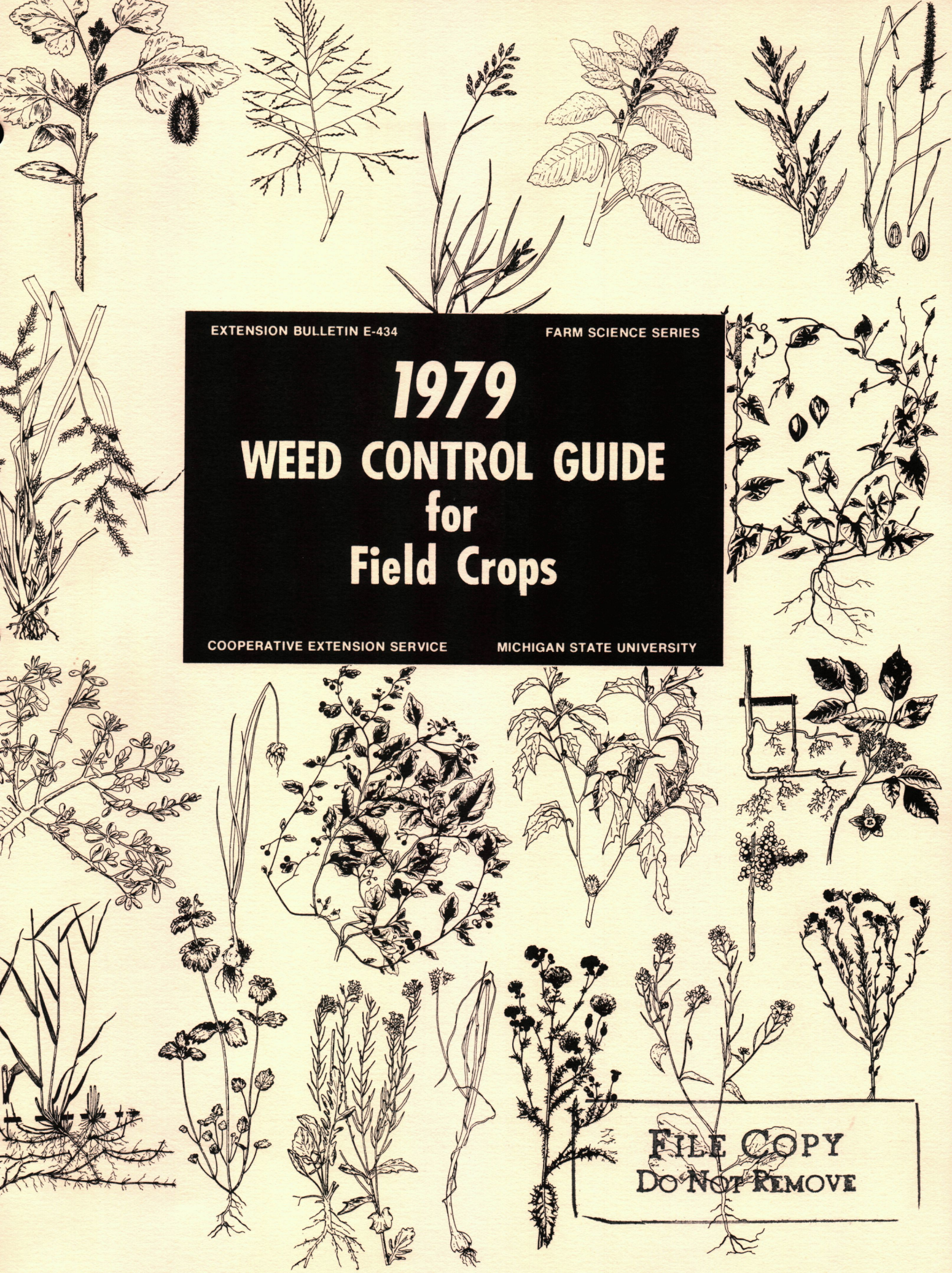




EXTENSION BULLETIN E-434

FARM SCIENCE SERIES

1979 WEED CONTROL GUIDE for Field Crops

COOPERATIVE EXTENSION SERVICE

MICHIGAN STATE UNIVERSITY

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WEED CONTROL GUIDE FOR FIELD CROPS

