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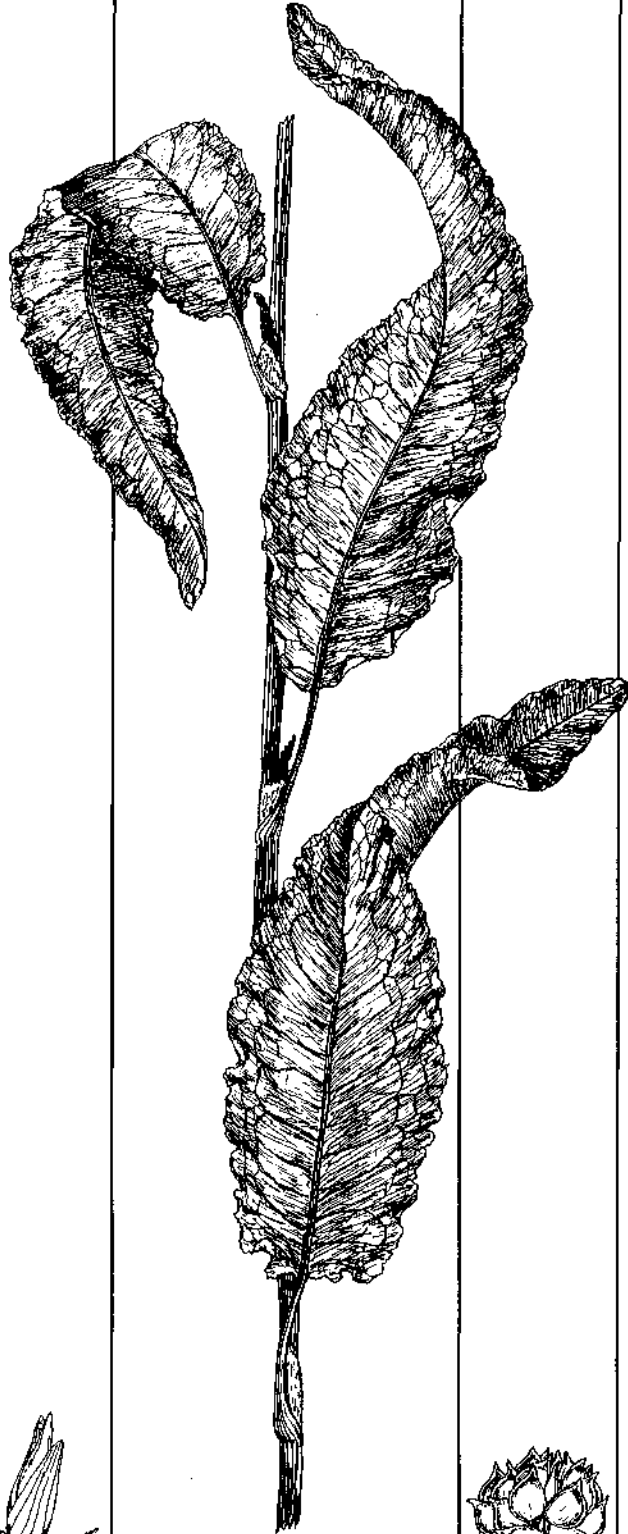
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Systemic Herbicides for Weed Control

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glyphosate



AD-BU-2281



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On February 28, 1979, the Environmental Protection Agency (EPA) announced emergency suspension of uses of 2,4,5-T products on forests, rights-of-way, and pastures. EPA also announced suspension of silvex products registered uses for forestry, rights-of-way, pasture, home, aquatic, and recreation areas. Cancellation proceedings were initiated at the same time. Decisions on use of these products will not be known until final actions have been taken. During the interim period, these uses are illegal.

Systemic Herbicides for Weed Control

Phenoxy herbicides, dicamba, picloram, amitrole, and glyphosate

Dayton L. Klingman, R. W. Bovey,
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The phenoxy herbicides (including 2,4-D, dichlorprop, 2,4,5-T, silvex, mecoprop, MCPA, and 2,4-DB) and some other systemics (dicamba, picloram, amitrole, and glyphosate) have been extremely helpful in controlling weeds. Systemic herbicides are translocated throughout the plant to their sites of physiological action. They are used to control weeds in many sites, including croplands, grazing lands, forests, lawns, rights-of-way, aquatic areas, and some other noncropland areas. Table 1 lists common, chemical, and trade names of the herbicides named above. Labels on each herbicide container show the specific registered uses. Follow all label directions for best results and to ensure safety. Some general uses are discussed in this bulletin. Table 2, which appears at the end of the text, lists common weed species and their responses to these herbicides.

The Herbicides

Phenoxy Herbicides

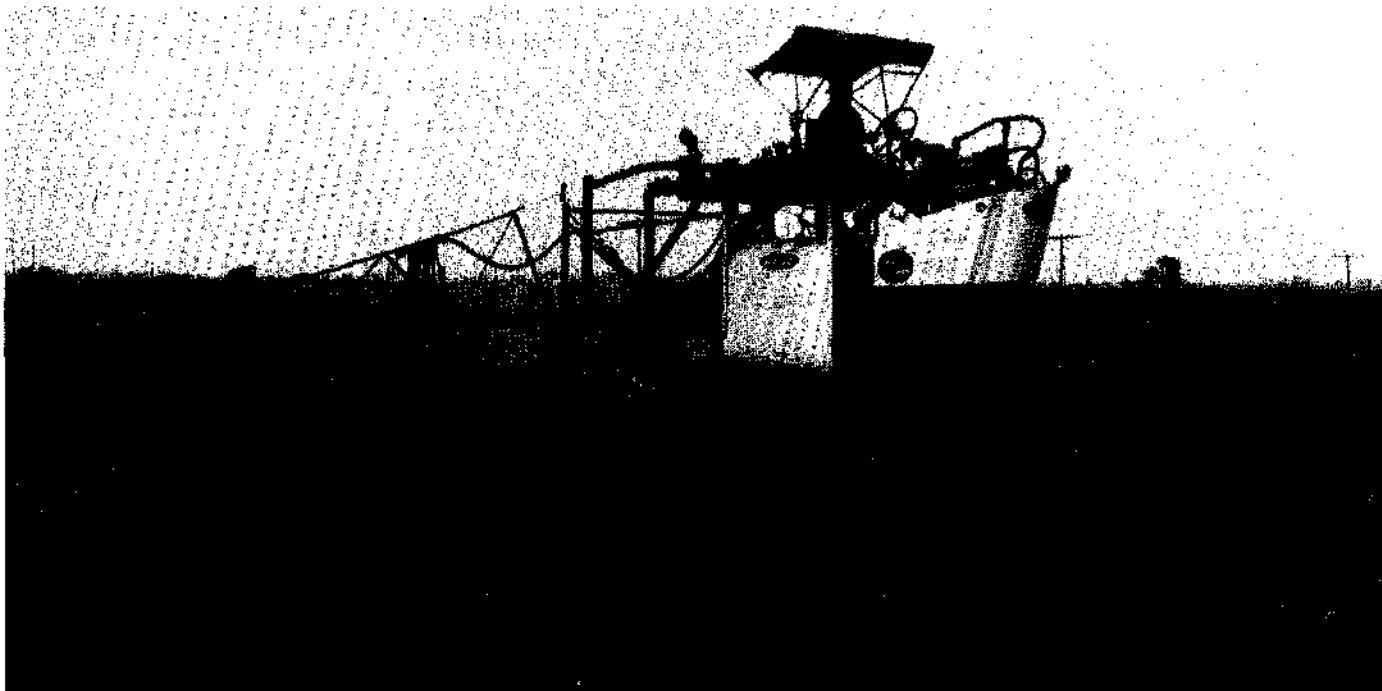
Phenoxy herbicides are registered for many uses and are especially helpful because:

- They are selective; they can kill many broadleaf plants without significant harm to established grasses or grain crops. They also can be used to control undesirable brush and trees without significant harm to certain desirable woody plants such as some conifers.
- They are effective and efficient; many species of weeds are controlled by less than 1 pound of herbicide per acre.

Table 1. Common, chemical, and the trade names of phenoxy and other systemic herbicides

Common name	Chemical name	Trade names ¹
<i>PHENOXY HERBICIDES</i>		
2,4-D	(2,4-dichlorophenoxy)acetic acid	Numerous
2,4-DB	4-(2,4-dichlorophenoxy)butyric acid	Numerous
dichlorprop (2,4-DP)	2-(2,4-dichlorophenoxy)propionic acid	Numerous
MCPA	[(4-chloro- <i>o</i> -tolyl)oxy]acetic acid	Numerous
mecoprop (MCP)	2-[(4-chloro- <i>o</i> -tolyl)oxy]propionic acid	Numerous
silvex (2,4,5-TP)	2-(2,4,5-trichlorophenoxy)propionic acid	Numerous
2,4,5-T	(2,4,5-trichlorophenoxy)acetic acid	Numerous
<i>OTHER SYSTEMIC HERBICIDES</i>		
amitrole	3-amino- <i>s</i> -triazole	amino triazole amitrol-T, amizol, cytrol, Weedazol
dicamba	3,6-dichloro- <i>o</i> -anisic acid	Banvel
glyphosate	<i>N</i> -(phosphonomethyl)glycine	Kleenup, Roundup
picloram	4-amino-3,5,6-trichloropicolinic acid	Amdon, Tordon

¹Mention of a trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture or an endorsement by the department over other products not mentioned.



The phenoxy herbicide 2,4-D has been effective for selectively controlling broadleaf weeds in corn. Sometimes 2,4-D and dicamba are applied together in a mixture that controls a broader spectrum of weed species.

- They are easy to use.
- They are not highly toxic to man, domestic animals, or wildlife when properly applied at recommended rates and as directed on the container label
- They do not accumulate in the soil from one year to the next and they have no harmful effects on soil organisms.
- They are not corrosive to spray equipment.

How Plants React to Phenoxy Herbicides

Phenoxy herbicides are absorbed by the leaves and other above ground parts of the plant. Roots can absorb these herbicides if the herbicide is sprayed on the soil, but the phenoxy herbicides are not very effective when applied to the soil. When applied to growing plants, phenoxy herbicides rapidly translocate or move into the leaves, stems, and roots of plants and cause susceptible plants to die.

These herbicides are absorbed most readily by plants that are actively growing. Annual weeds are easiest to kill when they are young; many perennial weeds are easiest to kill while they are seedlings. After perennials are established, it is often best to spray at the time flower buds appear. This is the time when food materials from the tops of the plants are actively moving to the roots and there is good opportunity for the herbicide to do likewise and be more effective in killing the weed plants.

