches is received within 7 days of planting. Wheat can be planted after 4 months. Field corn can be planted after 9.5 months if 15 inches of rainfall were received from 2 weeks before application through November 15. Do not allow grazing and do not feed treated soybean forage.
Imazethapyr (2) 0.063	4 oz **Pursuit, Thunder**	Controls many annual weeds. Apply up to 45 days before planting and incorporate with two passes into the top 1 to 2 inches of soil. Preemergence application can be effective if enough rainfall to wet the soil to a depth of 2 inches is received within 7 days of planting. Do not rotate to alfalfa or wheat for 4 months; cotton, oat, sorghum, or sunflower for 18 months; or canola for 40 months after application. Do not allow grazing or feed treated soybean forage, hay, or straw.
Imazethapyr (2) + Fomesafen (14) 0.063 + 0.25	0.063 + 0.25 1 pt **Torment**	Torment is a premix containing 0.5 lb imazethapyr (Pursuit) and 2 lb fomesafen (Reflex)/gal. Apply preplant up to 45 days before planting through preemergence for control of broadleaf weeds and suppression of certain grasses. Subsequent applications of imazethapyr or fomesafen are not allowed. Do not use in counties west of U.S. Highway 281. Do not plant wheat for 4 months; corn for 10 months; alfalfa, cotton, oat, sorghum, or sunflower for 18 months; or canola for 40 months after application. Do not graze treated areas or harvest for forage or hay.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Soybean

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Imazethapyr (2) + Glyphosate (9) 0.063 to 0.56 lb ae	3 pt **Thunder Master**	Thunder Master is a premix of 0.17 lb imazethapyr (Pursuit) and 1.5 lb ae glyphosate/gal. Can be applied in the fall or spring to provide burndown and residual grass and broadleaf weed control prior to planting soybeans. Apply with NIS plus AMS. Do not apply Pursuit or other imazethapyr products in the same crop season. Do not rotate to alfalfa or wheat for 4 months; field corn for 8.5 months; cotton, oat, sorghum, or sunflower for 18 months; or canola for 40 months after applications.
Iodosulfuron (2) + Thiencarbazone (2) 0.001 to 0.0019 + 0.0084 to 0.014	0.3 oz **Autumn Super**	Apply after fall harvest and at least 60 days prior to soybean planting in the spring for burndown control of broadleaf weeds. Generally tank mixed with 2,4-D, dicamba, or glyphosate for improved weed control. Apply to actively growing weeds. Apply with 1% v/v COC or MSO plus 28% nitrogen fertilizer at 1 to 2 qt/a or 1.5 to 3 lb/a AMS. Do not apply to frozen ground. Do not rotate to alfalfa, canola, or sunflower for 18 months after application. Do not use if soil pH is greater than 8.0.
S-metolachlor (15) 0.95 to 1.91	1 to 2 pt **Dual II Magnum, EverpreX, Charger Max,** or **Moccasin II Plus**	Controls grasses more effectively than broadleaf weeds. Apply preplant up to 30 days before planting or preemergence. Often tank mixed with other herbicides for enhanced broadleaf weed control. Small grains can be planted 4.5 months after treatment.
S-metolachlor (15) + Fomesafen (14) 0.98 + 0.25	2 pt **Prefix, Vise,** or **Statement**	Prefix is a premix of 4.34 lb *S*-metolachlor (Dual Magnum) and 0.95 lb fomesafen (Reflex)/gal. Vise and Statement contain metolachlor instead of *S*-metolachlor. Apply preplant up to 14 days before planting through preemergence for control of small-seeded grasses and pigweeds. Weak on large-seeded broadleaf weeds. May be tank mixed with glyphosate, paraquat, or 2,4-D for enhanced burndown control in no-till. Do not apply in counties west of U.S. Highway 281. Do not rotate to wheat for 4.5 months; corn for 10 months; or alfalfa, canola, sunflower, or sorghum for 18 months after application. Do not apply additional fomasefen product in the same season and only use in alternate years.
S-metolachlor (15) + Metribuzin (5) 0.98 to 1.94 + 0.24 to 0.5	1.5 to 2.75 pt **Boundary 6.5E** or **Tailwind** or 1.75 to 3.8 pt **Moccasin MTZ+**	Boundary 6.5E is a premix of 5.25 lb *S*-metolachlor (Dual II Magnum) and 1.25 lb metribuzin/gal. Tailwind contains metolachlor instead of *S*-metolachlor. Moccasin MTZ+ is a premix of 3.35 lb *S*-metolachlor and 1.1 lb metribuzin/gal. Apply preplant within 14 days ahead of planting or preemergence. Lower use rates are effective in a two-pass planned program ahead of a postemergence treatment. May be tank mixed with glyphosate, paraquat, or 2,4-D for enhanced burndown control in no-till. Do not use on soils with pH above 7.5 or less than 0.5% organic matter. Follow directions regarding rates, cropping limitations, and precautions on product labels.
Metribuzin (5) 0.38 to 0.75	0.5 to 1 lb **Metribuzin*** 750F or 12 to 24 oz **Metribuzin** 4F	Apply preplant up to 30 days before planting or preemergence to soybean. A sequential or "split-shot" treatment with one application up to 30 days preplant followed by a preemergence application often provides the best results. Add COC to enhance burndown of emerged weeds in no-till. Controls broadleaf weeds more effectively than grasses. Metribuzin (Sencor) has a narrow margin of safety. Plant seed at least 1.5 inches deep. Do not use on loamy sand or sandy loam with less than 2% organic matter. Do not allow grazing or feed forage from treated fields within 40 days. Can be tank mixed with other burndown or residual herbicides for broader spectrum weed control.
Paraquat (22) 0.5 to 1	2 to 4 pt **Gramoxone SL**	A restricted-use pesticide. Apply to control emerged weeds before or after soybean planting but before crop emergence. Always apply with NIS. Dust on plants can inactivate Gramoxone SL. Can be tank mixed with 2,4-D or various residual herbicides. Tank mixes with Sencor will increase burndown by Gramoxone SL.
Pendimethalin (3) + metribuzin (5) 0.66 to 1 + 0.25 to 0.38	29 to 44 oz **Tripzin ZC**	Tripzin ZC is a premix of 2.9 lb pendimethalin and 1.1 lb metribuzin/gal. Can be applied preplant incorporated through preemergence for residual grass and broadleaf weed control. Do not use on sand soils. Do not use on loamy sand or sandy loam soils with less than 1 % organic matter. Do not use on soils with pH greater than 7.5 or less than 0.5% organic matter. Follow directions regarding rates, cropping limitations, and precaution on product label.

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Herbicides for Soybean

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Pendimethalin (3) 0.5 to 1.5	1.2 to 3.6 pt **Pendimethalin 3.3*** or 1.5 to 3 pt **Prowl H_20, Sattelite, Hydrocap** or **Sattelite Flex**	Controls grasses more effectively than broadleaf weeds. Apply preplant incorporated up to 60 days before planting, preplant surface up to 45 days before planting, or preemergence. Can be surface applied or incorporated. Often tank mixed with other herbicides for enhanced broadleaf weed control. Use the lower rates on coarse-textured, lower-organic matter soils and the higher rates on fine-textured, high-organic matter soils.
Pyroxasulfone (15) 0.08 to 0.19	1.5 to 3.5 oz **Zidua** or 2.5 to 5.75 oz **Zidua SC**	Provides residual control of grasses and certain broadleaf weeds. Apply preplant up to 45 days before planting or preemergence. Use the lower rates on coarse-textured soils and the higher rates on fine textured soils. Early preplant applications more than 15 days before planting are not recommended on coarse-textured soils or in higher-rainfall areas. Do not apply more than 2.1 oz/a Zidua or 3.5 oz Zidua SC on coarse-textured soils, 3.0 oz/a Zidua or 5.0 oz Zidua SC on medium-textured soils, or 3.5 oz/a Zidua or 5.75 oz Zidua SC on fine-textured soils per crop season. Does not provide control of emerged weeds. Soybean and corn can be replanted any time after Zidua application. Do not plant wheat or cotton for 4 months; sorghum for 6 to 12 months; alfalfa for 10 months; small grains other than wheat for 11 months; or any other crop for 18 months after Zidua application.
Pyroxasulfone (15) + Fluthiacet (14) 0.065 to 0.18 + 0.002 to 0.005	2 to 5.5 oz **Anthem Maxx**	Apply preplant or preemergence for residual grass and broadleaf weed control and burndown of some small broadleaf weeds. Use lower rates on coarse textured low organic matter soils and higher rates on fine texture high organic matter soils. Do not plant wheat for 1 to 6 months; sunflower for 4 months; sorghum for 6 to 10 months; alfalfa for 10 months; canola for 12 to 18 months; or other crops not listed on the label for 18 months after application.
Pyroxasulfone + Saflufenacil + Imazethapyr 0.11 + 0.023 + 0.063	6 oz **Zidua PRO**	Zidua PRO is a pre-mix containing 2.38 lb pryoxasulfone, 0.048 lb saflufenacil, and 0.33 lb imazethapyr per gallon. Provides burndown and residual control of grass and broadleaf weeds. Can be applied in the fall, preplant or preemergence on most soils, but should be applied at least 30 days prior to planting on coarse-textured soils with less than 2% organic matter. Do not apply after soybean begins to break through the surface of the soil. For optimum burndown activity, apply with MSO at 1% v/v, but not less than 1 pt/a, plus 1.25 to 2.5% v/v liquid UAN fertilizer, or AMS at 8.5 to 17 lb/100 gal of spray solution. Do not apply Pursuit or other imazethapyr products for the remainder of the growing season. Do not apply as a tank mix or sequentially with other PPO-inhibiting herbicides such as sulfentrazone, flumioxazin, or fomesafen within 30 days of soybean planting. Postemergence PPO-inhibiting herbicides such as FlexStar, Cobra, or Ultra Blazer can be applied 14 days after soybean emergence. Do not plant wheat for 4 months; corn for 8.5 months; Clearfield sunflower for 9.5 months; alfalfa for 10 months; Clearfield canola for 12 months; cotton, oats, sorghum, or sunflower for 18 months, or other crops for 40 months and a successful field bioassay following application. Refer to the herbicide label for maximum cumulative rates of saflufenacil and pyroxasulfone per cropping season.
Saflufencil (14) 0.022 to 0.044	1 to 2 oz (fall) 1 to 1.5 oz (spring) **Sharpen**	Provides burndown and a short period of residual control of many broadleaf weeds, including marestail and pigweed species. Can be applied up to 2 oz/a as a fall treatment to control marestail and winter annual mustards. Can be applied at 1.5 oz/a at least 14 days prior to planting on medium and fine textured soils, but should be applied at least 30 days prior to planting on coarse-textured soils with less than 2 percent organic matter. Can be applied at 1 oz/a in the spring preplant or preemergence on most soils, but should be applied at least 30 days before planting on coarse-textured soils with less than 2% organic matter. Separate sequential applications by at least 30 days. Total seasonal use should not exceed 4 oz/acre. Do not apply after soybean begins to break through the soil surface. Apply with MSO at 1% v/v but not less than 1 pt/a, plus 1.25 to 2% v/v liquid UAN fertilizer, or AMS at 8.5 to 17 lb/100 gal spray solution. Do not apply as a tank mix or sequentially with other PPO-inhibiting herbicides such as sulfentrazone, flumioxazin, or fomesafen within 14 days of soybean planting on medium- and fine-textured soils and 30 days of planting on coarse-textured soils with less than 2% organic matter. Postemergence PPO-inhibiting herbicides such as Flexstar, Cobra, and Ultra Blazer can be applied 14 days after soybean emergence.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Soybean

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Saflufencil (14) + Dimethenamid-P (15) 0.022 to 0.044 + 0.195 to 0.39	5 to 10 oz (fall) 5 to 7.5 oz (spring) **Verdict**	Provides burndown and a short period of residual control of many broadleaf weeds, including marestail and pigweed species. Also provides a very short period of residual grass control, but does not control emerged grasses. Can be applied up to 10 oz/a as a fall treatment for control of marestail and winter annual mustards. Spring application at 7.5 oz should be made at least 30 days prior to planting on coarse-textured soils with less than 2% organic matter and at least 14 days prior to planting on other soils. Can be applied at 5 oz/a in the spring preplant or preemergence on most soils, but should be applied at least 30 days before planting on coarse-textured soils with less than 2% organic matter. Sequential applications must be separated by at least 30 days. Do not apply more than 0.089 lb of safluenacil per acre (cumulative) per cropping season from all product sources, including Sharpen. Do not apply after soybean begins to break through the soil surface. For optimum burndown control, apply with MSO at 1% v/v but not less than 1 pt/a, plus 1.25 to 2% v/v liquid UAN fertilizer, or AMS at 8.5 to 17 lb/100 gal spray solution. Do not apply as a tank mix or sequentially with other PPO-inhibiting herbicides such as sulfentrazone, flumioxazin, or fomesafen within 14 days of soybean planting on medium- and fine-textured soils and 44 days of planting on coarse-textured soils with less than 2% organic matter. Postemergence PPO-inhibiting herbicides such as Flexstar, Cobra, and Ultra Blazer can be applied 14 days after soybean emergence.
Sulfentrazone (14) 0.14 to 0.375	4.5 to 12 oz **Spartan, Blanket, Shutdown, Sulfin,** or **Antares**	Apply preplant or preplant incorporated up to 60 days before planting or preemergence to soybean. Add COC for enhanced burndown of existing weeds in no-till. Controls yellow nutsedge and several broadleaf weeds including pigweeds, morningglory, and black nightshade. Do not rotate to wheat for 4 months; field corn for 10 months; sorghum for 10 to 18 months; or alfalfa for 12 to 18 months after application.
Sulfentrazone (14) + Carfentrazone (14) 0.14 to 0.21 + 0.016 to 0.023	5.75 to 8.5 oz **Spartan Charge**	Apply in the fall, preplant, or preemergence to soybean for burndown and residual control of pigweeds, kochia, and other broadleaf weeds. The lower rates are for coarse-textured soils with low organic matter, and the higher rates are needed on fine-textured soils with higher organic matter content. May be tank mixed with glyphosate for improved grass burndown activity, or with 2, 4-D or dicamba for improved broadleaf control.
Sulfentrazone (14) + Chlorimuron (2) 0.12 to 0.37 + 0.015 to 0.047	3 to 9.6 oz **Authority XL**	Authority XL is a premix containing 62% sulfentrazone and 7.8% chlorimuron. Can be applied preplant in the fall or spring or preemergence until 3 days after planting for residual broadleaf control and some grass suppression. The low rates are recommended primarily as a foundation treatment ahead of a broad-spectrum postemergence treatment in herbicide-resistant soybean. Higher rates are recommended for use on conventional soybean or where herbicide-resistant weeds are present. Do not use on soils with greater than 7.6 pH. If soil pH is less than 7.2, or low rates are used, do not rotate to wheat for 4 months; sorghum or corn for 10 months; oats or alfalfa for 12 months; cotton or sunflower for 18 months; or canola for 36 months after application. If soil pH is 7.2 to 7.6 and higher rates are used, do not rotate to wheat for 4 months; sorghum, corn, oats, alfalfa, cotton, or sunflower for 18 months; or canola for 36 months after application.
Sulfentrazone (14) + Chlorimuron (2) 0.19 to 0.37 + 0.012 to 0.023	5 to 9.6 oz **Authority Maxx**	Authority Maxx is a premix containing 62% sulfentrazone and 3.9% chlorimuron that is more suitable for some areas than Authority XL. Can be applied preplant in the fall or spring, or preemergence until 3 days after planting for residual broadleaf weed control and some grass suppression. The lower rates are for coarse-textured soils with low organic matter, and higher rates are needed on fine-textured soils with higher organic matter content. Do not apply to soils with a pH greater than 7.6. Do not rotate to wheat or barley for 4 months; field corn for 10 months; oats or alfalfa for 12 months; sorghum for 10 to 18 months; cotton for 12 to 18 months; sunflower for 18 months; of canola for 36 months after application. Do not feed treated soybean forage or hay to livestock

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Soybean

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Sulfentrazone (14) + Imazethapyr (2) 0.10 to 0.31 + 0.02 to 0.063	4 to 12 oz **Authority Assist**	Authority Assist is a premix containing 3.33 lb sulfentrazone and 0.67 lb imazethapyr/gal. Can be applied preplant in the fall or spring or preemergence until 3 days after planting. Provides more grass control or suppression than Authority First or Authority MTZ. Higher rates are recommended for use on conventional soybean or where herbicide-resistant weeds are present. Do not rotate to wheat for 4 months; corn for 10 months; alfalfa for 12 months; oat, cotton, sorghum, or sunflower for 18 months; or canola for 40 months after application. Do not feed soybean forage, hay, or straw to livestock.
Sulfentrazone (14) + Metribuzin (5) 0.135 to 0.225 + 0.20 to 0.34	12 to 20 oz **Authority MTZ**	Authority MTZ is a premix of 27% metribuzin and 18% sulfentrazone. Can be applied preplant in the fall or spring or preemergence until 3 days after planting. Primarily controls yellow nutsedge and broadleaf weeds including kochia, waterhemp, Palmer amaranth, morningglory, velvetleaf, and black nightshade. Do not use on coarse-textured soils or soils with less than 1% organic matter. Do not rotate to wheat for 4 months; corn for 4 to 10 months; alfalfa, sorghum, or sunflower for 12 months; cotton for 18 months; or canola for 24 months after application.
Sulfentrazone (14) + pyroxasulfone (15) 0.098 to 0.187 + 0.098 to 0.187	6 to 11.5 oz **Authority Supreme**	Authority Supreme is a premix containing 2.08 lb of sulfentrazone + 2.08 lb of pyroxasulfone/gal. It may be applied in the fall before planting or spring up to 3 days after planting as a preemergence residual treatment for control of annual grasses and many broadleaf weeds including pigweeds, kochia, morningglory, and lambsquarters. The lower rates are for coarser textured soils with low organic matter, and the higher rates are needed on fine-textured soils with higher organic matter content. Do not apply more than 6.9 oz per year on coarse textured soils. Do not use on sand soils with less than 1% organic matter. Do not plant wheat or corn for 4 months; sorghum for 10 months; triticale rye, or barley for 11 months; alfalfa or oats for 12 months; cotton for 12 to 18 months; or canola for 24 months after application.
Sulfentrazone (14) + *S*-metolachlor (15) 0.10 to 0.17 + 0.99 to 1.67	19 to 32 oz **Authority Elite** or **Broadaxe XL**	Authority Elite is a premix containing 0.7 lb sulfentrazone and 6.3 lb *S*-metolachlor/gal. Can be applied in the spring as a preplant or preemergence treatment up to 3 days after planting for residual control of grass and small seeded broadleaf weeds. The lower rates are for coarse-textured soils with low organic matter, and higher rates are needed on fine-textured soils with higher organic matter content. Do not use on sandy soils with less than 1% organic matter. Do not rotate to wheat, barley, or triticale for 4.5 months; field corn or sorghum for 10 months; canola, oats, or alfalfa for 12 months; or cotton for 12 to 18 months after application. Do not graze or feed treated soybean forage, hay, or straw to livestock for 30 days after application.
Thifensulfuron (2) 0.014 to 0.028	0.45 to 0.9 oz **Harmony SG** or 0.3 to 0.6 oz **Unity** or **Harass**	Apply preplant until prior to soybean emergence for burndown of certain broadleaf weeds. Generally applied as a tank mix with other burndown herbicides such as 2,4-D or glyphosate for broader spectrum weed control. Apply with NIS or COC plus ammonium nitrogen fertilizer additives.
Thifensulfuron (2) + Chlorimuron (2) 0.004 to 0.013 0.013 to 0.04	1 to 3 oz **Synchrony XP**	Provides preplant burndown and/or residual control of small broadleaf weeds depending on the rate of application. Rates less than 1 oz/a are generally recommended only for tank mixes with glyphosate and will provide minimal residual weed control. Do not use rates higher than 1 oz/acreccre on soils with a pH greater than 7.0. Generally tank mixed with 2,4-D for enhanced broadleaf weed control and/or with glyphosate for enhanced grass and broadleaf weed control. Apply with COC plus nitrogen fertilizer solution additives when applied alone or with 2,4-D. Apply with NIS plus AMS when tank mixed with glyphosate. Do not rotate to wheat for 4 months; corn for 9 to 12 months; or sunflower for 18 months after treatment. Consult the herbicide label for more specific crop rotation and use guidelines.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Soybean

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Trifluralin (3) 0.5 to 1	1 to 2 pt **Trifluralin 4E***	Controls grasses more effectively than broadleaf weeds. Apply before planting and incorporate into the top 2 to 3 inches of soil within 24 hours. Usually controls shattercane. Can be applied through chemigation system when followed by 0.5 to 1 inch of irrigation to incorporate.
2,4-D (4) 0.38 to 1	0.75 to 2 pt of 4 lb/gal **2,4-D***	Apply 0.75 to 1 pt/a ester formulations 7 or more days before planting, 0.75 to 1 pt/a amine formulations or 1-2 pt ester formulations 15 days or more before planting, or 1 to 2 pt/a amine formulations 30 days or more before planting for control of emerged broadleaf weeds. Ester formulations generally provide better weed control with less risk of carryover injury to soybean than amine formulations. Often tank mixed with other herbicides for enhanced broadleaf weed control. May be especially cost-effective as a fall treatment for control of winter annual broadleaf weeds ahead of no-till soybean planted the following spring.
POSTEMERGENCE		
Acetochlor (15) 0.94 to 1.5	1.25 to 2 qt **Warrant**	Warrant is an encapsulated formulation of acetochlor. Used primarily as a tank mix with postemergence herbicides to provide residual control of certain annual grass and broadleaf weeds. Does not control emerged weeds. Apply after emergence but before the R2 stage of soybean. Do not graze or feed treated forage to livestock.
Acetochlor (15) + Fomesafen (14) 1.06 to 0.24	3 pt **Warrant Ultra**	Warrant Ultra is a premix of 2.82 lb acetochlor (Warrant) and 0.63 lb fomesafen (Reflex)/gal. Apply postemergence up to the R2 stage of soybeans for residual control of small-seeded grasses and broadleaf weeds and foliar control of certain small broadleaf weeds. Apply with oil concentrate or NIS for control of emerged broadleaf weeds. Do not apply in counties west of US Highway 281. Do not rotate to wheat for 4 months; corn for 10 months; or alfalfa, grain sorghum, or sunflower for 18 months after application.
Acifluorfen (14) 0.25 to 0.38	1 to 1.5 pt **Ultra Blazer** and others	A contact herbicide that controls many broadleaf weeds. Apply when seedling weeds are in the 4- to 6-leaf stage and growing actively. Apply with NIS. Ultra Blazer can burn, bronze, or crinkle some soybean leaves. Soybean outgrows this condition, and new growth develops normally. Do not apply within 50 days of harvest. Do not use treated plants for feed or forage.
Acifluorfen (14) + Bentazon (6) 0.25 + 0.5 to 1.0	1 pt **Ultra Blazer** + 1 to 2 pt **Basagran**, or 1.5 pt **Storm**	A combination of Ultra Blazer and Basagran can be used for control of annual broadleaf weeds. Storm is a premix of 2.67 lb bentazon and 1.33 lb acifluorfen/gal. Apply before seedling weeds reach size limits listed on the label. Apply with NIS. For improved velvetleaf control, apply with COC or with 1 gal 28% nitrogen solution/acre.
Bentazon (6) 0.5 to 1.0	1 to 2 pt **Basagran** or **Broadloom,** or 0.8 to 1.6 pt **Basgrain 5L**	Controls many broadleaf weeds. Apply when weeds are small and actively growing but before they reach size limits listed on the label. Apply with COC or MSO at 1% v/v and AMS at 8.5 to 17 lb/100 gal water or UAN at 1.25 to 2.5 gal/100 gal water.
Chlorimuron (2) 0.008 to 0.012	0.5 to 0.75 oz **Classic**	Controls annual broadleaf weeds. Apply to small, actively growing weeds through the 3 trifoliate-leaf stage of soybean. Apply with surfactant. Wheat or barley can be planted after 3 months and corn or sorghum after 9 months, except where Classic is applied after Canopy (15 months). Can be tank mixed with 2,4-DB to increase morningglory control or with glyphosate (Roundup Ready soybean only) for broad-spectrum weed control. Some pigweed species, such as waterhemp and Palmer amaranth, have developed resistance to Classic and other herbicides having the same mode of action. Management strategies such as alternative control methods, crop rotation, and using herbicides with a different mode of action to replace or supplement Classic in a tank mix need to be considered in areas that may have resistant weed biotypes. Do not allow grazing or harvest for forage.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Soybean

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Clethodim (1) 0.05 to 0.25	4 to 16 oz **Select**, **Arrow,** or **Tapout,** or 6 to 16 oz **Select Max** or 2.67 to 10.67 oz **Section Three**	Controls many annual and perennial grasses. Apply when grasses are growing actively but before they reach size limits listed on the label. The lowest application rates are primarily for control of volunteer Roundup Ready corn less than 12 inches tall. Apply Select and comparable products with COC at 1% v/v. Apply Select Max with COC at 1% v/v or NIS at 0.25% v/v plus AMS at 2.5 to 4 lb/acre. Tank mixing with broadleaf herbicides can reduce grass control, which can be compensated for by increasing the rate by 2 oz/acre. Do not apply within 60 days of harvest. Do not allow grazing or use treated plants for feed or forage.
Cloransulam (2) 0.016 to 0.032	0.3 to 0.6 oz **FirstRate**	Controls certain broadleaf weeds. Apply with NIS, COC, or MSO plus UAN fertilizer solution when weeds are at the 2- to 4-leaf stage and actively growing. Can be tank mixed with Basagran, Ultra Blazer, Cobra, Reflex, Pursuit, Assure II, Fusion, Poast Plus, Select, or glyphosate (Roundup Ready soybean only). Wheat can be planted after 4 months; and alfalfa, corn, sorghum, or cotton can be planted 9 months after application. Do not plant any other crop until 30 months after application and completion of a field bioassay. Do not apply through a chemigation system. Refer to supplemental label for aerial application.
Dicamba (4) 0.5	22 oz **Xtendimax** or **FeXapan,** or 12.8 oz **Engenia**	Restricted use pesticides. Apply only to Xtend soybeans from emergence through the R1 growth stage but before 45 days after planting for control of susceptible broadleaf weeds less than 4 inches tall. Non-Xtend soybeans will be severely injured or killed. Should be part of a planned weed control program following residual preemergence herbicides. Some crops such as non-Xtend soybeans are extremely susceptible to off-site movement of dicamba, so follow label guidelines near susceptible crops and sensitive areas. Do not spray when wind is blowing in direction of neighboring susceptible crops, including non-Xtend soybeans, and observe buffer guidelines. Only spray between 1 hour after sunrise and 2 hours before sunset when wind speed is between 3 and 10 mph. Do not spray during a temperature inversion. Do not apply with ammonium sulfate, which greatly increases the risk of volatility and vapor drift. Consult labels and respective websites for additional application guidelines and approved tank-mix combinations: xtendimaxapplicationrequirements.com for Xtendimax; fexapanapplicationrequirements.dupont.com for FeXapan; or engeniatankmix.com for Engenia.
Dimethenamid-P (15) 0.56 to 0.98	12 to 21 oz **Outlook**	Generally applied as a tank mix with other postemergence herbicides to provide residual control of later-germinating small seeded grass and broadleaf weeds. Does not provide control of emerged weeds. Use the lower rates on coarse-textured soils and the higher rates on medium- and finer-textured soils. Can be applied anytime between soybean emergence and the 5-trifoliate growth stage. Do not graze or feed treated forage, hay, or straw to livestock. Outlook can be applied sequentially after preplant/preemerge applications of dimethenamid-P containing herbicides Outlook or Verdict. If sequential applications are separated by 14 or more days, 24 fl oz Outlook can be applied per season.
Fluazifop-P (1) 0.06 to 0.19	4 to 12 oz **Fusilade DX**	Controls many annual and perennial grasses including shattercane, volunteer corn, and rhizome johnsongrass. Apply with COC or NIS. Repeat treatment for regrowth of rhizome johnsongrass. Apply when grasses are small and growing actively but before they reach size limits listed on the label. Make last application before soybean bloom. Do not harvest plants for forage or hay. Tank mixing with broadleaf herbicides can reduce grass control.
Fluazifop-P (1) + Fenoxaprop (1) 0.06 to 0.22 + 0.02 to 0.07	4 to 14 oz **Fusion**	Controls many annual grasses including foxtails, shattercane, and volunteer corn. Apply with COC or NIS. Apply when grasses are small and growing actively but before they reach size limits listed on the label. Make last application before soybean begins to bloom. Tank mixing with broadleaf herbicides can reduce grass control. Do not harvest plants for forage or hay.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Soybean

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Flumiclorac (14) 0.013 to 0.081	2 to 12 oz **Resource**	Controls velvetleaf and certain other broadleaf weeds. Apply to small, actively growing weeds before they reach the size limits listed on the label. The 2 oz rate is primarily to enhance velvetleaf control in tank mixes with other broadleaf herbicides. Large velvetleaf can be controlled with the higher use rates. Always apply with COC and AMS. Resource is a contact herbicide and can cause temporary leaf burning or speckling, but new soybean growth is unaffected. Do not allow grazing or use treated soybean plants for feed or animal bedding.
Fluthiacet (14) 0.003 to 0.006	0.4 to 0.9 oz **Cadet**	Primarily for velvetleaf control and suppression of certain other small broadleaf weeds. The low rate is primarily to enhance velvetleaf control in tank mixes with other herbicides. Apply to soybean from emergence through the full flower stage of growth to control or suppress labeled weeds less than 2 inches tall. Large velvetleaf can be controlled with the higher use rates. Always use in combination with 0.25% v/v NIS or 1 to 2 pt/a COC. Cadet is a contact herbicide and can cause temporary leaf burning or speckling, but new soybean growth is unaffected.
Fluthiacet (14) + fomesafen (14) 0.0055 to 0.066 + 0.14 to 0.16	6 to 7.25 oz **Marvel**	Marvel is a premix containing 0.12 lb fluthiacet and 2.88 lb of fomesafen/gal for postemergence broadleaf weed control. Can be applied to soybeans up to the R3 stage for control of actively growing weeds less than 4 inches tall. Apply with NIS, COC, or MSO for optimal weed control. Do not use in counties west of U.S. Highway 281. Do not rotate to wheat, barley, rye, oats, or triticale for 4 months; field corn for 10 months; or sunflower, alfalfa, sorghum, cotton, or canola for 18 months after Marvel application. Do not feed treated soybean forage or hay to livestock.
Fomesafen (14) 0.19 to 0.25	0.75 to 1 pt **Reflex, Flexstar, Dawn,** or **Rhythm,** or 0.52 to 0.7 pt **Sinister**	A contact herbicide that controls many broadleaf weeds. Apply to small, actively growing weeds before they reach size limits listed on the labels (normally 2 to 3 weeks after planting). Apply with oil concentrate or NIS plus UAN or AMS. Fomesafen can cause temporary leaf speckling and burning, but new soybean growth is unaffected. Do not use Dawn, Rhythm, or Sinister in counties west of U.S. Highway 281. Do not apply Reflex or Flexstar after June 20 in counties west of highway 281. Do not rotate wheat for 4 months; corn for 10 months; or alfalfa, canola, sorghum or sunflowers within 18 months of application. Do not allow grazing or harvest treated soybean for forage or hay. Do not use if fomesafen was applied earlier in the season and use only in alternate years.
Fomesafen (14) + Glyphosate (9) 0.25 + 1 lb ae	3.5 pt **Flexstar GT 3.5**	Apply only to Roundup Ready soybean. Application to other soybean will result in severe injury or death of the crop. Flexstar GT 3.5 is a premix of 0.66 lb fomesafen (Flexstar) and 2.63 lb ae glyphosate/gal. Flexstar GT 3.5 provides broad-spectrum control of emerged weeds and residual control of certain broadleaf weeds, including pigweeds. Condition spray solution by adding 1 to 2% AMS (8.5 to 17 lb/100 gal water) before adding Flexstar GT 3.5 to the spray tank. Under adverse growing conditions or if a known population of glyphosate-resistant broadleaf weeds is present, add 1% v/v COC or MSO to the spray solution. Do not apply in counties west of U.S. Highway 281 or to fields previously treated with Prefix herbicide. Do not rotate to wheat for 4 months; corn for 10 months; or alfalfa, canola, grain sorghum, or sunflowers for 18 months after application.
Fomesafen (14) + *S*-metolachlor (15) 0.24 + 1	1 qt **Prefix**	Prefix is a premix containing 4.34 lb *S*-metolachlor (Dual Magnum) and 0.95 lb fomesafen (Reflex)/gal that provides residual grass control and foliar and residual control of certain broadleaf weeds such as waterhemp. May be applied postemergence in soybean up to 90 days prior to harvest. Premix may be tank mixed with glyphosate to provide residual weed control along with enhanced control of waterhemp. Add NIS at 0.25% v/v if the glyphosate brand does not contain a built-in adjuvant. Always add AMS at 8.5 to 17 lb/100 gal to the Prefix + glyphosate tank mix in glyphosate-resistant soybean. Necrotic spotting, leaf bronzing, leaf crinkling, or curling of soybean leaves may occur after a postemergence application. Do not use COC with the Prefix + glyphosate tank mix, or increased soybean injury may occur. Do not apply in counties west of U.S. Highway 281 in Kansas. Do not rotate to wheat for 4.5 months; corn for 10 months; or alfalfa, canola, grain sorghum, or sunflowers for 18 months after application.