HERBICIDE SAFETY

1. Read label on the container carefully.
2. Use herbicides only on crops listed on the product label.
3. Apply at time and rate recommended.
4. Drift from any herbicidal spray may injure nearby crops; therefore, do all spraying on calm days.
5. A hood or shield built over the boom will help control drift.
6. Do not spray 2,4-D within $\frac{1}{2}$ mile of grapes or tomatoes. (State law prohibits use of 2,4-D esters in certain areas.)
7. Calibrate your sprayer carefully.

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Weed Control Guide for Field Crops

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THE MAIN REASON for cultivating crops is to control weeds. Chemicals (herbicides) often control weeds at a considerable savings over cultivation costs, and in some cases herbicides control weeds that cannot be controlled by normal tillage practices. However, tillage is the only practical control measure in some situations.

Cultural Control

Minimum tillage aids in control of annual weeds. The loose soil surface left by this method makes for a dry topsoil layer which discourages growth of weed seedlings.

The field cultivator equipped with duckfoot or wide shovels is one of the best tools for the control of weeds with deep roots, such as bindweed and thistles. Use the disk or springtooth harrow just before the duckfoot shovel if the soil is firm and needs loosening. Unplowed fields of quackgrass can be effectively controlled by a well-constructed field cultivator with narrow shovels if the operation is repeated often and if the season is dry.

The rotary hoe, spiketooth harrow, and weeder are effective on annual weed seedlings in row crops. Use these tools just after planting, while the crop is coming up or just after it is up. For effective weed control, use these tools when the weed seedlings are just coming through the ground; weeds with much top-growth may not be controlled.

Plowing is usually necessary to kill and bury a heavy weed growth. Fall plowing brings roots and root-stocks to the surface where they are injured by winter freezing.

Chemical Weed Control

Many chemical weed-killers are now available. Selective control of weeds in crops may be obtained by either foliage sprays (postemergence) or application of the chemicals to the soil either as preplanting or preemergence sprays.

Preplanting and preemergence sprays are available for corn, potatoes, field beans, soybeans, sugar beets, sunflowers, alfalfa and birdsfoot trefoil.

Preplanting sprays sometimes are applied to the weed before plowing (quackgrass).

Preemergence sprays are applied after planting but before the crop appears above ground.

Some advantages of preemergence herbicide applications are:

- (1) Generally better weed control than with post-emergence applications;
- (2) Less chance of damage to the crop, compared with postemergence applications;
- (3) No weed competition to the crop with early control of weeds;
- (4) Weeds already controlled in cases where wet weather later delays cultivation or spraying;
- (5) Planting and herbicide application may be done in one operation;
- (6) In the case of corn, herbicides can be used which will not present a hazard to nearby 2,4-D sensitive crops and plants.

Some disadvantages of preemergence herbicide applications are:

- (1) Preemergence applications are generally ineffective under dry soil conditions. Some preemergence herbicides are ineffective if dry conditions persist for only a few days; other herbicides may give weed control after as much as 10 days to 2 weeks of dry weather.
- (2) On sandy soils, heavy rains may leach the herbicide down to the germinating crop seed and cause injury.
- (3) Perennial weeds usually are not controlled by preemergence herbicide applications.
- (4) Planting operations may be slowed somewhat when herbicides are applied at planting time.

Postemergence sprays, applied after the crop has emerged, are available for corn, small grains, small seeded legumes, potatoes and sugar beets. Post-emergence sprays have the advantage of use in emergencies since they are not applied until the weeds are up. They can be used on any soil type, and soil moisture conditions are not a problem. However, in some cases there is greater risk of crop injury. Post-emergence sprays should not be applied when the plants are already wet with dew or rain. Postemergence sprays are usually more effective (though also more injurious to the crop) at high temperatures.

