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2017

Weed Control Guide

for Vegetable Crops

Information current as of November 1, 2016

MICHIGAN STATE UNIVERSITY | Extension

Herbicide Information

Some herbicides containing the same active ingredients but having different trade names are marketed by more than one company. Also, some herbicides are produced in several formulations. Products recommended in this bulletin are commonly used formulations of common herbicides. Other products and formulations may be equally good. Check labels on containers to determine that the product is labeled for your intended target crop and the amount of product to use per acre.

Pesticide Information

This publication contains pesticide recommendations based on research and pesticide regulations. However, changes in pesticide registrations occur frequently. Some pesticides mentioned may no longer be available, and some may no longer be legal in your state. The use of a pesticide in a manner not consistent with the label can lead to injury of crops, humans, animals and the environment, and can lead to civil fines and/or condemnation of the crop. If you have questions about the legality and/or registration status of pesticides, contact your county Extension office, pesticide dealer or manufacturer.

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

2017 Weed Control Guide for Vegetable Crops

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Table of Contents

 12/16 – 600 – BH – Bradford

Environmental Protection and Herbicide Use

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

An effective weed control program includes environmentally sound cultural, mechanical and chemical weed control methods. T he increasing concern with pesticide residues in the environment, food and groundwater make it especially important that growers use herbicides as efficiently as possible. Crop rotation, cultivation, use of cover and companion crops, and use of different herbicides help avoid buildup of resistant weeds and pesticide residues in the soil.

Pesticides and the Environment

Groundwater is stored in water-bearing geological formations called aquifers. It moves through **aquifers** and is obtained at springs, streams or wells. Many people obtain their drinking water from wells. Well water is groundwater.

The upper level of the saturated zone in the soil is called the **water table**. The water table depth fluctuates, depending on the amount of water removed from the ground and the amount of water added by recharge.

Both surface water and groundwater are subject to contamination by **point and non-point source pollution**. Point source contamination refers to movement of a pesticide into water from a specific site. Non-point source contamination generally results from land runoff, precipitation, acid rain or percolation rather than from discharge at a single location.

Several factors influence the fate of herbicides in groundwater.

Adsorption is the binding of chemicals to soil particles. The amount and persistence of pesticide adsorption varies with pesticide properties, soil moisture, soil pH and soil texture. Soils high in organic matter or clay are the most adsorptive; coarse, sandy soils are much less adsorptive.

A soil-adsorbed herbicide is less likely to volatilize, leach or be degraded by microorganisms. It is also less available for absorption by plants.

Volatilization occurs when a solid or a liquid turns into a gas. A pesticide in a gaseous state can be carried away from the treated area by air currents. This is called **vapor drift**. Unlike the drift of sprays and dusts that can sometimes be seen during application, vapor drift is invisible.

Avoid applying volatile herbicides when conditions favor volatilization, such as temperature inversions. Herbicide labels usually mention the potential for volatility of herbicides. Volatilization can sometimes be reduced through the use of low volatile formulations or soil incorporation of the herbicide.

Photodegradation is the breakdown of herbicides by the action of sunlight. Herbicides applied to foliage or the soil surface may be broken down by exposure to light. Soil incorporation can reduce herbicide exposure to sunlight.

Microbial degradation occurs when microorganisms such as fungi and bacteria use a herbicide as a food source. Conditions that favor microbial growth include warm temperatures, favorable pH levels, adequate soil moisture, oxygen and fertility. Adsorbed herbicides are more slowly degraded because they are less available to some microorganisms.

Chemical degradation is the breakdown of a herbicide by soil processes not involving a living organism. Adsorption of the herbicides, soil pH, soil temperature and moisture influence the rate of degradation. Some herbicides are more rapidly degraded on low pH soils.

Absorption is the process by which plants and microorganisms take up chemicals. Once absorbed, most herbicides are degraded within plants. Residues may persist inside the plant or be released back into the environment as the plant decays.

Runoff moves herbicides in surface water, either mixed in the water or bound to soil particles. The amount of herbicide runoff depends on the grade or slope of the field, the type of soil, the amount of rainfall (especially close to the time of application) and properties of the herbicide. For example, a herbicide applied to a saturated clay soil is highly susceptible to runoff. Established vegetation or plant residues reduce runoff.

Herbicide runoff is greatest when heavy rainfall occurs shortly after application. No-tillage, minimum-tillage and soil incorporation reduce runoff. Surface grading, drainage ditches and dikes, and the use of border vegetation can help reduce herbicide movement into surface water.

Leaching is the movement of herbicides through the soil into groundwater. Several factors influence leaching, including water solubility of the herbicide, soil structure and texture, and persistence of herbicide adsorption to soil particles. If a herbicide is strongly adsorbed to soil particles, it is less likely to leach, regardless of its solubility, unless the soil particles themselves move with the water flow.

Keeping Herbicides Out of Groundwater and Surface Water

It is very difficult to purify or clean contaminated groundwater or surface water. Management practices can be implemented to effectively reduce pesticide runoff and leaching and protect groundwater and surface water.

- **Use integrated crop management practices**—Minimize herbicide use by combining chemical control with other pest management practices such as tillage, cultivation, crop rotation and pest scouting.
- **Reduce compaction**—Surface water runoff increases when soils are compacted.
- **Rotate crops**—Crop rotations may provide more surface crop residue and may reduce the application of the same pesticides to a field.
- **Use conservation tillage practices**—Include no-till, minimum-till, cover crops, grass waterways and buffer strips.
- **Consider the geology of your area**—When planning herbicide applications, be aware of the water table depth and the permeability of the geological layers between the surface soil and groundwater.
- **Select herbicides carefully**—Choose herbicides with the least potential for leaching into groundwater or for runoff into surface water.
- **Transport pesticides safely**—Have pesticides delivered directly to your pesticide storage facility to avoid liability and potential accidents and spills in transit whenever possible. U.S. DOT shipping rules must be followed for transporting large quantities of pesticides, including proper placarding of the vehicle, liability insurance, special handling requirements, etc.
- **Follow label directions**—The label carries crucial information about the proper rate, timing and placement of the herbicide.
- **Calibrate accurately**—Equipment should be calibrated carefully and often.
- **Measure accurately**—Concentrates need to be carefully measured before they are placed into the spray tank. Do not "add a little extra" to ensure the herbicide will do a better job.
- **Avoid back-siphoning**—The end of the fill hose should remain above the water level in the spray tank at all times to prevent back-siphoning of chemical into the water supply. Use an anti-backflow device when siphoning water directly from a well, pond or stream. These practices also reduce the likelihood of the hose becoming contaminated with herbicides.
- **Consider weather and irrigation**—If you suspect heavy or sustained rain, delay applying herbicides. Control the quantity of irrigation to minimize the potential for herbicide leaching and runoff.
- **Avoid spray drift and volatilization**—Do not spray when the wind is greater than 10 miles per hour and/or weather conditions (e.g., inversions) are conducive to pesticide drift from the target area. Make every effort to AVOID PESTICIDE DRIFT!
- **Clean up spills**—Avoid spills. When they do occur, contain and clean them up quickly with an absorbent material such as cat litter. Chemicals spilled near wells and sinkholes can move directly and rapidly into groundwater. Chemicals spilled near ditches, streams or lakes can move rapidly into surface water.
- **Change the location of mixing areas**—Mix and load pesticides on an impervious pad, if possible. If mixing is done in the field, change the location of the mixing area regularly. Do not mix herbicides adjacent to the water source, and do not let the water run inadvertently onto the soil near the mixing area. This will increase herbicide leaching and/or runoff.
- **Dispose of wastes and containers properly**—All herbicide wastes must be disposed of in accordance with local, state and federal laws. Pesticide containers are considered hazardous waste until they are cleaned or disposed of properly. When possible, reduce the number of pesticide containers by using bulk or returnable containers.