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Herbicides for Soybean

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Glufosinate (10) 0.59 to 0.79	32 to 43 oz **Liberty** and others	Liberty is a nonselective herbicide for use only on soybean designated as Liberty Link. Application to other soybean varieties will result in severe injury or death of the crop. Apply to soybean from emergence until the bloom stage of growth for control of small, actively growing weeds less than 4 inches tall. Always condition spray water with spray-grade AMS at 1.5 - 3 lb/a before adding Liberty to the spray solution. Liberty is most effective with warm temperatures, high relative humidity, and bright sunlight. Application to stressed plants or late in the day may result in reduced weed control. Liberty has no residual activity, so two-pass weed control programs including a preemergence herbicide and postemergence tank-mix treatments with residual generally are required to achieve good weed control and minimize weed competition. Do not apply more than two applications of Liberty to Liberty Link soybean. If a new flush of weeds emerges or existing weeds are not adequately controlled, a second application can be applied 5 to 10 days after the first application. Do not apply more than 87 oz/a of Liberty per growing season. Do not graze or harvest the treated crop for hay.
Glufosinate (10) + *S*-metolachlor (15) 0.54 + 1.25	64 oz **Intermoc**	Intermoc is a premix containing 1.07 lb glufosinate and 2.5 lb *S*-metolachlor/gal. Apply only to soybean designated as Liberty Link or glufosinate resistant from emergence to the R1 stage of soybean development. Application to other soybean varieties will result in severe injury or death of the crop. Provides broad-spectrum postemergence control of small emerged weeds and residual control of certain grasses and small seeded broadleaf weeds. Add AMS at 8.5 to 17 lb/100 gal of water for enhanced weed control. Intermoc is most effective on emerged weeds with warm temperatures, high relative humidity, bright sunlight, and thorough spray coverage. Do not graze or feed treated forage, hay, or straw.
Glyphosate (9) 0.63 to 1.5 lb ae	1.5 to 4 pt of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	Apply only to Roundup Ready soybean from emergence through the R2 stage of growth. Application to other soybean varieties will result in severe injury or death of the crop. Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. Controls most annual and perennial weeds at the rates suggested on the label. To reduce selection pressure for glyphosate-resistant weeds, a foundation treatment with a residual herbicide is recommended. Glyphosate has no residual activity, so sequential applications or cultivation may be required for season-long control, especially in wide-row soybean. Condition spray solution with 1 to 2% spray-grade AMS by weight (8.5 to 17 lb/100 gal water) before adding glyphosate to the tank.
Glyphosate (9) + *S*-metolachlor (15) 0.68 to 0.95 lb ae + 1 to 1.4	2.5 to 3.5 pt **Sequence**	Apply only to Roundup Ready soybean. Application to other soybean varieties will result in severe injury or death of the crop. Sequence is a premix of 2.25 lb glyphosate and 3 lb *S*-metolachlor (Dual Magnum)/gal. Can be applied to soybean from emergence through the 3 trifoliate-leaf stage. Provides control of most emerged weeds and residual control of small-seeded grasses and some small-seeded broadleaf weeds. The addition of 2% AMS by weight or 17 lb/100 gal water can improve control of emerged weeds.
Imazamox (2) 0.031 to 0.039	4 to 5 oz **Raptor**	Controls many annual grasses and broadleaf weeds. Apply to small, actively growing weeds before they reach size limits listed on the label. Apply with NIS, COC, or MSO plus fertilizer solutions. Some weed species, such as Palmer amaranth, have developed resistance to Raptor and other herbicides having the same mode of action. Management strategies such as alternative control methods, crop rotation, and using herbicides with a different mode of action to replace or supplement Raptor in a tank mix need to be considered in areas that may have resistant weed biotypes. Do not rotate to wheat for 3 months or to corn; grain sorghum, and sunflower for 9 months after application. Raptor has no preharvest interval.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Soybean

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Imazethapyr (2) 0.063	4 oz **Pursuit**	Controls annual broadleaf weeds and grasses. Apply to small, actively growing weeds before they reach size limits listed on the label. Apply with NIS, COC, or MSO plus fertilizer solutions. Weed control with Pursuit has been enhanced more by MSO than by NIS or COC in research conducted at K-State. Some pigweed species, such as Palmer amaranth, developed resistance to Pursuit and other herbicides having the same mode of action. Management strategies such as alternative control methods, crop rotation, and using herbicides with a different mode of action to replace or supplement Pursuit in a tank mix need to be considered in areas that may have resistant weed biotypes. A tank mix with Cobra or Ultra Blazer improves control of pigweeds, ragweed, prickly sida, venice mallow, and copperleaf. Do not use other imazethapyr-containing products in the same crop season. Do not rotate to alfalfa or wheat for 4 months; field corn for 8.5 months; cotton, oat, sorghum, or sunflower for 18 months; or canola for 40 months after application. Do not allow grazing or feed treated soybean forage, hay, or straw.
Imazethapyr (2) + Fomesafen (14) 0.047 to 0.063 + 0.19 to 0.25	0.75 to 1 pt **Torment**	Torment is a premix containing 0.5 lb imazethapyr (Pursuit) and 2 lb fomesafen (Reflex)/gal. Apply early postemergence for control of actively growing weeds less than 3 inches tall. Apply with NIS or oil concentrate plus nitrogen fertilizer additives. Do not use in counties west of U.S. Highway 281. Cannot be used in fields previously treated with imazethapyr or fomesafen. Do not plant wheat for 4 months; corn for 10 months; alfalfa, cotton, oat, sorghum, or sunflower for 18 months; or canola for 40 months after application. Do not graze treated areas or harvest for forage or hay.
Imazethapyr (2) + Glyphosate (9) 0.063 + 0.56 lb ae or 0.031 + 0.75 lb ae	3 pt **Thunder Master**	Apply only to Roundup Ready soybean. Thunder Master is a premix of 0.17 lb imazethapyr (Pursuit) and 1.5 lb ae glyphosate/gal. Provides foliar and residual control of many grass and broadleaf weeds. Apply with NIS plus AMS. Do not use other imazethapyr-containing products in the same crop season. Do not rotate to alfalfa or wheat for 4 months; field corn for 8.5 months; cotton, oat, sorghum, or sunflower for 18 months; or canola for 40 months after application. Do not allow grazing or feed treated soybean forage, hay, or straw.
Lactofen (14) 0.16 to 0.2	10 to 12.5 oz **Cobra** or 10 to 12.5 oz **Phoenix**	A contact herbicide that controls many broadleaf weeds. Apply to small, actively growing weeds before they reach size limits listed on the labels (normally 2 to 3 weeks after planting). Apply with 1 pt/a COC when soybean is at the first or second trifoliate leaf stage. AMS or liquid nitrogen fertilizer can also be added for enhanced performance. Cobra can cause speckling, discoloration, cupping, or crinkling of leaves. Phoenix generally causes less soybean response than Cobra but also may be slightly less effective on certain weeds. Soybean outgrows these conditions, and new growth develops normally. Cobra can be especially helpful in controlling pigweed species. Palmer amaranth is more difficult to control and may require the high use rate and perhaps sequential applications, especially for larger plants. Do not use treated plants for feed or forage.
Pyroxasulfone (15) 0.08 to 0.19	1.5 to 3.5 oz **Zidua** or 1.75 to 5.57 oz **Zidua SC**	Generally applied as a tank-mix with other postemergence herbicides to provide residual control of later germinating grass and broadleaf weeds. Does not provide control of emerged weeds. Use the lower rates on coarse-textured soils and the higher rates on medium- and finer-textured soils. Can be applied to soybeans from emergence to third trifoliate leaf stage. If sequential applications are used, the maximum combined rate of Zidua that may be applied in a cropping season is 2.1 oz/a Zidua or 3.5 oz Zidua SC on coarse soils or 3.0 oz/a Zidua or 5.0 oz Zidua SC on medium-textured soils or 3.5 oz/a Zidua or 5.75 oz Zidua SC on fine-textured soils. Soybean and corn can be replanted anytime after Zidua application. Do not plant wheat or cotton for 4 months; alfalfa for 10 months; small grains other than wheat for 11 months; or any other crop for 18 months after Zidua application.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Soybean

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Pyroxasulfone (15) + Fluthiacet (14) 0.065 to 0.18 + 0.002 to 0.005	2 to 5.5 oz **Anthem Maxx**	Apply postemergence to soybeans through the 3 trifoliate stage for residual grass and broadleaf weed control and control of some small broadleaf weeds. Use lower rates on coarse textured low organic matter soils and higher rates on fine texture high organic matter soils. Do not plant wheat for 1 to 6 months; sunflower for 4 months; sorghum for 6 to 10 months; alfalfa for 10 months; canola for 12 to 18 months; or other crops not listed on the label for 18 months after application.
Quizalofop (1) 0.03 to 0.075	5 to 12 oz **Assure II** or **Targa**	Controls many annual and perennial grasses including shattercane, volunteer corn and wheat, and rhizome johnsongrass. Apply with 1% v/v COC or 0.25% v/v NIS. Slightly higher rates are recommended west of I-135. Tank mixing with broadleaf herbicides can reduce grass control.
S-metolachlor (15) 0.96 to 1.27	1 to 1.3 pt **Dual II Magnum, EverpreX, Charger Max,** or **Moccasin II Plus**	Generally applied as a tank-mix with other postemergence herbicides to provide residual control of later-germinating grass and broadleaf weeds. Does not provide control of emerged weeds. Can be applied to soybeans from emergence through the third trifoliate leaf stage. If sequential applications are used, the maximum combined rate of Dual II Magnum that may be applied in a cropping season is 2.5 pt/a. Do not plant alfalfa for 4 months or wheat or rye for 4.5 months after Dual II Magnum application. Do not graze or feed treated forage or hay to livestock within 30 days following application.
Sethoxydim (1) 0.1 to 0.28	0.75 to 2.25 pt **Poast Plus**	Controls annual and perennial grasses. Apply when grasses are growing actively but before they reach size limits listed on the label. Apply to annual grasses up to 8 inches, volunteer corn up to 20 inches, shattercane from 6 to 18 inches, and rhizome johnsongrass from 15 to 25 inches tall. Apply with COC. For improved control of volunteer corn, crabgrass, and rhizome johnsongrass, also apply with AMS at 2.5 lb/a or 28% UAN at 2 to 4 qt/acre. Do not apply within 75 days of harvest. Do not use treated plants for feed or forage. Tank mixing with broadleaf herbicides can reduce grass control.
Thifensulfuron (2) 0.004 to 0.016	0.125 to 0.5 oz **Harmony SG** or 0.083 to 0.33 oz **Unity**	Use only the lowest rate on non-STS soybean; higher rates should be used only on STS soybean. Primarily for control of lambsquarters, annual smartweeds, and velvetleaf at the 3- to 4-leaf stage. May be tank mixed with glyphosate in Roundup Ready soybean. Always apply with NIS and nitrogen fertilizer additives. Do not apply by chemigation. Do not feed forage from treated areas or allow livestock grazing within 7 days of application. Allow 30 days between application and feeding hay from treated areas to livestock.
Thifensulfuron (2) + Chlorimuron (2) 0.0016 to 0.0049 + 0.005 to 0.015	0.375 to 1.125 oz **Synchrony XP**	Use only the 0.375 oz rate on non-STS soybean. Rates above 0.375 should be used only on STS soybean. Controls several broadleaf weeds. Apply to small, actively growing weeds before they reach size limits listed on the label. Apply with COC plus nitrogen fertilizer solution. Some pigweed species, such as waterhemp and Palmer amaranth, have developed resistance to Synchrony and other herbicides with the same mode of action. Management strategies such as alternative control methods, crop rotation, and using herbicides with a different mode of action to replace or supplement Synchrony in a tank mix need to be considered in areas that may have resistant weed biotypes. Do not plant wheat for 3 months; corn, sorghum, or cotton for 9 months; alfalfa for 12 months; or sunflower or canola for 18 months after treatment.
2,4-DB (4) + tank mix partner 0.03	2 oz **Butyrac 200** or **2,4-DB 200**	Applied as a tank mix partner with other broadleaf herbicides to enhance control of morningglory, cocklebur, and other broadleaf weeds, particularly with late applications.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Soybean

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
DIRECTED POSTEMERGENCE		
Paraquat (22) 0.125 to 0.5	8 to 32 oz **Gramoxone SL**	A restricted-use pesticide. Apply spray between the rows with a hooded or shielded sprayer to prevent spray contact with soybean plants. Severe crop injury can occur if spray is allowed to come in direct contact with soybean plants. Apply with NIS at 0.5% v/v. Use the higher labeled rates on larger or hard-to-control weed species. Do not graze or harvest for forage or hay.
FOR SPOT TREATMENT ONLY		
Clethodim (1)	2 qt **Select** and others*/100 gal	For control of annual and perennial grasses, apply as a spot treatment until vegetation is uniformly wet but not to the point of spray runoff. Always apply with COC.
Fluazifop-P (1)	2 qt **Fusilade DX**/100 gal	Apply as spot treatment before bloom for control of annual and perennial grasses, including shattercane and rhizome johnsongrass. Treat again if necessary. Always apply with COC or NIS. Do not allow grazing of treated area or harvest for hay. Do not plant crops such as corn, sorghum, or cereals within 60 days after last application.
Glyphosate (9)	1 to 2 gal **Glyphosate***/100 gal or 1.33 to 2.67 oz **Glyphosate***/gal spray solution	Apply as spot treatment to control annual and perennial grasses, including shattercane and rhizome johnsongrass. Non-Roundup Ready soybean treated with glyphosate will be severely injured. Use the lower rates for control of small annual weeds and the higher rates for control of perennial weeds. Do not allow grazing of treated area or harvest for hay. Do not plant crops such as corn, sorghum, or cereals within 60 days after last application.
Quizalofop (1)	3 pt **Assure II**/100 gal water	Use as a spot treatment to control annual species like volunteer corn and perennials such as rhizome johnsongrass. Always apply with COC or NIS. Apply on a "spray to wet" basis.
Sethoxydim (1)	1.5 to 2.25 gal **Poast Plus**/100 gal water	Apply 1.5 to 2.25% solution as a spot treatment to control annual and perennial grasses. Always apply with COC or MSO. Apply spray for complete and uniform coverage but not to the point of runoff. Do not make more than one spot treatment in a given area per season. Do not apply broadcast and spot treatments in the same area in the same season.

RECIRCULATING, ROLLER, AND ROPE-WICK APPLICATIONS

Apply glyphosate in an applicator to actively growing, susceptible weeds after they are a minimum of 6 inches above soybean. Better results may be obtained if two applications are made in opposite directions. Operate equipment at ground speeds of less than 5 mph. Follow all label directions, warnings, and precautions.

Applicator	Gallons Glyphosate*:Water	Comments
Recirculating sprayer	0.5:20	Controls volunteer corn and shattercane.
Recirculating sprayer	0.75:20	Controls volunteer corn, shattercane, cocklebur, pigweed, sunflower, and johnsongrass.
Recirculating sprayer	1:20	Controls weeds listed above and suppresses milkweed and hemp dogbane.
Roller	1:19	A 5% solution for control of volunteer corn and shattercane.
Roller	1:9	A 10% solution for control of volunteer corn and shattercane. Suppresses johnsongrass, pigweed, giant ragweed, sunflower, velvetleaf, milkweed, and hemp dogbane.
Rope wick	1:2	This 33% solution in a rope wick should provide similar weed control to a 10% solution in the roller.

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Herbicides for Soybean

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
APPLICATION THROUGH SPOT SPRAYERS		
Apply glyphosate with a directed stream to actively growing weeds. Applications in soybean must be made before pod set. Best results are obtained when at least three leaves of the weeds are contacted with the directed spray. Apply glyphosate:water at 1:20 gal. Controls cocklebur, velvetleaf, sunflower, shattercane, and other weeds. Non-Roundup Ready soybean treated with glyphosate will be severely injured. Follow label directions.		
HARVEST AIDS		
Carfentrazone (14) 0.016 to 0.023	1 to 1.5 oz **Aim EC**	For desiccation of susceptible broadleaf weeds. Apply after soybean reaches maturity but at least 3 days before harvest. Always apply with 1% v/v COC in a minimum spray volume of 5 gal/a for aerial application or 10 gal/a for ground application. Do not exceed a total of 1.5 oz/a during the growing season.
Diquat (22) 0.38 to 0.5	1.5 to 2 pt **Reglone/Diquat**	Use on seed crop only. For preharvest desiccation of foliage, apply 1 week before harvest. Do not allow grazing of treated areas or feed treated forage. Do not use seed from treated plants for food, feed, or oil.
Glyphosate (9) 0.75 to 1.5 lb ae	1 to 2 qt of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	For control of broadleaf and grass weeds that can interfere with harvest, apply with ground or aerial equipment after soybean pods have lost all green color and at least 7 days before harvest. Glyphosate products vary in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. Do not allow grazing or feed treated crop to livestock within 25 days of treatment. Do not apply to soybean being harvested for use as seed.
Paraquat (22) 0.125 to 0.25	8 to 16 oz **Gramoxone SL**	For desiccation of crop and weed foliage to help facilitate harvest. Apply after soybean reaches physiological maturity and seed moisture is 30% or less and at least 15 days prior to harvest. Always apply with 0.25% v/v NIS or a 1% v/v COC. Do not graze or harvest treated fields for forage or hay.
Saflufenacil (14) 0.022 + 0.063 + 0.47	1 to 2 oz **Sharpen**	Apply by ground or aerial application to desiccate soybeans and/or weeds to help facilitate earlier harvest. Apply when soybeans have 65% brown pods, 70% leaf drop, and seed moisture is below 30%. Always apply with MSO at 1 pt/a and 1 to 2% ammonium sulfate by weight (8.5 to 17 lb/100 gal water). Use a minimum spray volume of 5 gpa for aerial application and 10 gpa for ground application. Allow a minimum of 3 days between application and soybean harvest.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Sunflower

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Ethalfluralin (3) 0.56 to 1.125	1.5 to 3 pt **Sonalan**	Controls grasses more effectively than broadleaf weeds. Apply before planting and incorporate within 48 hours. Can control shattercane.
Glyphosate (9) 0.38 to 0.75 lb ae	1 to 2 pt of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	Apply to control emerged weeds before or after sunflower planting but before crop emergence. Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. Condition spray solution with 1 to 2% spray-grade AMS by weight (8.5 to 17 lb/100 gal water) before adding glyphosate to the tank.
Halauxifen (4) 0.0045	1 oz **Elevore**	Apply at least 14 days prior to planting sunflower for control of emerged marestail, henbit, wild garlic, and other broadleaf weeds listed on the label. Often tank-mixed with other herbicides for broader spectrum weed control. Apply with COC or MSO at 0.5 to 1 % v/v. Do not plant corn, sorghum, soybeans, sunflowers, wheat or canola for 14 days; cotton for 30 days; alfalfa for 8 months; or other crops not listed on the label for 15 months after application.
S-metolachlor (15) 0.95 to 1.91	1 to 2 pt **Brawl, Dual Magnum, EverpreX, Medal, Charger Basic,** or **Moccasin II Plus**	Controls grasses and some small-seeded broadleaf weeds preemergence. Can be applied from 30 days before planting to crop emergence. Can be incorporated shallowly, but deep incorporation or excessive soil disturbance at planting may result in poor weed control. Use lower rates on coarse soils with low organic matter and the higher rates on fine textured soils with higher organic matter. Do not allow livestock to graze or feed in treated area.
Paraquat (22) 0.63 to 1	2.5 to 4 pt **Gramoxone SL**	A restricted-use pesticide. Apply before crop emergence for control of emerged weeds. Paraquat is a contact herbicide and does not have soil activity. Always apply with NIS to 0.5% v/v.
Pendimethalin (3) 0.5 to 1.5	1.2 to 3.6 pt **Pendimethalin 3.3*,** or 1.5 to 3 pt **Prowl H_2O, Sattelite Hydrocap** or **Sattelite Flex**	Controls grass weeds more effectively than broadleaf weeds. Refer to soybean weed-response table for weeds controlled with Prowl. Pendimethalin can be applied from 60 days before planting until 2 days after planting. Sunflowers should be planted at least 1.5 inches deep and completely covered with soil. Incorporation generally improves weed control in conventional tillage systems. Extremely cool, wet weather following application and sunflower planting can result in problems with sunflower emergence and injury. Do not feed forage or allow livestock to graze in treated fields.
Pyroxasulfone (15) 0.053 to 0.21	1 to 4 oz **Zidua**	Apply preplant or preemergence for residual control of grasses and small seeded broadleaf weeds. Use the lower rates on coarse textured soils and the higher rates on fine textured soils as recommended on the label. Does not control emerged weeds. Do not incorporate. Do not plant wheat or cotton for 4 months; sorghum for 6 to 12 months; alfalfa for 10 months; small grains other than wheat for 11 months; or any other crop for 18 months after Zidua application.
Sulfentrazone (14) 0.094 to 0.25	3 to 8 oz **Spartan 4F, Blanket, Shutdown,** or **HM-1512 Ag**	Apply in the fall, preplant, or preemergence to sunflower for control of pigweeds, kochia, Russian thistle, and certain other broadleaf weeds. The lower rates are for coarse-textured soils with low organic matter, and the higher rates are needed on fine-textured soils with higher organic matter content. Preplant treatments 14 days or more before planting have generally provided better weed control and crop tolerance than preemergence applications at planting time.
Sulfentrazone (14) + Carfentrazone (14) 0.07 to 0.21 + 0.008 to 0.023	3 to 8.5 oz **Spartan Charge**	Apply in the fall, preplant, or preemergence to sunflower for burndown and residual control of pigweeds, kochia, and other broadleaf weeds. The lower rates are for coarse-textured soils with low organic matter, and the higher rates are needed on fine-textured soils with higher organic matter content. May be tank mixed with glyphosate for improved grass burndown activity.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Sunflower

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Sulfentrazone (14) + *S*-metolachlor (15) 0.10 to 0.15 + 0.94 to 1.90	19 to 38.7 oz **Broadaxe XC, Spartan Elite,** or **Authority Elite**	Apply in the fall, preplant, or preemergence for residual control many grass and broadleaf weeds. The lower rates are for coarse-textured soils with low organic matter, and higher rates are needed on fine-textured soils with higher organic matter content. May be tank mixed with glyphosate for improved grass burndown activity.
Sulfentrazone (14) + pyroxasulfone (15) 0.098 to 0.187 + 0.098 to 0.187	6 to 11.5 oz **Authority Supreme**	Authority Supreme is a premix containing 2.08 lb of sulfentrazone and 2.08 lb of pyroxasulfone/gal. It may be applied in the fall before planting or spring up to 3 days after planting as a preemergence residual treatment for control of annual grasses and many broadleaf weeds including Palmer amaranth, waterhemp, kochia, Russian thistle, and lambsquarters. The lower rates are for coarser textured soils with low organic matter, and the higher rates are needed on fine-textured soils with higher organic matter content. Do not plant wheat or corn for 4 months; sorghum for 10 months; triticale rye, or barley for 11 months; alfalfa or oats for 12 months; cotton for 12 to 18 months; or canola for 24 months after application.
Trifluralin (3) 0.5 to 1	1 to 2 pt **Trifluralin 4E***	Controls grasses more effectively than broadleaf weeds. Apply before planting and incorporate within 24 hours. Can control shattercane.
Clethodim (1) 0.07 to 0.25	6 to 16 oz **Select, Arrow**, **Avatar, Dakota, Intensity, Section, Tapout, Shadow, Clethodim, Cleanse, Volunteer,** or **Tapout,** or 9 to 16 oz **Select Max**	Controls annual and perennial grasses. Apply when grasses are actively growing but before they exceed size limits listed on the label. Apply Select and comparable products with COC at 1% v/v. Apply Select Max with NIS at 0.25% v/v, or COC at 1% v/v plus AMS at 2.5 to 4 lb/acre. Weed control is reduced if applied when grasses are under drought stress. Do not apply within 70 days of harvest. Do not allow grazing or use treated plants for feed or forage.
Imazamox (2) 0.031	4 oz **Beyond**	Apply to Clearfield sunflower only. Can be applied up to 6 oz/a on Clearfield Plus hybrids. Beyond will severely injure or kill non-Clearfield sunflower. Can be applied from the V2 through the V8 stage of sunflower for control of susceptible broadleaf weeds before they exceed 3 inches and susceptible grasses before they exceed the 4- to 5-leaf stage. Apply with NIS and nitrogen fertilizer additives. MSO may be used instead of NIS on Clearfield Plus sunflowers. May not control ALS-resistant kochia, pigweed, or shattercane biotypes. Temporary yellowing of sunflower plants may occur shortly after application of Beyond, especially when applied to crops growing under environmental stress. Do not plant corn, sorghum, cotton, or sunflower within 9 months of Beyond application.
Pyroxasulfone (15) 0.053 to 0.11	1 to 2 oz **Zidua**	Apply after sunflower are in the V1 through the V8 stage of growth for residual control of later germinating weeds. Does not control emerged weeds, but can be tank-mixed with other postemergence herbicides. Leaf burn may occur to sunflowers following application. Use the lower rates on coarse textured soils and the higher rates on fine textured soils as recommended on the label. If sequential applications are used, the maximum combined rate of Zidua per cropping season is 1.5 oz/a on coarse textured soils and 5 oz/a on medium or fine textured soils. Do not plant wheat or cotton for 4 months; sorghum for 6 to 12 months; alfalfa for 10 months; small grains other than wheat for 11 months; or any other crop for 18 months after Zidua application.
Quizalofop (1) 0.03 to 0.075	5 to 12 oz **Assure II, Se-Cure** or **Targa**	Controls many annual and perennial grasses including shattercane, volunteer corn, and volunteer wheat. Apply with 1% v/v COC or 0.25% v/v NIS. Weed control is reduced if applied when weeds are under drought stress. Do not graze or feed forage, hay, or straw from treated areas to livestock. Do not apply within 60 days of sunflower harvest.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Sunflower

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Sethoxydim (1) 0.1 to 0.47	1 to 2.5 pt **Poast**	Controls annual and perennial grasses. Apply when grasses are growing actively but before they reach size limits listed on the label. Apply to annual grasses up to 8 inches, volunteer corn up to 20 inches, shattercane from 6 to 18 inches, volunteer wheat before tillering, and rhizome johnsongrass from 15 to 25 inches tall. Higher rates are recommended in the western third of Kansas than in the eastern part of the state. Always apply with COC or Dash. Weed control is reduced if applied when grasses are under drought stress. Do not apply within 70 days of harvest. Do not use treated plants for feed or forage.
Tribenuron (2) 0.0078 to 0.0156	0.25 to 0.5 oz **Express**	Apply to ExpressSun sunflower only. Express will severely injure or kill non-ExpressSun sunflower. Can be applied between the 1-leaf and the beginning of bud stage of sunflower growth for control of small, actively growing broadleaf weeds. Apply with MSO at 1% v/v. May not control ALS-resistant biotypes of kochia or pigweed. Temporary yellowing of sunflower plants may occur shortly after application of Express, especially when applied to crops growing under environmental stress. Do not apply within 70 days of sunflower harvest. Do not feed forage from treated areas or allow livestock grazing within 7 days of application. Allow 30 days between application and feeding hay from treated areas to livestock.
HARVEST AIDS		
Glyphosate (9) 0.75 lb ae	22 oz **Roundup WeatherMax** or **Roundup PowerMax**	Apply by ground or aerial equipment to control annual and perennial weeds and help facilitate harvest. Apply when sunflower seeds reach physiological maturity (when seed moisture is 35% or less). For many sunflower varieties, this stage is when the backs of heads are yellow and bracts are turning brown. Allow a minimum of 7 days between treatment and harvest for livestock feeding.
Paraquat (22) 0.3 to 0.5	1.2 to 2 pt **Gramoxone SL**	A restricted-use pesticide. Always apply with NIS. Apply with ground or aerial equipment 7 to 21 days before harvest to desiccate sunflower plants, broadleaf weeds, and grasses. Apply when sunflower seeds reach physiological maturity (when seed moisture is 35% or less). For many varieties, this stage is when backs of heads are yellow and bracts are turning brown. Do not allow grazing of treated areas or feed treated forage.
Saflufenacil (14) 0.022 to 0.044	1 to 2 oz **Sharpen**	Apply by ground or aerial equipment to desiccate sunflower to facilitate earlier harvest. Use a minimum spray volume of 5 gpa for aerial application and 10 gpa for ground application. Apply when sunflower reaches physiological maturity (when seed moisture is less than 36%). For many sunflower varieties, this stage is when the backs of heads are yellow and bracts are turning brown. Apply with 1.5 pt/a MSO plus AMS at 8.5 to 17 lb/100 gal of spray solution. The 2 oz rate has been more consistent than 1 oz. Applications made just before or after a light frost may be less effective. Allow a minimum of 7 days between treatment and sunflower harvest. Do not apply on sunflower grown for seed production.
Sodium chlorate (17) 6	3.2 qt **Defol 750**	Apply by ground or aerial equipment to facilitate harvest and reduce moisture in mature seed heads. Apply 7 or more days before harvest when seed heads are fully mature. Do not graze treated fields or feed treated forage within 14 days of application.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Winter Wheat

This publication primarily concerns chemical weed control. It is not intended to imply that cultivation, particularly in row crops, is undesirable. One or two cultivations can greatly improve weed control.

Weed Response to Selected Wheat Herbicides When Applied According to Label Directions[1]

		Winter Annuals												Summer Annuals, Broadleaf								Perennials
		Grasses					Broadleaf															
Herbicide(s)	Crop tolerance	Downy brome	Japanese brome	Cheat	Italian ryegrass	Jointed goatgrass	Blue mustard	Bushy wallflower	Tumble mustard	Field pennycress	Shepherdspurse	Flixweed/tansy mustard	Henbit	Wild buckwheat	Kochia	Lambsquarters	Prickly lettuce	Pigweed	Pennsylvania smartweed	Sunflower	Russian thistle	Field bindweed
PREPLANT																						
Amber	E	F	F-G	F	F-G	—	E	E[2]	E	E	E	E	G	G	G[2]	F	G	G-E	G	E	G[2]	—
Olympus	G	F-G	G	G	—	—	F-G	G[2]	F-G	G	F-G	F-G[2]	F	—	—	—	—	—	—	—	—	—
Pre-Pare	G-E	P	F	F	P	—	F-G	G*	F-G	G	F-G	F-G	—	—	—	—	—	—	—	—	—	—
PREEMERGENCE																						
Amber	E	F	F-G	F	F-G	—	E	E[2]	E	E	E	E	G	G	G[2]	F	G	G-E	G	E	G[2]	—
Finesse	G-E	F	F-G	F	F-G	—	E	E[2]	E	E	E	E	E	G	G[2]	G	G	G-E	F	E	G[2]	—
Olympus	G	F-G	G	G	—	—	F-G	G[2]	F-G	G	F-G	F-G[2]	F	—	—	—	—	—	—	—	—	—
Outrider	G-E	F-G	G	G	F	—	—	—	E	E	—	E	F-G	—	—	—	—	—	—	—	—	—
Pre-Pare	G-E	P	F	F	P	—	F-G	G*	F-G	G	F-G	F-G	—	—	—	—	—	—	—	—	—	—
Zidua/Anthem Flex	F-G	F	F	F	G	—	—	—	—	—	F	F	F	—	F	F	—	—	—	—	—	—
POSTEMERGENCE																						
Affinity BroadSpec	G-E	—	—	—	—	—	G	E[2]	G	E	E	G-E[2]	G	F-G	G[2]	E	G	G-E[2]	E	G	G-E[2]	—
Affinity TankMix	G-E	—	—	—	—	—	G-E	E[2]	G	E	E	G-E[2]	G	G	G[2]	E	G	G-E[2]	E	G	G-E[2]	—
Agility SG	G	—	—	—	—	—	E	E[2]	E	E	E	E[2]	G-E	E	E	E	G	G-E	E	E	E	—
Aim	G	—	—	—	—	—	—	G-E	F-G	E	F-G	G	—	F-G	F-G	F-G	—	G	—	—	F-G	—
Aggressor *(CoAXium wheat only)*	G-E	G-E	G-E	G-E	G-E	G-E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Amber	E	—	—	—	—	—	E	E[2]	E	E	E	E[2]	F-G	G-E	G[2]	F	G	G-E[2]	G	E	G[2]	—
Ally + 2,4-D	G-E	—	—	—	—	—	G-E	G-E	G-E	G-E	G-E	G-E	G	G	G[2]	G-E	G	G-E	G	E	G-E	—
Ally Extra SG	G-E	—	—	—	—	—	G-E	E[2]	G-E	E	E	G-E[2]	E	G-E	G[2]	E	G	G-E[2]	E	E	G-E[2]	—
Axial	G	—	—	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Beyond *(Clearfield wheat only)*	G	G-E	E	E	G-E	E	G	E	E	E	E	E	G-E	F	G[2]	G	G	G[2]	G	G[2]	G[2]	—
Bromoxynil MCPA	G-E	—	—	—	—	—	F-G	—	G-E	G-E	G-E	G-E	G	G-E	G	G-E	—	G-E	G-E	G-E	G-E	—
Bromoxynil	E	—	—	—	—	—	G-E	G-E	G-E	G-E	G-E	G	—	G-E	G	E	—	G	E	E	G	—
Carnivore	G-E	—	—	—	—	—	G	E	G	E	G-E	G	G	G	E	E	G	G	E	E	G-E	F
Dicamba	G	—	—	—	—	—	F	F	F	F-G	G	F	F	G-E	G-E	E	G	G-E	G-E	E	G-E	F-G
Dicamba + 2,4-D	F-G	—	—	—	—	—	F	G-E	G-E	G-E	G-E	G-E	P-F	G-E	E	E	E	E	E	G	E	—
Everest 2.0/Sierra	E	P-F	G-E	G-E	F-G	—	G	E[2]	G-E	E	E	G[2]	—	P	—	—	—	F[2]	—	—	—	—
Express	E	—	—	—	—	—	G	G[2]	F-G	G	F-G	G[2]	F-G	F	G-E[2]	G-E	G	F[2]	F-G	F-G	G[2]	—
Finesse	G-E	—	—	—	F	—	E	E[2]	E	E	E	E[2]	E	G-E	G[2]	E	E	E[2]	G	E	G[2]	—
Finesse G&B	G-E	P	E	E	G	—	E	E[2]	E	E	E	E[2]	E	G	G[2]	G	G	E[2]	G	G	G[2]	—
Glean	E	—	—	—	F	—	E	E[2]	E	E	E	E[2]	G-E	G	G[2]	G	G	E[2]	G	G	G[2]	—
Harmony SG	G-E	—	—	—	—	—	—	G-E[2]	G	G-E	G	G[2]	F-G	G	G[2]	E	G	E[2]	E	G	E[2]	—
Harmony Extra SG	G-E	—	—	—	—	—	G	G[2]	G	G	G	G[2]	G	G	E[2]	E	G	E[2]	E	G	E[2]	—
Hoelon	G-E	—	—	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

[1] Weed response ratings refer to application according to label directions and with favorable growing conditions:
E = Excellent, G = Good, F = Fair, P = Poor, and — = weed not listed on the herbicide label.
[2] Except where resistant weed populations have developed.

Herbicides for Winter Wheat

This publication primarily concerns chemical weed control. It is not intended to imply that cultivation, particularly in row crops, is undesirable. One or two cultivations can greatly improve weed control.