Temperature greatly influences the effectiveness and volatility of many postemergence herbicides. Ideally, postemergence herbicides should be applied when temperatures range between 65 and 85° F. Low tem-

peratures (below 60° F) may result in reduced weed control, while temperatures above 85° F may result in crop injury. If temperatures above 85° F are predicted during the day, late afternoon herbicide applications are less likely to result in herbicide injury than are early morning applications. Early morning application predisposes the crop plant to longer periods of high temperatures, which increases the potential for herbicide injury.

Volatile herbicides such as dicamba (*Banvel*) or ester formulations of 2,4-D or MCP may vaporize at temperatures as low as 70° F. Once they are vaporized, wind may move sufficient vapors to areas with sensitive crops to cause crop injury. Extreme caution is required when applying postemergence herbicides near sensitive crops. Amine formulation eliminates the danger of vapor drift; however, spray drift (droplets) may still occur. Reduce the possibility of spray drift by using a maximum of 35 pounds pressure, maintaining proper spray boom height and by using fan type nozzles rather than the hollow cone type.

Principles of Chemical Control of Weeds

1. Weeds are easiest to kill when they are small seedlings and when conditions favor rapid growth. Crop plants also are most easily injured under these conditions. Selective sprays (see Table 1) will control the weeds with little or no injury to the crop.

2. Preemergence applications will generally give better weed control than postemergence applications.

3. Time of spraying and rate of applications are very important. Spraying at the wrong time often results in poor weed control and greater crop injury. No crop plant is completely resistant to injury from herbicides. Too much chemical will cause damage.

4. With 2,4-D and most preemergence herbicides, do not cultivate for at least 3 weeks after pre-emergence spraying unless weeds appear that are resistant to the chemical. If weeds appear and dry weather persists for 2 weeks after herbicide application, rotary hoe or cultivate shallow. Delay cultivation after postemergence herbicide applications for at least 2 or 3 days to allow the chemical to move into stems and roots of the weed plants.

5. No one chemical used as a selective spray will kill all species of weeds. Therefore, select the right chemical for the job. Some weeds are resistant to all of the present selective sprays.

6. Read current labels carefully and never apply a chemical at rates higher than recommended on the label. Use chemicals only on crops for which they are recommended on the label. Store chemicals in a room not subject to freezing temperatures and away from both seed, fertilizer and other pesticides.

Herbicide Combinations

Two or more herbicides are often applied as a tank mix or in separate applications to give more consistent or broader spectrum weed control. Combinations are also used to decrease herbicide residue (for example, atrazine carryover) or to obtain adequate season-long control.

Only recommended or labeled herbicide combinations should be used. Growers and applicators are responsible for poor weed control, crop injury or herbicide residue from herbicides labeled for single application but used in combinations.

Pesticide — Fertilizer Compatibility

Combinations of herbicides, insecticides and/or fungicides applied in either water or liquid fertilizer carriers decrease trips over the field and application costs; however, compatibility is critical. Always test the compatibility of each mixture to be applied and follow label instructions.

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

If more than one pesticide is to be mixed with liquid fertilizer or water, the pesticides should be premixed in liquid fertilizer or water and tested for compatibility by mixing appropriate proportions of all components. The combination should be thoroughly agitated before each additional pesticide is added, and a specific mixing order should be followed. Generally, unless label directions state otherwise, add the pesticides being tested in the following order: first—wetable powders, second—flowables, third—water solubles, fourth—surfactants and emulsifiable concentrates. Spray tanks should be at least half filled with carrier before the pesticide premixes are added. If the mixture foams excessively, separates or becomes syrupy, do not apply the mixture. Compatibility agents are available which may be added to improve mixing ability.

Even if all components appear compatible, the field tank mixture will require constant, vigorous agitation to prevent separation or improper pesticide distribution in the tank. Do not store pesticide mixtures over-

night unless they are constantly agitated. Best results are obtained by applying the entire mixture in one day. (See Extension Bulletin E-1268)

Soil Type and Organic Matter

Soil texture (sand, silt, clay) and organic matter influence the effectiveness of soil-applied herbicides. Herbicide rate recommendations in this bulletin are given for medium-textured soils with greater than 3% organic matter. Clay and organic matter adsorb herbicides, making them less available to germinating weeds and crop plants. Soils with high clay and organic matter content require greater herbicide rates for adequate weed control. Sandy soils with low organic matter content require careful herbicide rate selection to avoid crop injury.