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

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

  Do not bury or burn any pesticide containers. Do not reuse any empty pesticide containers for any purpose.
- **Store herbicides away from water sources**—Herbicide storage facilities should be situated away from wells, cisterns, springs and other water sources. Pesticides must be stored in a facility that will protect them from temperature extremes, high humidity and direct sunlight. The storage facility should be heated, dry and well ventilated. It should be designed for easy containment and cleanup of pesticide spills and made of materials that will not absorb any pesticide material that leaks out of a container. Store only pesticides in such a facility and always store them in their original containers.

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

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

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

  For additional information on pesticide storage, refer to Midwest Plan Service Bulletin 37, *Designing Facilities for Pesticide and Fertilizer Containment*, available from Agriculture and Biosystems Engineering Dept., 122 Davidson Hall, Iowa State University Ames, IA 50011; and Michigan Bulletin

E-2335, *On-Farm Agrichemical Storage and Handling*.

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

Michigan Groundwater Stewardship Program (MGSP)

The Michigan Groundwater Stewardship Program (MGSP) is a cooperative effort designed to reduce the risks of groundwater contamination associated with the use of pesticides and nitrogen fertilizers. The MGSP has been authorized through the year 2010 by the state legislature. It is funded by assessments on the sale of nitrogen fertilizers and pesticides. The assessment generates $3.5 million each year that is used to deliver educational programs, technical assistance and cost-share programs that meet the needs and interests of pesticide and fertilizer users. Local MGSP's, usually associated with a county MSU Extension or Conservation District office, provide assisted farmstead pollution risk assessments (Farm*A*Syst and Field*A*Syst) and help in developing a groundwater stewardship plan, provide cost-share funds that are used to install groundwater stewardship practices, and conduct educational workshops and on-farm demonstrations.

The MGSP also sponsors the Spill Response Program (1-800-405-0101) to assist individuals dealing with pesticide, fertilizer and manure spills; Clean Sweep to dispose of unused and unwanted pesticides safely; container recycling to assist in the safe disposal of plastic pesticide containers; and the Michigan Emergency Tube project, which provides an emergency preparedness plan that helps meet the legal requirements of SARA Title III. Growers who participate in some of these programs are also eligible to obtain pesticide recertification credits.

Contact your MSU Extension, Conservation District or USDA NRCS representative to learn more about the MGSP serving your county.

Pesticide Emergency Preparedness

When purchasing a pesticide, obtain a specimen label from the dealer and keep it on file on the farm. This label will be available immediately if an emergency involving a pesticide occurs. Take the label along to a medical treatment center if an individual has suffered pesticide poisoning.

Read and observe closely the *Precautionary Statements* section of the label. Make sure that several people are aware of and can administer treatments for pesticide poisoning contained in the *Statement of Practical Treatment* on the label. (See also section on SARA Title III.)

Handling and Mixing Pesticides

Always wear protective clothing and equipment when handling, mixing and applying pesticides and during cleanup of application equipment. Always wear the personal protective equipment specified on the pesticide label.

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

Keep unauthorized persons out of the area in which you handle pesticides.

Cleaning Pesticide Application Equipment

Follow all specific label directions for cleaning application equipment. It is important to clean weed control sprayers after use, especially if they are used for more than one crop and for application of insecticides and fungicides. The need for extensive cleaning can be minimized if one sprayer is dedicated to herbicide application only.

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

When cleaning a sprayer used only for herbicide application, usually only water rinsing is necessary. Rinse the whole sprayer with water, inside and out, including boom, hoses and nozzles. Partially fill the spray tank with water and keep the pump running so that the water is circulated throughout the entire system. Spray the water through the nozzles. Apply the rinsate to cropland not exceeding labeled rates. Repeat the process when changing herbicides and at the end of each day.

Clean sprayers completely when changing from herbicides to other pesticides. Add 1 gallon of ammonia to 100 gallons of water. Pump it through the system. Leave the cleaning solution in the sprayer system for at least two hours and then pump it out through the nozzles. Do not apply the washing solution to crops. Rinse the system with water after draining the rinsate. Do not leave pesticide solution or cleaning solution in the tank overnight.

Protect Non-target Organisms

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

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

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

Worker Protection Standard

New federal rules for farm worker protection have been in effect since 1995. The Worker Protection Standard (WPS) covers pesticides that are used in the production of agricultural plants on farms and in forests, nurseries and greenhouses. The operators of these businesses are required to provide employees with:

- Information in the form of pesticide safety training, pesticide safety poster, access to labeling information and access to an application list of pesticide treatments on the establishment.
- Protection to ensure that employees will be protected from exposures to pesticides. Employers are required to prohibit handlers from applying pesticides in any way that will expose workers or others, exclude workers from areas being treated with pesticides, exclude workers from areas that remain under a restricted entry interval (REI), protect early entry workers who are doing permitted tasks in an area under REI, notify workers about treated areas, monitor handlers who are using highly toxic pesticides and provide instruction for use of personal protective equipment.
- Mitigation in the form of decon-tamination sites for washing up in the field and emergency assistance to make transportation available to a medical facility in the event of a pesticide-related injury or illness.

Details for compliance with the Worker Protection Standard as well as other regulations affecting worker safety can be obtained at your county MSU Extension office.

Right-to-Know

Plan to conduct a farm worker Right-to-Know training program for all your employees. Use this training time to maintain and improve safety procedures for using agricultural chemicals on your farm. Contact your county Extension agent to assist you in setting up a right-to-know employee training program.