Weed Response to Selected Wheat Herbicides When Applied According to Label Directions[1]

		Winter Annuals												Summer Annuals, Broadleaf								Perennials
		Grasses					Broadleaf															
Herbicide(s)	Crop tolerance	Downy brome	Japanese brome	Cheat	Italian ryegrass	Jointed goatgrass	Blue mustard	Bushy wallflower	Tumble mustard	Field pennycress	Shepherdspurse	Flixweed/tansy mustard	Henbit	Wild buckwheat	Kochia	Lambsquarters	Prickly lettuce	Pigweed	Pennsylvania smartweed	Sunflower	Russian thistle	Field bindweed
POSTEMERGENCE																						
Huskie	E	—	—	—	—	—	E	E	E	E	E	E	G-E	G	G	G	E	G-E	—	E	E	—
MCPA	G-E	—	—	—	—	—	F	E	F	E	G	G	F	P	P	E	G	—	F	F	F	—
Metribuzin	F-G	F	G	F-G	F	—	F-G	G	G	G	G	G	G	—	—	—	—	—	—	—	—	—
Olympus	G-E	F-G	E	E	F	P	E	E[2]	E	E	E	E[2]	F	P	—	—	—	—	—	—	—	—
Orion	E	—	—	—	—	—	E	E	E	E	E	E	P-F	F-G	P	E	G	G[2]	G-E	G	—	—
Osprey	G	F	F	F	E	—	—	—	—	—	F	—	F	—	—	—	—	F[2]	—	—	—	—
Outrider	G-E	F-G	G-E	G-E	F	—	—	E[2]	E	E	G	E[2]	F	—	—	—	—	—	—	—	—	—
Peak	E	—	—	—	—	—	E	E[2]	E	E	E	E[2]	F	G-E	G[2]	G	G	G-E[2]	F	G	G[2]	—
PowerFlex HL, GR1	G-E	F-G	E	E	E	—	E	E[2]	E	E	E	E[2]	G	F	—	G	—	G[2]	—	—	G[2]	—
Pulsar	G	—	—	—	—	—	—	—	—	—	—	—	—	E	E	E	—	G	—	G	G-E	F
Quelex	E	—	—	—	—	—	E	E	E	E	E	E	G-E	G-E	F	E	F	G	E	F	—	F
Rave	G	—	—	—	—	—	E	E	E	E	E	E	G	E	G-E	E	E	E	G	E	G-E	F
Sentrallas	G-E	—	—	—	—	—	—	E[2]	G-E	G-E	G-E	G-E[2]	F	G	G-E	G-E	F-G	G[2]	G	G	G	F
Starane Flex	G-E	—	—	—	—	—	E	E[2]	E	E	E	E[2]	—	G	G-E	—	E	—	G	G	G	F
Starane NXT	G-E	—	—	—	—	—	G-E	—	G	E	E	—	—	G-E	G-E	G-E	G	F-G	G-E	G-E	G	F
Starane Ultra/ StareDown	G-E	—	—	—	—	—	—	F	—	F	—	F	—	G	G-E	—	—	—	—	—	F	—
WideMatch, Colt	G	—	—	—	—	—	F	F	F	F	F	F	—	E	E	P	E	—	F	E	F	F
2,4-D	G	—	—	—	—	—	E	E	E	E	E	E	P	F	F-G	E	E	E	F	G	E	F-G

[1] Weed response ratings refer to application according to label directions and with favorable growing conditions:
E = Excellent, G = Good, F = Fair, P = Poor, and — = weed not listed on the herbicide label.
[2] Except where resistant weed populations have developed.

Herbicides for Winter Wheat

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
HERBICIDES TO REDUCE TILLAGE IN FALLOW BEFORE PLANTING WINTER WHEAT		
Chlorsulfuron (2) + Metsulfuron (2) 0.008 to 0.016 + 0.0016 to 0.0032	0.2 to 0.4 oz **Finesse**	Apply after wheat harvest in the fall or spring for broadleaf weed control. Always apply with NIS. Use in combination with tillage and a planned herbicide rotation program with other herbicides having different modes of action to minimize herbicide resistance problems. Do not use Finesse, Glean, Ally, or Amber on the same field within 24 months after application. Any remaining broadleaf weeds should be controlled before they produce seed to minimize the risk of resistant weed development. Do not rotate to oat for 10 months; to grain sorghum for 4 to 48 months; to non-STS soybean for 14 months (east of Highway 183, west of the Flint Hills); or to any other crop until a field bioassay has been completed. STS soybean and IR corn hybrids can be planted 4 months after application if the soil pH is 7.5 or lower. Refer to the label for additional use and crop rotation guidelines.
Dicamba (4) 0.13 to 2	0.25 to 4 pt **Dicamba***	Controls many annual and perennial broadleaf weeds. Apply to emerged and actively growing weeds after crop harvest and before a killing frost. Crop injury can occur if the interval between application and planting is less than 45 days/pt of product used per acre. Can be tank mixed with 2,4-D or glyphosate.
Diflufenzopyr (19) + Dicamba (4) 0.027 to 0.054 + 0.069 to 0.138	2 to 4 oz **Distinct**	Controls many annual broadleaf weeds. Apply to emerged and actively growing weeds after crop harvest and before a killing frost. Do not plant wheat until 30 days after a 1-inch rainfall is received following Distinct application. May be tank mixed with glyphosate, 2,4-D, or other herbicides for broader spectrum weed control.
Fluroxypyr (4) 0.14 to 0.25	0.4 to 0.7 pt **StareDown**	Controls kochia, including ALS and glyphosate resistant biotypes, and certain other broadleaf weeds. Apply to actively growing weeds before they exceed 8 inches tall. Often applied as a tank-mix with other herbicides for control of grasses and other weeds.
Fluroxypyr (4) + bromoxynil (6) + 2,4-D (4) 0.1 to 0.21 + 0.26 to 0.52 + 0.26 to 0.52	1.25 to 2.5 pt **Kochiavore**	Controls many emerged broadleaf weeds, including kochia and Russian thistle. Use the higher rate for larger weeds and under less favorable conditions. Add high surfactant oils for enhanced weed control. Do not plant wheat until 30 days after application.
Fluroxypyr (4) + dicamba (4) + 2,4-D (4) 0.047 to 0.25 + 0.063 to 0.33 + 0.19 to 1.0	0.5 to 2.67 pt **Scorch**	Controls many emerged broadleaf weeds including kochia and pigweeds. Use the higher rates and add COC for control of larger weeds and during less favorable conditions. Delay planting wheat 10 days for each pt of product applied.
Glyphosate (9) 0.28 to 1.13 lb ae	12 to 48 oz of 3 lb/gal **Glyphosate*** (see glyphosate table)	For control of actively growing volunteer grains and some weeds, such as downy brome and mustards up to 6 inches tall. Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. Can be used with dicamba or 2,4-D for enhanced control of certain broadleaf weeds. Apply in 3 to 10 gal spray/acre. The addition of 2% AMS by weight or 17 lb/100 gal water can increase performance of glyphosate. Dust on plants can reduce performance of glyphosate.
Glyphosate (9) + Dicamba (4) 0.55 to 0.76 lb ae + 0.1 to 0.14	32 to 44 fl oz **Fallow Master BS**	Fallow Master BS is a premix of 2.2 lb glyphosate and 0.4 lb dicamba (Banvel)/gal. Can control volunteer grains and certain annual weeds. Apply this product at least 15 days before planting wheat. Addition of 2% AMS by weight can increase performance.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Winter Wheat

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
HERBICIDES TO REDUCE TILLAGE IN FALLOW BEFORE PLANTING WINTER WHEAT		
Glyphosate (9) + 2,4-D (4) 0.28 to 0.75 lb ae + 0.5 to 1	12 to 32 oz of 3 lb ae/gal **Glyphosate*** (see glyphosate table) + 1 to 2 pt of 4 lb/gal **2,4-D***	For control of volunteer grains, downy brome, tansy mustard, and other weeds, apply to actively growing plants. The addition of 2% AMS by weight (17 lb/100 gal water) can increase performance of glyphosate. Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations.
Isoxaflutole (27) 0.047 to 0.078	1.5 to 2.5 oz **Scoparia**	A restricted use pesticide. Prohibited on fields that contain vulnerable sandy loam, loamy sand, or sand soils if the water table is less than 25 feet below the soil surface. Apply in the fall or early spring to stubble of harvested crops for residual control of unemerged kochia and Russian thistle in areas west of Highways I-35, I-135, and 81. Do not apply to frozen soils. May be applied with dicamba or metribuzin for enhanced residual and control of emerged weeds. Do not plant wheat within 4 months of Scoparia application.
Metribuzin (5) 0.38 to 0.75	0.5 to 1 lb **Metribuzin***	Apply after wheat harvest in fall or in early spring. Can be tank mixed with paraquat, glyphosate, or other burndown herbicides. Wheat can be seeded 120 days after application. Do not allow grazing of treated fields.
Metsulfuron (2) + tank mix partner 0.0038	0.1 oz **Ally** or **Metsulfuron*** + appropriate rate of tank mix herbicide	For control of certain broadleaf weeds, apply as a postemergence treatment in fallow in combination with glyphosate, 2,4-D, dicamba, or residual fallow herbicides. Always apply with NIS. Do not apply Ally alone to fallow, and always till at least once before planting wheat. Ally should be used no more than once in a 22-month period, and any remaining broadleaf weeds should be controlled before they produce seed to minimize the risk of resistant-weed development.
Paraquat (22) 0.5 to 1.0	2 to 4 pt **Gramoxone SL**	A restricted-use pesticide. This contact herbicide is applied in clean water or nitrogen solutions to annual weeds 1 to 6 inches tall to control existing vegetation. Always apply with NIS. Can be tank mixed with 2,4-D, or dicamba. Dust on plants can inactivate paraquat.
Picloram (4) + 2,4-D (4) amine or LVE 0.13 to 0.25 + 0.5 to 1	0.5 to 1 pt **Tordon 22K** + 1 to 2 pt of 4 lb/gal **2,4-D***	Picloram is a restricted-use pesticide. For reduction of field bindweed and for control of many annual broadleaf weeds after wheat harvest and before planting winter wheat, barley, or oat in continuous small grain or small grain/fallow systems. Allow a minimum of 45 (0.5 pt Tordon) to 60 days (0.5 to 1 pt Tordon) between application and planting wheat. Do not treat with Tordon more than once each calendar year. Some injury to wheat can occur even when applied as directed, especially if dry conditions prevail. Consider the risk of crop injury, and apply as a spot treatment where feasible. Broadleaf crops are extremely susceptible to Tordon. Avoid spray drift, and do not rotate to susceptible broadleaf crops until 36 months after treatment.
Quinclorac (4, 26) 0.26	22 oz **Facet L,** 0.5 pt **QuinStar 4L,** or 5.3 oz **QuinStar GT**	Apply for control of actively growing bindweed with at least 4-inch vines anytime before planting wheat. Plant wheat at least 1 inch deep to avoid possible injury to wheat. Apply with COC or MSO adjuvant for optimal bindweed control. Do not plant any crop other than wheat or sorghum within 10 months after Facet application. Do not plant alfalfa for at least 24 months after application.
Saflufencil (14) 0.022 to 0.088	1 to 4 oz **Sharpen**	Provides burndown and residual control of certain broadleaf weeds, including marestail and most mustard species. Can be applied preplant, preplant incorporated, or preemergence to wheat. Do not apply after wheat emergence, or crop injury will occur. Apply with MSO at 1% v/v, minimum of 1 pt/a, plus 1.25 to 2.5% v/v liquid UAN fertilizer, or AMS at 8.5 to 17 lb/100 gal of spray solution. Do not graze or feed treated wheat to livestock until 30 or more days after treatment.

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Herbicides for Winter Wheat

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
HERBICIDES TO REDUCE TILLAGE IN FALLOW BEFORE PLANTING WINTER WHEAT		
Triasulfuron (2) + tank mix partner 0.013 to 0.022	0.28 to 0.47 oz **Amber** + appropriate rate	Apply after wheat harvest in the fall or spring. Must be tank mixed with an herbicide having a different mode of action. Always apply with NIS. Do not apply any herbicide with the same mode of action within 12 (pH < 7.5) to 15 (pH > 7.5) months after Amber application. Do not rotate to oat, barley, or rye for 6 to 18 months; grain sorghum for 14 to 24 months; soybean or corn for 14 to 36 months; or any other crop until a field bioassay has been completed. Refer to the label for additional use and crop rotation guidelines.
Thifensulfuron (2) + Tribenuron (2) 0.0019 to 00.38 + 0.0075 to 0.015	0.3 to 0.6 oz **Panoflex**	Can be applied anytime prior to planting or emergence of wheat for control of emerged susceptible broadleaf weeds. Always apply with NIS or oil concentrate. Often tank-mixed with other herbicides for broader-spectrum weed control and herbicide resistance management. Do not allow grazing on fields for 7 days after application.
2,4-D LVE (4) 0.5 to 1.5	1 to 3 pt of 4 lb/gal **2,4-D***	Apply after wheat harvest and during fallow periods to control susceptible broadleaf weeds. Allow 2 weeks after a 0.5-inch rainfall for 2,4-D to degrade before planting wheat.
PREPLANT AND/OR PREEMERGENCE		
Chlorsulfuron (2) + Metsulfuron (2) 0.0195 + 0.0039	0.5 oz **Finesse**	Provides suppression of light to moderate populations of cheat, Japanese brome, and downy brome and control of many broadleaf weeds. Apply preplant or preemergence to wheat seeding but before wheat and grass emergence. Cheatgrass suppression depends on precipitation before emergence. Do not use west of Highway 183. Do not apply to soils with a pH less than 5 or greater than 7.9. Any broadleaf weeds that escape Finesse control should be controlled with a sequential application of an herbicide having a different mode of action. Do not rotate to oat for 10 months, grain sorghum for 4 to 48 months; soybean for 14 months (east of Highway 183, west of the Flint Hills); or any other crop until a field bioassay has been completed. STS soybean or IR corn hybrids can be planted 4 months after application if the soil pH is 7.5 or lower. Refer to the label for additional use and crop rotation guidelines.
Propoxycarbazone (2) 0.026	0.6 oz **Olympus**	Apply as a tank mix with glyphosate preplant/preemergence to wheat for suppression of later-germinating cheatgrass and certain broadleaf weeds. May be followed by a spring application of Olympus at 0.6 oz/acre, if needed, to provide adequate season-long control. Do not rotate to STS soybean for 4 months; grain sorghum for 6 months; cotton, sunflower, and non-STS soybean for 12 months (if cumulative precipitation exceeds 24 inches); corn can for 18 months (if cumulative precipitation exceeds 30 inches) after Olympus application. Rotation to other crops or with shorter interval requires successful completion of a field bioassay, and no sooner than 4 months after Olympus application.
Pyroxasulfone (15) 0.037 to 0.11	0.7 to 2 oz **Zidua** or 1.25 to 3.25 oz **Zidua SC**	Apply as a delayed preemergence treatment after planting and 80% of the germinated wheat seedlings have a shoot at least 0.5 inches long. Use 0.7 to 1 oz/a Zidua or 1.25 to 1.75 oz/a Zidua SC on coarse-textured soils, 1 to 1.5 oz/a Zidua or 1.75 to 2.5 oz/a Zidua SC on medium-textured soils, and 1 to 2 oz/a Zidua or 1.75 to 3.25 oz/a Zidua SC on fine-textured soils. Wheat should be planted between 1 and 1.5 inches deep. Provides residual control of Italian ryegrass and suppression of winter annual brome species. Does not control emerged weeds. May be tank-mixed with other registered herbicides.
Pyroxasulfone (15) + Carfentrazone (14) 0.058 to 0.13 + 0.0042 to 0.0095	2 to 4.5 oz **Anthem Flex**	Apply as a delayed preemergence treatment after planting and 80% of the germinated wheat seedlings have a shoot at least 0.5 inches long. Use the low rate on coarse-textured soils and the higher rates on medium- and fine-textured soils. Wheat should be planted between 1 and 1.5 inches deep. Provides residual control of Italian ryegrass and suppression of winter annual brome species. May control some emerged seedling broadleaf weeds, but not emerged grasses. May be tank-mixed with other registered herbicides.

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Herbicides for Winter Wheat

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
PREPLANT AND/OR PREEMERGENCE		
Saflufencil (14) 0.022 to 0.088	1 to 4 oz **Sharpen**	Provides burndown and residual control of certain broadleaf weeds, including marestail and most mustard species. Can be applied preplant, preplant incorporated, or preemergence to wheat. Do not apply after wheat emergence, or crop injury will occur. Apply with MSO at 1% v/v, minimum of 1 pt/a, plus 1.25 to 2.5% v/v liquid UAN fertilizer or AMS at 8.5 to 17 lb/100 gal of spray solution. Do not graze or feed treated wheat to livestock until 30 or more days after treatment.
Sulfosulfuron (2) 0.031	0.67 oz **Outrider**	Controls cheatgrass and certain broadleaf weeds. Apply after planting wheat but before wheat and weeds emerge. Preemergence treatments have been less consistent than fall post-emergence applications. If wheat is planted into dry soils and continued dry weather is forecasted, delay treatment until wheat and weeds have emerged and are growing actively. Wheat can be grazed anytime after treatment. STS soybean can be planted 3 months after treatment if soil pH is less than 7.5 and cumulative precipitation exceeds 18 inches. Cotton and non-STS soybean can be planted 12 months after treatment if soil pH is less than 7.5 and cumulative precipitation exceeds 30 inches. Planting sorghum, corn, or sunflower is not recommended until at least 22 months after treatment. Rotation to other crops or with shorter interval requires successful completion of a field bioassay, and no sooner than 3 months after application. The risk of Outrider carryover is greatest on high pH soils and with sorghum, sunflower, alfalfa, or canola.
Triasulfuron (2) 0.016 to 0.026	0.35 to 0.56 oz **Amber**	Provides suppression of light to moderate populations of cheat, Japanese brome, and downy brome, and control of many broadleaf weeds. Apply preplant, preplant shallowly incorporated, or preemergence after wheat seeding but before wheat and grass emergence. Cheatgrass suppression depends on precipitation before emergence. Do not apply the 0.56 oz/a rate on soils with a pH > 7.5. Do not apply any herbicide with the same mode of action within 12 (pH < 7.5) to 15 (pH > 7.5) months after Amber application. Any broadleaf weeds that escape Amber control should be controlled in the spring with an herbicide having a different mode of action. Do not rotate to oat, barley, or rye for 6 to 18 months; grain sorghum for 14 to 24 months; soybean or corn for 14 to 36 months; or any other crop until a field bioassay has been performed. Refer to the label for additional use and crop rotation guidelines.
POSTEMERGENCE		
Bicyclopyrone (27) + bromoxynil (6) 0.033 to 0.044 + 0.16 to 0.21	13.7 to 18.2 oz **Talinor**	Controls many broadleaf weeds as a fall or spring application when weeds are small and actively growing. Apply to wheat from the 2-leaf to the pre-boot stage of growth. Apply with CoAct+ and COC adjuvants. Do not plant oat for 3 months, sunflowers for 9 months, alfalfa for 9 to 12 months, canola for 9 to 10 months, cotton or sorghum for 10 months, or soybeans for 10 to 12 months after application. Do not graze or harvest forage for hay for a minimum of 30 days after application.
Bromoxynil (6) 0.25 to 0.5	1 to 2 pt **Broclean, Brox,** or **Moxy**	This is a contact herbicide for control of several broadleaf weeds. Apply in fall or in spring to seedling weeds until wheat reaches boot stage. Fall applications provide the best control of weeds that emerge in the fall. Can control wild buckwheat in spring. Can be tank mixed with MCPA, dicamba, Glean, Ally, Harmony Extra, Amber, Finesse, 2,4-D, or Sencor. Do not allow grazing on fields for 45 days after application.
Bromoxynil (6) + MCPA (4) 0.25 to 0.5 + 0.25 to 0.5	1 to 2 pt **Bison**, **Brox M,** or **Wildcard Xtra**	Controls many broadleaf weeds. Apply to wheat after 3-leaf stage but before boot stage. Apply to seedling weeds before they reach size limits listed on the labels. Can be tank mixed with Glean, Ally, Harmony Extra, Amber, Finesse, Sencor, or MCPA ester. Do not allow grazing on fields for 45 days after application.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Winter Wheat

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Bromoxynil (6) + 2,4-D (4) 0.25 to 0.5 + 0.25 to 0.5	1 to 2 pt **Buctril, Bromox, Brox,** or **Moxy** + 0.5 to 1 pt of 4 lb/gal **2,4-D*,** or 1-2 pt **DoubleUp B&D**	This is a tank mix of bromoxynil and 2,4-D. Can control wild buckwheat and other broadleaf weeds. Apply after tillering but before jointing stage. Apply before weeds are past 3- to 4-leaf stage or more than 2 to 6 inches tall. Do not allow grazing on fields for 45 days after application.
Carfentrazone (14) 0.008 to 0.017	0.5 to 1 oz **Aim EC**	A contact herbicide for control of certain broadleaf weeds. Apply in the fall or spring to seedling weeds prior to the boot stage of wheat. Apply with NIS at 0.25% v/v. May cause leaf burn on wheat leaves, especially with warm conditions at and following application. Can be tank mixed with Ally, Amber, dicamba, Express, Finesse, Harmony Extra, Peak, 2,4-D, or MCPA.
Chlorsulfuron (2) 0.008 to 0.016	0.17 to 0.33 oz **Glean**	Controls many broadleaf weeds. Apply after the 2-leaf stage but before the boot stage of wheat for control of weeds less than 2 inches tall or across. Apply with NIS at 0.25% to 0.5% v/v. Can be applied with liquid N fertilizer, but do not use surfactant if liquid fertilizer is the carrier. Tank mixes can improve weed control and reduce the risk of herbicide resistance problems. Glean can be tank mixed with MCPA, 2,4-D, bromoxynil, or dicamba. The maximum Glean use rate is 0.33 oz/acre, which can be applied once per crop period east of Highway 183 and once every 36 months west of Highway 183. Do not rotate to oat or barley for 10 months; grain sorghum for 4 to 48 months; non-STS soybean for 14 months (east of Highway 183, west of the Flint Hills); or any other crop until a field bioassay has been performed. STS soybean and IR corn hybrids can be planted 4 months after application if the soil pH is 7.5 or lower. Do not apply to soils with a pH above 7.9. Refer to the label for additional use and crop rotation guidelines.
Chlorsulfuron (2) + Metsulfuron (2) 0.008 to 0.016 + 0.0016 to 0.0031	0.2 to 0.4 oz **Finesse**	Controls many broadleaf weeds. Apply after 2-leaf stage but before boot stage of wheat. Always apply with NIS at 0.25 to 0.5% v/v. Can be applied with liquid nitrogen fertilizer, but do not add surfactant if liquid fertilizer is the carrier. Use higher rate for wild buckwheat control and extended residual control. Tank mixes can improve weed control and reduce the risk of herbicide resistance problems. Finesse can be tank mixed with dicamba, Buctril, MCPA, Sencor, or 2,4-D. Do not apply to soils with a pH below 5 or above 7.9. In the western tier of Kansas counties, the maximum use rate is 0.3 oz/a applied not more than once every 24 months. Do not rotate to oat for 10 months; grain sorghum for 4 to 48 months; non-STS soybean for 14 months (east of Highway 183, west of the Flint Hills); or any other crop until a field bioassay has been performed. STS soybean and IR corn hybrids can be planted 4 months after application if soil pH is 7.5 or lower. Refer to label for additional use and crop rotation guidelines.
Dicamba (4) 0.06 to 0.125	2 to 4 fl oz **Dicamba***	Controls certain broadleaf weeds. Apply after the 2-leaf stage but before the wheat joints in the spring. Application after jointing increases the risk of crop injury. Generally applied as a tank mix with another broadleaf herbicide for broad-spectrum broadleaf weed control. Can be tank mixed with Glean, Amber, Finesse, Ally, Express, Harmony Extra, bromoxynil, MCPA, or 2,4-D. Do not apply with surfactant unless tank mixing with a sulfonylurea herbicide. Refer to the label for grazing and hay restrictions.
Dicamba (4) + Fluroxypyr (4) 0.05 to 0.07 + 0.06 to 0.09	8.3 to 12.5 oz **Pulsar**	Controls emerged kochia, Russian thistle, wild buckwheat, and certain other broadleaf weeds. Apply prior to the jointing stage of wheat to small, actively growing weeds. Addition of NIS at 0.125 to 0.25% v/v can improve weed control during periods of environmental stress. Can be tank mixed with MCPA or other herbicides for enhanced control of mustard species. Do not allow livestock to graze treated areas or harvest treated forage within 7 days after application. Do not rotate to sorghum for 4 months; or alfalfa, canola, cotton, soybean, or sunflower for 9 months after Pulsar application.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Winter Wheat

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Dicamba (4) + 2,4-D (4) 0.06 to 0.13 + 0.25 to 0.38	2 to 4 fl oz **Dicamba*** + 0.5 to 0.75 pt of 4 lb/gal **2,4-D***	Apply to small, actively growing weeds after winter dormancy but before joint stage of wheat. Controls wild buckwheat and other broadleaf weeds. Follow label restrictions for pasture and hay for lactating dairy animals.
Diclofop (1) 0.5 to 1	1.33 to 2.67 pt **Hoelon**	A restricted-use pesticide. Primarily used for Italian ryegrass control. Apply postemergence in the fall or spring before wheat jointing for control of Italian ryegrass with up to 2 tillers. Do not apply 2,4-D, MCPA, or dicamba within 5 days of Hoelon application, or grass weed control may be reduced. Do not apply when wheat and weeds are dormant and not actively growing. Do not allow livestock to graze treated fields for 28 days after treatment or harvest forage, hay, or straw from treated fields before grain harvest.
Florasulam (2) + MCPA (4) 0.0044 + 0.31	17 oz **Orion**	Controls certain broadleaf weeds. Apply from the 3-leaf stage until jointing of wheat for control of small, actively growing weeds that have emerged at the time of application. Livestock can graze treated area 7 days after application. Do not apply within 60 days of harvest. Do not plant corn or sorghum within 3 months or alfalfa, soybean, and sunflower within 9 months after application. For kochia or Russian thistle control, tank mix with Starane or Huskie. Tank mix with metsulfuron for improved henbit control.
Flucarbazone (2) + Chlorsulfuron (2) 0.018 to 0.026 + 0.009 to 0.014	0.6 to 0.9 oz **Finesse Grass & Broadleaf**	Finesse Grass & Broadleaf is a premix of chlorsulfuron (Glean) and flucarbazone (Everest) herbicides. Controls cheat, Japanese brome, Italian ryegrass, and many broadleaf weeds. Much less effective for downy brome control than for cheat or Japanese brome. Apply in the fall to small, actively growing weeds after wheat is in the 2-leaf stage of growth but before grasses exceed the 2-tiller growth stage. Can be applied in liquid nitrogen fertilizer carrier. Apply with 0.25 to 0.5% v/v NIS plus 2 qt/a liquid nitrogen fertilizer when applied in water carrier, 0.06 to 0.25% v/v NIS with up to 50% liquid nitrogen carrier, and with no NIS if applied in greater than 50% liquid nitrogen carrier. Application in liquid nitrogen carrier tends to increase cheatgrass control and the risk of crop injury. Do not use if soil pH is greater than 7.9. Do not replant wheat until 4 months after application. Do not rotate to soybean for 14 to 48 months depending on geography, soil pH, and cumulative precipitation. Do not rotate to other crops until the completion of a successful field bioassay. Consult the label for additional use and crop rotation guidelines.
Fluroxypyr (4) 0.105 to 0.14	0.3 to 0.4 pt **Starane Ultra** or **StareDown**	Controls kochia, including ALS-resistant kochia, and certain other broadleaf weeds. Apply to small, actively growing weeds after winter dormancy but before the early boot stage of wheat. Often applied as a tank mix with other herbicides for broad-spectrum broadleaf weed control. Do not harvest treated forage or allow livestock to graze treated area within 7 days of application. Do not plant any crop except wheat, barley, oat, corn, or sorghum within 120 days after application.
Fluroxypyr (4) + Bromoxynil (6) 0.064 to 0.125 + 0.25 to 0.5	14 to 27.4 oz **Starane NXT**	Controls kochia and certain other broadleaf weeds. Apply to small actively growing weeds when wheat is from the 3-leaf stage up to flag leaf emergence. Starane NXT does not provide significant residual weed control. Do not allow livestock to graze or harvest for hay within 45 days after application. Oats, corn, and sorghum can be planted 30 days after application. Any crop can be planted 120 days after application.
Fluroxypyr (4) + bromoxynil (6) + 2,4-D (4) 0.08 to 0.13 + 0.21 to 0.31 + 0.21 to 0.31	1 to 1.5 pt **Kochiavore**	Controls many emerged broadleaf weeds, including kochia. Apply to small actively growing weeds when wheat is from the 4-leaf stage up to flag leaf emergence. Do not harvest treated forage or allow livestock to graze treated areas within 45 days of application.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Winter Wheat

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Fluroxypyr (4) + Clopyralid (4) 0.125 + 0.125	1.33 pt **WideMatch** or **Colt**	Controls Canada thistle, musk thistle, bull thistle, kochia, and wild buckwheat. Does not control most winter annual mustard species very well. Apply to small, actively growing weeds when wheat is from the 3-leaf through the flag-leaf emergence stage of growth. Do not plant alfalfa or grain sorghum for 10.5 months; soybean, dry bean, or sunflower for 10.5 to 18 months; or cotton until at least 10.5 months; and conduct a field bioassay after WideMatch application.
Fluroxypyr (4) + Florasulam (2) 0.088 + 0.0044	13.5 oz **Starane Flex**	Controls kochia and most winter annual mustards unless mustards are ALS-resistant. Apply to small actively growing weeds when wheat is from the 3-leaf stage up to flag leaf emergence. Starane Flex does not provide significant residual weed control. Do not allow livestock to graze the treated area within 7 days after application. Do not plant corn or sorghum for 3 months; alfalfa, canola, soybean, or sunflower for 9 months; or cotton for 12 months after application.
Fluroxypyr (4) + MCPA (4) 0.09 to 0.12 + 0.37 to 0.5	18 to 24 oz **Voucher**	Controls emerged kochia and many other broadleaf weeds. Apply to small actively growing weeds when wheat is from the 3-leaf stage up to flag leaf emergence. Do not allow livestock to forage or graze treated areas within 7 days after application. Do not apply within 14 days before cutting for hay or 40 days before harvesting of grain or straw. Do not plant any crops other than wheat, barley, or oats within 120 days following application.
Fluroxypyr (4) + thifensulfuron (2) 0.07 to 0.14 + 0.014 to 0.027	7 to 14 oz **Sentrallas**	Controls many broadleaf weeds, except ALS-resistant mustards. Apply to small actively growing weeds when wheat is from the 2-leaf stage up to flag leaf emergence. Apply with NIS at 0.06 to 0.25% v/v or oil concentrate at 1% v/v. Do not allow livestock to forage or graze treated areas within 7 days after application. Do not apply within 30 days before cutting for hay or 45 days before harvesting grain. Field corn, sorghum, wheat, barley and oats can be planted any time after application, but do not plant any other crops until 120 days after application.
Fluroxypyr (4) + 2,4-D (4) 0.09 to 0.165 + 0.375 to 0.66	1 to 1.33 pt **Colt + Salvo** or 1.25 to 2 pt **Trump Card**	Controls kochia, including ALS-resistant kochia, and most broadleaf weeds. Apply to small, actively growing weeds after winter dormancy and the 4-leaf stage of wheat but before the early boot stage of wheat. Do not harvest treated forage or allow livestock to graze treated area within 14 days of application. Do not plant any crop except wheat, barley, oat, corn, or sorghum within 120 days after application.
Halauxifen (4) + Florasulam (4) 0.0047 + 0.0047	0.75 oz **Quelex**	Controls many emerged broadleaf weeds other than kochia. Apply to small actively growing weeds when wheat is from the 2-leaf stage up to flag leaf emergence. Apply with NIS at 0.2 to 0.5% v/v or oil concentrate at 0.5 to 1% v/v. Do not allow livestock to forage or graze treated areas within 7 days after application. Do not apply within 21 days before cutting for hay or 60 days before harvesting grain. Do not plant corn, sorghum, soybean, cotton sunflower, or oats, within 3 months; fall seeded canola within 5 months; alfalfa within 9 months; or any crop not listed on the label for 15 months following application. In the event of cereal crop failure, no-till soybean, no-till cotton, field corn, or sorghum may be planted 45 days after application of Quelex.