The most susceptible broadleaf weeds are killed by small amounts of phenoxy herbicides. The most resistant species may be almost unaffected by even large amounts.

Table 2 (see pages 9-16) indicates the susceptibility of many common weeds to the phenoxy herbicides 2,4-D, MCPA, 2,4,5-T¹, silvex¹, mecoprop, and 2,4-DB. Responses to other systemic herbicides also are included.

Phenoxy Herbicide Formulations

Phenoxy herbicides usually are formulated for use as amine salts or esters. Amine salt formulations are water soluble; when added to water they form clear solutions. The various phenoxy herbicide esters are formulated as emulsifiable concentrates. These concentrates form solutions when mixed with oil; they form milk-white emulsions when mixed with water.

Amine salt formulations have little volatility and present less risk of injury to nearby susceptible plants than do ester formulations. Amine formulations usually are preferred for controlling weeds in lawns or in agricultural areas where a variety of crops are grown. Still another formulation is the lithium salt, which is a dry material that is mixed with water for spraying. It also is considered relatively safe compared to esters.

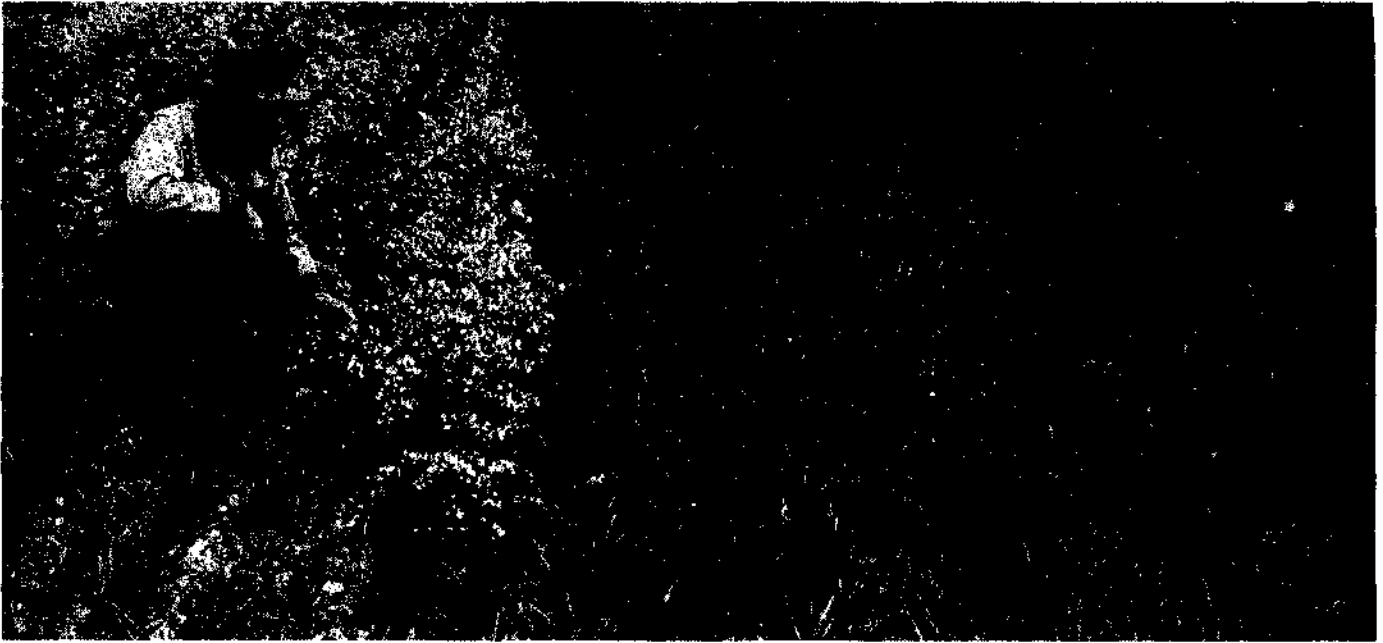
Vapors from ester formulations can kill susceptible plants growing near the area where they are used. High temperatures increase the risk from vapors. Low-volatile esters vaporize more slowly than high-volatile esters but also can present a risk, especially at temperatures above 90° F.

High-volatile esters are more likely to cause injury to susceptible plants in adjoining areas and probably should **not** be used in most situations. Low-volatile esters usually should be selected when ester formulations are needed.

Ester formulations of phenoxy herbicides generally are more effective, pound for pound, than amine salt formulations. The esters penetrate leaves and other plant surfaces more readily than amines. When a range of rates is recommended for herbicide application, use the lower rate for esters and the higher rate for amines.

Esters are more effective than amines for killing weeds that are growing slowly because of dry weather, and they usually are best for treating weeds in areas of low humidity. Since they are formulated in oils, esters remain in a moist condition on foliage

¹See limitation on use of 2,4,5-T and silvex on inside cover.



Weeds in this field of small grain (treated part at right) were controlled with 2,4-D. The herbicide costs less than \$1 per acre.

Types of Phenoxy Herbicides Commonly Available

Salts, such as:

Amine (triethanolamine, diethanolamine, trimethylamine, diethylamine, dimethylamine, isopropanolamine, and *N*-oleyl-1,3-propylenediamine)

Lithium

Low-volatile esters, such as:

Butoxyethanol Isooctyl, 2-ethyl hexyl
 Butoxyethoxypropanol Propylene glycol butyl ether
 Ethoxyethoxypropanol

High-volatile esters, such as:

Ethyl
 Isopropyl
 Butyl
 Amyl

longer and penetrate the waxy cuticle of leaves better than amines. Because they are oily, esters are less likely than salts to be washed off foliage if rain falls soon after they are applied.

Other Systemics

Dicamba

Dicamba is used either as a soil treatment or as a foliage spray for control of broadleaf weeds. It is more effective than phenoxy herbicides for controlling some weed species such as smartweed. The registered uses include: small grains, corn, sorghum, perennial seed grasses, turf, grass pastures, grazing land, and noncropland. Soybeans, many small-seeded legumes, and other broadleaf crops are sensitive to dicamba. Broadleaf plants in gardens and many broadleaf ornamentals also are quite

sensitive to it. Injury to desirable broadleaf plants can occur from small amounts of dicamba residue in soil or from a small amount of drift.

The nature of dicamba action in killing plants is similar to that of the phenoxy herbicides. It is absorbed by leaves and roots of plants and is translocated. It inhibits development of buds, causes stem swelling, and eventually kills all plant tissues.

Dicamba is relatively mobile in soil. It persists in soil much longer than 2,4-D. Persistence is longest under cool and dry or very moist conditions. Like 2,4-D, dicamba is broken down by soil microorganisms, so it usually does not cause problems in subsequent crops when it is applied at relatively low rates.



Although corn generally has good tolerance to 2,4-D, it may sometimes be injured. Certain genetic lines are more sensitive than others. Applying excessive amounts and spraying under very hot, humid conditions may increase risk of injury. One injury symptom of 2,4-D is the fasciation or fusion of brace roots as shown. Other symptoms are "onion-leaving" or plants may become brittle and under windy conditions corn may break off or lean.



Dicamba that has moved by spray drift to nearby soybeans may cause cupping and crinkling of leaves.

Dicamba has moderate to low **toxicological hazard** to animals, fish, and birds when it is used according to directions. It is somewhat less toxic than the phenoxy herbicides.

Dicamba usually is formulated as an amine or sodium salt and is sold as a liquid concentrate or as a low concentration granule. It often is used in mixtures with phenoxy herbicides and some other herbicides.

Dicamba should be applied only where the fine spray droplets will not drift to nearby sensitive crops such as beans, flowers, fruit trees, grapes, ornamentals, peas, potatoes, soybeans, sunflowers, tobacco, tomatoes, and other broadleaf crops. Vapors also may injure sensitive plants in areas near those treated. Precautions are necessary to prevent contamination of irrigation water or water used for domestic purposes. Do not apply on or near desirable trees or shrubs or in locations where the material may be washed or otherwise moved into contact with their roots. Follow all directions on container labels.

Picloram

Picloram is extremely active in killing broadleaf plants and is used for controlling many brush and woody plant species and annual and perennial broadleaf weeds. Most grasses are resistant if well established. **Bromegrass** may be injured somewhat. Controlling broadleaf weeds in most grass crops is feasible. Most broadleaf crops also are sensitive.

Formulations of picloram include the potassium salt of picloram as a liquid concentrate or as pellets. The amine salt of picloram is sold in mixtures with the amine salt of 2,4-D. Picloram also is sold in mixtures with 2,4,5-T. Usually, a higher rate of treatment is required when picloram is applied to the soil to kill plants than is required for foliage sprays.

Picloram is readily absorbed by both foliage and roots. It is extremely mobile in plants and is translocated, particularly to new growth. Symptoms include cupping and stunting of leaves, bending and splitting of the stems, and deterioration of the roots. Picloram is particularly effective in suppressing bud development. Although certain plant species, such as mustards, spurges, and kochia, are resistant to picloram, others are killed by minute quantities. On many susceptible plants, picloram may be considerably more effective than 2,4-D.

Picloram will remain in soil for a relatively long time compared to 2,4-D. The rate of its disappearance from surface soils is more rapid under high rainfall or high temperature conditions and in coarse-textured soils. When used at rates required to kill perennial weeds in cool, dry areas, picloram residue in soils may injure sensitive crops for more than a year. This persistence of picloram residue in the soil is utilized in some programs to control reinfestations from seedlings of certain weeds. Breakdown of picloram occurs in sunlight. Breakdown is enhanced by sunlight in clear moving water and on soil and plant surfaces.

Picloram has a relatively low order of toxicity to fish, wildlife, and other animals.

Picloram is a restricted use product. It is limited for retail sale to and for use only by certified applicators or persons under their direct supervision. Take special note of restrictions on the container label. Because of the activity of picloram on some plants, even at extremely low concentrations, drift of sprays to nontarget crops can cause great loss and should be avoided. Special care should be taken to avoid contamination of irrigation water. Picloram also may move from the treated area with surface runoff water to affect sensitive plants along drainage ways and downslopes. Consider this possibility when deciding whether to use picloram.

Amitrole

Amitrole is used to control poison ivy and to control other perennial broadleaf weeds and grasses in noncropland areas. It is used as a foliage spray on weeds.

Amitrole is absorbed slowly through the leaves and is readily translocated. It inhibits chlorophyll formation and regrowth from buds. New leaves that appear after a plant has been treated may be bone white.