Record Keeping

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

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

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

Endangered Species Act

To minimize the adverse impact of pesticides on endangered species, the EPA initiated the Endangered Species Act. The Michigan Department of Natural Resources (MDNR) administers the Michigan Endangered Species Act and maintains the federal and state endangered species lists in the state. Pesticide applications are a potential problem, particularly affecting birds, butterflies and moths. Alteration of the farm landscape can also negatively affect resident endangered species.

The Environmental Protection Agency (EPA) has determined threshold pesticide application rates that may affect listed species. This information is or will be included on pesticide labels. Counties with vulnerable endangered or threatened species will be identified on pesticide labels. Farmers must take the initiative and consult with the MDNR and the Fish and Wildlife Service (FWS) to be sure there are no endangered species in their area. The Nature Conservancy, a private land and habitat conservation organization, is working with the MDNR and the FWS and is conducting a landowner contact program to work with landowners who own property important for endangered species protection.

SARA Title III Emergency Planning and Community Right-to-Know Act

The Emergency Planning and Community Right-to-Know Law under SARA Title III requires farmers to notify their State Emergency Response Commission (SERC), Local Emergency Planning Committee (LEPC) and local fire department that they store extremely hazardous materials along with the name and telephone number of the facility representative. Check with your state Department of Environmental Quality or Extension to receive a list of EPA established "extremely hazardous substances" and their threshold planning quantities.

The LEPC and fire chief may request maps of your storage facility and detailed lists of materials you store.

This law also requires, in the event of a spill, that the SERC, LEPC and National Response Commission be notified. The reportable quantities for spills is much less than for storage and can be obtained from the above sources. See Extension bulletin E-2575 for more details on SARA Title III and a list of commonly used extremely hazardous substances.

Right-to-Farm Act

Farmers in Michigan are protected from nuisance lawsuits under the Right- to-Farm Act if they follow specific acceptable management practices. The Generally Accepted Agricultural and Management Practices for pesticide utilization and pest control, nutrient utilization and manure management have been completed and are revised annually. Contact your Extension agent or regional office of the Michigan Department of Agriculture to obtain copies.

Spraying Equipment

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

- A **tank** with a volume of 100 to 300 gallons to reduce filling and mixing operations.
- A **pump** with a capacity of at least 10 gallons per minute and pressure up to 100 pounds per square inch (PSI).
- An **agitation system**—The bypass from the pressure control is a good source of agitation. Direct the agitation line into the bottom of the tank. Make sure there is always some agitation in the tank.
- **Screens**—There should be 50-mesh screens in the intake line and at each nozzle.
- **Pressure gauge**—A pressure gauge calibrated to 100 PSI should be mounted on the boom as near to the nozzle as possible.
- **Boom**—The boom should be adjustable from 18 to 36 inches above the ground. It should be built so that it contains shock absorbers to keep it level when going over rough ground.
- **Nozzles**—Flat fan nozzles with 73 to 95-degree angles are best suited for most weed control work.

  Nozzle volume can vary from 1 to 10 gallons per minute, depending on the application; 8002 and 8004 are good general-use nozzles.

Sprayer Calibration

One of the most important factors in effective weed control is accurate calibration of the equipment. The following steps can be used as a guide to calibrate a ground sprayer.

1. **Determine** the desired application volume of the carrier (usually water) in gallons per acre (GPA). A rate of 10 to 30 GPA at 30 to 40 PSI is sufficient for most weed control applications.
2. **Adjust** the boom height so that the spray overlaps about 30 percent at the ground (or other surface to be sprayed). With 80-degree nozzles, this places the nozzles about 20 inches apart on the boom and 20 inches above the sprayed surface. Check each nozzle at the recommended pressure for output. Replace any defective nozzles and screens.
3. **Fill** the spray tank and system with water.
4. **Spray** a measurable area in the field at a fixed speed and at the desired pressure. Spray at least 20 percent of the total tank volume and at least 2 acres of area.
5. **Measure** the volume of water (in gallons) needed to refill the tank.
6. **Determine** the area (in acres) that was test sprayed using the following formula: length of area sprayed (in feet) X boom width (in feet) ÷ 43,560 = acres sprayed.
7. **Divide** the volume sprayed by the area sprayed to obtain the actual output of the sprayer in gallons per acre.
8. **Make adjustments** to tractor speed, pressure or nozzle size, and repeat steps 3 to 7 to change the application rate.
9. **Calculate** the amount of formulated pesticide needed to treat the desired area.

Band application—The expense of herbicide application can be reduced by spraying bands over the crop rows rather than the whole field (broadcast application). When spraying in bands, adjust the amount of herbicide for the area actually sprayed, rather than the total acreage. The amount of chemical per gallon of carrier will remain the same. Use even spray nozzles (e.g., 8004E) rather than tapered spray nozzles (e.g., 8004) for band applications.

Key to abbreviations in this publication

a = acre
ae = acid equivalent
ai = active ingredient
AMS = ammonium sulfate
AS = aqueous suspension
COC = crop oil concentrate
DF = dry flowable
DG = dispersible granule
DS = dry soluble
E or **EC** = emulsifiable concentrate
ES = emulsifiable solution
F = flowable
gal = gallon/gallons
G = granule
lb = pound/pounds
L = liquid
ME = microencapsulated
NIS = non-ionic surfactant
OM = organic matter
oz = ounce/ounces
pt = pint/pints
PHI = preharvest interval
POST = postemergence
PPI = preplant incorporated
PRE = preemergence
PSI = pounds per square inch
qt = quart/quarts
RUP = restricted, use pesticide
SC = suspension concentrate
SL = soluble liquid
S or **SP** = soluble powder
UAN = urea ammonium nitrate, 28%
W or **WP** = wettable powder
WSG = water-soluble granule
yr = year

Table 1. Herbicide formulations, sources, toxicity, runoff and leaching potential, and REI.