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Herbicides for Winter Wheat

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Imazamox (2) 0.031 to 0.047	4 to 6 oz **Beyond**	Apply to Clearfield wheat only. Beyond will severely injure or kill non-Clearfield wheat. Controls cheatgrass, jointed goatgrass, and many broadleaf weeds and suppresses feral rye. Can be applied to one gene Clearfield varieties between tiller initiation and jointing, and two gene Clearfield Plus varieties between 2-leaf and second joint. Fall applications have generally provided better control of winter annual grasses than spring applications. Do not apply more than 8 oz/a per growing season, which would allow for 4 oz/a in the fall followed by 4 oz/a in the spring for maximum feral rye suppression. Do not apply when wheat and weeds are dormant and not actively growing. Apply with NIS and nitrogen fertilizer additives. Liquid fertilizer should not exceed 50% of total spray volume. MSO can be used instead of NIS on 2-gene Clearfield wheat varieties for enhanced downy brome and rye control unless not allowed by tank-mix products. Do not use MSO on 1-gene Clearfield wheat varieties. Do not tank mix with sulfonylurea herbicides or apply within 7 days of an organophosphate insecticide. Do not plant corn, sorghum, cotton, or sunflower within 9 months of Beyond application.
MCPA ester (4) 0.25 to 0.75	0.5 to 1.5 pt of 4 lb/gal **MCPA ester**	Controls many broadleaf weeds. Apply to wheat from the 3-leaf to early boot stages of growth for control of small actively growing weeds. Much safer than 2,4-D as a fall treatment or on small wheat. Can be applied in nitrogen fertilizer and as a tank mix with many other herbicides. Do not allow livestock to graze treated wheat within 7 days after application.
MCPA (4) + bromoxynil (6) + fluroxypyr (4) 0.21 to 0.42 + 0.21 to 0.42 + 0.084 to 0.17	1 to 2 pt **Carnivore**	Controls many broadleaf weeds. Apply to wheat from the 2-leaf to flag leaf emergence stages of growth for control of small actively growing weeds. Do not harvest treated forage or allow livestock to graze treated areas within 45 days after application.
MCPA (4) + fluroxypyr (4) + clopyralid (4) 0.22 to 0.47 + 0.08 to 0.16 + 0.0625 to 0.125	1 to 2 pt **Weld** or 1 to 1.5 pt **Full Deck**	Controls many broadleaf weeds. Apply to wheat from the 3-leaf to flag leaf emergence stages of growth for control of small actively growing weeds. Do not rotate to alfalfa for 10.5 months, sorghum or canola for 12 months; soybean or sunflower for 12 to 18 months; or cotton for 18 months after application. Do not allow livestock to graze treated wheat within 7 days after application and do not cut for hay within 14 days after application.
Mesosulfuron (2) 0.013	4.75 oz **Osprey**	Controls Italian (annual) ryegrass. Apply to actively growing weeds after wheat emergence but before the jointing stage of growth. Applications before wheat tiller initiation have a greater risk of stunting the crop. Must be applied with MSO or NIS plus nitrogen fertilizer adjuvants. Topdress liquid nitrogen fertilizer applications are not recommended within 21 days of Osprey treatment because of the increased potential for crop injury. Can be tank mixed with Ally, Finesse, Harmony Extra, MCPA ester, or Starane Ultra. Do not plant barley, sunflower, soybean, or cotton until 90 days; corn until 12 months; or any other crop until 10 months after Osprey application.
Metribuzin (5) 0.19 to 0.5	2 to 10 oz **Metribuzin**	Can control winter annual weeds, such as cheat, downy brome, and mustards. Apply only on selected varieties of dryland winter wheat in fall or early spring. Wheat varieties differ in tolerance to metribuzin. Refer to the label for information on sensitive and tolerant varieties. Can be applied to wheat from the 2-leaf to jointing stage of growth, depending on application rate. Do not apply when wheat is in winter dormancy. Fall applications generally provide better cheatgrass control than spring applications. Can be tank mixed with 2,4-D, dicamba, bromoxynil, Ally, Amber, Finesse, Glean, Harmony Extra, or MCPA. Crop injury can occur from application to wheat that was seeded less than 1 inch deep, on coarse-textured soils, soils low in organic matter, calcareous soils, or soils with a pH above 7.7. Do not allow grazing on treated fields for 14 days after application.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Winter Wheat

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Metsulfuron (2) + MCPA (4) or 2,4-D (4) 0.0038 + 0.25 to 0.50	0.1 oz **Ally** or **Metsulfuron*** + 0.5 to 1 pt of 4 lb/gal **MCPA** or **2,4-D***	Controls many broadleaf weeds. Apply with MCPA in the fall or spring after the 2-leaf stage but before the boot stage of wheat. Apply with 2,4-D in the spring after the wheat is fully tillered but before the early boot stage. Apply to small, actively growing weeds up to 2 inches tall or across. Surfactant should be used at 0.12 to 0.25% v/v. Do not rotate to sorghum, STS soybean, IR corn, or proso millet for 4 months; barley or oat for 10 months; non-IR corn for 12 months; non-STS soybean for 12 to 34 months; or sunflower for 22 months after Ally application. Do not use on soil with pH above 7.9.
Pendimethalin (3) 0.71 to 1.43	1.5 to 3 pt **Prowl H_2O** or **Sattelite Hydrocap**	Prowl H_2O is an encapsulated formulation of pendimethalin that can be applied postemergence to wheat from the 1-leaf up to flag leaf emergence stage for preemergence residual weed control. Does not control emerged weeds, and performance will be variable depending on precipitation and weed germination patterns. Do not harvest wheat forage for 11 days, hay for 28 days, or grain for 60 days following application. Do not plant wheat for 4 months or sorghum for 10 months after application.
Pinoxaden (2) 0.054	16.4 oz **Axial XL**	Controls Italian ryegrass. Apply postemergence to actively growing plants when Italian ryegrass is in the 1- to 5-leaf stage and wheat is in the 2-leaf to pre-boot stage of growth. Do not graze livestock or harvest forage for hay from treated areas for a minimum of 50 days after application.
Propoxycarbazone (2) 0.026 to 0.039	0.6 to 0.9 oz **Olympus**	Controls cheatgrass and certain broadleaf weeds. Apply to small, actively growing weeds after wheat emergence but before the jointing stage of growth. Applications before wheat tiller initiation have a greater risk of stunting the crop. Cheat and Japanese brome are more susceptible than downy brome and generally are controlled adequately in both fall and spring with the 0.6 oz rate. Fall applications at 0.9 oz are recommended for downy brome control. Apply with NIS at 0.25 to 0.5% v/v. Liquid nitrogen fertilizer can be used as a spray carrier. Fall applications in liquid fertilizer solutions should not exceed 50% liquid nitrogen and no more than 30 lb of actual nitrogen per acre. Only add 0.25% v/v surfactant when applied with fertilizer carrier. Can be tank mixed with 2,4-D, Ally, Amber, Finesse, Harmony Extra, MCPA, dicamba, Starane, or Rave. Do not rotate to STS soybean for 4 months; grain sorghum for 6 months; cotton, sunflower, and non-STS soybean for 12 months (if cumulative precipitation exceeds 24 inches); corn for 18 months (if cumulative precipitation exceeds 30 inches) after Olympus treatment. Rotation to other crops or with shorter interval requires successful completion of a field bioassay, and no sooner than 4 months after Olympus application.
Prosulfuron (2) 0.15 to 0.29	0.25 to 0.5 oz **Peak**	Controls many broadleaf weeds. For control of small weeds, apply after wheat is in the 3-leaf stage but before the second node is detectable in stem elongation. For wild buckwheat control, apply after true leaves have developed on seedling plants. Apply with NIS at 0.25 to 0.5% v/v. Apply as a tank mix with another broadleaf herbicide with a different mode of action in areas of known weed resistance. Can be tank mixed at the lower application rates with 2,4-D, MCPA, dicamba, or Buctril. Do not rotate to soybean or canola for 10 months, alfalfa for 15 months, or sunflower for 24 months after Peak application. Do not allow grazing or feed forage from treated fields until 30 days after application.
Pyrasulfotole (27) + Bromoxynil (6) 0.027 to 0.036 + 0.15 to 0.21	11 to 15 oz **Huskie**	Controls many broadleaf weeds as a fall or spring application when weeds are small and actively growing. Apply when wheat is between the 1-leaf and flag leaf emergence stages of growth. Can be tank mixed with Ally, MCPA, 2,4-D, or dicamba. Apply with NIS at 0.25 to 0.5% v/v plus AMS at 0.5 to 1 lb/a or ammonium nitrogen fertilizer at 1 to 2 qt/acre. Huskie may be applied with liquid nitrogen fertilizer as the spray carrier. Do not graze or harvest forage for 25 days after application.

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Herbicides for Winter Wheat

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Pyroxasulfone (15) 0.053 to 0.13	1 to 2.5 oz **Zidua** or 1.75 to 4 oz **Zidua SC**	Apply to wheat from the spike up to the 4-tiller growth stage for residual control of Italian ryegrass and suppression of winter annual brome species. Does not control emerged weeds. May be tank-mixed with other registered herbicides. Wheat forage and hay can be fed or grazed 7 or more days after application.
Pyroxasulfone (15) + Carfentrazone (14) 0.058 to 0.13 + 0.0042 to 0.0095	2 to 4.5 oz **Anthem Flex**	Apply to wheat from the spike up to the 4-tiller growth stage for residual control of Italian ryegrass and suppression of winter annual brome species. Use the lower rates on coarse-textured soils and the higher rates on fine-textured soils. Controls some emerged broadleaf weeds, but not emerged grasses. Do not harvest, feed, or graze within 7 days after application.
Pyroxsulam (2) 0.0164	2 oz **PowerFlex HL** or **GR1**	Controls cheatgrass, Italian ryegrass, and many winter annual broadleaf weeds. GR1 herbicide is a component product available only in FMC PrecisionPac blends with other broadleaf herbicides, which may have different use guidelines and restrictions. Apply to small, actively growing weeds in wheat in the fall or spring from the 3-leaf stage up to jointing. Best control is obtained on grasses from 2-leaf to 2-tiller and before broadleaves are 2 inches tall or 2 inches in diameter. Cheat and Japanese brome are more susceptible than downy brome. Apply with NIS at 0.25 to 0.5% v/v, UAN fertilizer at 1 to 2 qt/acre, or AMS at 1.5 to 3 lb/a can also be added for enhanced weed control. Liquid nitrogen can be used as a spray carrier. The spray solution should not be more than 50% liquid nitrogen and should not exceed 30 lb of actual nitrogen per acre. Only use NIS at 0.25% v/v when applied in nitrogen carrier. May be tank mixed with labeled rates of other broadleaf herbicides as needed for optimal control. Do not mix with products containing dicamba or amine formulations of 2,4-D or MCPA as these products may antagonize grass control. Soybean, sunflower, sorghum, and cotton can be planted after 3 months but not prior to April 30. Alfalfa, barley, canola, or corn cannot be planted for 9 months after PowerFlex HL application. Wheat should not be grazed until 7 days after application or harvested for hay until 28 days after application.
Quizalofop (1) 0.055 to 0.083	8 to 12 oz **Aggressor**	Apply to CoAXium wheat only. Aggressor will severely injure or kill non-CoAXium wheat. Controls winter annual grasses, including cheatgrass, downy brome, jointed goatgrass, rye, volunteer cereals, and Italian ryegrass. Apply in the fall or spring between the 4-leaf to jointing stage of wheat for control of actively growing grasses before they exceed the 4 to 5 leaf stage. Does not provide residual weed control or control of any broadleaf weeds. Always apply with NIS or OC to optimize grass control. Do not tank-mix with DMA formulations of 2,4-D or MCPA or grass control will be severely reduced. To avoid crop injury, do not spray if the daily maximum temperature is not expected to exceed 40°F during the week following application. Do not apply more than 16 oz or make more than two applications per crop cycle. Do not harvest treated wheat for forage or hay within 60 days of application. Do not plant CoAXium wheat more frequently than every other year.
Sulfosulfuron (2) 0.031	0.67 oz **Outrider**	Controls cheatgrass and certain broadleaf weeds. Apply after wheat is in the 2-leaf stage but before jointing for control of small, actively growing weeds. Fall applications have provided better cheatgrass control than spring applications. Do not apply when wheat and weeds are dormant and not growing actively. Apply with NIS at 0.5% v/v. Liquid nitrogen fertilizer can be used at a maximum of 50% of the spray carrier volume. NIS should be used at 0.25% v/v when fertilizer is part of the carrier. Can be tank mixed with 2,4-D, Ally, Glean, Finesse, Express, Harmony Extra, bromoxynil, or MCPA. Wheat can be grazed immediately after application but should not be harvested for hay until 30 days after application. STS soybean can be planted 3 months after treatment if soil pH is less than 7.5 and cumulative precipitation exceeds 18 inches. Cotton and non-STS soybean can be planted 12 months after treatment if soil pH is less than 7.5 and cumulative precipitation is over 30 inches. Planting sorghum, corn, or sunflower is not recommended until at least 22 months after treatment. Rotation to other crops or with shorter interval requires successful completion of a field bioassay, and no sooner than 3 months after application. Risk of Outrider carryover is greatest on high pH soils.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Winter Wheat

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Thifensulfuron (2) + MCPA (4) or 2,4-D (4) 0.014 to 0.028 + 0.25 to 0.38	0.45 to 0.9 oz **Harmony SG** + 0.5 to 0.75 pt of 4 lb/gal **MCPA** or **2,4-D***	Controls many broadleaf weeds and wild garlic. Apply with MCPA in the fall or spring after the 2-leaf stage of wheat but before the flag leaf is visible. Apply with 2,4-D in the spring after wheat is fully tillered but before the flag leaf is visible. Apply with NIS at 0.12 to 0.25% v/v to small, actively growing weeds. Use 0.75 to 0.9 oz/a for wild buckwheat or wild garlic control. Does not provide residual weed control, but any crop can be planted 45 days after treatment. Do not feed forage from treated areas or allow livestock grazing within 7 days of application. Allow 30 days between application and feeding hay from treated areas to livestock.
Thifensulfuron (2) + Tribenuron (2) 0.009 to 0.019 + 0.005 to 0.009	0.45 to 0.9 oz **Harmony Extra SG**	Controls many broadleaf weeds and wild garlic. For control of weeds less than 4 inches tall or across, apply after wheat is at the 2-leaf stage but before the flag leaf is visible. Apply with NIS at 0.12 to 0.25% v/v. Apply as a tank mix with another broadleaf herbicide having a different mode of action in areas of known weed resistance. Do not feed forage from treated areas or allow livestock grazing within 7 days of application. Allow 30 days between application and feeding hay from treated areas to livestock.
Thifensulfuron (2) + Tribenuron (2) 0.003 to 0.0156 + 0.003 to 0.0156	0.4 to 1 oz **Affinity BroadSpec**	Controls many broadleaf weeds. For control of weeds less than 4 inches tall or across, apply after wheat is at the 2-leaf stage but before the flag leaf is visible. Apply with NIS at 0.12 to 0.5% v/v or an oil concentrate at 1% v/v. Apply as a tank mix with another broadleaf herbicide having a different mode of action in areas of known weed resistance and at rates of 0.6 or less. Generally recommended for use in western Kansas. Do not feed forage from treated areas or allow livestock grazing within 7 days of application. Allow 30 days between application and feeding hay from treated areas to livestock.
Thifensulfuron (2) + Tribenuron (2) 0.015 to 0.025 + 0.004 to 0.006	0.6 to 1 oz **Affinity TankMix**	Controls many broadleaf weeds. Apply after wheat is in the 2-leaf stage but before the flag leaf is visible for control of actively growing weeds less than 4 inches tall or across. Apply with NIS at 0.25 to 0.5% v/v or with an oil concentrate at 1% v/v. Recommended to be used in combination with other wheat herbicides having a different mode of action. Generally recommended for use in eastern and central Kansas. Do not feed forage from treated areas or allow livestock grazing within 7 days of application. Allow 30 days between application and feeding hay from treated areas to livestock.
Thifensulfuron (2) + Tribenuron (2) + Fluroxypr (4) 0.014 + 0.005 + 0.078	5 oz **Supremacy**	Controls many broadleaf weeds including ALS-resistant kochia. Apply after wheat is in the 2-leaf stage but before the flag leaf is visible for control of actively growing weeds less than 4 inches tall or across. Apply with NIS at 0.25% to 0.5% v/v unless tank mixed with an EC herbicide at 0.5 pt/a or more. Do not graze or feed forage or hay from the treated area. Small grains can be planted anytime after application. Do not plant corn or sorghum for 45 days, or any other crop until 120 days after application.
Thifensulfuron (2) + Tribenuron (2) + Metsulfuron (2) 0.0047 to 0.009 + 0.0023 to 0.0047 + 0.0019 to 0.0038	0.3 to 0.5 oz **Ally Extra SG**	Controls many broadleaf weeds and wild garlic. For control of weeds less than 4 inches tall or across, apply after wheat is at the 2-leaf stage but before the flag leaf is visible. Apply with NIS at 0.12 to 0.25% v/v. Apply as a tank mix with another broadleaf herbicide having a different mode of action in areas of known weed resistance. Do not feed forage from treated areas or allow livestock grazing within 7 days of application. Allow 30 days between application and feeding hay from treated areas to livestock. Do not apply to soils with a pH greater than 7.9. Crop rotation restrictions differ with application rate, soil pH, and geography. Refer to the label for crop rotation guidelines.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Winter Wheat

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Thifensulfuron (2) + Tribenuron (2) + Metsulfuron (2) + Dicamba (4) 0.0047 to 0.0094 + 0.0024 to 0.0048 + 0.0019 to 0.0038 + 0.058 to 0.116	1.6 to 3.2 oz **Agility SG**	Agility SG is a premix of Ally Extra SG plus dicamba. Apply after wheat is in the 2-leaf stage but before jointing of wheat for control of most broadleaf weeds. Can be applied with water, liquid nitrogen fertilizer, or a mixture of both as a carrier. If 50% or more of the carrier is liquid nitrogen fertilizer, a surfactant is not recommended. Otherwise, apply with NIS at 0.125 to 0.25% v/v. Do not feed forage from treated areas or allow livestock grazing within 7 days of application. Allow 30 days between application and feeding hay from treated areas to livestock. Crop rotation restrictions differ with application rate, soil pH, and geography. Do not rotate to sorghum, STS soybean, or proso millet for 4 months; corn for 12 months; sunflower for 10 to 22 months; non-STS soybean for 12 to 34 months; or other crops for 34 months unless a successful field bioassay is completed prior to planting the rotational crop.
Triasulfuron (2) 0.013 to 0.022	0.28 to 0.47 oz **Amber**	Controls many broadleaf weeds. Apply before boot stage of wheat. Use the higher rate for control of wild buckwheat and extended residual control. Can be applied with water, liquid nitrogen fertilizer, or mixture of both as a carrier. If 50% or more of the carrier is nitrogen fertilizer, no surfactant is needed. Otherwise, apply with NIS at 0.25 to 0.5% v/v. Tank mixes can improve weed control and reduce risk of herbicide resistance problems. Amber can be tank mixed with dicamba, bromoxynil, MCPA, Sencor, or 2,4-D. Do not apply any herbicide with same mode of action within 12 (pH < 7.5) to 15 (pH > 7.5) months after Amber application. Do not rotate to oat, barley, or rye for 6 to 18 months; grain sorghum for 14 to 24 months; soybean or corn for 14 to 36 months; or any other crop until a field bioassay is performed. Refer to label for additional use and crop rotation guidelines.
Triasulfuron (2) + Dicamba (4) 0.011 to 0.022 + 0.06 to 0.125	2 to 4 oz **Rave**	Rave is a premix of Amber and dicamba. Controls many broadleaf weeds. Apply after emergence but before jointing of wheat. Can be applied with water, liquid nitrogen fertilizer, or a mixture of both as a carrier. If 50% or more of the carrier is liquid nitrogen fertilizer, a surfactant is not recommended. Otherwise, apply with NIS at 0.25 to 0.5% v/v. Do not rotate to barley, oat, or rye for 6 to 18 months; corn for 14 to 36 months; sorghum for 14 to 24 months; STS soybean for 11 months; non-STS soybean for 14 to 26 months; or alfalfa for 24 months; and have a field bioassay performed, depending on soil pH and precipitation. In the event of catastrophic crop loss, grain sorghum and STS soybean can be planted 4 months after application if the grower is willing to accept the risk of crop injury. Refer to the label for additional use and crop rotation guidelines.
Tribenuron (2) 0.0078 to 0.015	0.25 to 0.5 oz **Express**	Controls many broadleaf weeds but is weak on wild buckwheat and pigweed species. For control of weeds less than 4 inches tall or across, apply after wheat is in the 2-leaf stage but before the flag leaf is visible. Apply with NIS at 0.25% to 0.5% v/v. Apply as a tank mix with another broadleaf herbicide in areas of known weed resistance. Can be tank mixed with MCPA, 2,4-D, dicamba, or bromoxynil. Do not feed forage from treated areas or allow livestock grazing within 7 days of application. Allow 30 days between application and feeding hay from treated areas to livestock.
2,4-D (4) 0.25 to 0.5 LVE, or 0.25 to 0.75 amine	0.5 to 1 pt of 4 lb/gal **2,4-D* LVE** or 0.5 to 1.5 pt of 4 lb/gal **2,4-D amine**	Controls many broadleaf weeds but not wild buckwheat. The least injury to wheat can be expected if applied between full tiller (about 4 to 8 inches) and early boot stages. Likelihood of injury is increased if 2,4-D is applied to wheat in the fall when it is not tillered fully. Can be applied in nitrogen fertilizers. Do not apply when wheat is between early boot stage and milk stage. Do not allow grazing on treated fields within 2 weeks after treatment.
2,4-D (4) 0.75 to 1 LVE	1.5 to 2 pt of 4 lb/gal **2,4-D* LVE**	Can be used to control wild garlic (wild onion). The least injury to wheat can be expected if 2,4-D is applied after full tiller stage (when wheat is 4 to 8 inches tall) but before wheat plants elongate rapidly or enter joint stage. This rate will not consistently kill wild garlic, but it reduces production of aerial bulblets and knocks down tops of plants.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Winter Wheat

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
PREHARVEST		
Carfentrazone (14) 0.016 to 0.031	1 to 2 oz **Aim EC**	For desiccation of susceptible broadleaf weeds. Apply after wheat is mature but at least 3 days before harvest. Always apply with 1% v/v COC in a minimum spray volume of 5 gal/a for aerial application and 10 gal/a for ground applications. Do not apply more than 2 oz of Aim during the growing season.
Dicamba (4) 0.25	0.5 pt **Dicamba***	Apply when wheat is in the hard dough stage and green color is gone from nodes of stem for control of certain broadleaf weeds. A waiting period of 7 days is required before harvest. Do not allow grazing or use feed from treated area.
Glyphosate (9) 0.5 to 1	1 to 2 pt of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	For control of broadleaf and grass weeds that can interfere with harvest, apply when wheat is in the hard dough stage (30% or less grain moisture) and at least 7 days before harvest. Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. Do not feed treated straw or permit dairy animals or meat animals being finished for slaughter to graze treated grain fields within 2 weeks after treatment. Not recommended for wheat being harvested for use as seed.
Metsulfuron (2) 0.0038	0.1 oz **Ally** or **Metsulfuron***	For control of broadleaf weeds, apply when wheat is in the dough stage and at least 10 days before harvest. Always apply with NIS at 0.25 to 0.5% v/v. Do not use on soils with a pH greater than 7.9. Weeds growing under limited moisture may not be controlled. Generally applied as a tank mix with glyphosate or 2,4-D.
2,4-D LVE (4) 0.5	1 pt of 4 lb/gal **2,4-D* LVE**	Apply when wheat is in the hard dough stage to control large, actively growing broadleaf weeds that can interfere with harvest. A waiting period of 14 days is required before harvest. Weeds growing under limited moisture may not be controlled.
FOR SPOT TREATMENT ONLY		
Glyphosate (9)	1.28 to 2.56 fl oz **Glyphosate***/gal spray solution (see glyphosate table)	Apply as spot treatment to control annual and some perennial weeds. Apply at the recommended stage of weed growth before wheat begins heading. Crop in treated area will be killed. Avoid drift outside target area.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Spring-Seeded Oat

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Bromoxynil (6) 0.25 to 0.38	1 to 1.5 pt **Broclean, Brox,** or **Moxy**	Apply before seedling weeds are past 3- to 4-leaf stage or 1.5 inches in diameter. Apply to oat from 1-leaf to boot stage. Can be used to control wild buckwheat. Do not allow grazing on treated fields for 30 days after application.
Bromoxynil (6) + 2,4-D (4) 0.25 to 0.38 + 0.25	1 to 1.5 pt **Broclean, Brox,** or **Moxy** + 0.5 pt of 4 lb/gal **2,4-D***, or 1 to 2 pt **Double Up B&D**	Can control wild buckwheat and other broadleaf weeds. Apply before weeds are past 3- to 4-leaf stage or more than 1.5 inches in diameter. Apply after tillering but before jointing stage of oat. Do not allow grazing on fields for 30 days after application.
Bromoxynil (6) + MCPA (4) 0.25 to 0.38 + 0.25 to 0.38	1 to 1.5 pt **Bison, Brox M,** or **Wildcard Xtra**	Controls many broadleaf weeds. Apply to oat after the 3-leaf stage but before boot stage. Most effective on small, seedling weeds.
Carfentrazone (14) 0.08 to 0.017	0.5 to 1 oz **Aim EC**	A contact herbicide for control of certain broadleaf weeds. Apply before jointing of oat for control of seedling weeds. Apply with NIS at 0.25% v/v. May cause leaf burn on oat leaves, especially with warm conditions at and following application.
Chlorsulfuron (2) 0.008 to 0.015	0.17 to 0.33 oz **Glean**	Controls many broadleaf weeds. For control of weeds less than 2 inches tall or across, apply after the 2-leaf stage but before the boot stage of spring oat. Apply with NIS at 0.25% to 0.5% v/v. Tank mixes can improve weed control and reduce the risk of herbicide resistance problems. Glean can be tank mixed with MCPA, 2,4-D, dicamba, or bromoxynil. Can be applied with liquid N fertilizer, if compatible, but then do not use surfactant. Glean can be applied once per crop period east of Highway 183 and once every 36 months west of Highway 183. STS soybean, grain sorghum, and IR corn hybrids can be planted 4 months after Glean application if the soil pH is 7.5 or lower. Do not plant oat or barley for 10 months, non-STS soybean for 14 to 26 months, or any other crop until a field bioassay has been performed. Refer to label for additional crop rotation restrictions and sprayer tank cleaning procedures. Do not apply on soil with pH higher than 7.9.
Dicamba (4) 0.13	0.25 pt **Dicamba***	Apply to small, actively growing weeds when oat is in the 2- to 3-leaf stage. Can control wild buckwheat. Do not allow grazing or harvest for dairy feed before milk stage of oat.
Florasulam (2) + MCPA (4) 0.0044 + 0.031	17 oz **Orion**	Controls certain broadleaf weeds. Apply from the 3-leaf stage until jointing of oat for control of small, actively growing weeds that have emerged at the time of application. Livestock can graze treated area 7 days after application. Do not apply within 60 days of harvest. Do not plant corn or sorghum within 3 months or alfalfa, soybean, and sunflower within 9 months after application. For kochia or Russian thistle control, tank mix with Starane or Buctril. For henbit control, tank mix with metsulfuron.
Fluroxypyr (4) + 2,4-D (4) 0.06 to 0.08 + 0.25 to 0.33	0.75 to 1 pt **Trump Card**	Controls kochia, including ALS-resistant kochia, and most broadleaf weeds. Apply to small, actively growing weeds after oat is fully tillered but before the early boot stage. Do not harvest treated forage or allow livestock to graze treated area within 14 days of application. Do not plant any crop except wheat, barley, oat, corn, or sorghum within 120 days after application.
MCPA (4) + bromoxynil (6) + fluroxypyr (4) 0.21 to 0.42 + 0.21 to 0.42 + 0.084 to 0.17	1 to 2 pt **Carnivore**	Controls many broadleaf weeds. Apply to oats from the 2-leaf to flag leaf emergence stages of growth for control of small actively growing weeds. Do not harvest treated forage or allow livestock to graze treated areas within 45 days after application.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Spring-Seeded Oat

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Mesotrione (27) 0.094	3 oz **Callisto** or **Motif**	Controls various grass and broadleaf weeds. Apply to emerged weeds less than 5 inches tall and at least 50 days prior to oat harvest. Apply with NIS at 0.25% v/v. May result in temporary crop injury. Avoid tank mixing with EC formulation pesticides. Do not graze or feed forage within 30 days after application.
Prosulfuron (2) 0.15 to 0.29	0.25 to 0.5 oz **Peak**	Controls many broadleaf weeds. For control of small broadleaf weeds, apply after oat is in the 3-leaf stage but before a second node is detectable as stem elongates. Apply with NIS at 0.25 to 0.5% v/v. Apply as a tank mix with another broadleaf herbicide in areas of known weed resistance. Can be tank mixed at the lower application rates with 2,4-D, MCPA, dicamba, or bromoxynil. Do not rotate to soybean or canola for 10 months, alfalfa for 15 months, or sunflower for 24 months following Peak application. Do not allow grazing or feed forage from treated fields until 30 days after treatment.
Thifensulfuron (2) 0.014 to 0.019	0.45 to 0.6 oz **Harmony SG,** or 0.3 to 0.4 oz **Unity**	Controls many broadleaf weeds and wild garlic. For control of weeds less than 4 inches tall or across, apply after oat is in the 3-leaf stage but before jointing. Apply with NIS at 0.25% v/v. Do not apply to Ogle, Porter, or Premier oat varieties. Apply as a tank mix with another broadleaf herbicide having a different mode of action in areas of known weed resistance. Do not feed forage from treated areas or allow livestock grazing within 7 days of application. Allow 30 days between application and feeding hay from treated areas to livestock.
Thifensulfuron + Tribenuron 0.009 to 0.012 + 0.005 to 0.007	0.45 to 0.6 oz **Harmony Extra SG**	Controls many broadleaf weeds and wild garlic. For control of weeds less than 4 inches tall or across, apply after oat is in the 3-leaf stage but before jointing. Apply with NIS at 0.25% v/v. Do not apply to Ogle, Porter, or Premier oat varieties. Apply as a tank mix with another broadleaf herbicide having a different mode of action in areas of known weed resistance. Do not feed forage from treated areas or allow livestock grazing within 7 days of application. Allow 30 days between application and feeding hay from treated areas to livestock.
Thifensulfuron (2) + Tribenuron (2) + Fluroxypr 0.014 + 0.005 + 0.078	5 oz **Supremacy**	Controls many broadleaf weeds including ALS-resistant kochia. Apply after oat is in the 2-leaf stage, but prior to jointing for control of actively growing weeds less than 4 inches tall or across. Apply with NIS at 0.25% to 0.5% v/v unless tank mixed with an EC herbicide at 0.5 pt/a or more. Do not graze or feed forage or hay from the treated area. Small grains can be planted anytime after application. Do not plant corn and sorghum for 45 days, or any other crop until 120 days after application.
2,4-D (4) 0.25 to 0.5 amine, or 0.25 LVE	0.5 to 1 pt of 4 lb/gal **2,4-D* **amine** or 0.5 pt of 4 lb/gal **2,4-D*** **LVE**	Controls most broadleaf weeds. Has least injury potential to oat if it is applied between full tiller (about 4 to 8 inches) and early boot stages. Do not apply before tiller stage or from early boot through milk stages. Do not allow grazing of fields within 2 weeks after treatment.
PREHARVEST		
2,4-D LVE (4) 0.5	1 pt of 4 lb/gal **2,4-D*** **LVE**	Apply when oat is in the hard dough stage to control actively growing, large, broadleaf weeds that can interfere with harvest. Weeds growing under limited moisture may not be controlled. Do not use treated straw for livestock feed.
Carfentrazone (14) 0.016 to 0.031	1 to 2 oz **Aim EC**	For desiccation of susceptible broadleaf weeds. Apply after oat is mature but at least 3 days before harvest. Always apply with 1% v/v COC in a minimum spray volume of 5 gal/a for aerial application and 10 gal/a for ground applications. Do not apply more than 2 oz of Aim during the growing season.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Alfalfa

This publication primarily concerns chemical weed control. It is not intended to imply that cultivation, particularly in row crops, is undesirable. One or two cultivations can greatly improve weed control.

Weed Response to Selected Alfalfa Herbicides When Applied According to Label Directions[1]

		Winter Annuals										Summer Annuals, Broadleaf										Perennials
		Grasses				Broadleaf						Grasses				Broadleaf						
Herbicide(s)	Crop tolerance	Volunteer wheat	Downy brome	Japanese brome	Cheat	Prickly lettuce	Henbit	Flixweed/tansy mustard	Bushy wallflower	Field pennycress	Shepherdspurse	Barnyardgrass	Crabgrass	Foxtail	Longspine sandbur	Kochia	Lambsquarters	Morningglory	Pigweed	Common ragweed	Pennsylvania smartweed	Dandelion
PREPLANT																						
Balan	G	—	—	—	—	—	G	—	—	—	—	E	E	E	E	—	F-G	—	F-G	—	—	—
Treflan	F-G	—	F-G	F-G	F-G	—	G	—	—	—	—	E	E	E	E	—	F-G	—	F-G	—	—	—
POSTEMERGENCE TO ALFALFA AND PREEMERGENCE TO WEEDS																						
Chateau	G	—	G	E	E	E	G	E	E	E	E	F-G	F-G	G	F	E	E	G	E	E	E	G
Pendimethalin	G	—	—	—	—	—	G	—	—	—	—	E	E	E	G-E	F-G	G-E	—	G-E	—	—	—
Treflan HFP	F-E	—	G	G	G	—	G	—	—	—	—	E	E	E	G-E	F-G	G-E	—	G-E	—	—	—
Warrant	E	F	—	—	—	—	G	—	—	—	—	G	G-E	E	F	—	G	—	G	—	—	—
POSTEMERGENCE																						
Buctril, Moxy *(Seedling only)*	G	—	—	—	—	—	F	—	—	G-E	G-E	—	—	—	—	G	G-E	G	F-G	G	G-E	—
Butyrac 200, 2,4-DB 200	F-G	—	—	—	—	—	—	G	G	G	G	—	—	—	—	F-G	G-E	G-E	G-E	G-E	G-E	—
Clethodim	E	G-E	G-E	G-E	G-E	—	—	—	—	—	—	E	G	E	E	—	—	—	—	—	—	—
Glyphosate *(Roundup Ready only)*	E	E	E	E	E	G	G	E	E	E	E	G	E	E	E	G	G	G	E	G	E	F-G
Gramoxone SL	F	G	—	—	—	—	G	—	—	—	—	G	G	G	G	F-G	G	G	G	G	G	G
Pursuit	G-E	—	—	—	—	—	F	G-E	G-E[2]	G-E	G-E	F-G	F	G	—	G	F	G	G[2]	F	G	F
Poast, Poast Plus	E	G	G	G	G	—	—	—	—	—	—	E	G	E	E	—	—	—	—	—	—	—
Raptor	G-E	E	G	E	E	—	F	E	E[2]	E	E	F-G	F-G	G-E	—	G[2]	G	G	G[2]	F	G	F
DORMANT TREATMENTS																						
Glyphosate	G	E	G	G	G	—	G	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Gramoxone SL	E	G	F	F	F	G	G	F	G	G	G	—	—	—	—	—	—	—	—	—	—	—
Karmex, Diuron	G	—	—	—	—	E	F	E	E	E	E	G-E	G-E	G-E	F	G	E	G	E	E	F-G	—
Metribuzin	G	—	G	G	G	—	G-E	G	E	E	E	F	F	F	—	E	E	—	G	E	E	F
Pursuit	G-E	—	—	—	—	—	F	G-E	G-E[2]	G-E	G-E	F-G	F-G	G-E	—	G	G	G	G[2]	F	G	F
Sharpen	G	—	—	—	—	G	F	G	—	E	E	—	—	—	—	G	G	—	—	—	G	F
Sinbar	G	—	G	G	G	E	G	E	E	E	E	G	G	G	G	G-E	E	E	G	E	E	G
Tripzin ZC	G	—	F-G	F-G	F-G	—	G	—	—	—	E	G-E	G	G-E	G	G-E	E	F	G	G-E	E	F-G
Velpar, Velossa	G	F	G	G	G	F	G	E	E	E	E	—	F	G	—	F	G	—	G	—	—	G
Velpar AlfaMax	G	F	G	G	G	E	G	E	E	E	E	G-E	G-E	G-E	—	G	E	G	E	E	F-G	G
Velpar AlfaMax Gold	G	F	G	G	G	E	G	E	E	E	E	E	G-E	G-E	—	G-E	E	G	E	E	F-G	G

[1] Weed response ratings refer to application according to label directions and with favorable growing conditions:
E = Excellent, G = Good, F = Fair, P = Poor, and — = weed not listed on the herbicide label.
[2] Except where resistant weed populations have developed.