Amitrole is broken down in moist, warm soil within 2 to 3 weeks. It often is applied in combination with a more soil-persistent herbicide (one that has a long residual effect in soil) for general weed control in noncrop areas or as a directed spray in ornamental nurseries. Small amounts of drift of amitrole to desirable plants may cause white-leaf symptoms (chlorosis) but usually will not kill the plants. For instance, poison ivy growing on tree trunks or under shrubs often can be safely treated if the spray is kept off the leaves of trees or shrubs.

Amitrole has very low acute oral toxicity and is not toxic to fish, birds, wildlife, or other animals. Two-year lifetime feeding trials with rats have shown that it is a weak goitrogen. (When ingested by animals, a goitrogen may cause enlargement of the thyroid gland.) Amitrole often is used in a mixture with ammonium thiocyanate. The mixture is known as amitrol-T. Ammonium thiocyanate is moderately toxic. Amitrole usually is formulated as a soluble powder, whereas amitrol-T is formulated as a liquid.

Glyphosate

Glyphosate is a broad spectrum herbicide. It is relatively nonselective and controls deep-rooted perennial weeds as well as annual and biennial species. It is effective on grasses, sedges, and broadleaf weeds. To avoid crop damage, glyphosate should be applied before crop emergence or as a directed spray to avoid crop contact. Directed spray is a spray applied to the weeds without contacting desirable plants. Glyphosate can be used as a directed spray at the base of woody plants if the bark is brown. Green bark absorbs the herbicide and injury may occur. Glyphosate is well adapted to "wipe-on" equipment such as the

rope-wick applicator. Or a recirculating sprayer can be used to kill tall weeds in low-growing crops.

Apply glyphosate to the foliage of vegetation to be controlled. It may be applied as a broadcast spray where there is no crop. Use low pressures and suitable nozzles to avoid small droplets, which can lead to spray drift and injury to nearby susceptible plants.

Glyphosate is relatively nonactive and nonpersistent in soil and offers little or no preemergence activity. Crops can be planted or seeded directly into areas soon after treatment.

Glyphosate is formulated as the water soluble isopropylamine salt. Do not use tank mixtures unless they are listed on the product label. Residual type sprays such as diuron, atrazine, or other materials may reduce the activity of glyphosate. Other combinations with foliage-absorbed herbicides such as paraquat, dalapon, MSMA, and phenoxy herbicides also may lower the activity of glyphosate.

Glyphosate is absorbed through foliage and green stems and translocated throughout the plant. Control of perennial species is more effective when applications are made at or beyond the early head or early bud stage of growth. Visible effects normally occur on annual species in 2 to 4 days and on perennial species in 7 to 10 days. Control of woody plants is best if glyphosate is applied in late summer. Rainfall within 6 hours of treatment may reduce effectiveness. Heavy rainfall within 2 hours of application may wash much of the herbicide off plants. Tillage or mowing of treated perennial plants should be delayed for at least 3 days after treatment to allow time for glyphosate translocation to underground roots and stems.

Glyphosate is strongly adsorbed on soil and soil organic matter, so soil treatments are ineffective. Microbial degradation is the major cause of decomposition in soil. Glyphosate is corrosive to iron and galvanized steel. Do not store spray mixtures in galvanized or unlined steel tanks (except stainless) for extended periods. Clean your sprayer with water after use.

Glyphosate presents a low toxicological hazard to birds, fish, wildlife, and other animals.

Acid Equivalent

Formulated phenoxy herbicide concentrates as well as dicamba, picloram, and glyphosate are available in various strengths. The amount of active ingredient in the concentrate is indicated on the



Apply glyphosate with a rope wick applicator to johnsongrass plants that are taller than the cotton crop. The "wipe-on" technique can kill many tall weeds in shorter crops, such as volunteer corn in soybeans or shattercane in grain sorghum. The special rope wicks are inserted into a large plastic pipe. The pipe is a container for the herbicide solution.

container label. Perhaps more important is the number of pounds of acid equivalent per gallon of concentrate, which is also shown on the container label. Acid equivalent is the theoretical yield of parent acid from an acid-based herbicide. It is this portion of the molecule that is responsible for the herbicidal action.

Usually the strongest concentrates are the most economical to use; they usually cost less per pound of acid equivalent than weaker concentrates. For example, 1 gallon of 2,4-D concentrate containing 4 pounds of acid equivalent per gallon usually will cost less per pound than 4 gallons of concentrate containing 1 pound of acid equivalent per gallon, and both contain the same amount of active ingredient.

Applying Herbicides

Avoiding Damage to Desirable Plants

If you apply herbicides carefully, they can save you money, time, and labor. If you apply them carelessly, they can damage crops or other desirable plants.

Some crops and ornamental plants are extremely sensitive to some herbicides and are severely injured or killed by small traces of herbicides from spray drift or vapors. Some of the most sensitive crops and ornamental plants include cotton, grapes, tomatoes, cucumbers, tobacco, mimosa, roses, Bradford pear, redbud, and dogwood. For more information about crop sensitivity to herbicides, ask your county agricultural extension agent.

When using herbicides near sensitive plants, observe all precautions regarding vapors, spray drift, and cleanliness of equipment.

For safe and effective control of weeds:

- Obtain professional advice before applying herbicides; ask your county agricultural extension agent or other local authorities for weed control recommendations.
- Use herbicides wisely. Follow label precautions. Do not apply herbicides for any use that is not listed on the label.



Cotton is extremely susceptible to phenoxy herbicides. This plant was killed when it was accidentally sprayed with 2,4-D.

- Avoid spraying on windy days.
- Do not apply ester formulations or other volatile herbicides when the temperature is above 90° F.
- Check the output of your sprayer frequently to prevent overapplication of herbicides.
- Avoid sprayer skips or overlapping swaths.
- Clean your spray equipment immediately after use.
- Before using spray equipment for applying insecticides or fungicides to crops, test it for injurious traces of herbicides. To be safe, use a separate sprayer for herbicides.

Application Methods for Cropland

You can apply some herbicides on cropland as preemergence sprays (after the crop is planted but before the crop or weeds emerge) or as postemergence sprays (after the crop or weeds emerge). These herbicides, with the exceptions of glyphosate and amitrole, are almost always applied as postemergence sprays in crops. Glyphosate will kill most crops if applied to them, and amitrole is not registered for use in crops.

Most modern ground spray equipment is designed for moderately low-volume application—from about 5 to 20 gallons of spray per acre. With the proper attachments, such equipment can be used for broadcast spraying, band treatments, or directed spraying.

Apply a broadcast spray if the crop plants are not sensitive to the herbicide. For broadcast application, the spray rig usually is equipped with a boom with multiple nozzles set to give uniform distribution of the spray in an overall swath to target plants or an area.

Airplanes sometimes are used for spraying crops, especially nonrow crops, such as small grains, rice, and grazing lands. Special precautions to reduce drift hazard should be followed for aerial spraying.

Band application means treating a narrow strip, usually directly over the crop row. The space between the rows is not treated, but usually it is cultivated for weed control.

If the crop plants are somewhat sensitive to the herbicide, a directed spray sometimes can be used. For directed application, the spray rig may be equipped with a boom and drop nozzles, which are adjusted to spray the weeds but no more than the base of the crop plants. Timing of directed sprays is especially important in relation to heights of weeds and crop plants and the relative susceptibility of both to the herbicides.

Application Methods for Noncropland

A ground sprayer with boom may be used to apply moderately low-volume broadcast sprays for controlling weeds, brush, and trees on some grazing land, forestland, Christmas tree plantations, and irrigation canal banks.

Airplanes and helicopters often are used for applying low-volume broadcast sprays to noncropland areas, forestlands, and rangelands where growth is too large, areas are too rough, and obstructions are too numerous for ground equipment.

High-volume directed sprays can be used to kill brush and trees along roads, utility lines, fencerows, and irrigation and drainage canals.

Equipment for high-volume spraying usually has a large capacity spray tank (more than 100 gallons per acre of spray can be used) and operates at moderately high pressure (about 60 to 100 pounds per square inch). Higher pressure causes too many fine droplets that can drift. The rig usually is equipped with a

Avoiding Spray Drift

Herbicide spray droplets or vapors moving outside the target area may damage nearby susceptible plants. To reduce the danger of damaging desirable plants with spray drift:

- Use nozzles that apply a coarse spray. Get advice from agricultural engineers and weed control specialists.
- Use low pressures—no more than 30 pounds per square inch for boom sprayers, 100 pounds for spray guns.
- Avoid spraying on windy days; do not spray with ground equipment or from airplanes when the wind velocity is sufficient to cause drift to sensitive crops. Never spray when wind speed is above 10 mph.
- Do not spray when an air temperature inversion exists. An inversion is characterized by little or no wind and by air temperatures that are lower near the ground than at higher levels. A continuous smoke generating device on aircraft can be used to indicate the direction and velocity of air movement. Layering of the smoke may indicate a temperature inversion. For ground spraying, use a burning tire or other smoke generator to indicate the presence of inversions.
- Spray when a light wind is blowing away from susceptible crops and toward the area being sprayed.
- Where special drift hazards exist, either do not spray or use specialized spray equipment. One of the special drift control agents or formulations in properly designed and adjusted equipment can help reduce drift. Obtain professional advice before using these products.

spray hose and adjustable nozzle. The spray often is applied as a drench that thoroughly wets the leaves and stems of the plants to be killed.

Apply sprays of ester formulations of phenoxy herbicides in diesel oil or kerosene to the bark at the base of small trees. Amine salts in water can be applied to cuts in the bark at the base of large trees.

Phenoxy ester formulations with oil as a carrier can be absorbed by the bark at the base of trees with trunk diameters up to about 4 inches. Oil solutions usually are applied all the way around the stem with a small handoperated sprayer; the lower 6 to 18 inches of bark on the trunk are thoroughly wetted with the solution. The bark of trees that are more than 4 inches in diameter may be too thick for the spray to penetrate. To kill such trees, ring the base of the tree with ax cuts and spray the ester or amine solution into the cuts. The ax cuts must go through the bark and into the sapwood and must completely circle each stem. The amine solution is less expensive and more effective for this use.

Testing Sprayer Output

Before mixing or applying herbicides on cropland, check the output of your spray equipment. If you apply too little herbicide, it is ineffective. If you apply too much, you waste the herbicide and increase costs and you may kill your crops.

Be sure your tractor speed and pump pressure are the same during the test as they will be when you apply herbicide. If your tractor is not equipped with a speedometer, make the test on the same type of terrain and soil conditions that you plan to spray and mark the throttle setting that you use.