Common Name	Trade Name[1] and Manufacturer, EPA Reg. No.	Formulations	Runoff/Leaching[2] Potential	LD_{50} mg/kg[3] Oral	Dermal	REI[4]
• acetachlor	HARNESS (Monsanto) 524-473	7E	3/2	1849	>5000	12 hrs
	SURPASS (Dow AgroSciences) 62719-367	6.4E	3/2	1426	>2240	12 hrs
acifluorfen	ULTRA BLAZER (United Phosphorus) 70506-60	2L	2/2	2020	>2000	48 hrs
• alachlor	MICRO-TECH (Monsanto) 524-344	4E	3/2	>5000	>2000	12 hrs
• atrazine	AATREX (Syngenta) 100-497	4L	2/1	972-5050	>3100	12 hrs
bensulide	PREFAR (Gowan) 10163-200	4E	1/2	960	>2000	12 hrs
bentazon	BASAGRAN (Arysta) 7969-45-66330	4SL	3/1	2063	>10000	48 hrs
bromacil	HYVAR X (DuPont) 352-287	80W	2/1	1300-2000	>2000	12 hrs
bromoxynil	MOXY (Winfield Solutions) 9779-346	2E	2/3	505	>2000	24 hrs
carfentrazone	AIM (FMC) 279-3241	2EC	3/3	4077	>4000	12 hrs
clethodim	SELECT MAX (Valent) 59639-132	0.97E	3/3	>5000	>5000	24 hrs
	CLETHODIM (Albaugh) 42750-72	2E	3/3	>5000	>5000	24hrs
clomazone	COMMAND (FMC) 279-3158	3ME	3/2	>1406	>2000	12 hrs
clopyralid	STINGER (Dow AgroSciences) 62719-73	3L	3/1	>5000	>5000	12 hrs
	SPUR (Albaugh) 42750-89	3L	3/1	>5000	>2000	12 hrs
cycloate	RO-NEET (Helm) 73637-5-74530	6E	3/2	3160	>4640	48 hrs
dicamba	BANVEL (Arysta) 66330-276	4L	3/1	2629	>2000	24 hrs
	CLARITY (BASF) 7969-137	4L	3/1	3512	>2000	24 hrs
dimethenamid-P	OUTLOOK (BASF) 7969-156	6E	3/2	695	>2000	12 hrs
diquat	REGLONE (Syngenta) 100-1061	2L	1/3	886	>5050	24 hrs
• diuron	KARMEX (Adama) 66222-51	80DF	2/2	1879	>5000	12 hrs
EPTC	EPTAM (Gowan) 10163-283	7E	3/3	1325	2750	12 hrs
ethalfluralin	CURBIT (Loveland) 34704-610	3E	1/3	3267	>5000	24 hrs
ethofumesate	NORTRON (Bayer CropScience) 264-613	4SC	3/2	>2100	>4100	12 hrs
fluazifop-P	FUSILADE DX (Syngenta) 100-1070	2E	2/3	>5000	>2000	12 hrs
flumioxazin	CHATEAU SW (Valent) 59639-119	51WDG	2/3	>5000	>2000	12 hrs
fluroxpyr	STARANE ULTRA (Dow AgroSciences) 62719-577	2.8L	2/3	>5000	>5000	24 hrs
fluthiacet-methyl	CADET (FMC) 279-3338	0.91EC	3/3	2537	>2020	12 hrs
fomesafen	REFLEX (Syngenta) 100-993	2E	2/1	>2000	>2000	24 hrs
foramsulfuron	OPTION (Bayer CropScience) 264-685	35WDG	3/2	2788-4157	>5000	12 hrs
fosamine	KRENITE (DuPont) 352-395	4L	3/3	>5000	>5000	12 hrs
glufosinate	RELY 280 (Bayer CropScience) 264-829	2.34L	3/3	300-2000	800-1400	12 hrs
	LIBERTY 280 (Bayer CropScience) 264-829	2.34L	3/3	300-2000	800-1400	12 hrs
glyphosate	ROUNDUP (Monsanto) 524-445	4L	1/3	>5000	>5000	12 hrs
halosulfuron	PERMIT (Gowan) 81880-2-10163	75WDG	3/2	1287	>5000	12 hrs
	SANDEA (Gowan) 10163-254	75WDG	3/2	1287	>5000	12 hrs
hexazinone	VELPAR (TKI) 352-392	90SP	2/1	4120	>5000	48 hrs
imazamox	RAPTOR (BASF) 241-379	1L	2/1	>5000	>4000	4 hrs
imazapyr	ARSENAL (BASF) 241-346	2AS	2/1	>5000	>2000	48 hrs
imazethapyr	PURSUIT (BASF) 241-310	2L	2/1	>5000	>5000	4 hrs
imazosulfuron	LEAGUE (Valent) 59639-166	75WDG	3/2	3129	>5000	12 hrs
linuron	LOROX (TKI) 61842-23	50DF	2/2	3489	>2000	1-8 days
MCPB	THISTROL (Nufarm) 71368-5	2L	3/1	4738	>2000	12-24 hrs

(continued on next page.)

[1] Trade names and formulations of herbicides are given for the convenience of the users. Other formulations of the same herbicides, or other herbicides with the same active ingredients also may be labeled for use on certain crops. The mention of trade names does not imply that they are endorsed or recommended over those of similar nature not listed.

[2] 1=high, 2=intermediate, 3=low. These leaching/runoff potential ratings are from the NRCS WIN-PST Pesticide Properties Database at **http://go.usa.gov/Kok**.

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

[4] REI=Restricted Entry Interval for the Worker Protection Standard.

• RESTRICTED USE PESTICIDES (RUP). All or certain formulations of these herbicides have been classified as RUP and are available only to certified applicators.

Table 1. Herbicide formulations, sources, toxicity, runoff and leaching potential, and REI *(cont)*.