Herbicides for Alfalfa

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN OR PREPLANT		
Benefin (3) 1.1 to 1.5	2 to 2.5 lb **Balan DF**	Controls grasses more effectively than broadleaf weeds. Apply before planting alfalfa and incorporate 2 to 3 inches deep within 4 hours.
Glyphosate (9) 0.38 to 0.75 lb ae	1 to 2 pt of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	Apply before crop emergence for control of emerged weeds. Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. Condition spray solution with 1 to 2% spray-grade AMS by weight (8.5 to 17 lb/100 gal water) before adding herbicide to the spray tank.
Trifluralin (3) 0.5 to 0.75	1 to 1.5 pt **Treflan HFP**	Supplemental label. Controls grasses more effectively than broadleaf weeds. Apply before planting alfalfa and incorporate 2 to 3 inches deep within 24 hours. Use the lower rate in coarsely textured soils and the higher rate on finely textured soils. Some crop stand reduction can occur, especially with cool, wet weather, and deep seeding.
POSTEMERGENCE TO CROP AND PREEMERGENCE TO WEEDS		
Acetochlor (15) 0.75 to 1.5	1.25 to 2 qt **Warrant**	For preemergence control of grasses and small seeded broadleaf weeds in seedling and established alfalfa. Apply after emergence through the 4 trifoliate stage of seedling alfalfa, after spring green-up in established alfalfa, or within 7 days after cutting alfalfa. Does not control emerged weeds. Tank mix with other labelled herbicides for control of emerged weeds. Maximum application rate depends on soil texture and organic matter content. Do not cut for forage or hay, or graze within 20 days after application. Do not use on alfalfa grown for seed production. Do not exceed a total of 4 qt/a per year when making multiple applications through the season.
Pendimethalin (3) 0.047 to 4	1.1 to 8.4 pt **Prowl H_2O,** **Sattelite Hydrocap,** or **Sattelite Flex**	For preemergence control of certain annual grass and broadleaf weeds in seedling or established alfalfa for forage or hay. Apply 1.1 to 2.1 pt/a to seedling alfalfa between the 2 trifoliate-leaf and 6-inch stages of growth. Apply 2.2 to 8.4 pt/a to established alfalfa from the last cutting in fall until alfalfa has 6 inches of spring regrowth. Do not harvest alfalfa less than 50 days after applying more than 4.2 pt/a. Can be applied between cuttings at rates up to 4.2 pt/a with a 28-day preharvest interval. Some stunting and chlorosis of alfalfa may occur with postemergence applications. Do not exceed a cumulative total of 8.4 pt/a in a single cropping season.
Trifluralin (3) 0.75 to 2	1.5 to 4 pt **Trifluralin 4E*** or 20 lb **Treflan TR 10**	For preemergence control of barnyardgrass, crabgrass, foxtail, and other annual weeds. Apply to dormant or semidormant alfalfa or throughout the growing season immediately after cutting. Irrigation (0.5 inch) or rainfall is needed within 3 days after application, or the treatment must be incorporated to mix the herbicide into the soil but with minimal damage to the alfalfa. Apply chemigation treatments in 0.75 to 1 inch of water through a center-pivot irrigation system to established alfalfa stands before weed emergence for all soil textures. If possible, inject only undiluted Treflan HFP into irrigation system. Use within 4 to 8 hours if mixed with water before application. Do not cut or allow grazing of plants within 21 days after application. Follow label and chemigation application directions.
POSTEMERGENCE		
Bromoxynil (6) 0.25 to 0.38	1 to 1.5 pt **Bromox**, **Brox,** or **Moxy**	Controls many broadleaf weeds. Apply in fall or spring to seedling alfalfa after 4 trifoliate-leaf stage and when weed seedlings are less than 2 inches tall. Fall applications provide the best control of weeds that emerge in the fall. Leaf burn of alfalfa can occur after application, but new growth will not be affected. Can be tank mixed with Pursuit or 2,4-DB. Do not apply if temperature is expected to exceed 70°F (eastern Kansas) to 80°F (western Kansas) at or within 3 days after treatment. Do not harvest or allow grazing of spring-treated alfalfa within 30 days or fall- or winter-treated alfalfa within 60 days.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Alfalfa

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Clethodim (1) 0.07 to 0.156	6 to 10 oz **Select, Arrow, Section, Volunteer,** or **Tapout,** or 9 to 16 oz **Select Max**	Controls annual and perennial grasses. Always apply Select and comparable products with COC at 1% v/v. Always apply Select Max with NIS at 0.25 % v/v or COC at 1% v/v plus AMS at 2.5 to 4 lb/acre. Can be applied to seedling or established alfalfa at least 15 days before grazing, feeding, or harvesting for hay. Apply to small, actively growing grasses before plants exceed the size limits on the label. Select is most effective on grasses before they have been mowed. Use the higher application rate and allow active regrowth before treating grasses that have been mowed.
Glyphosate (9) 0.38 to 1.55	1 to 4 pt of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	Broadcast apply only to Roundup Ready alfalfa. Application to conventional alfalfa varieties will result in severe injury or death of the crop. Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. Controls most annual and perennial weeds at the rates suggested on the label. Glyphosate has no residual activity, so multiple applications may be required through the season, particularly for control of both winter and summer annual weeds. The combined total per year for all in-crop applications should not exceed 6 qt of a 3 lb ae/gal glyphosate product*. Condition spray solution with 1 to 2% spray-grade AMS by weight (8.5 to 17 lb/100 gal water) before adding glyphosate to the tank. Remove domestic livestock before application, and wait a minimum of 5 days after the last application before grazing, or cutting and feeding of alfalfa forage or hay.
Imazamox (2) 0.031 to 0.047	4 to 6 oz **Raptor**	Controls many annual weeds. Apply to established or seedling alfalfa after it has reached the 2 trifoliate-leaf stage for control of small actively growing weeds less than 3 inches tall or across. Always apply with NIS or COC plus fertilizer additives. Raptor will provide better control of volunteer wheat, cheatgrass, and other winter annual grasses than Pursuit. Weeds that are not actively growing because of environmental stress are less susceptible to control. Raptor has no preharvest interval. Do not plant wheat for 3 months; corn, sorghum, cotton, or sunflower for 9 months; or canola (non-Clearfield) for 18 to 26 months after Raptor application.
Imazethapyr (2) 0.047 to 0.094	3 to 6 oz **Pursuit**	Controls many annual weeds. For control of small, actively growing weeds before they reach the size limits listed on the label, apply to established or seedling alfalfa after it has reached the 2 trifoliate-leaf stage. Always apply with NIS or COC plus fertilizer additives. Weeds that are not actively growing because of environmental stress are less susceptible to control. Do not apply more than 4 oz/a during the last year of the alfalfa stand. Do not feed, harvest, or allow grazing of alfalfa for 30 days after an application. Do not replant alfalfa within 4 months; field corn for 8.5 months; cotton, sorghum, or sunflower for 18 months; or canola (non-Clearfield) for 40 months after Pursuit application.
Paraquat (22) 0.25	16 fl oz **Gramoxone SL**	A restricted-use pesticide. Always apply with NIS. Apply for control of emerged annual grasses and broadleaf weeds in established stands (at least 1 year old) of alfalfa. Apply immediately after alfalfa has been removed but no more than 5 days after cutting. Alfalfa foliage present at time of application will be burned. Weeds that germinate after application will not be controlled. Do not cut, harvest, or allow grazing within 30 days of application.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Alfalfa

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Sethoxydim (1) 0.1 to 0.5	0.5 to 2.5 pt **Poast** or 0.75 to 2.25 pt **Poast Plus**	Controls annual and perennial grasses. Always apply with COC. UAN or AMS can also be added for enhanced activity. Can be applied to seedling or established alfalfa at least 7 days before grazing, feeding, or cutting undried forage or 14 days before cutting for hay. Apply to annual grasses 3 to 8 inches tall and actively growing. Poast is most effective on grasses before they have been mowed. Use higher application rates, and allow active regrowth before treating grasses that have been mowed. Higher application rates are recommended in western Kansas than in eastern Kansas.
2,4-DB (4) 0.5 to 1.5	1 to 3 qt **Butyrac 200** or **2,4-DB 200**	Controls seedlings of many broadleaf weeds. Apply to spring- or fall-seeded alfalfa at the 2 to 4 trifoliate-leaf stage and when weeds are less than 3 inches tall. Do not allow grazing or cut hay from treated fields of seedling alfalfa within 60 days and of established alfalfa within 30 days after treatment.
DORMANT SEASON		
Diuron (7) 0.8 to 2.4	1 to 3 lb **Karmex** or 0.8 to 2.4 qt **Diuron 4L**	Apply to established alfalfa (1 year or older) after it is dormant in fall but before it begins to grow in spring. Do not use on loamy sand or sand. Do not replant treated areas to any crop within 2 years.
Flumioxazin (14) 0.13	4 oz **Chateau**	For preemergence control of many annual grass and broadleaf weeds in established alfalfa. Does not provide good control of emerged weeds. Apply in fall or as a dormant season treatment. Works well for winter annual weed control when applied after the last alfalfa cutting in the fall. For maximum pigweed control, apply just before green-up in the spring and/or between cuttings. Between-cutting treatments can be applied only with chemigation. Provides excellent control of seedling dandelion but not established plants. Do not apply more than 8 oz/a during one growing season. Do not harvest or graze alfalfa within 25 days after Chateau application.
Glyphosate (9) 0.21 to 0.28	6 to 8 oz **Roundup PowerMax**	Controls cheat and downy brome. Apply in early spring when grasses have resumed growing, but before alfalfa regrowth is initiated. Application after spring growth of alfalfa has begun may result in crop injury and reduced crop yield. Do not add AMS. Do not graze or harvest alfalfa within 36 hours after application.
Hexazinone (5) 0.25 to 1.5	1 to 6 pt **Velpar L** or 0.8 to 5 pt **Velossa**	Controls annual grasses and broadleaf weeds. Apply to dormant, established alfalfa in fall or late winter but before new growth begins in spring. Use 1 to 2 pt/a to control tansy mustard and higher rates to control cheatgrass and other weeds. Do not allow grazing or feed treated forage for 30 days after treatment. Do not replant treated areas to corn for 12 months or any other crops within 2 years after treatment. Consult the label for soil texture guidelines and cropping limitations.
Hexazinone (5) + Diuron (7) 0.25 to 1.5 + 0.3 to 1.8	0.75 to 4.3 lb **Velpar AlfaMax**	Velpar AlfaMax is a unit pack that contains both hexazinone and diuron but is not a homogenous mix. One 14.2 lb unit pack treats between 3.3 and 10 acres, depending on soil texture, soil organic matter content, and weed species to be controlled. Controls annual grass and broadleaf weeds. Lower rates can be used specifically for tansy mustard control. Apply to dormant, established alfalfa in fall or late winter but before new growth begins in spring. Do not allow grazing or feed treated forage or hay for 30 days after treatment. Do not replant treated areas to corn for 12 months or any other crops within 2 years after treatment. Consult the label for soil texture guidelines and cropping limitations.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Alfalfa

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
DORMANT SEASON		
Hexazinone (5) + Diuron (7) 0.23 to 1 + 0.55 to 2.4	1 to 4.3 lb **Velpar AlfaMax Gold**	Velpar AlfaMax Gold is a premix that contains hexazinone and diuron but has more diuron relative to hexazinone than Velpar AlfaMax. Use rates depend on soil texture, soil organic matter content, and weed species to be controlled. Controls annual grass and broadleaf weeds. Lower rates can be used specifically for tansy mustard control. Apply to dormant, established alfalfa in fall or late winter but before new growth begins in spring. Do not allow grazing or feed treated forage or hay for 30 days after treatment. Do not replant treated areas to corn for 12 months or to any other crops within 2 years after treatment. Consult the label for soil texture guidelines and cropping limitations.
Imazethapyr (2) 0.047 to 0.094	3 to 6 oz **Pursuit**	Controls many annual weeds. Apply to established alfalfa in the fall or spring before plants have 3 inches of regrowth. Always apply with NIS or COC plus fertilizer solutions. Weeds that are not actively growing because of environmental stress are less susceptible to control. Do not apply during the last year of the alfalfa stand. Do not feed, harvest, or allow grazing of alfalfa for 30 days after an application.
Metribuzin (5) 0.4 to 1	0.5 to 1.33 lb **Dimetric** or **Tricor**	Controls winter annual and some summer annual weeds. Apply to dormant established alfalfa after first growing season. Do not apply after spring growth begins or before growth ceases in fall. Do not allow grazing or harvest within 28 days of treatment.
Paraquat (22) 0.5 to 0.75	2 to 3 pt **Gramoxone SL**	A restricted-use pesticide. Paraquat is a contact herbicide. Apply to winter dormant alfalfa for control of winter annual weeds. Always apply with NIS. Do not allow grazing, and do not cut or harvest within 60 days of application. Can be tank mixed with Velpar.
Pendimethalin (3) + metribuzin (5) 0.66 to 2 + 0.25 to 0.76	29 to 88 oz **Tripzin ZC**	Tripzin ZC is a premix containing 2.9 lb of pendimethalin and 1.1 lb of metribuzin/gal. Apply to dormant established alfalfa after the first growing season for control of winter annual and some summer annual weeds. Do not graze or harvest alfalfa forage or hay less than 28 days for application of rates up to 58 oz/a, or less than 50 days for rates more than 58 oz/a.
Saflufenacil (14) 0.022 to 0.044	1 to 2 oz **Sharpen**	Controls certain winter annual broadleaf weeds. Apply to dormant established alfalfa after the first growing season. Apply with MSO at 1% v/v plus 1.25 to 2.5% v/v liquid UAN fertilizer or AMS at 8.5 to 17 lb/100 gal of spray solution at a minimum spray volume of 10 gal/acre. Make applications no later than 90 days before the first alfalfa cutting.
Terbacil (5) 0.4 to 1.2	0.5 to 1.5 lb **Sinbar 80W**	Controls winter and summer annual weeds. Apply to established alfalfa (1 year or older) in fall or winter after alfalfa becomes dormant but before new growth starts in the spring. Do not use on sand, loamy sand, gravelly soils, or soils with less than 1% organic matter. Do not replant treated areas to other crops within 2 years.
HARVEST AIDS		
Diquat (22) 0.38 to 0.5	1.5 to 2 pt **Reglone/Diquat**	Use on seed crop only. Desiccation is complete in 3 to 10 days. Do not allow grazing of treated areas or feed treated forage. Do not use seed from treated plants for food, feed, or oil.
Glyphosate (9) 0.75 lb ae	1 qt of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. Apply to control weeds and assist in killing non-Roundup Ready alfalfa fields that are being terminated. Allow a minimum of 6 hours between application and alfalfa harvest. Subsequent tillage or herbicide treatment will be required for complete alfalfa kill.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Cotton

This publication primarily concerns chemical weed control. It is not intended to imply that cultivation, particularly in row crops, is undesirable. One or two cultivations can greatly improve weed control.

Weed Response to Selected Cotton Herbicides When Applied According to Label Directions[1,2]

		Annual Grasses				Annual Broadleaf Weeds								Perennials	
Herbicide(s)	Crop tolerance	Barnyardgrass	Crabgrass	Fall panicum	Foxtail	Cocklebur	Lambsquarters	Morningglory	Pigweed[3]	Common ragweed	Smartweed	Prickly sida	Velvetleaf	Johnsongrass	Yellow nutsedge
PREPLANT INCORPORATED															
Trifluralin	G	E	E	E	E	—	G	—	G	—	—	—	—	F	—
PREPLANT INCORPORATED OR PREEMERGENCE															
Pendimethalin	G	E	E	E	E	—	G	—	G	—	—	—	—	F	—
PREEMERGENCE															
Caparol	G	G	G	G	G	—	G	G	G-E	G	G	G-E	—	—	—
Cotoran	G	F	E	G	G	G	E	G	E	E	F	G	P	P	P
Dicamba *(resistant cotton only)*	E	—	—	—	—	E	G	E	G-E	E	E	G	G-E	—	—
Karmex, Diuron	G	F	G	G	G	F	E	G	G	G	F	F	P	P	P
Dual Magnum, and other *S*-metolachlor	G	E	G-E	G-E	E	—	F-G	—	G	—	—	—	—	—	F
POSTEMERGENCE															
Assure II	E	E	E	E	E	—	—	—	—	—	—	—	—	G-E	—
Clethodim	E	G	E	E	E	—	—	—	—	—	—	—	—	G-E	—
Cotoran	F	—	—	—	—	G	G	F	F	F	F	P	P	—	P
Dicamba *(resistant cotton only)*	E	—	—	—	—	E	G	E	G-E	E	E	G	G-E	—	—
Enlist Duo *(resistant cotton only)*	E	E	E	E	E	E	G	E	G-E	E	G	G	E	E	F
Enlist One *(resistant cotton only)*	E	—	—	—	—	E	G	E	G-E	E	G	G	G-E	—	—
Fusion	E	G	E	E	E	—	—	—	—	—	—	—	—	G-E	—
Liberty and other glufosinate *(resistant cotton only)*	E	G	G	G	G	G	G	G	G	G	G	G	G	F-G	F
Poast Plus	E	E	E	E	E	—	—	—	—	—	—	—	—	G	—
Staple	E	—	—	—	—	G	—	G	G[2]	F	F	F	G-E	—	F
Glyphosate *(resistant cotton only)*	E	E	E	E	E	E	G	G	E	G	G	F	G	E	P
DIRECTED POSTEMERGENCE															
Aim	F	—	—	—	—	G	E	G	G-E	F	G-E	G	E	—	—
Cobra	F	—	—	—	—	G	P	F	G-E	G	F	G	F	—	—
Karmex, Diuron	F	P	P	P	P	F	G	F	G	P	P	F	F	P	P
MSMA	G	G	G	G	G	E	P	P	P	P	P	—	—	F	P
Valor	G	—	—	—	—	G	E	G-E	G-E	G	G-E	G	E	—	—

[1] Weed response ratings refer to application according to label directions and with favorable growing conditions:
E = Excellent, G = Good, F = Fair, P = Poor, and — = weed not listed on the herbicide label.

[2] Except for resistant weed populations.

[3] Pigweed species vary in response to herbicides. Common waterhemp and Palmer amaranth tend to be less susceptible to postemergence herbicides than other pigweed species.

Herbicides for Cotton

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Dicamba (4) 0.5 to 1	22 to 44 oz **Xtendimax** or **FeXapan**, or 12.8 oz **Engenia**	Apply preplant or preemergence only where XtendFlex cotton will be planted. Provides burndown and some residual control of susceptible broadleaf weeds less than 4 inches tall. Some crops, such as non-Xtend soybeans and cotton, are extremely susceptible to off-site movement of dicamba, so follow label guidelines near susceptible crops and sensitive areas. Do not spray when wind is blowing in direction of neighboring susceptible crops, including non-Xtend cotton or soybeans, and observe buffer guidelines. Only spray between 1 hour after sunrise and 2 hours before sunset when wind is between 3 and 10 mph. Do not spray during a temperature inversion. Do not apply with ammonium sulfate, which greatly increases the risk of volatility and vapor drift. Consult supplemental labels and respective websites for additional application guidelines and approved tank-mix combinations: xtendimaxapplicationrequirements.com for Xtendimax; fexapanapplicationrequirements.dupont.com for FeXapan; or engeniatankmix.com for Engenia.
2,4-D choline (4) 0.48 to 0.95	1 to 2 pt **Enlist One**	Apply preplant or premergence to Enlist cotton or at least 15 days for 1 pt or 30 days for 1 to 2 pt prior to planting non-Enlist cotton for control of emerged broadleaf weeds less than 6 inches tall. Some crops, such as non-Enlist cotton or soybeans, are extremely susceptible to off-site movement of 2,4-D, so follow label guidelines for downwind buffers, and use restrictions near susceptible crops and sensitive areas. Do not spray if wind is blowing in the direction of adjacent susceptible crops. Consult the label for approved spray tips, maximum spray pressures, and acceptable wind speeds. Do not apply aerially or during temperature inversions.
2,4-D choline (4) + glyphosate (9) 0.7 to 0.95 + 0.75 to 1	3.5 to 4.75 pt **Enlist Duo**	Apply preplant or premergence to Enlist cotton or at least 30 days prior to planting non-Enlist cotton for control of emerged grass and broadleaf weeds less than 6 inches tall. Some crops, such as non-Enlist cotton or soybeans, are extremely susceptible to off-site movement of 2,4-D, so follow label guidelines for downwind buffers, and use restrictions near susceptible crops and sensitive areas. Do not spray if wind is blowing in the direction of adjacent susceptible crops. Consult the label for approved spray tips, maximum spray pressures, and acceptable wind speeds. Do not apply aerially or during temperature inversions.
Diuron (7) 0.8 to 1.6	1 to 2 lb **Karmex DF** or 0.8 to 1.6 qt **Diuron 4L**	Controls certain grass and broadleaf weeds. Apply preemergence only. Do not use on sand or loamy sand soils or soils with less than 1% organic matter. Follow label directions for use guidelines and crop rotation restrictions.
Flumioxazin (14) 0.03 to 0.06	1 to 2 oz **Valor SX** or **EZ, Panther SC,** or **Outflank**	Apply 1 oz/a at least 14 days or 2 oz/a at least 21 days before planting no-till cotton. Applications at shorter intervals before planting or with tilled seedbeds may injure cotton. Controls pigweeds, lambsquarter, and certain other broadleaf weeds.
Fluometuron (7) 1 to 2	2 to 4 pt **Cotoran 4L** or 1.2 to 2.4 lb **Cotoran DF**	Controls certain grass and broadleaf weeds. Apply preemergence only. Rates need to be adjusted for soil texture.
Glufosinate (10) 0.58 to 0.79	32 to 43 oz **Liberty** and **others**	Apply to control emerged weeds before or after cotton planting but before crop emergence. Always condition spray water with AMS at 3 lb/a before adding Liberty to the spray solution. Thorough spray coverage of small, actively growing weeds is essential for good weed control.
Glufosinate (10) + *S*-metolachlor (15) 0.54 + 1.25	64 oz **Intermoc**	Intermoc is a premix containing 1.07 lb glufosinate and 2.5 lb S-metolachlor/gal. Apply before or after cotton planting but before crop emergence for broad-spectrum control of small emerged weeds and residual control of certain grasses and small seeded broadleaf weeds. Add AMS at 8.5 to 17lb/100 gal of water for enhanced weed control. Intermoc is most effective on emerged weeds with warm temperatures, high relative humidity, bright sunlight, and thorough spray coverage. Do not use on coarse textured soils. Do not graze or feed forage or fodder to livestock.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Cotton

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Glyphosate (9) 0.28 to 1.125 lb ae	1 to 4 pt of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	Apply to control emerged weeds before or after cotton planting but before crop emergence. Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. The addition of 2% AMS by weight or 17 lb/100 gal water can improve weed control.
S-metolachlor (15) 0.48 to 1.27	0.5 to 1.33 pt **Dual Magnum, Charger Basic,** or **Moccasin II Plus**	Apply preemergence to control annual grasses and certain small-seeded broadleaf weeds. Do not apply on sand or loamy sand soils. May be applied postemergence when cotton is 3 to 12 inches tall for residual weed control but will not control emerged weeds.
Paraquat (22) 0.63 to 1	2.5 to 4 pt **Gramoxone SL**	A restricted-use pesticide. Apply before crop emergence for control of emerged weeds. Paraquat is a contact herbicide and does not have soil activity. Always apply with NIS to 0.5% v/v.
Prometryn (5) 0.8 to 1.2	1.6 to 2.4 pt **Caparol**	Do not use on sand or sandy loam soils. Apply preemergence. Controls small-seeded broadleaves and some grasses.
Pendimethalin (3) 0.5 to 1.5	1.2 to 3.6 pt **Pendimethalin 3.3EC*** or 1 to 3 pt **Prowl H_20, Satellite Hydrocap,** or **Satellite Flex**	Controls grass weeds more effectively than broadleaf weeds. Use the lower rates on coarse-textured soils and the highest rate on fine-textured soils. Can be applied preplant, preplant incorporated, or preemergence up to 2 days after planting but generally provides the best weed control when incorporated.
Pyrithiobac-sodium (2) 0.031 to 0.047	1.3 to 2.1 oz **Staple LX** or **Pyrimax**	Controls certain broadleaf weeds. Do not plant wheat for 4 months; corn for 9 months; soybeans or sorghum for 10 months; or alfalfa, sunflower, or canola for at least 10 months and completion of a successful field bioassay. Do not use on coarse-textured soils or soils with less than 0.5% organic matter.
Saflufencil (14) 0.022	1 oz **Sharpen**	Provides burndown and a short period of residual control of certain broadleaf weeds, including marestail and mustard species. Allow at least 42 days after application and the accumulation of at least 1 inch of rainfall or irrigation prior to cotton planting. Do not apply to coarse-textured soils with less than 1.5% organic matter, or cotton injury may occur. Do not apply on fields that will be treated with Valor herbicide or where an at-planting application of an organophosphate or carbamate insecticide will be used, or severe crop injury may occur. Apply with MSO at 1% v/v, minimum of 1 pt/a, plus 1.25 to 2% v/v liquid UAN fertilizer or AMS at 8.5 to 17 lb/100 gal of spray solution.
Trifluralin (3) 0.5 to 1	1 to 2 pt **Trifluralin 4 EC***	Controls grasses more effectively than broadleaf weeds. Apply before planting and incorporate within 24 hours.
POSTEMERGENCE		
Acetochlor (15) 0.94 to 1.5	1.25 to 2 qt **Warrant**	Does not control emerged weeds. Used primarily as a tank mix with postemergence herbicides to provide residual control of certain annual grasses and broadleaf weeds. Apply after emergence but before first bloom of cotton.
Clethodim (1) 0.07 to 0.156	6 to 10 oz **Select, Arrow, Section, Volunteer,** or **Tapout,** or 9 to 16 oz **Select Max**	Controls annual and perennial grasses. Apply when grasses are growing actively but before they reach size limits listed on the label. Select can be tank mixed with Cobra or MSMA. Always apply Select and comparable products with COC at 1% v/v but not less than 1 pt/a. Always apply Select Max with NIS at 0.25% v/v or COC at 1% v/v plus AMS at 2.5 to 4 lb/acre.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Cotton

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Dicamba (4) 0.5	22 oz **Xtendimax** or **FeXapan**, or 12.8 oz **Engenia**	Apply only to XtendFlex cotton from emergence up to 60 days after planting for control of susceptible broadleaf weeds less than 4 inches tall. Should be part of a planned weed control program following residual preemergence herbicides. Some crops, such as non-Xtend soybeans and cotton, are extremely susceptible to off-site movement of dicamba, so follow label guidelines near susceptible crops and sensitive areas. Do not spray when wind is blowing in direction of neighboring susceptible crops, including non-Xtend cotton or soybeans, and observe buffer guidelines. Only spray between 1 hour after sunrise and 2 hours before sunset when wind speed is between 3 and 10 mph. Do not spray during a temperature inversion. Do not apply with ammonium sulfate, which greatly increases the risk of volatility and vapor drift. Consult supplemental labels and respective websites for additional application guidelines and approved tank-mix combinations: www.xtendimaxapplicationrequirements.com for Xtendimax; www.fexapanapplicationrequirements.dupont.com for FeXapan; or www.engeniatankmix.com for Engenia.
Dimethenamid-P (15) 0.56 to 0.98	12 to 21 oz **Outlook**	Generally applied as a tank mix with other postemergence herbicides to provide residual control of later germinating small seeded grass and broadleaf weeds. Does not provide control of emerged weeds. Apply from first true leaf to two weeks after first bloom. Do not apply on coarse soils classified as sand with less than 3% organic matter and where depth to groundwater is 30 feet or less.
Fluazifop-P (1) + Fenoxaprop (1) 0.094 to 0.16 + 0.03 to 0.05	6 to 10 oz **Fusion**	Controls annual and perennial grasses. Apply when grasses are growing actively but before they reach size limits listed on the label. Apply with COC or NIS.
Fluometuron (5) 1 to 2	2 to 4 pt **Cotoran 4L** or 1.2 to 2.4 lb **Cotoran DF**	Controls certain grass and broadleaf weeds. Apply postemergence or postemergence directed after cotton is 3 inches tall for control of weeds less than 2 inches tall. Apply with NIS.
Glufosinate (10) 0.40 to 0.53	29 to 43 oz **Liberty** and others	Broadcast apply to Liberty Link cotton only. Apply to small, actively growing weeds before the early bloom stage of cotton. Thorough spray coverage of weed foliage is essential for effective weed control. Always condition spray water with AMS at 3 lb/a before adding Liberty to the spray solution. Liberty is most effective with warm temperatures, high relative humidity, and bright sunlight. Liberty has no residual activity, so two-pass weed control programs including a preemergence residual herbicide generally provide the best results. If a new flush of weeds emerges or existing weeds were not adequately controlled, a second application may be applied 10 to 14 days after the first application. Liberty can be applied to non-Liberty Link cotton if applied with a hooded sprayer that prevents the spray from contacting foliage and stems of cotton plants.
Glufosinate (10) + *S*-metolachlor (15) 0.54 + 1.25	64 oz **Intermoc**	Intermoc is a premix containing 1.07 lb glufosinate and 2.5 lb S-metolachlor/gal. Apply only to cotton designated as Liberty Link or glufosinate resistant from emergence to the early bloom stage of cotton development. Broadcast application to other cotton varieties will result in severe injury or death of the crop. Provides broad-spectrum postemergence control of small emerged weeds and residual control of certain grasses and small seeded broadleaf weeds. Add AMS at 8.5 to 17 lb/100 gal of water for enhanced weed control. Intermoc is most effective on emerged weeds with warm temperatures, high relative humidity, bright sunlight, and thorough spray coverage. Do not graze or feed forage or fodder to livestock.
Glyphosate (9)	0.56 to 0.75 lb ae 1.5 to 2 pt of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	Use only on Roundup Ready Flex cotton varieties. Apply from cracking to 60% bolls opening for control of many emerged grass and broadleaf weeds. Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. Condition spray solution with 1 to 2% spray-grade AMS by weight (8.5 to 17 lb/100 gal water) before adding herbicide to the spray tank.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Cotton

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE		
Pendimethalin (3) 0.475 to 0.95	1 to 2 pt **Prowl H_2O** or **Satellite Hydrocap**	Does not control emerged weeds. Used primarily as a tank mix with Roundup PowerMax or WeatherMax in Roundup Ready cotton, or with Liberty in Liberty Link cotton to provide residual control of certain annual grasses and broadleaf weeds. Apply after cotton reaches the 4-leaf stage, but before it exceeds the 8-leaf growth stage. Do not exceed the cumulative seasonal rate of 4.2 pt/a for combined preplant/preemergence and postemergence applications. Do not tank mix with Dual, Staple, Sequence, Cotoran, or Caparol.
Pyrithiobacsodium (2) 0.0625	2.6 oz **Staple LX** or **Pyrimax**	Controls certain broadleaf weeds. Apply to small, actively growing broadleaf weeds less than 2 inches tall after cotton has at least 1 true leaf. Apply with NIS or COC. Staple LX can be used at lower rates in tank mixes with glyphosate on Roundup Ready Flex cotton for residual control and enhanced control of morningglory, cutleaf eveningprimrose, and prickly sida. Do not plant wheat for 4 months; corn for 9 months; soybeans or sorghum for 10 months; or alfalfa, canola, or sunflower for at least 10 months and successful completion of a field bioassay.
Quizalofop (1) 0.34 to 0.69	5 to 10 oz **Assure II** or **Targa**	Controls annual and perennial grasses. Apply when grasses are growing actively but before they reach size limits listed on the label. Apply with COC or NIS.
Sethoxydim (1) 0.09 to 0.375	0.75 to 3 pt **Poast Plus**	Controls annual and perennial grasses. Apply when grasses are growing actively but before they reach size limits listed on the label. Higher rates are recommended in the western third of Kansas than in the eastern part of the state. Always apply with COC.
S-metolachlor (15) + Glyphosate (9) 0.94 to 1.31 + 0.70 to 0.98	2.5 to 3.5 pt **Sequence**	Apply postemergence to Roundup Ready Flex cotton at the low rate up to the 5-leaf growth stage and up to the high rate to the 10-leaf growth stage. Controls many emerged weeds and provides some residual control of grasses and pigweeds. Will not control emerged glyphosate resistant weeds.
2,4-D choline (4) 0.71 to 0.95	1.5 to 2 pt **Enlist One**	Apply postemergence to Enlist cotton only prior to the mid-bloom stage of cotton for control of emerged broadleaf weeds less than 6 inches tall. Should be part of a planned weed control program following residual preemergence herbicides. Some crops, such as non-Enlist cotton or soybeans, are extremely susceptible to off-site movement of 2,4-D, so follow label guidelines for downwind buffers, and use restrictions near susceptible crops and sensitive areas. Do not spray if wind is blowing in the direction of adjacent susceptible crops. Consult the label for approved spray tips, maximum spray pressures, and acceptable wind speeds. Do not apply aerially or during temperature inversions.
2,4-D choline (4) + glyphosate (9) 0.7 to 0.95 + 0.75 to 1	3.5 to 4.75 pt **Enlist Duo**	Apply postemergence to Enlist cotton only prior to the mid-bloom stage of cotton for control of emerged grass and broadleaf weeds less than 6 inches tall. Should be part of a planned weed control program following residual preemergence herbicides. Some crops, such as non-Enlist cotton or soybeans, are extremely susceptible to off-site movement of 2,4-D, so follow label guidelines for downwind buffers, and use restrictions near susceptible crops and sensitive areas. Do not spray if wind is blowing in the direction of adjacent susceptible crops. Consult the label for approved spray tips, maximum spray pressures, and acceptable wind speeds. Do not apply aerially or during temperature inversions.
DIRECTED POSTEMERGENCE		
Carfentrazone (14) 0.013 to 0.025	0.8 to 1.6 oz **Aim EC**	Controls certain broadleaf weeds. Apply with COC with a hooded sprayer that completely prevents coverage of cotton or with directed spray after cotton is at least 6 inches tall.
Diuron (7) 0.4 to 0.6	0.5 to 0.75 lb K**armex DF** or 0.4 to 0.6 qt **Diuron 4L**	Apply between rows after cotton is at least 6 inches tall but before blooming and before weeds are 2 inches tall. Do not use on sand or loamy sand soils or soils with less than 1% organic matter. Follow label directions for use guidelines and crop-rotation restrictions.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Cotton