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

Organic matter analyses are only as accurate or representative as the soil sample, so each field should be checked individually. See MSU Ag Fact 49 (Extension Bulletin E-498), *Sampling Soils*, for proper soil sampling procedure.

Follow herbicide label recommendations and adjust herbicide rate for soil texture and organic matter as specified on the label.

Herbicide Residues and Bioassay

With the advent of preplant and preemergence herbicides which give season-long weed control, the accumulation of herbicides in the soil and their influence on subsequent crops in the rotation have become important in crop management. This is particularly true since atrazine has come into common use on corn. However, when used at recommended rates in seasons of normal rainfall and temperature, most recommended herbicides for field crops do not present a problem on crops planted the following season. Exceptions are listed in "Remarks" column of Table 1.

Although there have been reports of injury to crops following atrazine applications on corn, these reports generally have been in situations where more than the recommended rate of 2 lb. per acre has been applied; exceptions have been on oats, sugar beets and field beans. There is more likely to be a problem with herbicide residues in a season of limited rainfall and cool temperatures, due to the slow dissipation of the herbicide. (See Extension Bulletin E-1215)

Carry-over problems have been most commonly reported for two groups of herbicides, the triazines (ex. atrazine) and the dinitroanilines (ex. *Treflan*). If soybeans follow corn, or sugar beets follow a crop treated with dinitroaniline and if herbicide carry-over is a possibility, a bioassay late in the fall prior to freeze-up or early in the spring may indicate whether enough herbicide is present to harm the crop. A herbicide bioassay is a means of biologically measuring the level of herbicide in the soil. The bioassay procedure is a relatively simple test but a few basic steps should be followed.

1. Collect soil samples from several locations in the field as when taking soil samples. Reliability of the assay depends on accurate sampling. Sample soil to the depth the field has been tilled. Approximately 5 lb. of soil are needed for each sample. Collect an equal amount of soil from an adjacent field where it is *known* no herbicide has been applied. This second sample is used as a "check."
2. Start bioassay within one or two weeks after soil is collected to prevent the loss of herbicide under warm conditions. If the assay cannot be run immediately, store the soil in a cool place, or even allow it to freeze.
3. If soil is wet, allow it to dry so that it may be worked easily. If the soil is cloddy, crush the clods but do not pulverize.
4. Partially fill two 1-qt. containers with soil, one with the soil being tested and the other with soil from the "check" field. Punch holes in the bottom of the containers to allow drainage. Tin cans or milk cartons make satisfactory containers.
5. Plant 15 seeds of a sensitive crop in each container and cover with $\frac{1}{2}$ inch of soil. Wet the soil but do not saturate. Oats are very sensitive to both triazines and dinitroanilines, and sugar beets and sorghum are extremely sensitive to dinitroanilines. Place exactly the same number of seeds in each container. By knowing the exact number of seeds planted, seedling emergence can be measured. Do not plant too many seeds or the seedlings may compete for the herbicide and decrease the injurious effects.
6. Place containers in a warm place (70 to 75° F), preferably in a window to receive as much sunlight as possible. Additional artificial light should also be supplied to obtain approximately a 15-hour day length. Water plants sparingly, but do not let soil dry out.
7. Determine plant emergence, and monitor plant growth for at least three weeks after planting. Compare "check" plants with those in the soil being tested.

8. Atrazine injury may cause yellowing of the oat leaves, with the plant becoming droopy and finally dying, or if carry-over is marginal, stunting may occur. Stunting can be determined by a comparison with "check" plants. Dinitroaniline (*Treflan*, etc.) injury may result in a decrease in seedling emergence and/or stunting of the sugar beet or sorghum.
9. If any evidence of herbicide carry-over is observed, it is advisable to plant a resistant crop.

Weed Sprayers

Crop injuries often result when sprayers used for weed control are also used for disease and insect control. Some chemicals are more difficult to wash from a sprayer than others, and wooden tanks are more difficult to clean than steel tanks. Hand sprayers of 3- or 4-gal. capacity are suitable for small areas of 1 acre or less and for patch spraying. Tractor-mounted sprayers driven from the power takeoff are very satisfactory for larger areas. (See Michigan Circular Bulletin C-24 for types of spray equipment.)