Common Name	Trade Name[1] and Manufacturer, EPA Reg. No.	Formulations	Runoff/Leaching[2] Potential	LD_{50} mg/kg[3] Oral	LD_{50} mg/kg[3] Dermal	REI[4]
mesotrione	CALLISTO (Syngenta) 100-1131	4SC	3/1	>5000	>5000	12 hrs
s-metholachlor	DUAL MAGNUM (Syngenta) 100-816	7.62E	2/1	2149	>2020	24 hrs
metribuzin	TRICOR DF (United Phosphorus) 70506-103	75DF	3/1	2379-2794	>5000	12 hrs
napropamide	DEVRINOL DF-XT (United Phosphorus) 70506-36	50DF	2/2	>5000	>5000	24 hrs
nicosulfuron	ACCENT (DuPont) 352-560	75WDG	3/1	>5000	>2000	4 hrs
norflurazon	SOLICAM (TKI) 61842-41	80DF	2/2	1140	>2000	12 hrs
oryzalin	SURFLAN (United Phosphorus) 70506-43	4AS	3/3	12600	>10000	24 hrs
oxyfluorfen	GOAL XL (Dow AgroSciences) 62719-424	2E	2/3	3129	>5000	24-48 hrs
	GOALTENDER (Dow AgroSciences) 62719-447	4SC	2/3	>5000	>5000	24-48 hrs
• paraquat	GRAMOXONE SL (Syngenta) 100-1217	2L	1/3	310	>2000	12-24 hrs
	FIRESTORM (Chemtura) 82557-1-400	3L	1/3	100	299	24 hrs
pelargonic acid	SCYTHE (Gowan) 10163-325	4.2L	3/3	>5000	>2000	12 hrs
pendimethalin	PROWL (BASF) 241-337	3.3E	1/3	3956	>2000	24 hrs
	PROWL H2O (BASF) 241-418	3.8CS	1/3	>5000	>5000	24 hrs
• phenmedipham	SPIN-AID (Engage Agro) 264-616-87865	1.3E	2/3	4000	>2000	12 hrs
primisulfuron	BEACON (Syngenta) 100-705	75DG	3/1	>5050	>2010	12 hrs
prometryn	CAPAROL (Syngenta) 100-620	4L	2/2	>5000	>5000	12 hrs
• pronamide	KERB (Dow AgroSciences) 62719-578	3.3 SC	2/1	>5000	>5000	24 hrs
pyrazon	PYRAMIN (Arysta) 7969-81-66330	68DF	3/2	1160	>2000	12 hrs
pyroxasulfone	ZIDUA (BASF) 7969-338	85WDG	3/2	>2000	>2000	12 hrs
quinclorac	QUINSTAR (Albaugh) 42750-169	4L	2/1	>3500	>2000	12 hrs
quizalofop	ASSURE II (DuPont) 352-541	0.88E	1/2	5900	>2000	12 hrs
rimsulfuron	MATRIX (DuPont) 352-556	25SG	3/2	>5000	>2000	4 hrs
saflufenacil	SHARPEN (BASF) 7969-278	2.85L	3/2	>2000	>5000	12 hrs
sethoxydim	POAST (BASF) 7969-58	1.5E	3/3	4285-5000	>5000	12 hrs
sulfentrazone	SPARTAN (FMC) 279-3220	4F	2/1	2084	>2000	12 hrs
sulfometuron	OUST (DuPont) 352-601	75DG	3/2	>5000	>5000	4 hrs
tembotrione	LAUDIS (Bayer CropScience) 264-860	3.5SC	2/1	1750	>5000	12 hrs
terbacil	SINBAR (TKI) 61842-27	80WDG	2/1	500-2784	>5000	12 hrs
topramezone	IMPACT (AMVAC) 5481-524	2.8L	2/1	>2000	>2000	12 hrs
• triclopyr	GARLON (Dow AgroSciences) 62719-40	4L	2/2	1338	>2000	12 hrs
trifluralin	TREFLAN (Helena) 5905-532	4E	1/3	>3700	>5000	12 hrs
triflusulfuron	UPBEET (DuPont) 352-569	50DG	3/3	>5000	>2000	4 hrs
2,4-D	FORMULA 40 (Nufarm) 228-357	2.8L	3/1	866-1058	>2000	48 hrs
	WEEDAR 64 (Nufarm) 71368-1	3.8L	3/2	1030	>5000	48 hrs
2,4-D + triclopyr	CROSSBOW (Dow AgroSciences) 62719-260	3L	2/2	1000	>5000	—

[1] Trade names and formulations of herbicides are given for the convenience of the users. Other formulations of the same herbicides, or other herbicides with the same active ingredients also may be labeled for use on certain crops. The mention of trade names does not imply that they are endorsed or recommended over those of similar nature not listed.

[2] 1=high, 2=intermediate, 3=low. These leaching/runoff potential ratings are from the NRCS WIN-PST Pesticide Properties Database at **http://go.usa.gov/Kok**.

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

[4] REI=Restricted Entry Interval for the Worker Protection Standard.

• RESTRICTED USE PESTICIDES (RUP). All or certain formulations of these herbicides have been classified as RUP and are available only to certified applicators.

Table 2. Herbicide mode of action, solubility, and soil half-life.[1]

Trade Name	Common Name	Mode of Action	WSSA (HRAC) Group	Solubility in Water ((ppm)	Soil half life (days)
Aatrex	atrazine	Photosystem II inhibitor	5(C1)	33	60
Accent	nicosulfuron	ALS inhibitor	2(B)	1200	21
Aim	carfentrazone	PPO inhibitor	14(E)	12K	0
Arsenal	imazapyr	ALS inhibitor	2(B)	11272	142
Assure	quizalofop-P	ACCase inhibitor	1(A)	0.3	60
Basagran	bentazon	Photosystem II inhibitor	6(C3)	2300K	20
Beacon	primisulfuron	ALS inhibitor	2(B)	3.3	30
Cadet	fluthiacet-methyl	PPO inhibitor	14(E)	850	2
Callisto	mesotrione	Carotenoid syn inhib (HPPD)	27(F2)	2200	21
Caparol	prometryn	Photosystem II inhibitor	5(C1)	33	60
Chateau	flumioxazin	PPO Inhibitor	14(E)	2	20
Clarity	dicamba	Auxin disruptor	4(O)	4500	14
Command	clomazone	Chlorophyll synthesis inhib	13(F4)	1100	24
Curbit	ethalfluralin	Mitosis inhibitor	3(K1)	0.3	60
Devrinol	napropamide	Mitosis inhibitor	15(K3)	73	70
Dual Magnum	S-metolachlor	Mitosis inhibitor	15(K3)	488	70
Eptam	EPTC	Lipid Biosynthesis inhibitor	8(N)	370	6
Formula 40	2, 4-D	Auxin disruption	4(O)	900	10
Fusilade	fluazifop-P	ACCase inhibitor	1(A)	1.1	15
Garlon	triclopyr	Auxin synthesis disruptor	4(O)	430	30
Goal Tender	oxyfluorfen	PPO inhibitor	14(E)	0.1	35
Gramoxone	paraquat	PS I inhibitor	22(D)	620K	1000
Impact	topramezone	Chlorophl syn. Inhib (HPPD)	27(F2)	0.69	14
Karmex	diuron	PS II inhibitor	7(C2)	42	90
Kerb	pronamide	Mitosis inhibitor	3(K1)	15	60
Laudis	tembotrione	Chlorophyll syn Inhib (HPPD)	27(F2)	28	32
League	imazosulfuron	ALS inhibitor	2(B)	308	70
Liberty	glufosinate	Glutamine inhibitor	10(H)	1370K	7
Lorox	linuron	Photosystem II inhibitor	7(C2)	75	60
Matrix	rimsulfuron	ALS inhibitor	2(B)	7300	3
Micro Tech	alachlor	Mitosis inhibitor	15(K3)	200	21
Moxy	bromoxynil	Photosystem II inhibitor	6(C3)	130	7
Nortron	ethofumesate	Lipid synthesis inhibitor	8(N)	110	30
Option	foramsulfuron	ALS inhibitor	2(B)	3293	18
Outlook	dimethenamid-p	Mitosis inhibitor	15(K3)	1174	20
Poast	sethoxydim	ACCase inhibitor	1(A)	4400	7
Prefar	bensulide	Mitosis inhibitor	8(N)	6	120
Princep	simazine	PS II inhibitor	5(C1)	2	60
Prowl H2O	pendimethalin	Mitosis inhibitor	3(K1)	0.3	44
Pursuit	imazethapyr	ALS inhibitor	2(B)	1400	90
QuinStar	quinclorac	Auxin disruptor	4(O)	62	n/a
Raptor	imazamox	ALS inhibitor	2(B)	n/a	30
Reflex	fomesafen	PPO inhibitor	14(E)	600K	100
Reglone	diquat	Photosystem I inhibitor	22(D)	718K	1000
Rely	glufosinate	Glutamine inhibitor	10(H)	1370K	7
Ro-Neet	cycloate	Lipid synthesis inhibitor	8(N)	85	30
Roundup	glyphosate	EPSP syntheses inhibitor	9(G)	15K	47