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
DIRECTED POSTEMERGENCE		
Flumioxazin (14) 0.6	2 oz **Valor, Panther, Outflank,** or **Rowel**	Apply after cotton is at least 6 inches tall with a hooded or shielded sprayer that prevents spray from contacting cotton plants. Provides foliar and residual control of certain broadleaf weeds. Apply with NIS at 0.25% v/v. Can be tank mixed with glyphosate or MSMA. Lay-by applications directed no higher than the lowest two inches of cotton stems can be applied after cotton is 18 inches tall and has a minimum of 4 inches of bark.
Lactofen (14) 0.2	12.5 oz **Cobra**	Apply between rows after cotton is at least 6 inches tall for control of small broadleaf weeds. Apply with COC. Cobra can be tank mixed with Karmex or MSMA.
MSMA (17) or DSMA (17) 2.5	3 pt of 6 lb/gal product	Apply between rows after cotton is at least 3 inches tall but before blooming and before weeds are 2 inches tall.
Prometryn (5) 0.8 to 1.2	1.6 to 2.4 pt **Caparol**	Apply with hooded sprayer to minimize contact and injury to cotton. Do not use on sand or sandy loam soils. Controls small-seeded broadleaves and some grasses.
Pyroxasulfone (15) 0.04 to 0.11	0.75 to 2.1 oz **Zidua** or 1.25 to 3.5 oz **Zidua SC**	Apply between cotton rows from the 5-leaf to the beginning bloom stage of cotton growth for residual control of small seeded grasses and certain broadleaf weeds. Does not control emerged weeds. Do not use on coarse-textured soils. Use the lower rates on medium-textured soils and the higher rates on fine-textured soils. Can be tank mixed with other registered herbicides for control of emerged weeds.
Pyroxasulfone (15) + Carfentrazone (14) 0.041 to 0.11 + 0.003 to 0.008	1.4 to 3.8 oz **Anthem Flex**	Apply as a post-directed treatment between cotton rows after cotton is 6 inches tall to the beginning of bloom stage. Applications to cotton between 6 and 12 inches tall requires the use of a hooded or shielded sprayer to completely avoid spray contact with cotton plants. Do not use on coarse-textured soils. Use the lower rates on medium-textured soils and the higher rates on fine-textured soils. Provides residual control of certain grass and broadleaf weeds and control of some emerged broadleaf weeds. Apply with NIS or oil concentrate for enhanced control of emerged weeds. Can be tank mixed with other registered herbicides for improved control of emerged weeds.
HARVEST AIDS		
Carfentrazone (14) 0.016 to 0.025	1 to 1.6 oz **Aim EC**	Apply with COC when 60 to 70% of bolls are open and at least 7 days before harvest.
Carfentrazone (14) + fluthiacet (14) 0.0065 to 0.012 + 0.002 to 0.004	0.5 to 1 oz **Display**	Apply when 60 to 70% of balls are open and at least 7 days before harvest. Use a minimum spray volume of 5 gpa for aerial application and 10 gpa for ground application. Apply with COC when temperature is less than 80°F and NIS when temperature is above 80°F.
Glyphosate (9) 0.75 to 1.5 lb ae	1 to 2 qt of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	Apply when at least 20% of bolls are cracked and at least 7 days before harvest for control of annual and perennial weeds and to inhibit regrowth of non-Roundup Ready cotton. Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations.
Paraquat (22) 0.05 to 0.17	3 to 11 fl oz **Gramoxone SL**	A restricted-use pesticide. Apply for boll opening and plant desiccation when 75% or more of bolls are open and remaining bolls to be harvested are mature. Do not harvest for 3 days after application. Do not allow grazing on treated fields or feed treated foliage.
Saflufenacil (14) 0.022 to 0.044	1 to 2 oz **Sharpen**	Apply when bolls are 60 to 70% open and at least 5 days before harvest. Use a minimum spray volume of 5 gpa for aerial application and 10 gpa for ground application. Apply in combination with MSO and ammonium based spray adjuvants. Can be tank mixed with other cotton harvest aids or glyphosate. Do not apply to cotton grown for seed production.
Tribufos (NC) 0.75 to 1.125	1 to 1.5 pt **Def/Folex**	Apply when 50% or more of bolls are open and at least 7 days before harvest. A minimum spray volume of 10 gal/a by ground or 5 gal/a by air is required.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Canola

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BURNDOWN, PREPLANT, AND/OR PREEMERGENCE		
Ethalfluralin (3) 0.56 to 0.94	1.5 to 2.5 pt **Sonalan**	Controls grasses more effectively than broadleaf weeds. Apply before planting and incorporate within 48 hours. Do not graze or forage crop grown in treated soil or cut for hay or silage.
Glyphosate (9) 0.38 to 1.5 lb ae	1 to 4 pt of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	Apply to control emerged weeds before or after canola planting but before crop emergence. Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. Condition spray solution with 1 to 2% spray-grade AMS by weight (8.5 to 17 lb/100 gal water) before adding glyphosate to the tank.
Trifluralin (3) 0.5 to 1	1 to 2 pt **Trifluralin 4E***	Controls grasses more effectively than broadleaf weeds. Apply before planting and incorporate within 24 hours.
POSTEMERGENCE		
Glyphosate (9) 0.56 to 0.75 lb ae	1.5 to 2 pt of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	Apply only to Roundup Ready canola from emergence through the 6-leaf stage of growth. Application to conventional canola varieties will result in severe injury or death of the crop. Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. Controls many annual weeds and suppresses perennial weeds at the labeled rates for canola. Can be applied twice at the lower application rate, but allow a 10-day interval between applications, with the last application no later than the 6-leaf stage of canola. Do not apply after the 6-leaf stage of canola, or injury may occur. Condition spray solution with 1 to 2% spray-grade AMS by weight (8.5 to 17 lb/100 gal water) before adding glyphosate to the tank.
Clethodim (1) 0.07 to 0.09	4 to 6 oz **Select, Section, Arrow, Volunteer,** or **Tapout,** or 9 to 12 oz **Select Max**	Controls annual and perennial grasses. Apply before canola begins to bolt and when grasses are growing actively but before they reach size limits listed on the label. Always apply Select and comparable products with COC at 1% v/v. Always apply Select Max with NIS at 0.25% v/v.
Imazamox (2) 0.031	4 oz **Beyond**	Apply to Clearfield Canola only. Beyond will seriously injure or kill non-Clearfield canola. Apply to small actively growing weeds after canola emergence until the bloom stage of growth. Always apply with NIS at 0.25% v/v and a liquid nitrogen source at 2.5% v/v or AMS at 12 to 15 lb/100 gal. May not control ALS-resistant weed populations. Do not plant corn, sorghum, cotton or sunflower within 9 months after Beyond application. Beyond has no preharvest interval.
Quizalofop (1) 0.05 to 0.0625	8 to 10 oz **Assure II** or **Targa**	Controls annual and perennial grasses. Apply when grasses are growing actively but before they reach size limits listed on the label. Always apply with COC or NIS.
Sethoxydim (1) 0.19 to 0.38	1 to 2 pt **Poast**	Controls annual and perennial grasses. Apply when grasses are growing actively but before they reach size limits listed on the label. Higher rates are recommended in the western third of Kansas than in the eastern part of the state. Always apply with COC and at least 60 days before harvest.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Canola

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
HARVEST AIDS		
Diquat 0.375 to 0.5	1.5 to 2 pt **Reglone**	Apply by ground or aerial equipment to desicate canola and weeds to facilitate harvest. Use a minimum spray volume of 5 gpa for aerial application and 15 gpa fro ground application. Apply after canola reaches physiological maturity (when seeds in middle pods have started to turn in color). Apply with nonionic surfactant at 0.06 to 0.5% v/v.
Saflufenacil (14) 0.022 to 0.044	1 to 2 oz **Sharpen**	Apply by ground or aerial equipment to desiccate canola to facilitate earlier harvest. Use a minimum spray volume of 5 gpa for aerial application and 10 gpa for ground application. Apply when canola reaches physiological maturity (when seed in middle pods have started to turn in color). Apply with 1.5 pt/a MSO plus AMS at 8.5 to 17 lb/100 gal of spray solution. Allow a minimum of 3 days between treatment and canola harvest. Do not apply to canola grown for seed production.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Conservation Reserve Program (Native Grasses)

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
For control of noxious weeds, refer to the Herbicides for Noxious Weeds table.		
GRAIN SORGHUM COVER CROP Short-residual herbicides for grain sorghum can be applied as directed on a grain sorghum cover crop.		
PREPLANT AND PREEMERGENCE		
Glyphosate (9) 0.38 to 0.75 lb ae	1 to 2 pt of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	For control of actively growing volunteer grains and annual weeds up to 6 inches tall. Apply in 3 to 10 gal spray/a with NIS. The addition of 2% AMS by weight or 17 lb/100 gal water can increase performance of Roundup. Use flat-fan nozzles for best results. Dust on plants can reduce performance of Roundup.
Imazapic (2)	2 to 6 oz **Plateau**	For annual weed control in new plantings of labeled warm-season grasses and forbs.
Imazapic (2) + Glyphosate (9)	5.4 to 16 oz **Journey**	For annual weed control in new plantings of labeled warm-season grasses and forbs.
Metsulfuron (2) 0.0038	0.1 oz **Escort XP***	Controls susceptible broadleaf weeds. Apply preplant or preemergence for some native grasses. See label for species. Do not use on soil with pH above 7.9.
Paraquat (22) 0.5 to 1	2 to 4 pt **Gramoxone SL**	A restricted-use pesticide. A contact herbicide. Apply in clean water to annual weeds 1 to 6 inches tall. Use flat-fan nozzles for best results. Always add NIS or COC. Dust on plants can inactivate paraquat.
POSTEMERGENCE FOR SEEDLING GRASSES		
Dicamba (4) 0.13 to 0.5	0.25 to 1 pt **Clarity,** **Sterling Blue,** or **Vision**	Controls annual broadleaf weeds in seedling grasses. Do not apply until seedling grasses exceed the 3-leaf stage of growth. Can be tank mixed with 2,4-D.
Metsulfuron (2) 0.0038	0.1 oz **Escort XP*** + 2 qt surfactant/100 gal	Controls susceptible broadleaf weeds. Apply to some native grasses after the 3- to 4-leaf stage. See label for species. Apply after weeds have emerged but while they are small and actively growing. Do not use on soil with pH greater than 7.9.
Quinclorac (4) 0.14 to 0.75	12 to 64 oz **Facet L**	Apply to established stands of cool- and warm-season grasses to control grasses and broadleaf weeds. Consult label for additives and tank-mixing partners.
2,4-D (4) 0.25 to 0.5	0.5 to 1 pt 4 lb/gal **2,4-D* amine**	Controls many broadleaf weeds. Do not use on new seedlings until established (6 or more leaves or tillered). Because buffalo and grama grass seedlings are more susceptible to injury by 2,4-D, do not apply it unless broadleaf weeds provide a canopy over grasses.
Alternative method: Sickle-bar or rotary mower	- - - -	Mow grasses to 4 to 6 inches in height after spring seeding and after vegetation is 6 to 8 inches tall. Use of rotary mower in heavy weed growth can cause windrows and smothering of grass seedlings. To avoid this, use sickle-bar mower.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Conservation Reserve Program (Native Grasses)

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE FOR ESTABLISHED GRASSES		
Aminopyralid (4) 0.047 to 0.109	3 to 7 fl oz **Milestone**	Apply to control broadleaf weeds in established grass stands. During the season of establishment application should be postponed until plants have developed a secondary root system and have begun to show good vigor. This is generally associated with the appearance of two true leaves, which can occur 45-60 days after application under good growing conditions.
Aminopyralid (4) + Metsulfuron (2)	1 to 3.3 oz **Chaparral**	Apply to control broadleaf weeds in established grass no earlier than the growing season after planting. Can be tank mixed with other herbicides.
Aminopyralid (4) + 2,4-D (4)	1.2 to 2.1 pt **ForeFront HL** or **GrazonNext HL**	Apply to control broadleaf weeds in established grass stands no earlier than the growing season after planting. Can be tank mixed with other herbicides.
Bromoxynil (6) 0.25 to 0.5	1 to 2 pt **Buctril** or **Brox**	Apply in fall or spring after grasses have reached the 2- to 3-leaf stage. Apply to weeds up to the 4-leaf stage or 2 inches in height, whichever comes first. Consult label for mixing and application instructions. See label for tank mix recommendations with MCPA.
Dicamba (4) 0.13 to 1	0.25 to 2 pt **Clarity**, **Sterling Blue,** or **Vision**	Apply to control susceptible broadleaf weeds in established grasses, that is, the season after planting. Certain grasses, such as smooth brome and buffalograss, can be injured at rates exceeding 1 pt (0.5 lb ai/treated acre). Can be tank mixed with 2,4-D. A total of 4 pt (2 lb ai/acre) per year can be applied if retreatment is necessary.
Dicamba (4) + 2,4-D (4) 0.13 to 0.5 + 0.36 to 1.44	1 to 4 pt **Range Star** 0.5 to 5.25 pt **Outlaw** 0.33 to 2.5 pt **Latigo**	Apply when weeds are actively growing. Injury may occur to seeded grasses with fewer than 6 leaves or before grasses are well established. Do not apply to buffalograss.
Dicamba (4) + Diflufenzopyr (19)	2 to 8 oz **Overdrive**	Controls a wide range of broadleaf weeds. Addition of NIS or MSO is needed to achieve consistent weed control. Can be tank mixed with other CRP-labeled herbicides to enhance control. Overdrive may injure buffalograss.
Halosulfuron (2) + Dicamba (4)	4 to 8 oz **Yukon**	Apply after weed emergence to small, actively growing broadleafs. Can be tank mixed with 2,4-D, dicamba, and picloram.
Imazapic (2) 0.063 to 0.188	4 to 12 oz **Plateau**	Controls most annual grasses and broadleaf weeds. Apply to small, actively growing weeds before they reach size limits listed on the label. Apply with NIS, COC, or fertilizer/surfactant blend.
Metsulfuron (2) + Chlorsulfuron (2) 0.009 to 0.018 + 0.012 to 0.023	0.5 to 1 oz **Cimarron X-tra**	For broadleaf weed control in established stands. Treat when weeds are less than 4 inches tall or in diameter.
Metsulfuron (2) + Chlorsulfuron (2) 0.004 to 0.008 + 0.001 to 0.002	0.125 to 0.25 oz **Cimarron Plus**	For broadleaf weed control in stands planted the previous season and fully tillered. Treat when weeds are less than 4 inches tall or in diameter.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Conservation Reserve Program (Native Grasses)

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
POSTEMERGENCE FOR ESTABLISHED GRASSES		
Metsulfuron (2) + Dicamba (4) + 2,4-D amine (4) 0.0053 + 0.125 + 0.36 to 0.11 + 0.25 + 0.72	Rate I and II **Cimarron Max**	Apply for control of broadleaf weeds in established stands (planted previous year or earlier). See label for list of tolerant grasses.
Picloram (4)	**Tordon 22K** See label for specific rates.	A restricted-use pesticide. Primarily for noxious weed control. Controls susceptible annual and perennial broadleaf weeds in established grasses. Can be tank mixed with 2,4-D. Apply only after established grasses have a good secondary root system and are growing actively. Can be applied as a spot treatment.
Picloram (4) + 2,4-D (4) 0.068 + 0.25 to 0.27 + 1	1 to 4 pt **Grazon P+D**	A restricted-use pesticide. For season-long control of annual and perennial broadleaf weeds. Apply after perennial grasses are well established (have developed a good secondary root system and show good vigor).
Quinclorac (4) 0.14 to 0.75	12 to 64 fl oz **Facet L**	Apply to established stands of cool- and warm-season grasses or control grasses and broadleaf weeds. Consult label for additives and tank-mixing partners.
Triasulfuron (2) + Dicamba (4) 0.011 + 0.069 to 0.028 + 0.172	2 to 5 oz **Rave**	Controls many broadleaf weeds. Apply to actively growing weeds at least 60 days after emergence of seedlings in early spring. Can be tank mixed with 2,4-D, Grazon P+D, Tordon 22K, and others. See label for list of tolerant grasses.
2,4-D (4) 0.25 to 2	0.5 to 4 pt of 4 lb/gal **2,4-D* amine** or **LVE**	Controls many broadleaf weeds. Consider native grasses as "established grasses" in the year following seeding, unless many new seedlings are present. Use label rate to control hard-to-kill annual or perennial weeds.
2,4-D (4) + Triclopyr (4) 0.5 + 0.25 to 3 + 1.5	1 qt to 1.5 gal **Crossbow**	Apply to control susceptible broadleaf weeds in established grasses, that is, the season after planting. Certain grasses, such as smooth brome and buffalograss, can be injured at the high rates. Higher rates are for control of deep-rooted perennial and susceptible woody species.
Triclopyr (4) 0.50 to 1.5	1 to 3 pt **Remedy Ultra**	Apply to control broadleaf weeds in established grass stands. For sericea control, apply at 1 to 2 pt/a once plants have reached 8 in. in height. May be used in a mixture with diesel, kerosene, or basal oil as a low-volume basal treatment for trees. Basal mixture: 25% Remedy Ultra + 75% oil.
Triclopyr (4) + Fluroxypyr (4) 0.28 + 0.09 to 0.75 + 0.25	0.75 to 2 pt **PastureGard HL**	Apply to control broadleaf weeds in established grass stands. For sericea control, apply at 0.75 to 1 pt/a once plants have reached 8 in. in height. Treated areas may be rotated to crops 120 days after PastureGard HL application.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Bermudagrass

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BROADLEAF WEEDS-POSTEMERGENCE		
Aminopyralid (4) 0.047 to 0.109	3 to 7 fl oz **Milestone**	Apply to control broadleaf weeds in established grass stands no earlier than the growing season after planting. Can be tank mixed with other herbicides.
Aminopyralid (4) + Metsulfuron (2)	1 to 3.3 oz **Chaparral**	Apply to control broadleaf weeds in established grass stands. Grasses need to be established at least 4 months before the application of Chaparral. See label for tall fescue and smooth bromegrass precautions.
Aminopyralid (4) + 2,4-D (4)	1.2 to 2.1 pt **ForeFront HL**	Apply to control broadleaf weeds in established grass stands. During the season of establishment, application should be postponed until plants have developed a secondary root system and have begun to show good vigor. This is generally associated with the appearance of two true leaves, which can occur 45-60 days after application under good growing conditions.
Dicamba (4) 0.25 to 1	0.25 to 1 qt **Clarity**	Apply when the problem weed is in the prebud growth stage and growing actively. Use 20 gal or more of solution per acre for ground application. Repeat applications may be necessary, but do not exceed 1 qt/a during a growing season. Depending on rate, do not let dairy animals graze on treated areas for 7 to 40 days after treatment. Follow directions, precautions, and grazing limitations on product label.
Dicamba (4) + 2,4-D (4) 0.25 to 0.5 + 0.72 to 1.44	2 to 4 pt **Range Star** 1.75 to 3.5 pt **Outlaw** 1 to 2 pt **Latigo**	Apply at the germinating stage of weeds. Control will be reduced if weeds are greater than 1 inch in height. See label for grazing and haying restrictions.
Metsulfuron (2) 0.0038 to 0.038	0.1 to 1 oz **Metsulfuron***	Apply when weeds are less than 4 inches tall or in diameter. Can be tank mixed with Clarity, Grazon P+D, 2,4-D, Tordon 22K, or WeedMaster. Include NIS at 0.25 to 0.5% v/v.
Metsulfuron (2) + Chlorsulfuron (2) 0.009 to 0.038 + 0.012 to 0.047	0.5 to 2 oz **Cimarron X-tra**	Same as for Metsulfuron (see above).
Metsulfuron (2) + Chlorsulfuron (2) 0.004 to 0.038 + 0.001 to 0.012	0.125 to 1.25 oz **Cimarron Plus**	Same as for Metsulfuron (see above).
Metsulfuron (2) + Dicamba (4) + 2,4-D (4)	Rates I, II, and III **Cimarron Max**	Same as for Metsulfuron (see above).
Picloram (4) up to 1	Up to 2 qt **Tordon 22K**	A restricted-use pesticide. Primarily for noxious weed control. Controls susceptible annual and perennial broadleaf weeds in established grasses. Can be tank mixed with 2,4-D. Apply only after established bermudagrass has a good secondary root system and is growing actively. Can be applied as a spot treatment. See label for rates, directions, and precautions.
Picloram (4)/2,4-D (4)	**Grazon P+D** (see label for notes)	A restricted-use pesticide. Apply according to label directions. Follow directions, grazing limitations, and precautions on label.
Triclopyr (4) + Fluroxypyr (4) 0.28 + 0.09 to 0.75 + 0.25	0.75 to 2 pt **PastureGard HL**	Apply to control broadleaf weeds in established grass stands. For sericea control, apply at 0.75 to 1 pt/a once plants have reached 8 in. in height. Treated areas may be rotated to crops 120 days after PastureGard HL application.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Bermudagrass

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BROADLEAF WEEDS-POSTEMERGENCE		
Saflufenacil (14) 0.022	1 fl oz **Sharpen**	Dormant season application requires MSO at 1% v/v and AMS at 17 1b/gal. Use only MSO and do not use AMS for in-season applications.
Triclopyr (4) 0.50 to 1.5	1 to 3 pt **Remedy Ultra**	Apply to control broadleaf weeds in established grass stands. For sericea control, apply at 1 to 2 pt/a once plants have reached 8 in. in height. May be used in a mixture with diesel, kerosene, or basal oil as a low-volume basal treatment for trees. Basal mixture: 25% Remedy Ultra + 75% oil.
Triasulfuron (2) + Dicamba (4) 0.011 + 0.069 to 0.028 + 0.172	2 to 5 oz **Rave**	Controls many broadleaf weeds. Apply to actively growing weeds in early spring. Can be tank mixed with 2,4-D, Grazon P+D, Tordon 22K, and others. See label for list of tolerant grasses.
2,4-D (4) 0.5 to 2	0.5 to 2 qt of 4 lb/gal **2,4-D* amine, LVE,** or mixed formulations	Apply when the problem weed is in the prebud growth stage and growing actively. Use 20 gal or more of solution per acre for ground application. Repeat applications may be necessary. Do not let dairy animals graze on treated areas within 7 days after treatment.
2,4-D (4) + Dicamba (4) 1 + 0.25	1 qt of 4 lb/gal **2,4-D*** + 0.25 qt **Clarity**	Same as above. Follow directions, precautions, and grazing limitations on product label.
GRASS AND BROADLEAF WEEDS-POSTEMERGENCE		
Sulfosulfuron (2) 0.062	1.33 oz **Outrider**	Controls or suppresses certain annual and perennial grasses and broadleaf weeds. For best control of johnsongrass, apply to actively growing plants at least 18 to 24 inches tall up to the head stage of growth. Add 0.25% NIS.
Nicosulfuron (2) + Metsulfuron (2) 0.035 to 0.053 + 0.009 to 0.014	1 to 1.5 oz **Pastora**	Controls or suppresses grass and broadleaf weeds in bermudagrass pasture. For best results, apply to young actively growing weeds. Applications may result in temporary yellowing and/or stunting of bermudagrass. Grass response is minimized by treating when bermudagrass has less than 2 inches of new growth during initial green-up or by treating within 7 days after cutting for hay. Do not apply more than 2.5 oz/a per year. Include NIS at 0.25 to 0.5% v/v or COC at 1 to 2% v/v plus an ammonium nitrogen fertilizer, such as AMS at 2 to 4 lb/acre. Can be tank mixed with other herbicides.
GRASS AND BROADLEAF WEEDS-PREEMERGENCE		
Pendimethalin (3) 2 to 4	2.1 to 4.2 qt **Prowl H_2O**	Apply before target weed germination in the dormant season, in the early spring before Bermudagrass green up, or in-season between cuttings. Controls most annual grasses and some broadleaf weeds.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Weed and Brush Control Practices for Pasture and Rangeland

Chemical and mechanical practices are available for control of weeds and brush. Identify the problem plant and select the effective control practice(s).

Common names	Life cycle	Season	Mechanical	Burning	Herbicides
TAME PASTURES					
Broadleaf weeds					
Bull thistle	A,B	W	—	—	F
Cocklebur	A	W	M	—	F
Common ragweed	A	W	M	—	F
Common sunflower	A	W	M	—	F
Musk thistle (nodding thistle)	A,B	C	M-R	—	F**
Tall thistle	A,B	W	M	—	F
Wavyleaf thistle	P	W	M	—	F
Western ragweed	P	W	M	—	F-R
Brush					
Eastern red cedar	P	E	C	CN	F,S
Buckbrush (coralberry)	P	W	M-R	—	F-R
Honey locust	P	W	CU	—	F,S,B
Multiflora rose	P	W	—	—	F,S
Osage orange (hedge)	P	W	CU	—	F,S,B
RANGELAND					
Broadleaf weeds					
Annual broomweed	A	W	—	—	F
Broom snakeweed	P	W	—	—	F
Bull thistle	A,B	W	—	—	F
Cocklebur	A	W	M	CN	F
Common mullein	B	W	—	—	F
Common ragweed	A	W	M	—	F
Common sunflower	A	W	M	—	F
Goldenrods	P	W	—	R-A	F
Hoary vervain	P	W	—	—	F
Lanceleaf ragweed	A	W	M	—	F
Musk thistle (nodding thistle)	A,B	C	M-R	—	F**
Poison and water hemlock	B,P	W	—	—	F
Tall thistle	A,B	W	M	—	F
Sericea lespedeza	P	W	M-R	IP	F**
Wavyleaf thistle	P	W	—	—	F
Western ironweed (Baldwin ironweed)	P	W	—	R-A	F-R
Western ragweed	P	W	—	R-A	F-R

Common names	Life cycle	Season	Mechanical	Burning	Herbicides
Grasses					
Cheatgrass	A	C	M	CN	F
Downy brome	A	C	M	CN	F
Japanese brome	A	C	M	CN	F
Little barley	A	C	M	CN	F
Sandbur	A	W	—	—	F
Brush					
Ash	P	W	CU	M-A	F,B
Blackberry	P	W	—	M-A	F-R
Blackjack oak	P	W	CU	CN-A	F,S,B
Buckbrush (coralberry)	P	W	M-R	CN-A	F-R,S
Cottonwood	P	W	CU	—	F,S,B
Eastern persimmon	P	W	CU	—	F,R,S
Eastern red cedar	P	E	C	CN	F,S
Honey locust	P	W	CU	R,A	F,S,B
Indigo bush	P	W	—	M-A	—
Mutiflora rose	P	W	—	M-A	F,S
Osage orange (hedge)	P	W	CU	R-A	F,S,B
Poison ivy	P	W	—	—	F
Post oak	P	W	CU	CN-A	F,S,B
Pricklypear cactus	P	W	—	R-A	F
Raspberry	P	W	—	—	F-R
Rough-leaved dogwood	P	W	—	M-A	S,F-R
Russian olive	P	W	CU	R-A	S,F,B
Sand plum	P	W	—	R,CN-A	F
Sand sagebrush (sandhill sage)	P	W	—	R	F
Siberian elm	P	W	CU	R	F,S,B
Smooth sumac	P	W	M-R	IP	F,S
Tamarisk (saltcedar)	P	W	CU	IP	F
Willow	P	W	CU	—	F,S,B
Yucca (small soapweed)	P	W	—	M	S,F-R

KEY:

Life cycle
A = Annual
P = Perennial
B = Biennial

Season
C = Cool season
E = Evergreen
W = Warm season

Mechanical
CU = Cut and treat cut surface
M = Mow
C = Cut below green growth
R = Repeat treatments needed
— = No recommendation

Burning
- A = with 2 or more yearly treatments
CN = Controls
IP = Increases population
M = Maintains population
R = Reduces population
— = No recommendation

Herbicides
- R = Repeat treatments needed
F = Foliar treatment
B = Basal bark treatment
S = Soil treatment
**= Refer to Herbicides for Noxious Weeds table
— = No recommendation

Grazing Restrictions for Certain Range and Pasture Herbicides[1]

	Beef and non-lactating animals			Lactating dairy animals	
Herbicide	**Before grazing**	**Before hay harvest**	**Removal before slaughter**	**Before grazing**	**Before hay harvest**
2,4-D	0	7 to 30 days	3 days	7 days	30 days
Arsenal	0	7 days	0	0	7 days
Chaparral	0	0	0	0	0
Cimarron Max	0	37 days	30 days	7 days	37 days
Cimarron Plus	0	0	0	0	0
Cimarron X-tra	0	0	0	0	0
Dicamba[2]	0	7	30	7 to 40 days	37 to 70 days
Crossbow	0	14 days	3 days	Next growing season	14 days
Escort XP	0	0	0	0	0
ForeFront HL	0	7	0	0	7
Glyphosate	(Check label. Restrictions vary by product, rate, and method of application.)				
Grazon P+D	0	30 days	3 days	7 days	30 days
Journey	0	7 days	0	0	7 days
Milestone	0	0	0	0	0
Overdrive	0	0	0	0	0
Pastora	0	0	0	0	0
PastureGard HL	0	14 days	3 days	Next growing season	14 days
PathFinder II	0 to 14 days	7 to 14 days	3 days	14 days	Next growing season
Plateau	0	7 days	0	0	7 days
Pronone Power Pellets	0	0	0	0	0
Rave	0	0	30 days	7 days	0
Remedy Ultra, Trycera	0	14 days	3 days	Next growing season	14 days
Spike 20P	0	1 year	0	0	1 year
Surmount	0	7 days	3 days	14 days	7 days
Tordon 22K	0	0 to 14 days	3 days	14 days	0 to 14 days
Velpar L[3], Velossa[3]	0	0	0	0	0
Yukon	0	37 days	0	0	37 days
Weedmaster/Range Star	0	7 days	3 days	7 days	7 days

[1] Check individual product labels for restrictions.
[2] Dicamba is the active ingredient in Banvel, Clarity, Sterling Blue, and Vision. Restrictions vary with rate and product.
[3] No restrictions for grazing or hay when applied as a basal soil treatment.

Herbicides for Cool-Season Pastures

Weeds and brush	Herbicide and active ingredient needed/acre	Formulated product and amount/acre*	Comments and limitations
ANNUAL AND BIENNIAL WEEDS			
Ragweed Sunflower Thistle	Aminopyralid (4)	3 to 7 fl oz **Milestone**	Apply to control broadleaf weeds. Can be tank mixed with other herbicides.
	Aminopyralid (4) + Metsulfuron (2)	1 to 3.3 oz **Chaparral**	Apply to control broadleaf weeds in established grass stands. Grasses need to be established at least 4 months before the application of Chaparral. See label for tall fescue and smooth bromegrass precautions.
	Aminopyralid (4) + 2,4-D (4)	1.2 to 2.1 pt **ForeFront HL** or **GrazonNext HL**	Apply to control broadleaf weeds in established grass stands. During the season of establishment, application should be postponed until plants have developed a secondary root system and have begun to show good vigor. This is generally associated with the appearance of two true leaves, which can occur 45 to 60 days after application under good growing conditions.
	Dicamba (4) + Diflufenzopyr (19)	2 to 8 oz **Overdrive**	Controls a wide range of broadleaf weeds. Addition of NIS or MSO is needed to achieve consistent weed control. Can be tank mixed with other herbicides to enhance control.
	Dicamba (4) + 2,4-D (4)	2 to 4 pt **Range Star** 0.5 to 3.5 pt **Outlaw** 0.33 to 2.5 pt **Latigo**	See label for weed-specific rates and grazing restrictions. Legumes interseeded with cool-season grasses will likely be injured.
	Metsulfuron (2)	0.1 to 1 oz **Metsulfuron***	Use maximum of 0.4 oz/a on fescue and timothy. Use NIS at 2 pt/100 gal.
	Metsulfuron (2) + Chlorsulfuron (2)	0.125 to 1.25 oz **Cimarron Plus**	Use maximum of 0.5 oz/a on fescue. Do not use on timothy, Garrison creeping foxtail, or ryegrass.
	Metsulfuron (1) + Chlorsulfuron (2)	0.5 to 2 oz **Cimarron X-tra**	Use maximum of 0.5 oz/a on fescue. Do not use on timothy, Garrison creeping foxtail, or ryegrass.
	Metsulfuron (2) +2,4-D amine (4) + Dicamba (4)	**Cimarron Max**	See label for rates, directions, restrictions, and cautions.
	Pendimethalin (3)	1.1 to 4.2 qt **Prowl H_2O**	Apply before target weed germination in the fall, after the last cutting/mowing/grazing, in winter, in spring or in-season between cuttings. Apply only to established cool-season grasses with 6 or more tillers per plant. Controls most annual grasses and some broadleaf weeds.
	Picloram (4) 0.063 to 0.125 lb	0.25 to 0.5 pt **Tordon 22K**	A restricted-use pesticide. Apply before bud stage when plant is growing actively. Follow directions, grazing limitations, and precautions on label.
	Picloram (4)/ 2,4-D (4)	**Grazon P+D** (see label for rates)	A restricted-use pesticide. Apply according to label directions. Follow directions, grazing limitations, and precautions on label.
	2,4-D* amine (4), LVE, or mixed formulations 1 to 2 lb	1 to 2 qt of 4 lb/gal **2,4-D* amine** or **LVE**	Apply when the problem weed is in the early leaf stage and growing actively. Use 20 gal or more of solution per acre for ground application. Repeat applications may be necessary. Do not apply when grass is in early boot to milk stages if grass seed production is desired. Do not let dairy animals graze on treated areas within 7 days after treatment.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Cool-Season Pastures

Weeds and brush	Herbicide and active ingredient needed/acre	Formulated product and amount/acre*	Comments and limitations
ANNUAL AND BIENNIAL WEEDS			
Most annual weeds	Aminopyralid (4) + Metsulfuron (2)	1 to 3.3 oz **Chaparral**	Apply to control broadleaf weeds in established grass stands. Grasses need to be established at least 4 months before the application of Chaparral. See label for tall fescue and smooth bromegrass precautions.
	Aminopyralid (4) + 2,4-D (4)	1.1 to 2.1 pt **ForeFront HL** or **GrazonNext HL**	Apply to control broadleaf weeds in established grass stands. During the season of establishment, application should be postponed until plants have developed a secondary root system and have begun to show good vigor. This is generally associated with the appearance of two true leaves, which can occur 45 to 60 days after application under good growing conditions.
	Halosulfuron (2) + Dicamba (4)	4 to 8 oz **Yukon**	Apply after weed emergence to small, actively growing broadleafs. Can be tank mixed with 2,4-D, dicamba, and picloram.
	Saflufenacil (14)	1 to 2 fl oz **Sharpen**	Apply postemergence in-season for broadleaf weed control. Use 1% MSO. Sharpen may be applied preplant, preplant incorporated, or preemergence in the fall or spring when establishing cool-season grasses. Verify grass selectivity to Sharpen to help avoid potential injury.
	Triasulfuron (2) + Dicamba (4)	**Rave** (see label for rates)	Controls many broadleaf weeds. Apply to actively growing weeds in early spring. See label for tank mix instructions and list of tolerant grasses.
	Triclopyr (4) + Fluroxypyr (4)	0.75 to 2 pt **PastureGard HL**	Apply to control broadleaf weeds in established grass stands. For sericea control, apply at 0.75 to 1 pt/a once plants have reached 8 in. in height. Treated areas may be rotated to crops 120 days after PastureGard HL application.
PERENNIAL WEEDS			
Asters Western ironweed Western ragweed	Aminopyralid (4) + Metsulfuron (2)	1 to 3.3 oz **Chaparral**	Apply to control broadleaf weeds in established grass stands. Grasses need to be established at least 4 months before the application of Chaparral. See label for tall fescue and smooth bromegrass precautions.
	Aminopyralid (4) + 2,4-D (4)	1.1 to 2.1 pt **ForeFront HL** or **GrazonNext HL**	Apply to control broadleaf weeds in established grass stands. During the season of establishment, application should be postponed until plants have developed a secondary root system and have begun to show good vigor. This is generally associated with the appearance of two true leaves, which can occur 45 to 60 days after application under good growing conditions.
	Metsulfuron (2) + 2,4-D amine (4) + Dicamba (4)	**Cimarron Max**	See label for rates, directions, restrictions, and cautions.
	Picloram (4) 0.25 to 0.5 lb	1 to 2 pt **Tordon 22K**	A restricted-use pesticide. Apply before bud stage when plant is actively growing. Follow directions, grazing limitations, and precautions on label.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Cool-Season Pastures