A good weed sprayer should:

1. Have a pump which is inexpensive, easily replaced, resistant to wear and chemicals and has a minimum capacity of 4 gal. per minute.
2. Provide some means of keeping the solution well mixed. This can be by mechanical or jet agitation, using a bypass from the pump.
3. Have 50-mesh screens for suction line and nozzles.
4. Have a gauge which measures pressure accurately in the range of 20 to 100 lb. per square inch.
5. Have flat fan nozzles with replaceable tips. Wide angle nozzles (73 to 80 degrees) will permit the boom to be carried closer to the ground and thus reduce spray drift.

Cleaning and Storage

Keep weed sprayers clean. Where preemergence spraying only is practiced, thorough rinsing with water is sufficient. For other spraying purposes, wash out the sprayer (tank, hose, boom, nozzles) with one of the following in 100 gal. water:

1. 1 gal. household ammonia (allowed to stand in sprayer overnight).
2. 5 lb. of sal soda.
3. 8 lb. trisodium phosphate.

Corrosion and mechanical damage to pumps, tanks, nozzles, etc. may result from leaving water in spray equipment over winter. Thoroughly clean spray equipment after each spraying operation; however, even when properly cleaned, some water may remain in the sprayer. To prepare the spray equipment for storage, disconnect all hoses, and allow all water to drain. Coat all bare metal parts with oil or a rust inhibitor.

Disassemble metal nozzles, and store them in oil. Prepare the sprayer pump for storage based on the manufacturer's recommendations.

Band Application

In cultivated crops, spraying narrow bands of herbicide over the rows will take less material per acre, cutting the cost per acre for the chemical. Where chemical costs are high, band spraying may be justified. However, with band spraying, timely cultivation of weeds in the unsprayed area between rows is necessary. In seasons when the soil is too wet to cultivate, overall spraying has the advantage of controlling weeds between the rows.

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

Accurate Calibration

MATERIALS REQUIRED

A quart container graduated in ounces.

Sufficient string to tie container to nozzle tip.

PRELIMINARY STEPS

1. Make certain that nozzle tips are of proper type for the spray job and of proper size for gal./acre. (When in doubt, consult a *Spraying Systems* catalog.)
2. Be sure all nozzle tips are of the same size and type and that screens are of proper mesh. (For most wettable powders, 50-mesh or coarser screens are recommended.)
3. For spraying wettable powders, be sure the sprayer is equipped with some type of jet or mechanical agitation.

PROCEDURE

1. In a band application, accurately determine the width, in inches, of the band sprayed. In a broadcast application, measure the distance, in inches, between two adjacent nozzles.
2. Locate this width in the table below and read off the corresponding course distance.

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

3. In the field to be sprayed, mark off course of the proper distance.

4. Tie quart container to one nozzle on the sprayer so as to catch all of that nozzle's spray when sprayer is turned on.

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

6. Remove quart container, and read volume collected IN OUNCES.

7. Ounces Collected = gal./acre.

This procedure can be used to calibrate sprayers for both banded and broadcast type applications. For a given recommendation, the actual amount of material to be applied per square foot of soil treated should be the same for both types of application. Banding reduces the amount of chemical used by reducing the number of square feet treated per acre.

After using the above procedure for calibration of sprayer, remember that the gal./acre figure determined is for each acre (43,560 sq. ft.) treated, NOT necessarily each acre driven over. In a broadcast application, the acres treated will be equal to the acres driven over.

When using a banded application, add material to the volume of water so as to achieve the overall recommended rate. For example, a sprayer attachment applying a 12-in. band on 36-in. rows is calibrated by this method, and is found to be delivering 20 gal./acre.

Granular Formulations

Herbicides are available in granular form for dry application. Granules are usually applied in a band over the row at planting time, but they may also be broadcast. Usually, equal weed control can be expected from granular and spray formulations, but in some cases granules have not given as good weed control as the sprays. This generally has been due to either the use of equipment giving nonuniform distribution of the granules or to formulations with too

high a concentration, resulting in inadequate volume for uniform distribution.