(continued on next page.)

[1] Mode of action, solubility, and soil half-life from Shaner, D.L. 2014. Herbicide handbook (Tenth edition). Weed Science Society of America, Lawrence, KS.

Table 2. Herbicide mode of action, solubility, and soil half-life[1] *(cont)*.

Trade Name	Common Name	Mode of Action	WSSA (HRAC) Group	Solubility in Water ((ppm)	Soil half life (days)
Sandea	halosulfuron	ALS inhibitor	2(B)	15	30
Scythe	pelargonic acid	Nucleic Acid inhibitor	26(Z)	10	n/a
Select	clethodim	ACCase inhibitor	1(A)	NA	3
Sharpen	saflufenacil	PPO inhibitor	14(E)	0.2	32
Sinbar	terbacil	PS II inhibitor	5(C1)	710	120
Solicam	norflurazon	Pigment synth. inhibitor	12(F1)	28	45
Spartan	sulfentrazone	PPO inhibitor	14(E)	780	120
Spin-Aid	phenmedipham	Photosystem II inhibitor	5(C1)	10	25
StaraneUltra	fluroxypyr	Auxin disruption	4(O)	4000	36
Stinger	clopyralid	Auxin disruption	4(O)	1000	40
Surflan	oryzalin	Mitosis inhibitor	3(K1)	3	20
Surpass	acetachlor	Mitosis inhibitor	15(K3)	223	50
Thistrol	MCPB	Auxin disruption	4(O)	200K	14
Touchdown	glyphosate	EPSP synth. inhibitor	9(G)	15.7K	47
Treevix	saflufenacil	PPO inhibitor	14(E)	2100	17
Treflan	trifluralin	Mitosis inhibitor	3(K1)	0.3	45
TriCor DF	metribuzin	Photosystem II inhibitor	5(C1)	1100	30
Ultra Blazer	acifluorfen	PPO inhibitor	14(E)	120	37
Velpar	hexazinone	PS II inhibitor	5(C1)	33K	90
Venue	pyraflufen	PPO inhibitor	14(E)	<1	7
Zidua	pyroxasulfone	Mitosis inhibitor	15(K3)	4	60

[1] Mode of action, solubility, and soil half-life from Shaner, D.L. 2014. Herbicide handbook (Tenth edition). Weed Science Society of America, Lawrence, KS.

Table 3. Effectiveness of preemergence herbicides on weeds.