Weeds and brush	Herbicide and active ingredient needed/acre	Formulated product and amount/acre*	Comments and limitations
PERENNIAL WEEDS			
Asters Western ironweed Western ragweed	Picloram (4) + 2,4-D (4)	**Grazon P+D** (see label for rates)	A restricted-use pesticide. Apply according to label directions. Follow directions, grazing limitations, and precautions on label.
	2,4-D* amine, LVE, or mixed formulations (4) 1 to 2 lb	1 to 2 qt of 4 lb/gal **2,4-D* amine** or **LVE**	Apply when the problem weed is in the early leaf stage and actively growing. Use 20 gal or more of solution per acre for ground application. Do not apply when grass is in early boot to milk stages if grass seed production is desired. Do not let dairy animals graze on treated areas within 7 days after treatment.
	2,4-D* amine (4) + Dicamba (4) 1 lb + 0.25 lb	1 qt of 4 lb **2,4-D** + 0.5 pt **Clarity, Banvel,** or **Vision**	Dicamba can injure cool-season grasses. Follow directions, grazing limitations, and precautions on Clarity label.
	2,4-D* amine (4) + Dicamba (4) 1 lb + 0.25 lb	1 to 4 pt **WeedMaster** or **Range Star,** 0.5 to 3.5 pt **Outlaw,** or 0.33 to 2.5 pt **Latigo**	See label for rates, directions, and species controlled. Do not graze lactating dairy animals within 7 days of treatment. Do not harvest treated grasses for hay within 37 days of treatment. Suppression only.
Most perennial weeds	Aminopyralid (4)	3 to 7 fl oz **Milestone**	Apply to control broadleaf weeds. Can be tank mixed with other herbicides.
	Dicamba (4) + Diflufenzopyr (19)	4 to 8 oz **Overdrive**	Addition of NIS or MSO is needed to achieve consistent weed control. Lower rate should be tank mixed with other herbicides to enhance control.
	Halosulfuron (2) + Dicamba (4)	4 to 8 oz **Yukon**	Apply after weed emergence to small, actively growing broadleafs. Can be tank mixed with 2,4-D, dicamba, and picloram.
	Triasulfuron (2) + Dicamba (4)	**Rave** (see label for rates)	Controls many broadleaf weeds. Apply to actively growing weeds in early spring. See label for tank mix instructions and list of tolerant grasses.
Summer and winter annual grasses and many broadleaves	Imazapic (2) 0.063 to 0.125 lb	4 to 8 oz **Plateau**	Apply in spring after 100% greenup of smooth bromegrass, Kentucky bluegrass, and wheatgrass. See label for precautions and use of adjuvants.
WOODY PLANTS			
Multiflora rose	Aminopyralid (4) + Metsulfuron (2)	3.3 oz **Chaparral**	Apply when leaves have fully expanded in late spring. Application can occur throughout the year as long as leaves are healthy and green. Use a minimum of 15 gal/a of solution to ensure good coverage of the entire plant. See label for tall fescue and smooth bromegrass precautions.
	Aminopyralid (4)/ 2,4-D (4) + Triclopyr (4)	1.5 pt **ForeFront HL** + 1 to 2 pt **Remedy Ultra** or 3 pt **Trycera**	Apply when leaves have fully expanded in late spring. Application can occur throughout the year as long as leaves are healthy and green. Use a minimum of 15 gal/a of solution to ensure good coverage of the entire plant.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Cool-Season Pastures

Weeds and brush	Herbicide and active ingredient needed/acre	Formulated product and amount/acre*	Comments and limitations
WOODY PLANTS			
Multiflora rose	Glyphosate (9) 1% solution	**Glyphosate***	Apply as spot treatment with hand equipment before leaves lose green color. Damage can occur in surrounding vegetation.
	Metsulfuron (2) 0.3 to 0.6 oz	0.5 to 1 oz **Escort XP**	Apply in the spring, shortly after full-leaf stage. Complete coverage is necessary for effective control. Application to tall fescue may reduce production or cause chlorosis.
	Picloram (4)/2,4-D (4) + Triclopyr (4)	2 qt **Grazon P+D** + 1 pt **Remedy Ultra** or 1.5 pt **Trycera**	A restricted-use pesticide. Apply according to label directions. Follow directions, grazing limitations, and precautions on label.
Buckbrush	2,4-D* amine, LVE, or mixed formulations (4) 1 to 2 lb	1 to 2 qt of 4 lb/gal **2,4-D* amine** or **LVE**	Apply to foliage in spring when brush is nearing full-leaf stage (normally about May 1 to May 15) and growing actively. Do not let dairy animals graze on treated areas within 7 days after treatment.
Eastern red cedar	Metsulfuron (2)	1 to 2 oz **Escort XP** to 100 gal water	**Use high volume application.** Spray to wet during period of active growth.
	Picloram (4)	**Tordon 22K** 3 to 4 mL of product/3 feet of plant height	A restricted-use product. Apply on upslope side of plant during April and May or September and October with exact delivery hand-gun applicator. Rainfall is needed for activation. Surrounding vegetation can be damaged.
Eastern red cedar Honey locust Multiflora rose Osage orange	Hexazinone (5)	**Velpar L** 2 to 4 mL of product/inch stem diameter or **Velossa** 1.6 to 3.2 mL of product/inch stem diameter	Apply before or during period of active growth with exact delivery hand-gun applicator. Rainfall is needed for activation. Surrounding vegetation can be damaged. See label for additional instructions.
Honey locust Multiflora rose Osage orange	Aminopyralid (4) + Metsulfuron (2)	3.3 oz **Chaparral** or 3 oz **Chaparral** + 1 qt **2,4-D**	Apply when plants have reached 6 to 8 in. of new growth. Chaparral may be applied later in the growing season than 2,4-D (mid to late June). See label for tall fescue and smooth bromegrass precautions.
	Aminopyralid (4)/ Metsulfuron (2) + Triclopyr (4)	2.5 oz **Chaparral** + 1 pt **Remedy Ultra** or 1.5 pt **Trycera**	Apply once leaves have fully expanded in late spring. Applications can be made into mid-September as long as leaves are healthy and green. See label for tall fescue and smooth bromegrass precautions.
	Aminopyralid (4)/ 2,4-D (4) + Triclopyr (4)	1.5 pt **Forefront HL** + 1 to 2 pt **Remedy Ultra** or 1.5 to 3 pt **Trycera**	Apply once leaves have fully expanded in late spring. Applications can be made into mid-September as long as leaves are healthy and green.
Many woody plants and broadleaf weeds	Picloram (4) + Fluroxypyr (4)	1.5 to 6 pt **Surmount**	A restricted-use pesticide. Foliar applications should be made when woody plants are actively growing.
	Picloram (4)/ 2,4-D (4) + Triclopyr (4)	2 qt **Grazon P+D** + 1 pt **Remedy Ultra** or 1.5 pt **Trycera**	Grazon P+D is a restricted-use pesticide. For control of many woody plants on rangeland, pasture, and noncropland. Apply to foliage and green stems when woody plants are growing actively.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Cool-Season Pastures

Weeds and brush	Herbicide and active ingredient needed/acre	Formulated product and amount/acre*	Comments and limitations
WOODY PLANTS			
Many woody plants and broadleaf weeds	Triclopyr (4) + Fluroxypyr (4)	0.75 to 4 pt **PastureGard HL**	Foliar applications should be made when woody plants and weeds are actively growing.
	2,4-D* (4) + Triclopyr (4)	2 to 3 qt **2,4-D** + 2 to 4 pt **Remedy Ultra** or 3 to 5.3 pt **Trycera**	Foliar applications should be made when woody plants and weeds are actively growing.
FESCUE PASTURE RENOVATION			
Established fescue	Glyphosate (9) 0.75 lb ae	1 qt of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	In fall, apply to actively growing plants when most are 4 to 12 inches tall. If tall fescue has been mowed or grazed before application, do not treat until new growth has occurred. Remove livestock before application. Do not allow grazing or harvest for 8 weeks after application.
Seedling fescue	Glyphosate (9) 0.3 lb ae	0.4 qt of 3 lb ae/gal **Glyphosate***	In the spring after fall application, apply to seedlings that are 4 inches or less in height.
Established fescue	Imazapic (2)	8 to 12 oz **Plateau**	For control of tall fescue and conversion to warm-season grasses.
	Imazapic (2) + Glyphosate (9)	24 to 32 oz **Journey**	For control of tall fescue and conversion to warm-season grasses.
	Paraquat (22) 0.25 to 0.5 lb	1 to 2 pt **Gramoxone SL**	A restricted-use pesticide. Apply to fescue when actively growing and no more than 4 inches tall. Apply a second time at the same rate 10 to 21 days after the first treatment.
BASAL BARK APPLICATION			
Many woody plants	Triclopyr (4)	**Remedy Ultra** or **Trycera** 25% in diesel oil or kerosene	Controls woody plants, such as cottonwood, elm, locust, oaks, and osage orange (hedge). Spray basal parts of brush or trees to a height of 15 to 20 inches above ground. Thoroughly wet all basal bark areas, including crown buds and ground sprouts. Best root control is obtained when application is made from mid-July to mid-January. Periods of dry weather also will aid in root control.
		Pathfinder II	A ready-to-use product. No mixing required. Use on susceptible woody plants with less than 6-inch basal diameter. Spray basal parts of brush and trees to thoroughly wet lower 12 to 15 inches of stems. Apply at any time, except when snow or water prevent spraying to the ground line.
	Triclopyr (4) + Fluroxypyr (4)	**PastureGard HL** 25% in diesel oil or kerosene	Apply to susceptible woody plants less than 6 inches in diameter at any time, except when snow or water prevent spraying to the ground line. Thoroughly wet the lower 12 to 15 inches of stems.
Black locust and honeylocust	Aminopyralid (4)	**Milestone** 1 to 5% in basal diluent	Apply to stems less than 6 inches in diameter at any time, except when snow or water prevent spraying to the ground line. Spray basal trunks to a height of 12 to 15 inches.
CUT STUMP			
Black locust and honeylocust	Aminopyralid (4)	**Milestone** 10% in water	Spray cut surfaces as soon as possible after cutting. Cambium next to bark is most vital area to wet.
	Picloram (4)	**Tardon 22K** 10% in water	Spray cut surfaces within 15 minutes of cutting stem. Cambium next to bark is most vital area to treat.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Rangeland Weeds

Weeds	Herbicide and active ingredient needed/acre	Formulated product and amount/acre*	Comments and limitations
For control of noxious weeds, refer to Herbicides for Noxious Weeds table.			
ANNUAL AND BIENNIAL WEEDS			
Annual broomweed Cocklebur Common ragweed Sunflower Thistles	Aminopyralid (4) 0.047 to 0.109 lb	3 to 7 fl oz **Milestone**	Apply to control broadleaf weeds. Can be tank mixed with other herbicides.
	Aminopyralid (4) +2,4-D (4)	1.2 to 2.1 pt **ForeFront HL** or **GrazonNext HL**	Apply when broadleaf weeds are actively growing.
	Dicamba (4) + Diflufenzopyr (19)	2 to 8 oz **Overdrive**	Controls a wide range of broadleaf weeds. Can be tank mixed with other herbicides.
	Dicamba (4) + 2,4-D (4)	1 to 4 pt **Range Star,** 0.5 to 3.5 pt **Outlaw,** or 0.33 to 2.5 pt **Latigo**	See label for weed-specific rates and grazing restrictions. Do not use on buffalograss as injury will occur.
	Halosulfuron (2) + Dicamba (4)	4 to 8 oz **Yukon**	Apply after weed emergence to small, actively growing broadleafs. Can be tank mixed with 2,4-D, dicamba, and picloram.
	Metsulfuron (2)	0.1 to 1 oz **Metsulfuron***	Apply when weeds are less than 4 inches tall or in diameter. Can be tank mixed with Clarity, Grazon P+D, 2,4-D, Tordon 22K, or WeedMaster. Include NIS at 0.25 to 0.5% v/v.
	Metsulfuron (2) + Chlorsulfuron (2)	0.125 to 1.25 oz **Cimarron Plus**	Apply when weeds are less than 4 inches tall or in diameter. Do not apply more than 0.625 oz/a to buffalograss. See label for tank mix and surfactant recommendations.
	Metsulfuron (2) + Chlorsulfuron (2)	0.5 to 2 oz **Cimarron X-tra**	Apply when weeds are less than 4 inches tall or in diameter. Do not apply more than 1 oz/a to buffalograss. See label for tank mix and surfactant recommendations.
	Metsulfuron (2) + 2,4-D amine (4) + Dicamba (4)	**Cimarron Max**	See label for rates, directions, restrictions, and cautions.
	Picloram (4) + 2,4-D (4)	**Grazon P+D** (see label for rates)	A restricted-use pesticide. Apply according to label directions. Follow directions, grazing limitations, and precautions on label.
	Saflufenacil (14)	1 to 2 fl oz **Sharpen**	Apply postemergence in-season for broadleaf weed control. Use 1% MSO. Do not use AMS. Do not apply in-season to buffalograss or switchgrass.
	Triasulfuron (2)/ Dicamba (4)	2 to 5 oz **Rave**	See label for directions, species, and restrictions.
	2,4-D* amine, LVE, or mixed formulations (4) 1 to 2 lb		Apply when problem weed has leaves and is growing actively. Do not let dairy animals graze on treated area within 7 days after treatment. Do not cut for hay for 30 days. Use 20 gal or more of solution per acre for ground application. Repeat applications may be necessary.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Rangeland Weeds

Weeds	Herbicide and active ingredient needed/acre	Formulated product and amount/acre*	Comments and limitations
ANNUAL AND BIENNIAL WEEDS			
Common mullein	Aminopyralid (4)	5 to 7 fl oz **Milestone**	Apply to rosettes in the spring. Add NIS at 0.25 to 0.5%.
	Aminopyralid (4) + 2,4-D (4)	1.5 to 2.1 pt **ForeFront HL** or **GrazonNext HL**	Apply to rosettes in the spring. Add NIS at 0.25 to 0.5%.
	Metsulfuron (2)	0.2 oz **Metsulfuron*** or 0.375 to 0.625 oz **Cimarron Plus**	Apply during the rosette stage in the spring when plants are actively growing. Add a surfactant.
	Picloram (4) + 2,4-D (4)	4 pt **Grazon P+D**	A restricted-use pesticide. Apply during the rosette stage in spring or fall before bolting. Add a surfactant.
Lanceleaf ragweed	Dicamba (4) 0.25 to 0.5 lb	0.5 to 1 pt **Clarity, Banvel,** or **Vision**	Apply when weed has leaves and is growing actively. Do not let dairy animals graze on treated area within 7 days after treatment. Do not cut for hay for 37 days. Repeat applications may be necessary.
	2,4-D* amine (4) + Dicamba (4) 1 lb + 0.25 lb	1 qt of 4 lb/gal **2,4-D* amine** or **LVE** + 0.5 pt **Clarity** or **Banvel**	Apply when weed has leaves and is growing actively. Do not let dairy animals graze on treated area within 7 days after treatment. Do not cut for hay for 37 days. Repeat applications may be necessary.
Annual bromes	Glyphosate (9) 0.28 to 0.39 lb ae	8 to 11 fl oz of 4.5 lb ae/gal **Glyphosate*** (see glyphosate table)	Apply to rangeland when native grasses are dormant in the fall or early spring and annual bromes (downy brome and Japanese brome) are actively growing. Desirable cool-season grasses, such as western wheatgrass, will be damaged. Do not use AMS. See various labels for rates, directions, and precautions.
Annual grasses and many broadleaves	Imazapic (2) 0.032 to 0.188 lb	2 to 12 oz **Plateau**	See label for tolerance of native grasses to imazapic and recommended use rates, timing, and use of adjuvants.
PERENNIAL WEEDS			
Goldenrod Hoary vervain Western ironweed Western ragweed	Aminopyralid (4) + 2,4-D (4)	1.2 to 2.1 pt **ForeFront HL** or **GrazonNext HL**	Apply when broadleaf weeds are actively growing.
	Aminopyralid (4) 0.047 to 0.109 lb	3 to 7 fl oz **Milestone**	Apply to control broadleaf weeds. Can be tank mixed with other herbicides.
	Dicamba (4) 0.5 to 2 lb	1 to 4 pt **Clarity, Sterling Blue,** or **Vision**	Apply when problem weed has leaves and is growing actively. Ironweed can be treated until bud stage. Use 20 gal or more of solution per acre. Repeat applications may be necessary. Consult herbicide labels for grazing and haying instructions.
	Dicamba (4) + Diflufenzopyr (19)	4 to 8 oz **Overdrive**	Addition of NIS or MSO is needed to achieve consistent weed control. Lower rate should be tank mixed with other herbicides to enhance control.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Rangeland Weeds

Weeds	Herbicide and active ingredient needed/acre	Formulated product and amount/acre*	Comments and limitations
PERENNIAL WEEDS			
Goldenrod Hoary vervain Western ironweed Western ragweed	Halosulfuron (2) + Dicamba (4)	4 to 8 oz **Yukon**	Apply after weed emergence to small, actively growing broadleafs. Can be tank mixed with 2,4-D, dicamba, and picloram.
	Metsulfuron (2) + 2,4-D amine (4) + Dicamba (4)	**Cimarron Max**	See label for rates, directions, restrictions, and cautions.
	Picloram (4) 0.25 to 0.5 lb	1 pt to 1 qt **Tordon 22K**	A restricted-use pesticide. Apply before bud stage when plant is growing actively. Follow directions, grazing limitations, and precautions on label.
	Picloram (4) + Fluroxypyr (4)	**Surmount** (see label for rates)	A restricted-use pesticide. Apply when weeds are small and actively growing.
	Picloram (4) + 2,4-D (4)	**Grazon P+D** (see label for rates)	A restricted-use pesticide. Apply according to label directions. There are no grazing restrictions for non-lactating dairy animals or other livestock including horses, sheep, goats, and other animals in the treated area.
	2,4-D* amine, LVE, or mixed formulations (4) 1 to 2 lb	1 to 2 qt of 4 lb/gal **2,4-D* amine** or **LVE**	Apply when problem weed has leaves and is growing actively. Ironweed can be treated until bud stage. Use 20 gal or more of solution per acre. Repeat applications may be necessary. Consult herbicide labels for grazing and haying instructions. Follow directions and precautions on label.
	2,4-D* amine (4) + Dicamba (4) 1 lb + 0.25 lb	1 qt of 4 lb/gal **2,4-D* amine** or **LVE** + 0.5 pt **Clarity, Banvel,** or **Vision**	Apply when problem weed has leaves and is growing actively. Ironweed can be treated until bud stage. Use 20 gal or more of solution per acre. Repeat applications may be necessary. Consult herbicide labels for grazing and haying instructions. Follow directions and precautions on label.
Broom snakeweed	Metsulfuron (2) 0.019 to 0.038 lb	0.5 to 1 oz **Escort XP** or 0.625 oz **Cimarron Plus**	Apply in fall when the plant is actively growing.
	Metsulfuron (2) + 2,4-D amine (4) + Dicamba (4)	**Cimarron Max**	Apply according to label directions. Follow directions, grazing limitations, and precautions on label.
	Picloram (4) 0.25	1 pt **Tordon 22K**	A restricted-use pesticide. Apply during active growth between the full-leaf and early bloom stages.
	Picloram (4) + 2,4-D (4)	1 to 2 qt **Grazon P+D**	A restricted-use pesticide. Apply according to label directions. Follow directions, grazing limitations, and precautions on label.
Poison and water hemlock	Picloram (4) + 2,4-D (4)	2 to 4 pt **Grazon P+D**	A restricted-use pesticide. Apply to poison hemlock from rosette stage in spring or fall up to 36 inches tall. Apply to water hemlock from rosette stage in spring or fall up to bud stage.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Rangeland Weeds

Weeds	Herbicide and active ingredient needed/acre	Formulated product and amount/acre*	Comments and limitations
PERENNIAL WEEDS			
Poison hemlock	Aminopyralid (4) + Metsulfuron (2)	2.5 to 3.3 oz **Chaparral**	For best results, apply in early March through late May. Use higher rates if application occurs later in this time frame. See label for tall fescue and smooth bromegrass precautions.
	Metsulfuron (2)	1 to 2 oz **Escort XP**	Add appropriate spray adjuvant.
	Metsulfuron (2) + Chlorsulfuron (2)	1.25 oz **Cimarron Plus**	Add appropriate spray adjuvant.
Old World Bluestems	Glyphosate (9)	2 to 3 lb/a	Use higher rate if dry soil conditions exist. Apply when Old World Bluestem is actively growing, preferably prior to seed production. Add a non-ionic surfactant. For spot treatment use 4 to 6 pt in 25 gallons of water. Check the glyphosate label to determine use on rangeland and pasture. Glyphosate is a non-selective herbicide and will damage most green growing plants.
	Imazapyr (2)	0.25 to 0.5 lb/a **Arsenal**	Apply when Old World Bluestem is actively growing. For lower rate, 2 applications per year may be necessary about 8 weeks apart. Add a non-ionic surfactant. For spot treatment use 1 to 2 pt in 25 gallons of water. At the recommended rates, imazapyr is selective with most native grasses and forbs surviving treatment.
Crownvetch	Aminopyralid (4)	0.5 oz **Milestone**	Apply when plants are actively growing and under conditions favorable for growth. Add 0.25 to 0.5% non-ionic surfactant. Smooth brome may be suppressed by Milestone.
	Aminopyralid (4) + Metsulfuron (2)	1.5 to 2 oz **Chaparral**	Apply to vegetative growth stage prior to bloom. Use higher rate when growing conditions are less favorable or plants are more mature. Add 0.25 to 0.5% non-ionic surfactant. Smooth brome may be suppressed when plants are environmentally stressed. Tall fescue may be stunted.
	Aminopyralid (4) + 2,4-D (4)	1.2 to 1.5 pt **ForeFront HL** or **GrazonNext HL**	Apply when plants are actively growing up to the bloom stage. Use higher rate when growing conditions are less favorable or plants are more mature. Smooth brome may be suppressed when plants are environmentally stressed. Add 0.25 to 0.5% non-ionic surfactant.
	Metsulfuron (2)	0.5 oz **Escort XP**	Apply when plants are actively growing. Environmental stress will reduce herbicide effectiveness. See label for suggested surfactants. Tall fescue may be stunted. Smooth brome may be suppressed when plants are environmentally stressed.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Brush and Trees on Rangeland

Brush or tree	Herbicide and active ingredient needed/acre	Formulated product and amount/acre*	Comments and limitations
FOLIAR APPLICATION			
Buckbrush Plum, sand and American Smooth sumac	Picloram (4)/ 2,4-D (4)	1 to 2 qt **Grazon P+D**	A restricted-use pesticide. Apply according to label directions. Follow directions, grazing limitations, and precautions on label.
	Picloram (4)/ 2,4-D (4) + Triclopyr (4) 0.54/2 lb + 0.5 to 1 lb	1 gal **Grazon P+D** + 1 to 2 pt **Remedy Ultra** or 1.5 to 3 pt **Trycera** in 100 gal water	A restricted-use pesticide. Apply according to label directions. Follow directions, grazing limitations, and precautions on label.
	2,4-D* amine, LVE, or mixed formulations (4) 1 to 2 lb	1 to 2 qt of 4 lb/gal **2,4-D**	Apply to foliage in spring when brush is nearing full-leaf stage and growing actively. Repeat applications may be necessary in following years. Normal treatment time: buckbrush (May 1-15), sand plum (May 20-June 10), and sumac (June 10-25).
Blackberry Roughleaf dogwood	Picloram (4) + Fluroxypyr (4)	**Surmount**	A restricted-use pesticide. Apply as a high-volume spray 1 to 2% v/v. Dogwood can be controlled with 0.5% v/v spray solution. Control can be improved by addition of NIS.
	Picloram (4)/ 2,4-D (4) + Triclopyr (4) 0.135/0.5 + 0.5 lb	1 qt **Grazon P+D** + 1 pt **Remedy Ultra** or 1.5 to 3 pt **Trycera** in 100 gal water	A restricted-use pesticide. Apply according to label directions. Follow directions, grazing limitations, and precautions on label. Label recommends 1 gal Grazon P+D plus 1 to 2 qt Remedy Ultra/100 gal spray solution.
Eastern red cedar	Picloram (4)	**Tordon 22K**	A restricted-use pesticide. Apply 1% solution as a high-volume foliar spray. Complete coverage is essential. Treat anytime during the growing season.
	Picloram (4) + Fluroxypyr (4)	**Surmount**	A restricted-use pesticide. Apply 1-2% solution as a high-volume foliar spray. Complete coverage is essential. Add 0.25-0.5% non-ionic surfactant. Plants greater than 3 feet tall may not be controlled. Treat anytime during the growing season.
	Metsulfuron (2)	**Escort XP**	Apply 1-2 oz/100 gal as a high-volume foliar spray. Add 0.25-0.5% non-ionic surfactant. Treat anytime during the growing season.
Black locust and honeylocust	Aminopyralid (4) 0.11 lb	7 fl oz **Milestone**	Apply during early summer during full-leaf stage.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Brush and Trees on Rangeland

Brush or tree	Herbicide and active ingredient needed/acre	Formulated product and amount/acre*	Comments and limitations
FOLIAR APPLICATION			
Multiflora rose Poison ivy	Glyphosate (9) 1% solution	**Glyphosate***	Apply as spot treatment with hand equipment before leaves lose green color. Vegetation in treated area can be damaged. Avoid drift outside target area.
Multiflora rose	Aminopyralid (4) + Metsulfuron (2)	3.3 oz **Chaparral**	Apply when leaves have fully expanded in late spring. Application can occur throughout the year as long as leaves are healthy and green. Use a minimum of 15 gal/a of solution to ensure good coverage of the entire plant. See label for tall fescue and smooth bromegrass precautions.
	Aminopyralid (4)/ 2,4-D (4) + Triclopyr (4)	1.5 pt **ForeFront HL** + 1 to 2 pt **Remedy Ultra** or 1.5 to 3 pt **Trycera**	Apply when leaves have fully expanded in late spring. Application can occur throughout the year as long as leaves are healthy and green. Use a minimum of 15 gal/a of solution to ensure good coverage of the entire plant.
	Metsulfuron (2) 0.019 to 0.038 lb	0.5 oz **Escort XP,** 0.5 to 1 oz **Metsulfuron*,** or 0.625 oz **Cimarron Plus**	Apply in the spring, shortly after full-leaf stage. Complete coverage is necessary for effective control. Do not apply to tall fescue.
	Picloram (4) + 2,4-D (4)	**Grazon P+D** (see label for rates)	A restricted-use pesticide. Apply according to label directions. Follow directions, grazing limitations, and precautions on label.
	Picloram (4)/ 2,4-D (4) + Triclopyr (4) 0.27/1 + 0.5 lb	2 qt **Grazon P+D** + 1 pt **Remedy Ultra** or 1.5 pt **Trycera** in 100 gal water	A restricted-use pesticide. Apply according to label directions. Follow directions, grazing limitations, and precautions on label. Label recommends 1 gal Grazon P+D plus 1 to 2 qt Remedy Ultra/100 gal spray solution.
Many woody plants and broadleaf weeds	Picloram (4) + Fluroxypyr (4)	3 to 6 pt **Surmount**	A restricted-use pesticide. Apply broadcast or as a 1 to 2% v/v spray to foliage. Control may be improved by addition of NIS.
	2,4-D* (4)/ Triclopyr (4) 1/0.5 lb	2 qt **Crossbow**	Crossbow is a premix of 2 lb 2,4-D and 1 lb triclopyr/gal for control of many woody plants on rangeland and pasture. Apply to foliage and green stems when woody plants are growing actively. Apply Crossbow in water at 1.5% spray mix or 1.5 gal/100 gal spray mix.
	2,4-D* (4) + Triclopyr (4) 1 lb + 0.5 lb	1 qt of 4 lb/gal **2,4-D*** + 1 pt **Remedy Ultra** or 1.5 pt **Trycera**	
Mixed brush including Osage orange (hedge) and locust	2,4-D (4) + Triclopyr (4) + Picloram (4) 1 lb + 0.5 lb + 0.25 lb	1 qt of 4 lb/gal **2,4-D*** + 1 pt **Remedy Ultra** or 1.5 pt **Trycera** + 1 pt **Tordon 22K**	Tordon 22K is a restricted-use pesticide. Apply before full-leaf stage to foliage and green stems when woody plants are growing actively. See label for methods of application, rates for tank mixes, and precautions.
Prickly pear	Picloram (4) 0.125 to 0.25 lb	**Tordon 22K** 0.5 to 1 pt	A restricted-use pesticide. Apply before full-bloom stage while plant is growing actively (May-June). Use higher rate for more complete control. Follow directions, grazing limitations, and precautions on label. For spot treatment apply 0.5% solution plus non-ionic surfactant.
	Picloram (4) + Fluroxypyr (4)	3 to 4 pt **Surmount**	A restricted-use pesticide. See label for proper timing, spray volumes, and other directions and precautions. For spot treatment apply 1-2% solution plus non-ionic surfactant.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Brush and Trees on Rangeland

Brush or tree	Herbicide and active ingredient needed/acre	Formulated product and amount/acre*	Comments and limitations
FOLIAR APPLICATION			
Prickly pear	Picloram (4) + 2,4-D (4) 1.1 + 4 lb	**Grazon P+D**	Use for spot treatment any time of the year with 2% solution. Spray pads to runoff. Use 0.25 to 0.5% non-ionic surfactant.
Russian olive	2,4-D* amine (4) + Dicamba (4) 1 lb + 0.25 lb	1 qt **2,4-D*** + 0.5 pt **Clarity** or **Banvel**	Apply from late May to mid-June when plant is growing actively. For aerial application, use 3 gal or more of total solution per acre. For individual plant treatment, use 25 gal of solution; wet leaves for complete coverage.
Saltcedar (tamarisk)	Imazapyr (2)	2 qt **Arsenal**	Add 1 qt/a MSO. For high-volume foliar sprays, use 1% Arsenal + 1% MSO. Apply to wet, not run off.
	Imazapyr (2) + Glyphosate (9)	**Arsenal** + **Glyphosate***	For high-volume foliar sprays, use 0.5% Arsenal + 0.5% glyphosate + 1% MSO or 0.25% NIS.
	Imazapic (2)	**Plateau**	For high-volume foliar sprays, use 1% Plateau plus a MSO or NIS according to the label.
Sand sagebrush	2,4-D* amine, LVE, or mixed formulations (4) 1 lb	1 qt of 4 lb/gal **2,4-D***	Leave untreated strips in areas with high wind-erosion hazard. Apply when sagebrush is in the bud stage.
Yucca (small soapweed)	Aminopyralid (4) + metsulfuron (2) + 2,4-D (4)	3.3 oz + 2 pt **Chaparral + 2,4-D**	Apply during flower stalk elongation through pod development stages. By air, use a minimum of 4 gal/a spray volume. Add an adjuvant. May require repeat application.
	Metsulfuron (2) + chlorsulfuron (2) + 2,4-D (4)	0.625 to 1 oz + 2 pt **Cimarron Plus** + **2,4-D**	For suppression only. Apply from 2 weeks before blooming to 2 weeks after blooming. By air, use a minimum of 3 gal/a spray volume. Add an adjuvant.
DORMANT STEM APPLICATION			
NOTE: Do not apply herbicides when grass is in boot to milk stage where grass seed production is desired. Do not apply to newly seeded areas or after grasses begin to head. See herbicide labels for directions, precautions, and grazing limitations.			
Many woody plants	Triclopyr (4)	**Remedy Ultra** 0.75 to 1.5% in diesel oil or kerosene	Thoroughly wet upper and lower stems, including root collar and any ground sprouts. Treat when brush is dormant and bark is dry. Follow label directions.
		Trycera	See label for methods, rates, tank mixes, and precautions.
Mixed brush including blackberry and multiflora rose	2,4-D* (4)/ Triclopyr (4)	**Crossbow** 1 to 4% in diesel oil or kerosene	Crossbow is a premix of 2 lb 2,4-D and 1 lb triclopyr/gal for control of many woody plants on rangeland and pasture. Thoroughly wet all stems. Treat any time when brush is dormant and the bark is dry.
Multiflora rose	Dicamba (4)	**Dicamba***	Apply as undiluted spot treatment or as low-oil basal bark treatment when plants are dormant.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Brush and Trees on Rangeland

Brush or tree	Herbicide and active ingredient needed/acre	Formulated product and amount/acre*	Comments and limitations
SOIL APPLICATION			
Buckbrush, Cottonwood, Dogwood, Elm, Multiflora rose, Oaks, Smooth sumac, Willow	Tebuthiuron (7)	**Spike 20P** (see label for rates)	Apply to soil surface on grid pattern or evenly spaced under drip line of plants. See label for rates, directions, and precautions. Spike 20P is recommended for multistemmed species, such as dogwood, buckbrush, and smooth sumac.
Eastern red cedar	Picloram (4)	**Tordon 22K** 3 to 4 mL of product/ 3 feet of plant height	A restricted-use product. Apply on upslope side of plant during April and May or September and October with exact delivery hand-gun applicator. Rainfall is needed for activation. Surrounding vegetation can be damaged.
Eastern red cedar, Elm, Hackberry, Honey locust, Multiflora rose, Oaks, Osage orange, Russian olive, Willow	Hexazinone (5)	**Velpar L** 2 to 4 mL of product/ inch of stem diameter or 1 to 2 pellets **Pronone Power Pellet Herbicide**/inch stem diameter or 1.6 to 3.2 ml **Velossa**/inch of stem diameter	Apply from April through June in period of active growth. Apply Velpar L with exact delivery hand-gun applicator. Precipitation is needed for activation. Do not apply to brush in standing water or use on marshy or poorly drained areas. Expect to see some grass damage.
Yucca (small soapweed)	Hexazinone (5)	**Velpar L** 4 mL of product/inch of stem diameter, or 1 to 2 pellets **Pronone Power Pellet Herbicide**/plant, or 1.66 to 3.32 ml **Velossa/**inch of stem diameter	Apply from April through June when plants are actively growing. Apply Velpar L with an exact delivery hand-gun applicator. Apply on the uphill side at the edge of the plant. Expect to see some grass damage.
BASAL BARK APPLICATION			
Many woody plants	Triclopyr (4)	**Pathfinder II**	A ready-to-use product. No mixing required. Use on susceptible woody plants with less than 6-inch basal diameter. Spray basal parts of brush and trees to thoroughly wet lower 12 to 15 inches of stems. Apply at any time, except when snow or water prevent spraying to the ground line.
	Triclopyr (4)	**Remedy Ultra** or **Trycera** 25% in diesel oil or kerosene	Controls woody plants, such as elm, Osage orange, ash, locust, mulberry, and oaks. Spray basal parts of brush or trees to a height of 15 to 20 inches above the ground. Thoroughly wet all basal bark areas, including crown buds and ground sprouts. Best root control is obtained when application is made from mid-July to mid-January. Periods of dry weather also will aid in root control.
	Triclopyr (4) + Fluroxypyr (4)	**PastureGard HL** 25% in diesel oil or kerosene	Use on susceptible woody plants with less than 6-inch basal diameter. Spray basal parts of brush and trees to thoroughly wet lower 12 to 15 inches of stems. Apply at any time, except when snow or water prevent spraying to the ground line.
Black locust and honeylocust	Aminopyralid (4)	**Milestone** 1 to 5% in basal diluent	Apply to stems less than 6 inches in diameter at any time, except when snow or water prevent spraying to the ground line. Spray basal trunks to a height of 12 to 15 inches.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Brush and Trees on Rangeland

Brush or tree	Herbicide and active ingredient needed/acre	Formulated product and amount/acre*	Comments and limitations
CUT STUMP OR FRILL APPLICATION			
Ash Cottonwood Willow	Triclopyr (4) + 2,4-D (4)	**Crossbow** 4% in diesel, fuel oil, or kerosene	Apply to stump immediately after cutting. Thoroughly wet stump, especially the cambium layer just inside the bark. Apply at any time of the year except when snow or water prevent spraying to the ground line.
Cottonwood Elm Oak species	Dicamba (4)	**Dicamba*** (see label for specific directions)	Apply to stump or frill immediately after cutting. See labels for rates, directions, and precautions. Best root control is obtained when application is made from mid-July to mid-January. Periods of dry weather also will aid in root control.
Many woody plants, including saltcedar (tamarisk)	Imazapyr (2)	**Arsenal** 10% in water	Apply to cambium area of freshly cut stump surface.
	Triclopyr (4)	**Pathfinder II**	A ready-to-use product. No mixing required. Apply product to wet the cut surface and sides of the stumps. Apply at any time, except when snow or water prevent spraying to the ground line.
Many woody plants, including saltcedar (tamarisk)	Triclopyr (4)	**Remedy Ultra** 25% in diesel oil or kerosene	Apply to stump or frill immediately after cutting. See label for rates, directions, and precautions. Best root control is obtained when application is made from mid-July to mid-January. Periods of dry weather also will aid in root control.
		Trycera	See label for methods, rates, tank mixes, and precautions.
	Triclopyr (4) + Fluroxypyr (4)	**PastureGard HL** 25% in diesel oil or kerosene	Apply to stump or frill immediately after cutting. Thoroughly wet sides of stump, root collar, and cut surface. Apply at any time, except when snow or water prevent spraying to the ground line. Use undiluted PastureGard for saltcedar control.
Black locust and honeylocust	Aminopyralid (4)	**Milestone** 10% in water	Spray cut surface as soon as possible after cutting. Cambium next to bark is most vital area to wet.
	Picloram (4)	**Tordon 22K** 10% in water	Spray cut surfaces within 15 minutes of cutting stem. Cambium next to bark is most vital area to treat.
GROWING POINT AND LEAF BASE (CROWN) TREATMENT			
Yucca (small soapweed)	Triclopyr (4)	**Pathfinder II**	A ready-to-use product. Thoroughly wet the center of the plant, including growing point. Complete coverage of leaves is not necessary.
	Triclopyr (4)	**Remedy Ultra** 2% in diesel or fuel oil	Thoroughly wet the center of the plant, including growing point and leaf bases to the soil surface. Complete coverage of leaves is not necessary.
	Triclopyr (4) + Fluroxypyr (4)	**PastureGard HL** 1% in diesel or fuel oil	Thoroughly wet the center of the plant, including growing point and leaf bases to the soil surface. Complete coverage of leaves is not necessary.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Noncropland

Many herbicides, including some used for selective weed control in crops, can be used for nonselective weed control on noncropland areas, such as industrial sites, around buildings, on storage areas, under fences, and in road ditches. Caution must be used to avoid damaging desirable plants. Drift during application, volatility of some materials after spraying, and water movement through or on soil surfaces can seriously injure surrounding vegetation. For more effective weed control and least injury to nearby desirable plants, follow label directions and observe precautions.