To test the output:

1. Fill spray tank with water. (Be sure sprayer is on a level area.)

2. Measure width of spray swath (number of nozzles X spacing on spray boom).
3. Spray a strip over a measured distance. Multiply distance by spray swath width to get square feet in the test-sprayed area.
4. Measure water required to refill the tank (quarts).
5. Convert to gallons sprayed (quarts ÷ 4 = gallons sprayed).
6. To figure number of test-sprayed areas in one acre, use this calculation:

43,560 square feet per acre

Distance test sprayed (feet) X spray swath width (feet).

7. To figure gallons per acre, multiply gallons to refill tank X number of test-sprayed areas per acre.

Example: Your spray rig treats a strip 20 feet wide (12 nozzles, 20-inch spacing). You spray a test strip 600 feet long. It requires 5.5 quarts of water to refill the tank:

$$5.5 \text{ quarts} \div 4 = 1.375 \text{ gallons test sprayed.}$$

$$\frac{43,560}{600 \text{ feet X } 20 \text{ feet}} = 3.63 \text{ test-sprayed areas in one acre.}$$

$$1.375 \text{ gallons} \times 3.63 = 4.99 \text{ or about } 5 \text{ gallons per acre.}$$

The output of the sprayer is for the area treated. If your sprayer is adjusted to apply spray in bands to row crops, calculate the total width of the spray pattern. To do this, multiply the number of nozzles by the width that each nozzle treats.

If you are using six drop nozzles and each treats a 20-inch

width, then the total width of the spray pattern is 10 feet, regardless of the nozzle spacing.

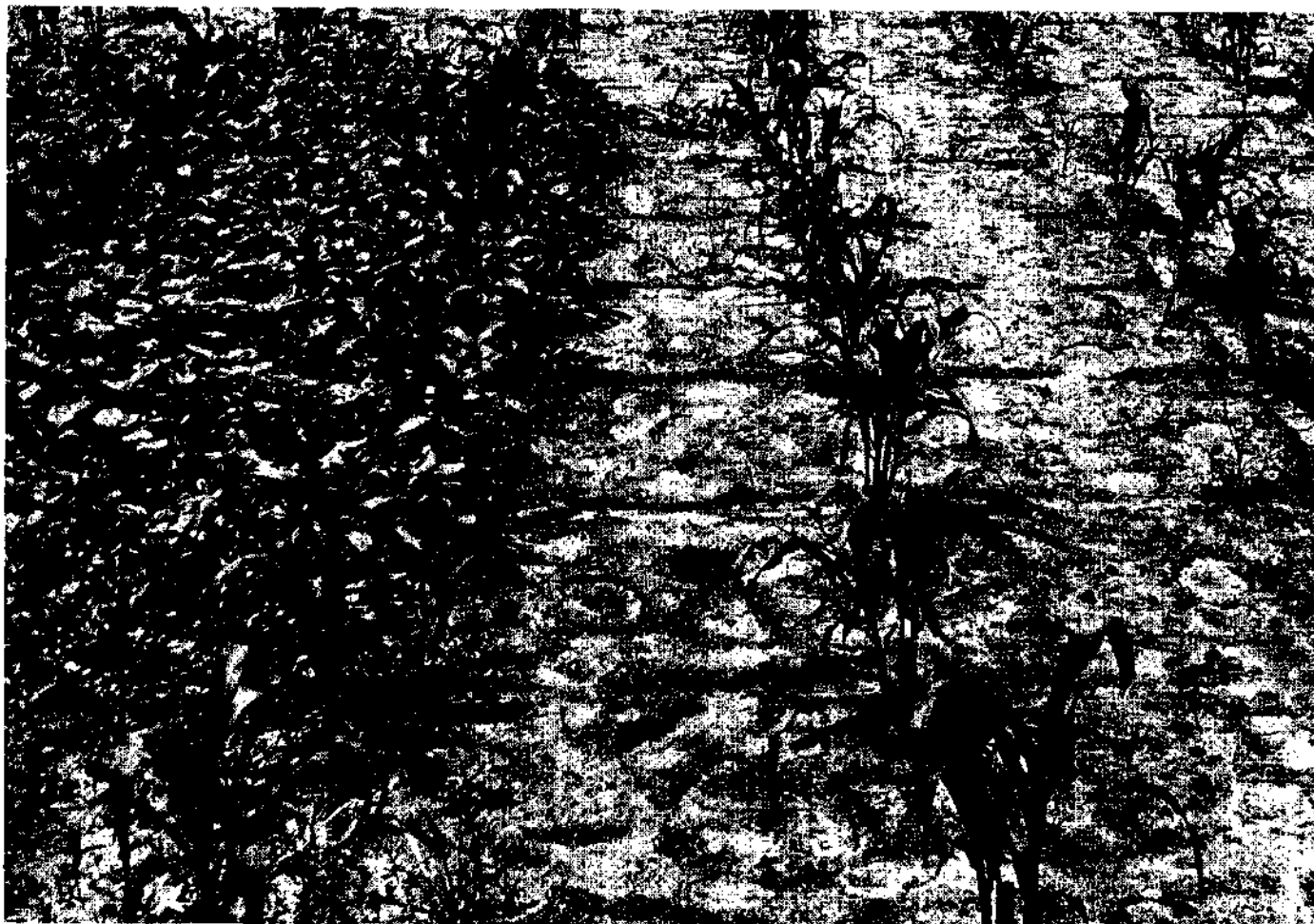
Output of the spray equipment may change because of an enlarged nozzle opening or worn parts in the pump. Check the output periodically to prevent application at the wrong rate.

After you know the output of your sprayer, you can mix the spray accurately. To calculate the total amount of spray needed, multiply the area to be sprayed, in acres, by the output per acre. Add the recommended amount of herbicide—in the form of herbicide concentrate—to about half the needed carrier (water or oil) while stirring or agitating the mixture. The remaining carrier can then be added with additional stirring or agitation. Periodic agitation is necessary for water suspensions. If the mixture is left overnight, agitate it thoroughly before spraying.

Example 1: The calculated output is 5 gallons per acre and you plan to spray 10 acres at a recommended rate of 1 pound of acid equivalent per acre. Therefore, you will need a total of 50 gallons of spray containing 10 pounds of acid equivalent.

If the herbicide concentrate contains 4 pounds of acid equivalent per gallon, add 2.5 gallons of concentrate (10 pounds total acid equivalent) to 47.5 gallons of water.

Example 2: You want to apply 4 pounds active ingredient per acre of a 75 percent wettable powder to 5 acres at 10 gallons spray per acre. Thus 4 pounds ÷ 0.75 (that is, 75 percent) = 5.3 pounds of product to be applied per acre. Five acres will require 26.7 pounds of product (5 X 5.3) added, with agitation, to enough water to make 50 gallons of spray.



The right half of this field was sprayed with 2,4-D. The left half of the field was not treated.

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 and insecticides and fungicides. If it is necessary to use a herbicide sprayer for insecticides and fungicides, use all precautions available.**

For greatest safety with sensitive crops, apply fungicides or insecticides with equipment that has not been used for applying herbicides.

You can clean spray equipment quickly with a suspension of activated charcoal in water. Triple rinse the sprayer and then spray the rinse 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 gallons of water add ¼ pound of activated charcoal and ⅓ to ¼ pound of laundry detergent. Agitate this mixture vigorously to distribute the charcoal throughout the water. Wash the equipment for 2 minutes by swirling the charcoal suspension liquid around in the tank so that it reaches all parts of the tank. Pump some of the liquid through the hose and nozzles. Then drain the tank and rinse the equipment with clean water. Drain the tank away from areas where rinse water might contaminate water supplies or animal feed.

For phenoxy herbicides, a 1-percent ammonia-water solution is effective. Follow the general instructions above. Soak equipment for 24 hours.

Precautions

The herbicides discussed in this bulletin are toxic to many crop plants and ornamentals. Some are volatile, and very small amounts of their vapors and spray drift can cause damage to desirable plants. Avoid spraying when it is windy.

Herbicides generally are safe when they are stored, handled, mixed, and used in accordance with label instructions and sound agricultural practices. Most herbicides are relatively low in oral toxicity. Some, however, can cause injury to man, domestic animals, and fish and wildlife if improperly used.

Keep herbicides away from children, livestock, and pets. Store herbicides in closed, well-labeled original containers in a dry place where they cannot contaminate food, feed, or water. Always lock the storage area.

Wear clean, dry clothing when handling herbicides. Launder clothing at the end of each day or after a spraying operation.

Do not wear clothing a second time after handling herbicides.

Do not inhale herbicides, and avoid contact with spray mist and drift. Avoid repeated or prolonged contact of herbicide with your skin. Avoid spilling it on any part of your body, especially your eyes, nose, and mouth. If you spill it on your body, wash it off with soap and water and remove contaminated clothing. Always wash before eating or smoking.

To protect fish, wildlife, and livestock, do not clean spraying equipment or dump excess spray material near lakes, streams, or ponds.

Empty herbicide containers may be hazardous. Dispose of them in accordance with label instructions and the recommendations of your state or local agricultural authorities.

Susceptibility Chart

Table 2 lists the effects of phenoxy and some other systemic herbicides when applied as sprays on the foliage of a number of common weeds. These comparisons are based on an application rate of 1 pound acid equivalent per acre for 2,4-D, MCPA, 2,4,5-T², silvex², mecoprop, dicamba, and picloram; 1.5 pounds per acre for 2,4-DB and glyphosate; and 4 pounds per acre for amitrole (active ingredient).

The control ratings for the herbicides are interpreted as follows:

- Excellent (E) Over 95 percent of the weed population is killed by a single treatment.
- Good (G) One treatment per year maintains 85 to 94 percent suppression of top growth, or more than 95 percent of the weed population is killed by two or three treatments.
- Fair (F) From 60 to 85 percent of the weed population is killed by a single treatment, or two or three treatments per year maintain 85 to 94 percent suppression of top growth.
- Poor (P) From 10 to 59 percent of the weed population is killed by one treatment, or two or three treatments per year maintain 60-84 percent suppression of top growth.
- None (N) Little or no effect is gained from treatments.

Woody plants have been largely excluded from table 2. For response of woody plants to herbicides, see USDA AH 493, *Response of Woody Plants in the United States to Herbicides*.

²See limitation on use of 2,4,5-T and silvex on inside cover.