	Annual Grasses						Annual Broadleaves												Perennial Weeds							
HERBICIDE[1] (TRADE NAMES)	**Annual Bluegrass**	**Barnyardgrass**	**Crabgrass, large**	**Fall Panicum**	**Foxtails (green, giant, yellow)**	**Sandbur (field, longspine)**	**Common Chickweed**	**Common Lambsquarters**	**Common Groundsel**	**Common Purslane**	**Common Ragweed**	**Galinsoga**	**Horseweed (Marestail)**	**Mustards, Wild Radish**	**Nightshades**	**Spotted Spurge**	**Pigweeds, Amaranth**	**Smartweeds, Ladysthumb**	**Velvetleaf**	**Canada Thistle**	**Carrot, Wild**	**Dandelion**	**Field Bindweed**	**Horsenettle**	**Quackgrass**	**Vetches**	**Yellow Nutsedge**
AATREX	F	**G**	F	P	**G**	N	**G**	**E**	N	**E**	**E**	**G**	**E**	**E**	**E**	**G**	**E**	**E**	F	N	N	N	N	N	**G**	N	F
CALLISTO	N	N	**G**	N	N	N	**G**	**G**	N	N	**G**	**G**	N	P	**G**	P	**G**	**G**	**G**	N	F	N	N	F	N	N	N
CAPAROL	N	F	**G**	F	F	**G**	**G**	**E**	N	**G**	**G**	F	F	**G**	**G**	**G**	**E**	F	F	N	N	N	N	N	P	N	P
CHATEAU	**G**	**G**	**G**	**G**	**G**	N	**G**	**E**	**G**	**G**	F	**G**	F	**E**	**E**	**E**	**E**	F	**G**	N	N	**G**	**G**	N	N	N	N
COMMAND	N	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**E**	**G**	**G**	P	F	P	F	P	F	**E**	N	N	N	N	N	P	N	P
CURBIT	N	**E**	**E**	**E**	**E**	N	N	**G**	N	**G**	P	P	N	F	F	P	**G**	**G**	P	N	N	N	N	N	P	N	P
DEVRINOL XT	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	**G**	**G**	P	P	N	P	P	P	**G**	P	P	N	N	N	N	N	P	N	P
DUAL MAGNUM	**G**	**E**	**E**	**E**	**E**	F	N	F	N	F	P	**G**	N	P	**G**	**G**	**G**	F	P	N	N	N	N	N	P	N	**G**
EPTAM	**G**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	N	P	F	F	P	F	F	P	**G**	F	F	N	N	N	N	N	**G**	N	**G**
GOAL	**G**	P	F	P	F	**G**	**G**	**G**	**E**	**E**	**G**	**G**	**G**	**G**	**G**	F	**E**	**G**	**G**	N	N	N	N	N	P	N	P
HARNESS/SURPASS	N	**E**	**E**	**E**	**E**	**G**	N	**G**	N	**G**	F	F	P	P	**G**	F	**G**	F	P	N	N	N	N	N	N	N	F
KARMEX	**G**	**E**	F	F	**E**	**G**	**G**	**E**	N	**E**	**E**	**G**	F	**G**	**G**	F	**E**	**E**	F	N	N	N	N	F	P	N	P
KERB	**G**	F	F	P	F	N	**G**	F	N	**G**	F	P	N	P	P	F	P	F	P	N	N	N	N	N	**G**	N	P
LASSO	N	**E**	**E**	**E**	**E**	N	**G**	F	F	**G**	F	**G**	N	P	**G**	**G**	**E**	F	P	N	N	N	N	N	P	N	F
LOROX	N	**G**	F	F	**E**	N	**G**	**E**	F	**G**	F	**G**	P	**G**	**G**	**G**	**G**	**G**	F	N	N	N	N	N	P	N	P
MATRIX	F	**G**	F	F	**G**	N	F	F	F	**G**	F	F	N	**G**	P	F	**G**	F	P	**G**	N	**G**	N	N	P	N	F
NORTRON	F	P	F	P	F	N	F	F	**G**	F	P	P	N	**G**	F	F	F	**G**	P	N	N	N	N	N	N	**G**	F
OUTLOOK	**G**	**E**	**E**	**E**	**E**	**G**	N	P	N	**G**	P	**G**	N	F	**G**	**G**	**G**	F	N	N	N	N	N	N	N	N	**G**
PREFAR	N	**E**	**E**	**E**	**E**	N	N	F	N	F	P	P	N	P	P	P	**G**	P	P	N	N	N	N	N	P	N	P
PROWL H2O	**G**	**E**	**E**	**E**	**E**	**G**	**G**	**G**	N	F	P	F	P	P	P	**G**	**G**	F	F	N	N	N	N	N	P	N	P
PURSUIT	P	F	F	F	**G**	P	**G**	**G**	**G**	**E**	**G**	**G**	F	**E**	**E**	**G**	**E**	**G**	**G**	P	P	F	N	N	N	P	P
REFLEX	N	P	P	P	P	N	N	**G**	N	**E**	**G**	**G**	P	**E**	**G**	F	**E**	F	P	N	N	N	F	**G**	N	N	N
RONEET	**G**	**E**	**E**	F	**E**	N	N	F	N	F	F	F	N	P	P	P	**G**	P	F	N	N	N	N	N	P	N	F
SANDEA	N	P	P	P	P	N	N	**G**	**G**	F	**G**	**G**	F	**G**	P	F	**E**	**G**	**G**	N	N	N	N	N	P	N	**G**
SHARPEN							**G**	**G**		**G**		**G**	**G**	**G**	**G**		**G**	**G**	**G**								
SINBAR	**G**	**G**	**G**	**G**	**G**	**G**	F	**E**	F	**G**	**G**	**G**	**E**	**E**	**G**	F	F	**G**	**G**	N	N	**G**	N	N	F	N	P
SOLICAM	**G**	**E**	**E**	**E**	**E**	F	**G**	F	F	F	**G**	**G**	N	**E**	F	**G**	F	**G**	F	N	N	N	N	N	F	N	F
SPARTAN	N	F	**G**	**G**	**G**	N	**G**	**G**	**G**	**G**	F	**G**	N	F	**G**	**G**	**E**	**G**	**G**	N	N	**G**	F	N	P	N	F
SURFLAN	**G**	**E**	**E**	**E**	**E**	**G**	**G**	**G**	**G**	**G**	F	F	N	F	F	F	**G**	F	P	**G**	N	N	N	N	P	N	P
TREFLAN	**G**	**E**	**E**	**E**	**E**	**G**	**G**	F	N	F	P	P	N	P	P	P	**G**	P	P	N	N	N	P	N	P	N	P
TRICOR	**G**	**G**	F	**G**	**G**	F	**G**	**E**	N	**E**	**E**	**E**	F	**E**	P	**G**	**G**	**E**	**G**	N	N	N	N	N	P	N	P
ULTRA BLAZER	N	P	P	F	F	N	N	P	N	**G**	**G**	F	P	**G**	**G**	P	**G**	F	N	N	N	N	F	N	N	N	N
ZIDUA	**G**	**G**	**G**	**G**	**G**	**G**	**G**	F	**G**	**G**	P	P	P	F	**G**	**G**	**G**	**G**	P	N	N	N	N	N	N	N	P

E = Excellent, **G** = Good, F = Fair, P = Poor, N = None. Weed control will vary with soil type and weather.

[1] Herbicides with different trade names but the same active ingredient will perform similarly to product listed.

Table 4. Effectiveness of postemergence herbicides on weeds.