Granular herbicides eliminate the need for a water supply and they reduce the drift hazard. But there still is a volatility hazard from granular formulations of 2,4-D ester applied near sensitive crops—especially grapes and tomatoes. Granules give best results on fine, firm seedbeds. A wide, flat press wheel on the planter is desirable for band application at planting. Weed control may be hampered when granules are applied on a rough seedbed, because of uneven application, such as that often obtained with minimum tillage.

The use of granular formulations does not eliminate the need for calibration. Various materials will “feed” differently because of variations in carrier and in particle size. Therefore, granular applicators should be accurately calibrated, just as a sprayer should be accurately calibrated.

Herbicide Rates and Spray Volume

Table 1 lists chemicals which will give satisfactory weed control without injury to crops, except as noted under “Remarks.” The volume of water to use will vary with the herbicide, although generally 10 to 40 gal. per acre and a spraying pressure of 30 to 40 lb. is recommended. A minimum of 10 gal. of water per acre is recommended for the phenoxy herbicides [2,4-D, MCPA, 4—(2,4-DB)]. With wettable powders such as atrazine and linuron, use nozzles that deliver at least 15 gal. per acre. Use 30 to 40 gal. of spray per acre when spraying quackgrass with atrazine or dalapon.

Some herbicides are available in a number of different formulations and concentrations. For this reason the recommended rates in Table 1 (col. 3) are given as pounds of active ingredients per acre. Thus when a liquid formulation contains 4 lb. of active ingredient (or acid equivalent) per gallon, 1 pt. will provide ½ lb. of active ingredient, or 1 qt. will provide 1 lb. of active ingredient.

TABLE 1—CHEMICALS FOR WEED CONTROL IN FIELD CROPS

Rates are expressed in pounds of active ingredient (a.i.) per acre for the area actually sprayed: rates in formulation column are expressed as pounds or liquid measure of product unless otherwise noted. (NOTE: COMMERCIAL RATES ARE EXPRESSED IN PT OR QT OR GAL OR LB.)

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

WEED CONTROL GUIDE FOR CORN

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A*	Remarks and Limitations
Preplant — Mineral Soil				
Annual broadleaves Annual grasses (except green foxtail, fall panicum, witchgrass and crabgrass)	atrazine (commercial product)*	2	2½ lb or 2 qt	— Usually obtain season-long control. — Do not plant small grain, small seed forages, sugar beets, field beans or vegetable crops the year following corn. — Rates of 2½ to 3 lb per acre may be necessary on soil high in organic matter (5 to 8%). — Residues more likely to persist if soil conditions are cool and dry. — Incorporation is not necessary.
Annual broadleaves (including green foxtail, fall panicum, witchgrass, and crabgrass)	butylate (Sutan Plus) + atrazine (commercial product)*	3½ + 1	2 qt + 1½ lb or 1 qt	— DO NOT USE ON CORN SEED STOCKS (Breeders, Foundation, or Increase). — Must be incorporated or mixed into top 2 to 3 in. of soil immediately after application; work in 2 directions. — Usually obtain season-long control. — For good control of nutsedge, increase rate of Sutan Plus to 2½ qt per acre.
Nutsedge	butylate (Sutan Plus) + cyanazine (Bladex)*	3½ + 2	2 qt + 2½ lb or 2 qt	— DO NOT USE ON CORN SEED STOCKS (Breeders, Foundation, or Increase). — Must be incorporated or mixed into top 2 to 3 in. of soil immediately after application. — For good control of nutsedge, increase rate of Sutan Plus to 2½ qt per acre.
Nutsedge	butylate (Sutan Plus)	4	2½ qt	— Incorporate to depth of 2 to 3 in. — Control of late-season grasses.
Annual broadleaves (including green foxtail, fall panicum, witchgrass and crabgrass)	atrazine (commercial product)* + EPTC with protectant (Eradicane)	1 + 6	1½ lb or 1 qt + 3½ qt	— Incorporate to a depth of 4 to 5 in. immediately after application with a disk in both directions.
Nutsedge Quackgrass				— Quackgrass control with no soil residue or carry-over.