Table 2 (continued). Susceptibility of common weeds to control by phenoxy and some other systemic herbicides

Plant name	Type of plant	Control ¹									
		2,4-D	MCPA	2,4,5-T ²	Silvex ²	Mecoprop	2,4-DB	Dicamba	Picloram	Amitrole	Glyphosate
Burcucumber (<i>Sicyos angulatus</i>)	Annual	P	F	E				P	E	E	E
Burdock, common (<i>Arctium minus</i>)	Biennial	E	E	E	E			E	E	E	G
Great (<i>A. lappa</i>)	Biennial	E	E	E	E			E	G	F	E
Wooly (<i>A. tomentosum</i>)	Biennial	E	E	E	E			E	F	F	E
Bur-head (<i>Echinodorus cordifolius</i>)	Annual	E	E	E	E					F	E
Burweed (<i>Haplopappus tenuisectus</i>)	Perennial	G		E				E		E	
Buttercup											
Bur (<i>Ceratocephalus testiculatus</i>)	Annual	P	F		G			F			
Celery leaf (<i>Ranunculus sceleratus</i>)	Annual	F				G					
Corn (<i>R. arvensis</i>)	Annual	G	E	E	E	G		E	F	F	G
Creeping (<i>R. repens</i>)	Perennial	G	E	E	E	F		G	G	G	
Tall (<i>R. acris</i>)	Perennial	G	E	E	E			E	G	G	E
Campion, bladder (<i>Silene vulgaris</i>)	Perennial	N	N	N	N			N	G	E	E
Canarygrass, reed (<i>Phalaris arundinacea</i>)	Perennial	N	N	N	N			N	N	N	G
Carpetgrass (<i>Axonopus affinis</i>)	Perennial	F	P	F	F			P	F	F	E
Carpetweed (<i>Mollugo verticillata</i>)	Annual	E	E	N	N			E	E	E	E
Carrot, wild (<i>Daucus carota</i>)	Biennial	F	F	F	F	P		F	G	G	G
Catchfly, night flowering (<i>Silene noctiflora</i>)	Annual	N	N	N	F	N		N	E	E	E
Catnip (<i>Nepeta cataria</i>)	Perennial	G		E				E	E	E	G
Catsear, spotted (<i>Hypochoeris radicata</i>)	Perennial	G	E	E	E			E	E	E	
Cattail											
Broadleaf (<i>Typha latifolia</i>)	Perennial	F	P	F	F			P	G	G	G
Narrowleaf (<i>T. angustifolia</i>)	Perennial	F	P	F	F			P		G	G
Celandine, greater (<i>Chelidonium majus</i>)	Biennial									G	E
Chamomile, corn (<i>Anthemis arvensis</i>)	Biennial	F	G	E	E			G	G	E	E
Garden (<i>Chamaemelum nobile</i>)	Annual							G	F		E
Yellow (<i>Anthemis tinctoria</i>)	Perennial							F	N	F	E
Cheat (<i>Bromus secalinus</i>)	Annual	N	N	N	N			N	N	N	E
Chervil, wild (<i>Chaerophyllum tainturieri</i>)	Annual		F					N	G		E
Chess, hairy (<i>Bromus commutatus</i>)	Annual	N	N	N	N			N	N	N	E
Soft (<i>B. mollis</i>)	Annual	N	N	N	N			N	N	N	E
Chickweed											
Common (<i>Stellaria media</i>)	Annual	F	P	G	E	E		F	E	E	E
Field (<i>Cerastium arvense</i>)	Perennial	F	P	G	E			P	E	E	E
Mouseear (<i>C. vulgatum</i>)	Perennial	F	P	G	E	E		P	E	E	E
Sticky (<i>C. viscosum</i>)	Annual	G	G	E	E			E	E	E	E
Chicory (<i>Cichorium intybus</i>)	Perennial	G	G	G	G	P		F	E	E	G
Cinquefoil											
Blueleaf (<i>Potentilla diversifolia</i>)	Perennial	F		F				N			G
Common (<i>P. canadensis</i>)	Perennial	G	F	F	F				E	E	E
Rough (<i>P. norvegica</i>)	Annual ³	E							E	E	E
Sulfur (<i>P. recta</i>)	Perennial	G	F	G	F				E	E	E
Clover, hop (<i>Trifolium agrarium</i>)	Annual	F		E	E	F		G			F
White (<i>T. repens</i>)	Perennial	F		E	E	E		E			F
Cockle											
Corn (<i>Agrostemma githago</i>)	Annual ³	P	P	N	N			N	G	E	E
Cow (<i>Vaccaria pyramidata</i>)	Annual	G							E	E	E
White (<i>Lychnis alba</i>)	Perennial	P	N	N				N	G	E	E
Cocklebur, common (<i>Xanthium pensylvanicum</i>)	Annual	E	F	E		E		G	E	E	E
Coffeeweed (<i>Daubentonia texana</i>)	Woody	E		E	G			E	E	E	E
Coreopsis, plains (<i>Coreopsis tinctoria</i>)	Annual	E	G	E	E			E	E	G	E
Cornflower											
Batchelor's button (<i>Centarea cyanus</i>)	Annual	E						E	E	E	E
Costmary (<i>Chrysanthemum balsamita</i>)	Perennial	F		G	G			F	F	E	G
Cranebill, cutleaf (<i>Geranium dissectum</i>)	Annual ³		E			E			E	G	
Creeper, Virginia (<i>Parthenocissus quinquefolia</i>)	Woody	P	P	G	F			P	F	F	G
Cress, hoary (<i>Cardaria draba</i>)	Perennial	F	F	F	F			F	G	P	G
Mouseear (<i>Arabidopsis thaliana</i>)	Annual	E	E	E	E	E		E	E	E	E
Croton											
Lindheimer (<i>Croton lindheimeri</i>)	Annual	E	E	G	G			G	E	E	E
Texas (<i>C. texensis</i>)	Annual	E		E	E				E	E	E
Wooly (<i>C. capitatus</i>)	Annual	E		E	E			E	E	E	E
Crown vetch (<i>Coronilla varia</i>)	Perennial	G	G		E			G	E	E	G
Cudweed (<i>Gnaphalium peregrinum</i>)	Annual	N							E		G
Daisy, English (<i>Bellis perennis</i>)	Perennial	G	G	E	G			F	G	E	E
Oxeye (<i>Chrysanthemum leucanthemum</i>)	Perennial	F	F	G	F			N	E	E	G
Dallisgrass (<i>Paspalum dilatatum</i>)	Perennial	N	N	N	N			N	N	N	F
Dandelion (<i>Taraxacum officinale</i>)	Perennial	E	E	E	E			F	G	E	G
Darnel (<i>Lolium temulentum</i>)	Annual										E
Dayflower (<i>Commelina communis</i>)	Annual	F	G	G	G			P	F	P	E
Deadnettle, red (<i>Lamium purpureum</i>)	Annual ³	P	P					P	E	E	E

¹For explanation of control ratings, see page 8; E=excellent, G=good, F=fair, P=poor, and N=none.

²See limitation on use of 2,4,5-T and silvex on inside cover.

³Sometimes biennial.

Table 2 (continued). Susceptibility of common weeds to control by phenoxy and some other systemic herbicides

Plant name	Type of plant	Control ¹									
		2,4-D	MCPA	2,4,5-T ²	Silvex ²	Mecoprop	2,4-DB	Dicamba	Picloram	Amitrole	Glyphosate
Deathcamas (<i>Zigadenus gramineus</i>)	Perennial	F		P				E	E	G	G
Foothill (<i>Z. paniculatus</i>)	Perennial	G		F							
Deerweed (<i>Lotus scoparius</i>)	Woody	E		E							
Devil's claw (<i>Proboscidea louisianica</i>)	Annual	E						E	E		E
Dill (<i>Anethum graveolens</i>)	Annual	E	F	E	E			G	E	E	E
Dock											
Broadleaf (<i>Rumex obtusifolius</i>)	Perennial	F	F	G	G	F	F	E	E	E	E
Curly (<i>R. crispus</i>)	Perennial	F	F	G	P	F	F	E	E	G	E
Fiddle (<i>R. pulcher</i>)	Perennial	E				F		G	E	E	E
Pale (<i>R. altissimus</i>)	Perennial	G	G	G	G	F	P	G	E	E	E
Veiny (<i>R. venosus</i>)	Perennial	F									
Dodder											
Largeseed (<i>Cuscuta indecora</i>)	Annual	P	N	N	N		N				E
Smallseed alfalfa (<i>C. pentagona</i>)	Annual	P	N	N	N		N				
Dogbane, hemp (<i>Apocynum cannabinum</i>)	Perennial	F	P	F	F		P	F		G	G
Prairie (<i>A. sibiricum</i>)	Perennial	P	N	F	F		P	F	F	F	G
Spreading (<i>A. androsaemifolium</i>)	Perennial	P	N	F	F		P	F	F	F	G
Duckweed, common (<i>Lemna minor</i>)	Annual	P		N	N			N	N	G	N
Eveningprimrose, common (<i>Oenothera biennis</i>)	Biennial	E		G	E			E	E		E
False boneset (<i>Kunia eupatorioides</i>)	Perennial	G	F	E	E		F	F	E	G	G
Falseflax, smallseeded (<i>Camelina microcarpa</i>)	Annual	E				E		E	E		
Fennel, dog (<i>Eupatorium capillifolium</i>)	Annual	G		E	E		N	E	E		G
Fescue, sixweeks (<i>Vulpia octoflora</i>)	Annual	N	N	N	N		N	N	N	E	E
Fiddleneck, coast (<i>Amsinckia intermedia</i>)	Annual	G	F	G	E		N	E	G	N	E
Fieldcress, yellow (<i>Roripa sylvestris</i>)	Perennial	G	F	G	E		F	F	G	G	G
Filaree, redstem (<i>Erodium cicutarium</i>)	Annual ³	G					P	E	E	E	F
Fireweed (<i>Epilobium angustifolium</i>)	Perennial	G		G	E						
Fleabane											
Annual (<i>Erigeron annuus</i>)	Annual	F	F	G	E		E	E	E	E	E
Oregon (<i>E. speciosus</i>)	Perennial	F						F	G	E	E
Rough (<i>E. strigosus</i>)	Annual ³	G		E	E			E	E	E	E
Flixweed (<i>Descurainia sophia</i>)	Annual	E	F				G		G		
Florida betony (<i>Stachys floridana</i>)	Perennial	P		P				F	G	E	G
Foxtail, meadow (<i>Alopecurus pratensis</i>)	Perennial	N	N	P	P		N	P	N	E	E
Slender (<i>A. myosuroides</i>)	Perennial	N	N	N	N		N	N	N	G	E
Water (<i>A. geniculatus</i>)	Perennial	N	N	N	N		N	N	N		E
West India (<i>Andropogon bicornis</i>)	Perennial	N	N	N	N		N	N	N		
Franseria											
Bur (<i>Franseria discolor</i>)	Perennial	F						G	E		G
Woollyleaf (<i>F. tomentosa</i>)	Perennial	F	F	F	F		P	F	F	F	F
Galinsoga, hairy (<i>Galinsoga ciliata</i>)	Annual	G	E	E	E			E	E	G	E
Smallflower (<i>G. parviflora</i>)	Annual	E	G	E	E		G	E	E	E	E
Garlic, wild (<i>Allium vineale</i>)	Perennial	F	P	P	N		P	F	G	F	P
Geranium, Carolina (<i>Geranium carolinianum</i>)	Annual ³	G	E	G	G		E	E	E	E	E
Goatgrass, barb (<i>Aegilops triuncialis</i>)	Annual	N	N		N		N	P	N		E
Jointed (<i>A. cylindrica</i>)	Annual	N	N	N	N		N		N	G	E
Goatsrue (<i>Galega officinalis</i>)	Perennial	F						G	E	F	F
Goldenrod (<i>Solidago spp.</i>)	Perennial	F		G	G	F		G	E	P	E
Goosefoot											
Blite (<i>Chenopodium capitatum</i>)	Annual	E	E	E	E		E	E	E	E	E
Jerusalem-oak (<i>C. botrys</i>)	Annual	F						E	E	E	E
Mapleleaf (<i>C. hybridum</i>)	Annual	E	E	E	E		E	E	E	E	E
Nettleleaf (<i>C. murale</i>)	Annual	E	E	E	E		E	E	E	E	E
Oakleaf (<i>C. glaucum</i>)	Annual	E	E	E	E		E	E	E	E	E
Gooseweed (<i>Sphenoclea zeylanica</i>)	Annual	F	P	F	P		N				
Gourd, buffalo (<i>Cucurbita foetidissima</i>)	Perennial	P									
Goutweed, Bishops (<i>Aegopodium podagraria</i>)	Perennial	N				N					
Gramma, six weeks needle (<i>Bouteloua aristidoides</i>)	Annual	N	N	N	N	N		N			E
Gromwell (<i>Lithospermum officinale</i>)	Perennial	N						E			
Groundcherry											
Clammy (<i>Physalis heterophylla</i>)	Perennial	N		F	F		N	E	E		
Purple flower (<i>P. lobata</i>)	Perennial	N									
Smooth (<i>P. subglabrata</i>)	Perennial	F	N	P	P		N	F			P
Wrights (<i>P. acutifolia</i>)	Annual	E		E	E			E	E		E
Ground-ivy (<i>Glechoma hederacea</i>)	Perennial	F	P	F	G	F	N	G	E		G
Groundsel											
Arrowleaf (<i>Senecio triangularis</i>)	Perennial	F		F			N				E
Common (<i>S. vulgaris</i>)	Annual	P	P	N	N		N	E			E
Cressleaf (<i>S. glabellus</i>)	Annual	E	E	E	G		G				E
Riddell (<i>S. riddellii</i>)	Perennial	E								E	E
Threadleaf (<i>S. longilobus</i>)	Perennial	F						G	E		E