Persistent herbicides remain in the soil and can prevent plant growth for a full season or longer. Rates of breakdown and disappearance depend on several factors, including soil type, rainfall, temperature, and soil microorganisms. Rates and optimum times to apply also differ with the soil, rainfall, and weed species. When hard-to-kill species are problems or where environmental factors reduce chemical activity, (1) increase the application rate, (2) use a mixture of chemicals, or (3) repeat the treatment.

Translocated or contact herbicides control existing vegetation. The foliage must be covered thoroughly, and applications may have to be repeated for season-long control.

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
PERSISTENT HERBICIDES		
Aminocyclopyrachlor (4) + Chlorsulfuron (2)	1.75 to 11 oz **Perspective**	Controls many broadleaf weeds and invasive species, such as Canada thistle, field bindweed, and sericea lespedeza.
Aminocyclopyrachlor (4) + Metsulfuron (2)	1.25 to 11.5 oz **Streamline**	Controls many broadleaf weeds, invasive species, such as field bindweed and sericea lespedeza, and woody plants.
Aminocyclopyrachlor (4)	4 to 18 oz **Method 240SL**	Controls many broadleaf weeds, invasive species, such as leafy spurge and sericea lespedeza, and woody plants.
Borate, Chlorate, or mixtures of Borate or Chlorate with other chemicals	Numerous products*	Apply before spring rainy season begins.
Bromacil (5) 3 to 24	1.5 to 12 gal **Hyvar XL**	Controls woody plants and many annual and perennial weeds, particularly perennial grasses. Apply before weeds start active growth in the spring. Bromacil controls deep-rooted weeds.
Bromacil (5) + Diuron (2)	4 to 30 lb **Krovar I DF**	Controls many annual and perennial weeds. Apply before weeds start active growth or shortly after weeds emerge. Krovar I is a premix containing 40% bromacil and 40% diuron.
Chlorsulfuron (2)	0.25 to 3 oz **Telar DF**	For control of many annual and perennial broadleaf weeds in noncrop areas. Can be applied preemergence or postemergence, but for best results, apply to young weeds growing actively. Do not use on food or feed crops. Do not apply on or near desirable trees or plants. Do not contaminate water.
Chlorsulfuron (2)+ Sulfometuron (2) + Sulfentrazone (14)	12.5 oz **Throttle XP**	Controls many annual and perennial grasses and broadleaves. Can be tank mixed with other herbicides labeled for site, but do not mix with Hyvar XL.
Diuron (7)	5 to 15 lb **Karmex DF**	Controls many annual and perennial weeds. Apply in the spring. Remove heavy top growth before treatment. Karmex controls shallow-rooted weeds.
Hexazinone (5) 2 to 8	1 to 4 gal **Velpar L** or 0.8 to 3.3 gal **Velossa**	Controls annual and perennial weeds and some woody plants. Apply before or soon after weeds emerge. For best results, apply when weeds are young and growing actively.
Imazapic (2) 0.063 to 0.188	4 to 12 oz **Plateau**	Controls most annual grasses and broadleaf weeds. Apply to small, actively growing weeds before they reach size limits listed on the label. Apply with NIS, COC, or MSO plus fertilizer solution.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Noncropland

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
PERSISTENT HERBICIDES		
Imazapyr (2)	2 to 6 pt **Arsenal**	Controls most annual and perennial grasses and broadleaf weeds, in addition to many woody plants and vines. Mix in water and add a surfactant.
Imazapyr (2)+ Aminocyclopyrachlor (4) + Metsulfuron (2)	13 to 20 oz **Viewpoint**	Controls broadleaves, grasses, and woody species. Can be used for bareground treatments. Product can be applied up to the water's edge.
Imazapyr (2) + Diuron (7) 0.4 + 3.1 to 1.5 + 11.8	5 to 19 lb **Sahara**	Controls most annual and perennial weeds and some woody plants on noncropland areas. Can be applied preemergence, but applying postemergence to actively growing weeds is preferred. Apply with NIS or COC. Do not treat where roots of desirable plants may extend into the treated zone or allow drift to nontarget areas. Do not contaminate water. Sahara can be applied to nonirrigation ditches and low-lying areas when water has drained but can be isolated in pockets because of uneven or unlevel conditions.
Metsulfuron (2)	0.25 to 2 oz **Escort XP**	Controls many annual and perennial broadleaf weeds and some woody plants. Do not use on food or feed crops. Prevent drift of spray to desirable plants.
Picloram (4)	**Tordon RTU**	Tordon RTU is a ready-to-use product that is effective in cut-surface applications for killing unwanted trees in noncrop areas, such as fencerows and rights-of-way. Spray or paint freshly cut surfaces of trees, such as cedar, dogwood, elm, oaks, and persimmon.
Picloram (4) + 2,4-D (4) 0.25 + 1 to 2 + 8	0.5 to 4 gal **Tordon 101**	A restricted-use pesticide. Tordon 101 is a premix of 0.5 lb picloram and 2 lb 2,4-D/gal for control of broadleaf weeds, woody plants, and vines. Does not mix readily with oil. Avoid application to sites susceptible to contamination of groundwater or surface water.
Prometon (5) 10 to 60	5 to 30 gal **Pramitol 25E**	Controls annual and many perennial weeds. Apply before or after plant growth begins. Mix in water or oil; oil spray kills top growth faster than water spray.
Simazine (5) 4.8 to 22.5	4L, 90 WDG, or 80 W **Simazine***	Controls many annual weeds and suppresses perennials. Clean Crop Simazine can be tank mixed with herbicides, such as glyphosate, Karmex, 2,4-D, or Oust, to broaden control spectrum.
Sulfometuron (2)	1.33 to 8 oz **Oust XP**	For control of many annual and perennial weeds on noncropland areas. Can be applied preemergence or postemergence to weeds, but best results are obtained if application is made before or during early stages of weed growth. Do not use on food or feed crops. Do not apply on or near desirable trees or plants. Do not contaminate water. In areas where kochia and Russian thistle are present or are target species, this product should be tank mixed to guard against resistant biotypes.
Tebuthiuron (7) 1 to 4	5 to 20 lb **Spike 20P**	For control of woody plants and vines in noncrop areas. Apply broadcast or as an individual-plant treatment, depending on size, density, and location of brush. For best results, apply before active seasonal growth in spring and/or periods of rainfall. Do not apply on any area into which roots of desirable plants may extend. Do not contaminate water.
NONSELECTIVE, TRANSLOCATED, OR CONTACT HERBICIDES		
Aminopyralid (4) 0.047 to 0.109	3 to 7 fl oz **Milestone**	Apply to control broadleaf weeds. Can be tank mixed with other herbicides.
Aminopyralid (4) + Metsulfuron (2)	1 to 3.3 oz **Opensight**	For control of broadleaf weeds and certain woody plants. Can be tank mixed with other herbicides.
Aminopyralid (4) + Triclopyr amine (4)	4 to 9 pt **Capstone**	For control of broadleaf weeds and woody plants. Can be tank mixed with other herbicides. See label for species controlled, methods, and precautions.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Noncropland

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
NONSELECTIVE, TRANSLOCATED, OR CONTACT HERBICIDES		
Dicamba (4)	**Dicamba***	Herbicide for cut-surface treatment to control undesirable trees in noncrop areas, such as fencerows, drainage-ditch banks, and rights-of-way. Spray or paint freshly cut surfaces of trees, such as ash, cedar, cottonwood, dogwood, elm, oak, persimmon, sumac, and willow.
Fosamine (27) 6 to 24	1.5 to 6 gal **Krenite S**	Controls many susceptible brush species and some perennial plants, including field bindweed. Apply as foliar spray to mature vegetation. Can use on noncropland adjacent to domestic water-supply reservoirs, lakes, and ponds.
Glyphosate (9) 0.75 to 3.75 lb ae	1 to 5 qt of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. Controls annual and perennial weeds. Apply to annual weeds before they head and to perennial weeds from early bud to early seed stages. The addition of 2% AMS by weight or 17 lb/100 gal of water can increase the performance of glyphosate. Can be tank mixed with Princep. Do not apply when wind or other conditions might cause spray mist to drift.
Indaziflam	3.5 to 7 fl oz **Esplanade**	Apply as preemergent treatment for many grass and broadleaf weeds. Higher rate of 5 to 7 fl oz can be used as bareground treatment. Can be tank mixed with other herbicides.
Paraquat (22) 0.625 to 1	2.5 to 4 pt **Gramoxone SL**	A restricted-use pesticide. Spray young weeds. Repeat as necessary to maintain control. Kills annual weeds and tops of perennials.
Saflufenacil (14)	2 to 6 oz **Sharpen**	For selective broadleaf or bareground treatment in tank mixes with other herbicides. See label for specific rates, tank mix partners, and other directions.
Topramezone (27)	1 to 4 oz **Frequency**	Controls or supresses broadleaf and grassy weeds. Can be applied for selective or bareground treatment. See label for specific rates, additives, tank mix partners, and other directions.
Triclopyr (4) 1 to 8	0.25 to 2 gal **Garlon 4 Ultra**	Controls broadleaf weeds and woody plants. Keep out of streams, lakes, and irrigation ditches.
Triclopyr (4)	**Pathfinder II**	A ready-to-use product for woody plant control. Apply as a low-volume basal bark treatment or on cut stumps. See label for species controlled, methods, and precautions.
Triclopyr (4)	**Remedy Ultra** or **Trycera**	See label for methods, rates, tank mixes, and precautions.
2,4-D (4) + Triclopyr (4)	1 to 4 gal **Crossbow**	Crossbow is a premix of 2 lb 2,4-D and 1 lb triclopyr (Garlon)/gal for control of many woody plants. Apply to foliage and green stems when woody plants are growing actively. Apply Crossbow in water at 1 to 1.5% spray mix or at 1 to 1.5 gal/100 gal spray mix.
PREEMERGENCE FOR TANK MIXING		
Oryzalin (3)	**Surflan A. S.**	See label for methods, rates, tank mixes, and precautions.
Pendimethalin (3)	**Pendulum**	See label for methods, rates, tank mixes, and precautions.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Noxious Weeds

This table lists alternative herbicides that are registered for use on bur ragweed, field bindweeed, johnsongrass, musk thistle, and sericea lespedeza. Other products are registered for use to control noxious weeds but are not included in this publication. For information on herbicides registered for use on hoary cress, hogpotato (pignut), kudzu, leafy spurge, quackgrass, and Russian knapweed, contact your K-State Research and Extension Office; the Plant Health Division, Kansas Department of Agriculture, Manhattan; or your county Noxious Weed Office.

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
BUR RAGWEED (WOOLLY LEAF BURSAGE)		
Dicamba (4) 1 to 2	1 to 2 qt **Dicamba***	Apply as broadcast or spot treatment to actively growing plants after crop harvest and before killing frost. See label for cropping limitations.
Dicamba (4) 2 to 6	2 to 6 qt **Dicamba***	For use on pastures, rangeland, and noncropland. For suppression and top growth control. Can injure cool-season grasses.
Dicamba (4) + 2,4-D (4) 0.5 + 1	1 pt **Dicamba*** + 1 qt of 4 lb/gal **2,4-D* LVE**	For best control of bur ragweed, apply to regrowth in late summer or fall.
Glyphosate (9) + Dicamba (4) 0.75 to 1.5 lb ae + 0.5	1 to 2 qt of 3 lb ae/gal **Glyphosate*** + 1 pt **Dicamba***	Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. Apply when plants are producing new growth initiated by moisture for at least 2 weeks and when plants are at or beyond flowering.
Picloram (4) + 2,4-D (4) 0.25 + 1.0	1 pt **Tordon 22K** + 1 qt of 4 lb/gal **2,4-D***	Tordon 22K is a restricted-use pesticide. For use in pastures, rangeland, noncropland, and fallow. Apply when bur ragweed is flowering or in the fall. Allow a minimum of 60 days between application of Tordon and planting wheat. Do not plant susceptible broadleaf crops for 36 months or more after application.
2,4-D LVE (4) 2	2 qt of 4 lb/gal **2,4-D* LVE**	Apply during fallow period to actively growing plants at bud stage. Provides seasonal suppression only.
CANADA THISTLE		
Aminopyralid (4) 0.078 to 0.109	5 to 7 fl oz **Milestone**	Use for broadcast or spot treatment in rangeland, pastures, noncropland, or CRP. Apply in the fall to vegetative plants or in the spring to plants in the pre-bud growth stage.
Aminopyralid (4) + Metsulfuron (2)	2 to 3.3 oz **Chaparral**	Use for broadcast or spot treatment in rangeland, pastures and CRP. Apply in spring or summer to fully emerged plants. Can be applied in fall prior to killing frost.
Aminopyralid (4) + 2,4-D (4)	1.5 to 2.1 pt **ForeFront HL** or **GrazonNext HL**	Use for broadcast or spot treatment in rangeland, pastures, and CRP. Apply when plants are actively growing.
Clopyralid (4) 0.13 to 0.25	0.33 to 0.67 pt **Stinger**	Apply to Canada thistle in field corn after corn emergence through 24-inch corn and when thistles are at least 4 inches in diameter or height but before bud stage. Do not cultivate before or within 2 weeks after treatment. Apply over-the-top of the crop or with drop nozzles in 10 gal or more of spray per acre. Can rotate to small grains anytime. Other crops may require a waiting period of 12 months or more. Do not apply aerially. Do not contaminate irrigation ditches or water used for irrigation or domestic purposes. Can be tank mixed with 2,4-D. See label for uses in rangeland, CRP, and fallow.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Noxious Weeds

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
CANADA THISTLE		
Clopyralid (4) + 2,4-D (4)	2 to 4 pt **Curtail**	Use the 2 pt rate in small grains and higher rates in fallow, CRP, and noncropland. Apply after small grains have 4 leaves and 2 tillers until early jointing. Treat Canada thistle after it is 4 inches in diameter or height but before the bud stage. The best control is obtained with treatment during the rosette to early bolting stages of growth. Do not harvest hay from treated grain fields. Note rotation guidelines on label.
Dicamba (4) 1 to 2	1 to 2 qt **Dicamba***	For use in grassland, CRP, and fallow. Can injure forage grasses. Do not use on leaching type soils. Can persist up to 2 years.
Glyphosate (9) 0.75 to 2.25 lb ae	1 to 3 qt of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	Use in fallow and noncropland or as a spot treatment in cropland. Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. Treated crop and nontarget plants will be injured or killed. Apply to Canada thistle that is growing actively and at or beyond the bud stage of growth or to actively growing rosettes in the fall. Wait at least 3 days after treatment before tilling treated areas.
Picloram (4) 0.5 to 1	1 to 2 qt **Tordon 22K**	A restricted-use pesticide. Use for spot treatment only in noncropland, CRP, range, and pastureland. Can injure forage grasses. Apply to actively growing Canada thistle in fall or in spring at early flower bud. Do not allow grazing for 2 weeks after treatment. Not recommended for coarsely textured soils. Picloram can remain in the soil for 3 or more years.
FIELD BINDWEED		
Dicamba (4) 1 to 2	1 to 2 qt **Dicamba***	Apply as broadcast or spot treatment to actively growing plants after crop harvest and before killing frost. See label for cropping limitations.
Dicamba (4) + Glyphosate (9) 0.5 to 2 lb + 0.75 to 1.5 lb ae	1 to 4 pt **Dicamba*** + 1 to 2 qt of 3 lb ae/gal **Glyphosate***	Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. Apply when weed is growing actively, at or beyond full bloom, or between August and October at least 8 weeks after last tillage. Do not disturb treated areas for 7 days after application. Do not plant wheat for 45 days for each pint of Banvel or Clarity applied. For best results, use flat-fan nozzles.
Dicamba (4) + 2,4-D (4) 0.5 + 1	1 pt **Dicamba*** + 1 qt of 4 lb/gal **2,4-D* amine** or **LVE**	Apply to pasture, rangeland, cropland, and noncropland areas. Follow label directions and note cropping limitations.
Fosamine (22) 8 to 24	2 to 6 gal **Krenite S**	Do not use on food crops. Apply in noncropland areas after plants begin to bloom.
Glyphosate (9) 3 lb ae	1 gal of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. Apply to actively growing bindweed from August to October on land not in crops. Can be applied as spot treatment in some crops.
Imazapic (2) 0.1875	12 oz **Plateau**	Apply with an adjuvant (2 pt/a MSO or 0.25% NIS) to actively growing runners. For use on CRP, roadsides, and other noncropland sites.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Noxious Weeds

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
FIELD BINDWEED		
Imazapic (2) + Glyphosate (9) 0.1875 + 0.375 lb ae	32 oz **Journey**	Apply with 2 pt/a MSO to actively growing runners on noncropland.
Picloram (4) + 2,4-D (4) 0.25 to 0.5 + 1	1 to 2 pt **Tordon** 22K + 1 qt **2,4-D***	Tordon 22K is a restricted-use pesticide. Can be broadcast applied to grasslands and fallow cropland. Persistent in soils. See label precautions for aerial applications.
Picloram (4) + 2,4-D (4) 0.13 to 0.25 + 0.5 to 2	0.5 to 1 pt **Tordon 22K** + 0.5 to 2 qt of 4 lb/gal **2,4-D* amine** or **LVE**	Tordon 22K is a restricted-use pesticide. For reduction of field bindweed and for control of many annual weeds after wheat harvest and before planting winter wheat, barley, or oat. Apply after grain harvest and again about mid-May during fallow season. Do not treat with Tordon more than once in each calendar year. Avoid spray drift.
Quinclorac (4) 0.25 to 0.38	22 to 32 oz **Facet L,** 0.5 to 0.75 pt **QuinStar 4L,** or 5.3 to 8 oz **QuinStar GT**	Apply to actively growing bindweed with at least 4-inch vines in sorghum or in fallow before planting sorghum or wheat. Always apply with COC or methylated seed soil adjuvant. Include AMS at 17 lb/100 gal for best performance. Do not plant any crop other than wheat or sorghum within 10 months after application. Do not plant alfalfa for at least 24 months after application. Paramount has a supplemental label for use in pasture, rangeland, Conservation Reserve Program land, and switchgrass establishment and maintenance.
2,4-D (4) 0.75 to 2	0.75 to 2 qt of 4 lb/gal **2,4-D* amine** or **LVE**	Apply in spring when plant is in bud stage or in fall after 12 inches of new growth.
JOHNSONGRASS		
Glyphosate (9) 0.75 to 2.25 lb ae	1 to 3 qt of 3 lb ae/gal **Glyphosate*** (see glyphosate table)	Glyphosate products differ in concentration and adjuvant requirements. Refer to specific product labels for rate and adjuvant recommendations. For best results, apply to actively growing plants when most are at least 18 inches tall and at the boot to head stages of growth. Do not apply after the plants turn brown in the fall. Allow 7 or more days between application and tillage. Can be used as a spot treatment in some crops. Always follow label directions. For best results, use flat-fan nozzles and 3 to 10 gal spray/acre.
Imazapic (2) 0.125 to 0.1875	8 to 12 oz **Plateau**	Apply with an adjuvant (2 pt/a MSO or 0.25% NIS). For use on CRP, roadsides, and other noncropland sites.
Imazapic (2) + Glyphosate(9)	24 to 32 oz **Journey**	Apply with 2 pt/a MSO on roadsides and other noncropland sites.
Nicosulfuron (2) + Metsulfuron (2)	1 oz **Pastora**	Controls seedlings or plants up to 18 inches tall in established bermudagrass pastures or hay meadows. Applications of Pastora may result in temporary yellowing and/or stunting of bermudagrass. Grass response is minimized by treating when bermudagrass has less than 2 inches of new growth during initial green-up or by treating within 7 days after cutting for hay.
Prometon (5) 40 to 60	20 to 30 gal **Pramitol 25E**	For use on industrial sites and noncrop areas. Apply before or up to 3 months after weeds emerge.
Sulfosulfuron (2)	0.75 to 2 oz **Outrider**	For control in select pasture grasses, rangeland, and noncropland areas. For best results, apply to actively growing plants at least 18 to 24 inches tall up to the head stage of growth. Add 0.25% NIS. See label for specific rates, further directions, and precautions.
Sulfometuron (2) 0.28 to 0.375	6 to 8 oz **Oust XP**	Do not apply to cropland. Apply preemergence or early postemergence to boot stage. To reduce drift, apply at low pressures with coarse-spray nozzles.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Noxious Weeds

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
JOHNSONGRASS		
Trifluralin (3), Fluazifop-P (1), Nicosulfuron (2), Primisulfuron (2), and Quizalofop (1)	**Treflan, Fusilade, Accent, Beacon,** and **Assure**	Refer to corn and soybean sections for general recommendations.
MUSK THISTLE		
Aminopyralid (4) 0.047 to 0.078	3 to 5 fl oz **Milestone**	Use for broadcast or spot treatment in rangeland, pastures, noncropland, or CRP. Treat plants in the spring during rosette through bolting stages of development or in the fall.
Aminopyralid (4) + Metsulfuron (2)	1 to 2.5 oz **Chaparral**	Use for broadcast or spot treatment in rangeland, pastures, and CRP. Treat plants in the spring or fall. See label for recommendations for bolted to early bloom stage plants.
Aminopyralid (4) + 2,4-D (4)	1.2 to 1.5 pt **ForeFront HL** or **GrazonNext HL**	Use for broadcast or spot treatment in rangeland, pastures, and CRP. Treat plants in the spring during rosette through bolting stage of development or in the fall.
Chlorsulfuron (2) 0.023 to 0.047	0.5 to 1 oz **Telar DF**	For use on rangeland, permanent grass pasture, CRP, and noncropland. Apply in spring from rosette to pre-bloom stages of growth. Do not allow spray drift to contact nearby crops or other nontarget plants; injury can occur.
Clopyralid (4)/ 2,4-D (4) 0.095 + 0.5 to 0.19 + 1	2 to 4 pt **Curtail**	For use on rangeland, permanent grass pasture, CRP, and noncropland. Apply to actively growing rosettes in the spring or fall or to bolted thistles up to the bud stage.
Dicamba (4) 0.33	0.67 pt **Dicamba***	Apply in spring during rosette stage of growth. Can be applied for control in fall if soil moisture is favorable and air temperature exceeds 50°F.
Dicamba (4) + 2,4-D (4) 0.25 + 0.75	0.5 pt **Dicamba*** + 0.75 qt **2,4-D* amine** or **LVE**	Apply in spring during rosette stage of growth. Can be applied for control in fall if soil moisture is favorable and air temperature exceeds 50°F.
Diflufenzopyr (19)/ Dicamba (4)	4 oz **Overdrive**	For use on noncropland, pasture, hay, and rangeland. Apply in the spring to actively growing rosettes or bolted thistles up to the bud stage. Add NIS or MSO.
Metsulfuron (2) 0.009 to 0.019	0.25 to 0.50 oz **Escort XP** or **Metsulfuron***	Apply in the spring or fall to rosettes. Add 0.5 lb 2,4-D to enhance activity up to flowering. Note: Do not apply if drought conditions exist at intended time of application.
Metsulfuron (2) + Chlorsulfuron (2)	0.25 to 0.5 oz **Cimarron Plus**	Apply in spring or early summer before flowering or to rosettes in the fall. Apply before the ground freezes.
Metsulfuron (2) + Chlorsulfuron (2)	0.5 to 1 oz **Cimarron X-tra**	Apply in spring or early summer before flowering or to rosettes in the fall. Apply before the ground freezes.
Metsulfuron (2) + Dicamba (4) + 2,4-D (4)	Rate I **Cimarron Max**	Apply in the spring or early summer before flowering or in the fall. Add NIS or other adjuvant.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Herbicides for Noxious Weeds

Herbicide and lb active ingredient needed/acre	Formulated product/acre*	Comments and limitations
MUSK THISTLE		
Picloram (4) 0.13	0.5 pt **Tordon 22K**	A restricted-use pesticide. Apply during rosette stage in the fall, before soil freezes.
Picloram (4) + 2,4-D (4) 0.13 + 1.0	0.5 pt **Tordon 22K** + 1 qt of 4 lb/gal **2,4-D* amine, LVE,** or mixed formulations	Tordon 22K is a restricted-use pesticide. Apply from rosette up to flowering stage in spring after soil thawing.
Triasulfuron (2)/ Dicamba (4)	4 oz **Rave**	Apply in spring to rosette stage or up to 5-inch tall bolted thistles. Add 0.5 lb 2,4-D (1 pt of 4 lb/gal) for enhanced control.
2,4-D amine (4) 1.5 to 2	1.5 to 2 qt of 4 lb/gal **2,4-D* amine, LVE,** or mixed formulations	Apply during rosette stage of growth. In spring, apply 2,4-D at 1.5 lb ae/acre. For best control in fall, apply 2,4-D LVE at 2 lb/acre. 2,4-D amine can be applied in fall, if soil moisture is favorable and air temperature exceeds 50°F
SERICEA LESPEDEZA		
Aminopyralid (4) + Metsulfuron (2)	2.5 to 3 oz **Chaparral**	Apply beginning at flower bud initiation through the full bloom stage of growth. Chaparral may suppress smooth brome, especially during environmental stress. Tall fescue may be stunted.
Metsulfuron (2) 0.015 to 0.0375	0.4 to 0.5 oz **Metsulfuron*** or 0.5 to 1 oz **Escort XP**	Apply after bud/bloom stage until first frost. For aerial application, use 3 to 5 gal spray/acre, flat-fan nozzles, and NIS. See label for additional instructions and precautions. Note: Do not apply if drought conditions exist at intended time of application.
Metsulfuron (2) + Chlorsulfuron (2)	**Cimarron Plus**	Apply at 0.625 oz/a beginning at flower bud initiation through the full-bloom stage.
Metsulfuron (2) + Chlorsulfuron (2)	**Cimarron X-tra**	Apply at Rate II from the beginning of flower bud initiation through the full-bloom stage.
Metsulfuron (2) + Dicamba (4) + 2,4-D (4)	Rate II **Cimarron Max**	Apply from beginning of flower bud initiation to full bloom. Note: Do not apply if drought conditions exist at intended time of application.
Picloram (4) + Fluroxypyr (4)	2 pt **Surmount**	A restricted-use pesticide. Apply when plants are 12 to 15 inches tall in the late spring to early summer before bloom.
Triclopyr (4) 0.5 to 1.0	1 to 2 pt **Garlon 4 Ultra**	Do not apply to cropland, including rangeland and pasture. Apply when plants are actively growing. Use a minimum of 20 gal spray/a for ground application.
Triclopyr (4) 0.5 to 1.0	1 to 2 pt **Remedy Ultra** or 1.4 to 2.8 pt **Trycera**	Apply when plants are growing actively in the vegetative stage (June) or in flower (late July to September). Use a minimum of 20 gal spray/a for ground application. For aerial application, use 3 to 5 gal spray/acre.
Triclopyr (4) + Fluroxypyr (4) 0.28 + 0.094 to 0.56 + 0.19	0.75 to 1.5 pt **PastureGard HL**	Apply when plants are 12 to 15 inches tall in the late spring to early summer before bloom. Use higher rate for dense stands or later stages of growth.

* Numbers in parentheses indicate herbicide site of action; see p. 3 for more information. Products often are available in several formulations or brand names, and label information may vary. Refer to the Names, Toxicities, and Persistence table, p. 12.

Weed Control Publications

Available from K-State Research and Extension offices or from the Bookstore, 16 Umberger Hall, Kansas State University, Manhattan, KS 66506; 785-532-5830; fax: 785-532-7938; email: orderpub@k-state.edu

C402 Smooth Brome Production and Utilization

C449 Soybean Production Handbook

C529 Wheat Production Handbook

C560 Corn Production Handbook

C667 Aquatic Plants and Their Control

C683 Alfalfa Production Handbook

C687 Grain Sorghum Production Handbook

C715 Herbicide Mode of Action

C729 Tall Fescue Production and Utilization

L231 Musk Thistle: Identification and Control

L815 Prescribed Burning as a Management Practice

MF913 Field Bindweed: Control in Field Crops and Fallow

MF948 Managing the Farmstead to Minimize Groundwater and Well Contamination

MF958 Factors Affecting Pesticide Behavior and Breakdown

MF1020 Rangeland Weed Management

MF1021 Rangeland Brush Management

MF1088 Cotton Production in Kansas

MF1089 Cleaning Field Sprayers

MF2086 Managing Kansas Grazinglands for Multiple Benefits

MF2208 Managing to Minimize Atrazine Runoff

MF2239 Woollyleaf Bursage Biology and Control

MF2339 Weed Control in Dryland Cropping Systems

MF2384 High Plains Sunflower Production Handbook

MF2408 Sericea Lespedeza: History, Characteristics, and Identification

MF2461 Atrazine Herbicide: A Water Quality Concern for Kansas

MF2734 Great Plains Canola Production Handbook

MF2767 Glyphosate Stewardship: Optimizing and Preserving Glyphosate Performance

MF2869 Droplet Size Calibration: A New Approach to Effective Spraying

MF2894 Calibrating Boom Sprayers

MF2915 Hand Sprayer Calibration Steps Worksheet

MF3014 Marestail Control in Kansas

MF3100 Calculating Pesticide Measurements

MF3240 Guide to Spray Nozzle Tip Selection by Droplet Size

S54 Diagnosing Corn Production Problems in Kansas

S80 Pigweed Identification: A Pictorial Guide to the Common Pigweeds of the Great Plains

S84 Diagnosing Wheat Production Problems in Kansas

S125 Diagnosing Sorghum Production Problems in Kansas

Additional weed management information and research summaries from Kansas State University can be accessed at ***www.agronomy.k-state.edu/extension/weed-management***

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Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned. Persons using such products assume responsibility for their use in accordance with current label directions of the manufacturer.

Publications from Kansas State University are available at ***www.ksre.ksu.edu***

Additional information about herbicide site of action and herbicide resistance can be accessed at the Weed Science Society of America website: ***wssa.net*** and the Take Action Herbicide Resistance website: ***takeactiononweeds.com***

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