HERBICIDE[1] (TRADE NAMES)	Annual Grasses						Annual Broadleaves												Perennial Weeds							
	Annual Bluegrass	Barnyardgrass	Crabgrass	Fall Panicum	Foxtails (green, giant, yellow)	Sandbur (field, longspine)	Common Chickweed	Common Lambsquarters	Common Groundsel	Common Purslane	Common Ragweed	Galinsoga	Horseweed (Marestail)	Mustards, Wild Radish	Nightshades	Spotted Spurge	Pigweeds, Amaranth	Smartweeds, Ladysthumb	Velvetleaf	Canada Thistle	Carrot, Wild	Dandelion	Field Bindweed	Horsenettle	Quackgrass	Vetches	Yellow Nutsedge
ACCENT	N	**E**	P	**E**	**E**	**G**	N	F	N	N	P	N	P	N	P	N	**E**	**G**	F	**G**	N	**G**	N	N	**G**	N	F
AIM	N	N	N	N	N	N	P	**G**	F	N	F	P	N	P	**G**	F	**G**	F	**G**	N	N	F	P	N	N	N	N
ASSURE	N	F	F	**G**	**G**	**G**	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	F	N	N
AATREX	**G**	**G**	**G**	F	**G**	N	**G**	**E**	N	**E**	**E**	**G**	P	**E**	**G**	**G**	**E**	**E**	**G**	N	F	N	N	N	F	N	P
BANVEL/CLARITY	N	P	P	P	P	N	**G**	**G**	**G**	**G**	**G**	**G**	**E**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	F	P	**G**	P
BASAGRAN	N	P	P	P	P	N	N	**G**	**G**	**G**	**G**	**G**	P	**G**	F	P	P	**E**	**G**	**G**	N	N	**G**	N	P	N	**G**
BEACON	N	P	P	**G**	F	**G**	N	F	N	N	**E**	N	F	F	**G**	N	**E**	**G**	**G**	**G**	N	N	N	F	**G**	N	F
CADET	N	N	N	N	N	N	**G**	**G**	**G**	N	N	N	N	N	**G**	N	**G**	N	**G**	N	N	**G**	N	N	N	N	N
CALLISTO	N	N	**G**	N	N	N	**G**	**G**	N	N	P	**G**	**G**	**G**	**G**	P	**G**	**G**	**G**	**G**	**G**	**G**	N	F	N	N	N
CAPAROL	N	F	F	F	F	**G**	N	**E**	**G**	**G**	**E**	**G**	P	**G**	**G**	**G**	**E**	F	F	N	N	N	N	N	P	N	P
CHATEAU	P	N	N	N	N	N	**G**	**E**	**G**	**E**	**G**	**G**	N	**E**	**E**	**G**	**E**	**G**	**G**	N	N	**G**	**G**	N	N	N	P
2,4-D	N	N	N	N	N	N	**G**	**E**	N	P	**E**	**G**	**E**	**G**	**E**	**E**	**E**	F	F	F	**G**	**G**	N	**G**	P	**G**	P
DISTINCT	N	P	P	P	P	N	N	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	N	P	N	P
FUSILADE	N	**G**	**G**	**G**	**G**	**G**	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	**G**	N	N
GOALTENDER	N	P	P	P	P	N	F	F	**G**	**E**	**G**	F	**G**	F	**G**	P	**E**	F	**G**	N	N	N	N	N	P	N	P
GRAMOXONE	F	**E**	**E**	**E**	**E**	P	**G**	**E**	**G**	**E**	**E**	**G**	**G**	**E**	**E**	**G**	**E**	**E**	**G**	**G**	N	**G**	**G**	N	**G**[2]	P	**G**[2]
IMPACT	N	**G**	**G**	F	F	N	**G**	**G**	N	P	**G**	F	**G**	**G**	**G**	**G**	**G**	F	**G**	**G**	N	**G**	N	N	N	N	N
LAUDIS	N	**G**	**G**	P	**G**	**G**	**G**	**G**	N	P	**G**	**G**	F	**G**	**G**	P	**G**	**G**	**G**	F	N	F	N	N	N	N	N
LOROX	N	F	F	F	**G**	N	**G**	**E**	**G**	**G**	**E**	**G**	P	**G**	**G**	**G**	**E**	**E**	F	N	N	N	N	N	P	N	P
MATRIX	**G**	**G**	**G**	**G**	**G**	N	**G**	F	F	F	F	F	P	**G**	P	**G**	**G**	F	F	**G**	N	**G**	N	N	F	N	F
MOXY	N	N	N	N	N	N	F	**E**	**G**	P	**G**	**G**	P	**G**	**G**	F	F	**G**	**G**	F	N	F	F	N	P	N	P
NORTRON	F	P	P	P	F	N	F	F	**G**	F	P	P	N	**G**	**G**	F	P	**G**	P	N	N	N	N	N	N	**G**	F
OPTION	**G**	**G**	**F**	**G**	**G**	**G**	N	**G**	N	P	**G**	F	P	**G**	**G**	P	**G**	P	**G**	N	N	N	N	N	**G**	N	N
POAST	N	**G**	**G**	**G**	**G**	**G**	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	F	N	N
PURSUIT	P	F	**G**	N	**G**	P	F	F	P	P	**G**	P	F	**E**	**E**	F	**E**	**G**	F	P	F	P	N	N	N	P	P
QUINSTAR		**G**	**G**		**G**			F			F								F	F		F	**G**		**G**	
RAPTOR	F	**G**	F	**G**	**G**	P	F	**G**	F	F	F	F	P	**G**	**G**	**G**	**G**	**E**	**G**	P	P	P	P	P	F	F	F
REFLEX	N	P	P	P	P	N	N	P	N	**E**	**G**	**G**	P	**E**	**G**	F	**E**	F	P	N	N	N	F	P	N	N	N
ROUNDUP	**G**	**E**	**E**	**E**	**E**	**G**	**G**	**E**	**G**	**E**	**E**	**E**	F	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	**G**	P	**G**	**E**	N	F
SANDEA	N	P	P	P	P	N	N	P	N	P	**G**	**G**	N	**G**	P	**G**	**E**	**G**	**G**	**G**	N	N	**G**	F	P	N	**G**
SELECT	**G**	**G**	**G**	**G**	**G**	**G**	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	F	N	N
SINBAR	**G**	F	P	F	P	**G**	**G**	**E**	F	**E**	**G**	**G**	**G**	**E**	**G**	**G**	F	**G**	F	N	N	F	N	F	P	F	P
SPARTAN	N	P	P	F	F	N	N	**G**	N	F	F	F	N	P	**G**	F	**E**	**G**	**G**	N	N	**G**	N	N	P	N	F
SPINAID	N	P	P	P	P	N	**G**	**G**	N	**G**	**G**	**G**	P	**G**	F	F	P	**G**	P	N	N	N	N	N	P	N	P
STARANE	N	N	N	N	N	N	**G**	**G**	N	F	**G**	F	**G**	F	F	N	P	F	**G**	N	N	N	F	N	N	N	N
STINGER	N	N	N	N	N	N	N	P	**G**	P	**G**	**G**	**E**	P	F	P	P	F	P	F	N	**G**	N	N	N	**G**	N

Table 4. Effectiveness of postemergence herbicides on weeds *(cont)*.

	Annual Grasses						Annual Broadleaves												Perennial Weeds							
HERBICIDE[1] (TRADE NAMES)	**Annual Bluegrass**	**Barnyardgrass**	**Crabgrass**	**Fall Panicum**	**Foxtails (green, giant, yellow)**	**Sandbur (field, longspine)**	**Common Chickweed**	**Common Lambsquarters**	**Common Groundsel**	**Common Purslane**	**Common Ragweed**	**Galinsoga**	**Horseweed (Marestail)**	**Mustards, Wild Radish**	**Nightshades**	**Spotted Spurge**	**Pigweeds, Amaranth**	**Smartweeds, Ladysthumb**	**Velvetleaf**	**Canada Thistle**	**Carrot, Wild**	**Dandelion**	**Field Bindweed**	**Horsenettle**	**Quackgrass**	**Vetches**	**Yellow Nutsedge**
TRICOR	**G**	F	F	F	**G**	F	**G**	**E**	N	**E**	**E**	**E**	F	**E**	P	**G**	**G**	**E**	**G**	N	N	N	N	N	P	N	P
UPBEET	N	P	P	P	N	N	P	P	N	P	F	F	P	**G**	F	P	F	F	**G**	N	N	N	N	N	N	N	P

E = Excellent, **G** = Good, F = Fair, P = Poor, N = None. Weed control will vary with soil type and weather.

[1] Herbicides with different trade names but the same active ingredient will perform similarly to product listed.

[2] Kills top growth only.