*NOTES: Commercial atrazine is available under several trademarks. Most formulations are 80W (80% wettable powder)—1¼ lb of product equals 1 lb of active ingredient—or 4L (flowable)—1 qt of product equals 1 lb of active ingredient. Princep and Bladex are also available as an 80W or 4L. Volumes of 2,4-D and MCPA based on 4 lb/gal formulation. Sencor and Lexone available as 50W (50% wettable powder) and 4 lb/gal flowable formulations as Sencor 4 and Lexone 4L.

Annual broadleaves Annual grasses (including green foxtail, fall panicum, witchgrass and crabgrass)	atrazine (commercial product) *	1	1 ¼ lb or 1 qt	— CLEARED FOR GRAIN CORN ONLY. — Gives better nutsedge control if incorporated 2 to 3 in. — Will be more effective preplant, especially on nutsedge, in areas where soils tend to be dry.
	+ metolachlor (Dual)	+	+	
		2	1 ½ qt	
	atrazine (commercial product) *	1	1 ¼ lb or 1 qt	— For fair to good control of nutsedge, increase rate of <i>Lasso</i> to 3 qt per acre.
	+ alachlor (Lasso)	+	+	— Will be more effective preplant, especially on nutsedge, in areas where soils tend to be dry.
		2	2 qt	— 2 ½ qt per acre of <i>Lasso</i> should be used for more effective fall panicum control.
	atrazine (commercial product) *	½	½ lb or ½ qt	— NOTE SPECIFIC REMARKS ABOVE FOR SUTAN PLUS, ERADICANE, DUAL AND LASSO.
	+ cyanazine (Bladex) *	+	+	— Can be used to reduce possibility of atrazine carry-over.
	+ Sutan Plus or Eradicane or Dual or Lasso	1	1 ¼ lb or 1 qt	
		+	+	
		3 ½	2 qt	
		or	or	
		6	3 ½ qt	
		2	or	
		or	1 ½ qt	
		2	or	
		or	2 qt	

Preemergence — Mineral Soil

Annual broadleaves Annual grasses (including fall panicum, green foxtail, witchgrass and crabgrass)	atrazine (commercial product) *	1	1 ¼ lb or 1 qt	— For fair to good control of nutsedge, increase rate of <i>Lasso</i> to 3 qt per acre.
	+ alachlor (Lasso)	+	+	— Will be more effective preplant, especially on nutsedge, in areas where soils tend to be dry.
		2	2 qt	— 2 ½ qt acre of <i>Lasso</i> should be used for more effective fall panicum control.
				— May substitute <i>Princep</i> for Atrazine if fall panicum is a severe problem.
	atrazine (commercial product) *	1	1 ¼ lb or 1 qt	— CLEARED FOR GRAIN CORN ONLY.
	+ metolachlor (Dual)	+	+	— May substitute <i>Princep</i> for Atrazine if fall panicum is a severe problem.
		2	1 ½ qt	
	atrazine (commercial product) *	1	1 ¼ lb or 1 qt	— DO NOT INCORPORATE.
	+ pendimethalin (Prowl)	+	+	— Do not use on sandy soils with less than 1.5% organic matter.
		1 ½	1 ½ qt	