¹For explanation of control ratings, see page 8; E=excellent, G=good, F=fair, P=poor, and N=none.

²See limitation on use of 2,4,5-T and silvex on inside cover.

³Sometimes biennial.

Table 2 (continued). Susceptibility of common weeds to control by phenoxy and some other systemic herbicides

Plant name	Type of plant	Control ¹										
		2,4-D	MCPA	2,4,5-T ²	Silvex ²	Mecoprop	2,4-DB	Dicamba	Picloram	Amitrole	Glyphosate	
Guineagrass (<i>Panicum maximum</i>)	Perennial	N	N	N	N			N	N	N		E
Gumweed (<i>Grindelia squarrosa</i>)	Perennial	E							G	E	F	G
Hairgrass, silver (<i>Aira caryophylla</i>)	Annual	N	N		P			N	N	N		E
Halogeton (<i>Halogeton glomeratus</i>)	Annual	F	P	P	P			N				
Hawksbeard, smooth (<i>Crepis capillaris</i>)	Annual ³	P	P	N	N			P				
Hawkweed												
Orange (<i>Hieracium aurantiacum</i>)	Perennial	F	P	P		P			G	E		G
Yellow (<i>H. caespitosum</i>)	Perennial	F	P	P		P			G	E		E
Healall (<i>Prunella vulgaris</i>)	Perennial	G	N	P	P	P		N	G			G
Hellebore, false western (<i>Veratrum californicum</i>)	Perennial	G							P		P	
Hemlock, poison (<i>Conium maculatum</i>)	Biennial	G	E	F	E			E	E	E	F	G
Hemp (<i>Cannabis sativa</i>)	Annual	G		G				G	G	E	E	E
Hempnettle (<i>Galeopsis tetrahit</i>)	Annual	P	F				N					
Henbit (<i>Lamium amplexicaule</i>)	Annual	P	P	F	G	G		P	E	E	E	E
Hogpeanut (<i>Amphicarpa bracteata</i>)	Perennial	E										
Hogpotato (<i>Hoffmanseggia densiflora</i>)	Perennial	F	N	N	N			N				
Hollyhock (<i>Althea rosea</i>)	Biennial	E	G	E	E			G		E	G	E
Honeysuckle (<i>Lonicera japonica</i>)	Perennial	F	E	G	G			G	E	E	E	G
Horehound, white (<i>Marrubium vulgare</i>)	Perennial	E		E	E			G	G	E		
Horsebrush, littleleaf (<i>Tetradymia glabrata</i>)	Perennial	P		P				G	E			
Horsenettle, Carolina (<i>Solanum carolinense</i>)	Perennial	P	N	F				P	F	G	F	G
Horsetail, field (<i>Equisetum arvense</i>)	Perennial	P	F	P	P	P			N	F	E	P
Horseweed, mare's tail (<i>Conyza canadensis</i>)	Annual	F	F	G	G			F	E	E	E	E
Houndstongue (<i>Cynoglossum officinale</i>)	Biennial	F							G	E		
Indiantobacco (<i>Lobelia inflata</i>)	Annual	F							E			
Iris, Rocky Mountain (<i>Iris missouriensis</i>)	Perennial	F		P								
Ironweed, Western (<i>Vernonia baldwinii</i>)	Perennial	F		G	N			P	G	E		E
Itchgrass (<i>Rottboellia exaltata</i>)	Perennial											E
Ivy, English (<i>Hedera helix</i>)	Perennial			E					E	E	E	F
Jerusalem artichoke (<i>Helianthus tuberosus</i>)	Perennial	F		E					P	F	P	F
Jewelweed (<i>Impatiens pallida</i>)	Annual	E							E	E	E	E
Jimmyweed (<i>Haplopappus pluriflorus</i>)	Perennial	F		F								
Jimsonweed (<i>Datura stramonium</i>)	Annual	P	P	P				P	F	E	G	E
Jobs tears (<i>Coix lacryma</i>)	Annual											E
Johnsongrass (<i>Sorghum halepense</i>)	Perennial	N	N	N	N			N	N	N	P	E
Jointvetch, Northern (<i>Aeschynomene virginica</i>)	Annual	F	F	E	F			N				
Knapweed												
Black (<i>Centaurea nigra</i>)	Perennial	F	F	G	G			F	F	E	G	G
Brown (<i>C. jacea</i>)	Perennial	F										
Diffuse (<i>C. diffusa</i>)	Biennial	E	N	P	P			N	E	E		
Russian (<i>C. repens</i>)	Perennial	P	P	P	P			N	G	G	F	G
Spotted (<i>C. maculosa</i>)	Biennial	F	E	F	G				E	E	E	E
Squarrose (<i>C. virgata</i> var. <i>squarrosa</i>)	Perennial	F										
Vochin (<i>C. nigrescens</i>)	Perennial											E
Knawel (<i>Scleranthus annuus</i>)	Annual	N	N					G	E	E	E	E
Knotweed												
Japanese (<i>Polygonum cuspidatum</i>)	Perennial	P		P	F				F	G	F	G
Prostrate (<i>P. aviculare</i>)	Annual	P	P	F	F			P	E	E	G	E
Sakhalin (<i>P. sachalinense</i>)	Perennial	G						P	P	G	F	G
Silversheath (<i>P. argyrocoleon</i>)	Annual	F							F	E	G	G
Kochia (<i>Kochia scoparia</i>)	Annual	E	G	E	E			E	G	F	G	E
Kudzu (<i>Pueraria lobata</i>)	Perennial	F	F	F	F				G	E	G	G
Lambsquarters (<i>Chenopodium album</i>)	Annual	E	E	E	E	E		E	E	E	E	E
Netseed (<i>C. berlandieri</i>)	Annual	E	E	E	E			G	E	E	E	E
Larkspur												
Duncecap (<i>Delphinium occidentale</i>)	Perennial	N	N	F	F							
Little (<i>D. bicolor</i>)	Perennial	N		N				N				
Menzies (<i>D. menziesii</i>)	Perennial	F		F	N							
Tall (<i>D. barbeyi</i>)	Perennial	N		N							G	
Leek, wild (<i>Allium tricoccum</i>)	Perennial	F	P	F	F			P	F	P		F
Lespedeza (<i>Lespedeza striata</i>)	Annual	P		E	E	G			G			G
Sericea (<i>L. cuneata</i>)	Perennial	P		E	E	G			G			F
Lettuce												
Blue (<i>Lactuca pulchella</i>)	Perennial	F	F	F	F			F	G	E	F	G
Wild (<i>L. serriola</i>)	Annual	E						E	E	E	E	E
Loco, bigbend (<i>Astragalus earlei</i>)	Annual ³	E										
Blue (<i>A. lentiginosus</i> var. <i>diphysus</i>)	Perennial	G		G	G				G	E	E	E
Woolly (<i>A. mollissimus</i>)	Perennial	G		G	G				G	E	E	E
Locoweed, white (<i>Oxytropis lambertii</i>)	Perennial	F		F	F				G			
London rocket, annual (<i>Sisymbrium irio</i>)	Annual	E	E	E	E			E				

¹For explanation of control ratings, see page 8; E=excellent, G=good, F=fair, P=poor, and N=none.

²See limitation on use of 2,4,5-T and silvex on inside cover.

³Sometimes biennial.

Table 2 (continued). Susceptibility of common weeds to control by phenoxy and some other systemic herbicides

Plant name	Type of plant	Control ¹										
		2,4-D	MCPA	2,4,5-T ²	Silvex ²	Mecoprop	2,4-DB	Dicamba	Picloram	Amitrole	Glyphosate	
Lupine												
Silver (<i>Lupinus argenteus</i>)	Perennial	F	N	E	E			E	E	E	F	F
Tailcup (<i>L. caudatus</i>)	Perennial	G										
Maidencane (<i>Panicum hemitomon</i>)	Perennial											E
Mallow												
Common (<i>Malva neglecta</i>)	Annual ³	P	N	P	P				G	E	E	E
Dwarf (<i>M. rotundiflora</i>)	Perennial	F							G	E	E	G
Little (<i>M. parviflora</i>)	Annual	F	N						E	E	E	G
Venice (<i>Hibiscus trionum</i>)	Annual	G	E	E					E	E	E	G
Marshelder (<i>Iva xanthifolia</i>)	Annual	E	G	G	E			E	E	E	E	E
Mayweed, dogfennel (<i>Anthemis cotula</i>)	Annual	F	P	F	P			N	E	E	E	E
Medic, black (<i>Medicago lupulina</i>)	Annual	F	F	F	G		G	P	G	E	G	E
Medusahead (<i>Taeniatherum asperum</i>)	Annual	N	N	N	N			N	N	N	E	E
Mexican weed (<i>Caperonia palustris</i>)	Annual	F	F	G	G			N	E	E	E	E
Mexicantea (<i>Chenopodium ambrosioides</i>)	Annual	E	E	E	G			E	E	E	E	E
Milkvetch, cicer (<i>Astragalus cicer</i>)	Perennial	E	E	E	E			G	E	E	E	E
Nuttall (<i>A. nuttallianus</i>)	Perennial	G		G	G				G	E	E	E
Timber (<i>A. miser</i>)	Perennial				E							
Milkweed, bloodflower (<i>Asclepias curassavica</i>)	Perennial	G		E				N	P	G	G	G
Broadleaf (<i>A. latifolia</i>)	Perennial	F			F				P	G	G	E
Butterfly (<i>A. tuberosa</i>)	Perennial	P	N	G	G			P	P	G	G	G
Climbing (<i>Funastrum cynanchoides</i>)	Perennial	F							P	F	F	F
Common (<i>Asclepias syriaca</i>)	Perennial	P	N	P	F		P	N	F	G	F	F
Eastern whorled (<i>A. verticillata</i>)	Perennial	N	N	P				N	G	F	F	G
Green (<i>A. viridiflora</i>)	Perennial	P	N	G	G			P	P	G	F	G
Purple (<i>A. purpurascens</i>)	Perennial	P	N	G	F			P	P	G	F	G
Showy (<i>A. speciosa</i>)	Perennial	N	N	P	G			N	F	E	G	G
Swamp (<i>A. incarnata</i>)	Perennial	P	N	G	F			N	P	G	F	G
Western whorled (<i>A. subverticillata</i>)	Perennial									E		
Mint, field (<i>Mentha arvensis</i>)	Perennial	G	G	E	G			F	F	E	G	E
Moneywort (<i>Lysimachia nummularia</i>)	Perennial	E										G
Morningglory												
Bigroot (<i>Ipomoea pandurata</i>)	Perennial	F	P	P	P			N	P	F	P	F
Common (<i>I. purpurea</i>)	Annual	E		E				E	E	E	E	E
Ivyleaf (<i>I. hederacea</i>)	Annual	E		E				E	E	E	E	E
Woolly (<i>I. hirsutula</i>)	Annual	E	E	E	E				G	E	G	E
Mother-of-thyme (<i>Acinos thymoides</i>)		G	F						E	E		E
Mudplantain (<i>Hebeanthera limosa</i>)	Perennial	E	G	G	G		P	F				
Mugwort (<i>Artemisia vulgaris</i>)	Perennial	P	N	N					F	G		F
Mulsears (<i>Wyethia amplexicaulis</i>)	Perennial	G		G					G	E	F	F
Mullein												
Common (<i>Verbascum thapsus</i>)	Biennial	P	P	F	G			N	G	E	G	G
Moth (<i>V. blattaria</i>)	Biennial	F		F					F	G	G	E
Mustard												
Black (<i>Brassica nigra</i>)	Annual	E	E	E	G			E	E	G	G	E
Blue (<i>Chorispora tenella</i>)	Annual	F	P	G	G			N	G	E	G	E
Haresear (<i>Conringia orientalis</i>)	Annual	E	G						E	E	E	E
Hedge (<i>Sisymbrium officinale</i>)	Annual	E	E	E	E			E	E	E	E	E
Indian (<i>Brassica juncea</i>)	Annual	E	E	E	G			E	E	E	E	E
Tansy (<i>Descurainia pinnata</i>)	Annual	E	E						E	E	G	E
Treacle (<i>Erysimum repandum</i>)	Annual	G	G						F			
Tumble (<i>Sisymbrium altissimum</i>)	Annual	E	G	E				E	E	E	G	G
Wild (<i>Sinapis arvensis</i>)	Annual	E	E	E	G			E	E	E	E	E
Wormseed (<i>Erysimum cheiranthoides</i>)	Annual ³	E	E	E				E	E	E	E	E
Nettle												
Stinging (<i>Urtica dioica</i>)	Perennial	G		G					G	G	G	G
Tall (<i>U. procera</i>)	Annual	G							E	E	E	E
Niggerhead (<i>Rudbeckia occidentalis</i>)	Perennial	G							E	E		
Nightshade												
Black (<i>Solanum nigrum</i>)	Annual	F	F	F	G		N	F	G	E	G	E
Cutleaf (<i>S. triflorum</i>)	Annual	F										
Silverleaf (<i>S. elaeagnifolium</i>)	Perennial	P		P	P				G	E	F	E
Nimblewill (<i>Muhlenbergia schreberi</i>)	Perennial	N	N	N	N			N	N	N	G	E
Norcal bean (<i>Sophora secundiflora</i>)	Perennial			E	E							
Nutsedge												
Purple (<i>Cyperus rotundus</i>)	Perennial	P	N	N	N			N	P	P	F	G
Yellow (<i>C. esculentus</i>)	Perennial	F	N	N	N			N	N	F	F	F
Oats, slender (<i>Avena barbata</i>)	Annual	N		N	N							
Wild (<i>A. fatua</i>)	Annual	N	N	N	N			N	N	N	E	E
Onion, wild (<i>Allium canadense</i>)	Perennial	F	P	P				P	F	P	F	F
Orache (<i>Atriplex hastata</i>)	Annual	G		E								

¹For explanation of control ratings, see page 8; E=excellent, G=good, F=fair, P=poor, and N=none.

²See limitation on use of 2,4,5-T and silvex on inside cover.

³Sometimes biennial.

Table 2 (continued). Susceptibility of common weeds to control by phenoxy and some other systemic herbicides

Plant name	Type of plant	Control ¹										
		2,4-D	MCPA	2,4,5-T ²	Silvex ²	Mecoprop	2,4-DB	Dicamba	Picloram	Amitrole	Glyphosate	
Paragrass (<i>Brachiaria mutica</i>)	Perennial	N	N	N	N			N	N	N		G
Parsley, desert (<i>Lomatium grayi</i>)	Perennial	E	E		E			E	E	E	E	E
Parsnip, wild (<i>Pastinaca sativa</i>)	Biennial	E		E				E	E	E		
Partridgepea (<i>Cassia fasciculata</i>)	Annual	E	E	E	E			E	E	E		E
Paspalum, field (<i>Paspalum laeve</i>)	Perennial											E
Passionflower, Maypop (<i>Passiflora incarnata</i>)	Perennial	F						F	F			F
Peavine (<i>Astragalus emoryanus</i>)	Annual	G		G								
Pellitoryweed (<i>Parietaria floridana</i>)	Annual	N	N	E				N				
Pennycress, field (<i>Thlaspi arvense</i>)	Annual	E	E	E	G	E		G	E	E	E	E
Pennywort, lawn (<i>Hydrocotyle sibthorpioides</i>)	Perennial	G		E	E			E	E			
Penstemon, Rydberg (<i>Penstemon rydbergii</i>)	Perennial	F		P				N				
Pepperweed												
Field (<i>Lepidium campestre</i>)	Annual	E	E	G	F			E	E	E	E	E
Perennial (<i>L. latifolium</i>)	Perennial	F		F				G	F	E		
Virginia (<i>L. virginicum</i>)	Annual	E	E					E	E	E	E	E
Yellowflower (<i>L. perfoliatum</i>)	Annual	E	E	E	E							
Pheasanteye (<i>Adonis annua</i>)	Annual	F										
Pickeralweed (<i>Pomederia cordata</i>)	Perennial											G
Pigweed												
Prostrate (<i>Amaranthus blitoides</i>)	Annual	E	E	E	E	E	E	E	E	E	E	E
Redroot (<i>A. retroflexus</i>)	Annual	E	E	E	E	E	E	E	E	E	E	E
Tumble (<i>A. albus</i>)	Annual	E	E	E	E	E	E	E	E	E	E	E
Tumbleweed (<i>A. graecizans</i>)	Annual	E	E	E	E	E	E	E	E	E	E	E
Pimpernel, scarlet (<i>anagallis arvensis</i>)	Annual	E	G	E	E			F	E	E	E	E
Pineappleweed (<i>Chamomilla suaveolens</i>)	Annual	F	P	N	P	N		N	E	E	F	G
Plantain												
Blackseed (<i>Plantago rugelii</i>)	Perennial	E	E	E	G	P		E	E	E	E	E
Bracted (<i>P. aristata</i>)	Annual	E	G	E	E	P		G	E	E	E	E
Broadleaf (<i>P. major</i>)	Perennial	E	E	E	E	P		E	G	E	G	G
Buckhorn (<i>P. lanceolata</i>)	Perennial	E	G	E	E	P		E	G	E	E	E
Poison ivy (<i>Toxicodendron radicans</i>)	Woody	F	F	E	E			N	G	E	E	G
Poison oak (<i>T. toxarium</i>)	Woody	F	P	E	E			N	F	G	E	G
Pokeweed (<i>Phytolacca americana</i>)	Perennial	F	F	G	G				G	E	E	E
Pondweed (<i>Potamogeton spp.</i>)	Perennial	E	N	P	P							
Ponyfoot (<i>Dichondra repens</i>)	Perennial	E				G			E	E	E	E
Poorjoe (<i>Diodia teres</i>)	Annual	G	F	G	F			F	E	E	E	E
Poppy, Roemer (<i>Roemeria refracta</i>)	Annual	E										
Povertygrass (<i>Aristida dichotoma</i>)	Annual	N	N	N	N			N	N	N	E	E
Povertyweed (<i>Iva axillaris</i>)	Perennial	G	F	F	F			G	G	G	G	G
Prickly poppy (<i>Argemone intermedia</i>)	Annual	E										
Puncturevine (<i>Tribulus terrestris</i>)	Annual	G	F		F			G	E	E	F	E
Purslane, common (<i>Portulaca oleracea</i>)	Annual	F	F	E	G	G		G	E	E	G	E
Pusley, Florida (<i>Richardia scabra</i>)	Annual	E							E	E		
Pussytoes, field (<i>Antennaria neglecta</i>)	Perennial	G	G	E	E			F	G	E	E	E
Plantainleaf (<i>A. plantaginifolia</i>)	Perennial	G	G	E	E			F	G	E	E	E
Quackgrass (<i>Agropyron repens</i>)	Perennial	N	N	N	N			N	N	N	F	G
Queensdelight (<i>Stillingia sylvatica</i>)	Perennial	N										
Rabbitbrush												
Gray (<i>Chrysothamnus nauseosus</i>)	Woody	F	P	P	P				G	E		
Yellow (<i>C. viscidiflorus</i>)	Woody	F	P	P	P				G	E		
Radish, wild (<i>Raphanus raphanistrum</i>)	Annual	G	F	E	E			F	E	E	E	E
Ragweed												
Blood (<i>Ambrosia texana</i>)	Annual	E		G	G				E	E		
Common (<i>A. artemisiifolia</i>)	Annual	F	P	E	E	E		G	E	E	E	E
Giant (<i>A. trifida</i>)	Annual	F	P	E	E			G	E	E	E	E
Lanceleaf (<i>A. bidentata</i>)	Annual	E	E	G	G			G	E	E	E	E
Western (<i>A. psilostachya</i>)	Perennial	G		E	E			G	E	E	E	E
Ragwort, tansy (<i>Senecio jacobaea</i>)	Perennial ³	G	F	F	F			P				
Rape, bird (<i>Brassica rapa</i>)	Biennial	E	E	E	E			E				G
Redstem (<i>Ammannia coccinea</i>)	Annual	E	E	E	E			G				
Redtop (<i>Agrostis gigantea</i>)	Perennial	N	N	N	N			N	N	F	G	G
Redvine (<i>Brunnichia cirrhosa</i>)	Perennial	N	N	P	P			N	G	G		G
Reed, common (<i>Phragmites australis</i>)	Perennial											
Giant (<i>Arundo donax</i>)	Perennial	N	N	N	N			N	N	N		
Rhodesgrass (<i>Chloris gayana</i>)	Perennial	N	N	N	N			N	N	N		
Rockcress, tower-mustard (<i>Arabis glabra</i>)	Perennial	E	E	E	E			F	G	E	E	G
Virginia (<i>A. virginica</i>)	Annual	E	E	E	E			F	E	E	E	E
Rubberweed												
Bitter (<i>Hymenoxys odorata</i>)	Annual	E							F	E		
Colorado (<i>H. richardsoni</i>)	Perennial	G		F								
Rue, African (<i>Peganum harmala</i>)	Perennial			F	F							G

¹For explanation of control ratings, see page 8; E=excellent, G=good, F=fair, P=poor, and N=none.

²See limitation on use of 2,4,5-T and silvex on inside cover.

³Sometimes biennial.

Table 2 (continued). Susceptibility of common weeds to control by phenoxy and some other systemic herbicides

Plant name	Type of plant	Control ¹									
		2,4-D	MCPA	2,4,5-T ²	Silvex ²	Mecoprop	2,4-DB	Dicamba	Picloram	Amitrole	Glyphosate
Sage											
Creeping (<i>Salvia somnensis</i>)	Perennial	G	F	G	F		F				
Purple (<i>S. leucophylla</i>)	Perennial	G									
White (<i>S. apiana</i>)	Perennial	G									
Sagewort, prairie (<i>Artemisia campestris</i>)	Perennial	G	G	E	G		F	G	E	G	E
Wild green (<i>A. caudata</i>)	Perennial	G	G	E	G		G	G	E	G	E
Salsify											
Common (<i>Tragopogon porrifolius</i>)	Biennial	G									
Meadow (<i>T. pratensis</i>)	Biennial	G						E	E		
Sandbur, field (<i>Cenchrus incertus</i>)	Perennial	N	N	N	N		N	N	N	G	E
Longspine (<i>C. longispinus</i>)	Annual	N	N	N	N		N	N	N	E	E
Southern (<i>C. echinatus</i>)	Annual										E
Sandwort, thymeleaf (<i>Arenaria serpyllifolia</i>)	Annual	E						G			E
Sedge, beaked (<i>Carex rostrata</i>)	Perennial	N	N	P	P		N	N	N		G
Hop (<i>C. lupulina</i>)	Perennial	N	N	P	P		N	N	N		G
Ripgut (<i>C. lacustris</i>)	Perennial	N	N	P	P		N	N	N	F	G
Sugargrass (<i>C. atherodes</i>)	Perennial	N	N	P	P		N	N	N	F	G
Umbrella (<i>Cyperus difformis</i>)	Annual	F	F	P	P						
Water (<i>Carex aquatilis</i>)	Perennial	N	N	P	P		N	N	N	F	G
Woolfruit (<i>C. obtuscarpa</i>)	Perennial	N	N	P	P		N	N	N		G
Senna, coffee (<i>Cassia occidentalis</i>)	Annual	G	P	G	G		P	E	E	E	E
Sensitive (<i>C. nictitans</i>)	Annual	G	P	E	E		P	E	E	E	E
Sicklepod (<i>C. obtusifolia</i>)	Annual	F	P	G	G		P	E	E	E	E
Wild (<i>C. marilandica</i>)	Perennial	P	P	G	E		N	G	G	G	E
Sesbania, coffeebean (<i>Sesbania exaltata</i>)	Annual	F	G	E	E		F	E	E	E	G
Shepherdspurse (<i>Capsella bursa-pastoris</i>)	Annual	G	G	E	G		G	E	E	E	E
Sida, prickly (<i>Sida spinosa</i>)	Annual	E	G	E	E		P	E	E	E	E
Signalgrass, broadleaf (<i>Brachiaria platyphylla</i>)	Annual	N	N	N	N					G	G
Fringed (<i>B. ciliatissima</i>)	Perennial	N	N	N	N		N	N	N		
Skeletonweed, rush (<i>Chondrilla juncea</i>)	Perennial	F	F					G	E		
Skunkcabbage (<i>Symplocarpus foetidus</i>)	Perennial	G		G	F						G
Smartweed											
Ladysthumb (<i>Polygonum persicaria</i>)	Annual	G	F	G	G	F	G	E	E	E	E
Pennsylvania (<i>P. pennsylvanicum</i>)	Annual	G	F	G	F		G	E	E	E	E
Water (<i>P. amphibium</i>)	Perennial	P	P	P	P		P	F	F	F	G
Snakeroot, white (<i>Eupatorium rugosum</i>)	Perennial	F		F	P						
Snakeweed											
Broom (<i>Gutierrezia sarothrae</i>)	Perennial	F	F	F	P		P	G	E	F	F
Threadleaf (<i>G. microcephala</i>)	Perennial	G		G	G				E		
Snappedragon (<i>Antirrhinum majus</i>)	Annual										E
Sneezeweed (<i>Helenium autumnale</i>)	Perennial	G	G	E	G		F	F	G	G	G
Bitter (<i>H. tenuifolium</i>)	Annual	E	E	E	E		G	E	E	E	E
Snow-on-the-mountain (<i>Euphorbia marginata</i>)	Annual	F	F	G	F		F	E	E	E	G
Sorrel (<i>Rumex acetosa</i>)	Perennial	G	F	G	F		F	E	E	E	E
Heartwing (<i>R. hastatus</i>)	Perennial	E						E	E	E	E
Red (<i>R. acetosella</i>)	Perennial	N	N	N	P	N	N	E	E	G	E
Sowthistle											
Annual (<i>Sonchus oleraceus</i>)	Annual	E	E	E			E	E	E	E	E
Perennial (<i>S. arvensis</i>)	Perennial	F	F	F	F		F	G	E	G	E
Spiny (<i>S. asper</i>)	Annual	E	E	E			E	E	E	E	E
Spanishneedles (<i>Bidens bipinnata</i>)	Annual	E	G	E	E		G	E	E	E	E
Spatterdock (<i>Nuphar lutea macrophylla</i>)	Perennial										E
Speedwell											
Common (<i>Veronica officinalis</i>)	Perennial	P	N	N	P		N	F	F		
Corn (<i>V. arvensis</i>)	Annual	P	N	N	P		N	F	F		
Purslane (<i>V. peregrina</i>)	Annual	F	N	F		F		F			
Spikerush (<i>Eleocharis macrostachya</i>)	Perennial	F	F	P	P		P				
Spurge											
Flowering (<i>Euphorbia corollata</i>)	Perennial	P		G				G	E		
Leafy (<i>E. esula</i>)	Perennial	P	N	P	F	N	N	F	G	F	F
Spotted (<i>E. maculata</i>)	Annual	P	F	P	G	F	P	E	E	F	G
Spurry, corn (<i>Spergula arvensis</i>)	Annual	P	F	N	F		N	G	E		
St. Johnswort (<i>Hypericum perforatum</i>)	Perennial	P				N					
Spotted (<i>H. punctatum</i>)	Perennial	F		F							
Star-of-Bethlehem (<i>Ornithogalum umbellatum</i>)	Perennial	N	N	P	P		N	N	N	G	G
Starbur, bristly (<i>Acanthospermum hispidum</i>)	Annual	P	N	F	F		N	G	E	E	E
Paraguay (<i>A. Australe</i>)	Annual	P	N	F	F		N	G	E	E	E
Starthistle, malta (<i>Centaurea melitensis</i>)	Annual	E		F	F			E	E		
Purple (<i>C. calcitrapa</i>)	Biennial	E	G	E	E		G	G	G	G	E
Yellow (<i>C. solstitialis</i>)	Annual	F					N	G	E	G	E
Sticktight, European (<i>Lappula echinata</i>)	Annual	G									
Strawberry, wild (<i>Fragaria spp.</i>)	Perennial	P	N	P	F	N	N	G	G	E	G
Sumpweed, rough (<i>Iva ciliata</i>)	Annual	E						E	E	E	E
Sunflower (<i>Helianthus annuus</i>)	Annual	E	G	E	E		E	E	E	G	E
Sweetclover, annual yellow (<i>Melilotus indica</i>)	Annual	E	E				E	E	E	E	E

¹For explanation of control ratings, see page 8; E=excellent, G=good, F=fair, P=poor, and N=none.

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