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A*	Remarks and Limitations
	cyanazine (<i>Bladex</i>)* + alachlor (<i>Lasso</i>)	1½ + 2	1½ lb or 1½ qt + 2 qt	— No residue carry-over. — Can be used where residue problems have existed with atrazine.
	cyanazine (<i>Bladex</i>)* + metolachlor (<i>Dual</i>)	1½ + 2	1½ lb or 1½ qt + 1½ qt	— CLEARED FOR GRAIN CORN ONLY. — No residue carry-over. — Can be used where residue problems have existed with atrazine.
	cyanazine (<i>Bladex</i>)* + atrazine (commercial product)*	2 + 1	2½ lb or 2 qt + 1¼ lb or 1 qt	— Reduced residue carry-over. — Less effective on fall panicum, witchgrass and crabgrass.
	dicamba (<i>Banvel</i>) + alachlor (<i>Lasso</i>)	% + 2	¼ pt + 2 qt	— HAZARD OF INJURY FROM <i>BANVEL</i> ON NEARBY SENSITIVE CROPS. — Injury may occur on sandy and loamy sand soils. — Longevity of broadleaved weed control is limited.
	atrazine (commercial product)* + simazine (<i>Princep</i>)*	1 + 2	1¼ lb or 1 qt + 2½ lb or 2 qt	— Corn must be grown a second year as residue will result. — Rainfall necessary for effective early control.
	atrazine (commercial product)* + cyanazine (<i>Bladex</i>)* + <i>Lasso</i> or <i>Prowl</i> or <i>Dual</i>	½ + 1 + 2 or 1½ or 2	½ lb or 1 pt + 1¼ lb or 1 qt + 2 qt or 1½ qt or 1½ qt	— Can be used to reduce possibility of atrazine carry-over. — See specific remarks below for <i>Lasso</i> , <i>Dual</i> and <i>Prowl</i> .
Annual broadleaves Annual grasses (except green foxtail, fall panicum, witchgrass and crabgrass)	atrazine (commercial product)*	2	2½ lb or 2 qt	— Usually obtain season-long control. — Do not plant small grain, small seeded forages, sugar beets, field beans or vegetable crops the year following this treatment. — Rates of 2½ to 3 lb per acre may be necessary on soils high in organic matter (5 to 8%). — Residues more likely to persist if soil conditions are cool and dry.

Annual broadleaves (except pigweed)	pendimethalin (<i>Prowl</i>) + cyanazine (<i>Bladex</i>)*	1½	1½ qt	— Do not use on sandy soils with less than 1.5% organic matter. — Both materials weak on pigweed.
		+ 1½	+ 1½ lb or 1½ qt	
Annual grasses (including fall panicum, green foxtail, witchgrass and crabgrass)	cyanazine (<i>Bladex</i>)*	2%	3¼ lb or 2% qt	— No residue carry-over. — Poor control of pigweed.
Annual grasses (including fall panicum, green foxtail, witchgrass and crabgrass)	alachlor (<i>Lasso</i>)	2	2 qt	— Fair to good control of nutsedge at 3 lb per acre. — Follow with 2,4-D amine postemergence for control of annual broadleaved weeds if needed. — Application may be made preplant. — (See remarks under "Nutsedge control.")
		2	1½ qt	— Follow with 2,4-D amine postemergence for control of annual broadleaved weeds if needed. — Application may be made preplant. — (See remarks under "Nutsedge control.")
Nutsedge	alachlor (<i>Lasso</i>)	3	3 qt	— Under conditions of limited rainfall, shallow incorporation (2 to 3 in.) may improve control of nutsedge and late-season grasses.
		2	1½ qt	— Under conditions of limited rainfall, shallow incorporation (2 to 3 in.) may improve control of nutsedge and late-season grasses. Labeled for grain corn only.

Postemergence — Mineral Soils

Annual broadleaves only	2,4-D* amine	½	1 pt	— For corn over 6 to 8 in. use drop nozzles. — Ester formulations will cause more crop injury and are not recommended. — Not effective on smartweed. — Hybrids vary in tolerance. — Most effective when weeds are small (2-4 in.).
		2	2½ lb	— USE WETTABLE POWDER ONLY. — Apply before weeds are 1½ in. tall. — Apply before corn is 4 in. tall. — Some temporary setback or stunting of corn may occur, especially in sandy soil.
Annual broadleaves Annual grasses	cyanazine (<i>Bladex</i>)* ametryne (<i>Evik</i>) + surfactant	1%	2 lb	— CAUTION—KEEP OFF CORN FOLIAGE. — Emergency use.
		+ 1 pt	+ 1 pt	— Use drop nozzles or directed spray.

Corn —

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A*	Remarks and Limitations
Annual broadleaves Annual grasses (except green foxtail, fall panicum, witchgrass and crabgrass)	atrazine + crop oil or emulsifier concentrate	2 + 1 gal or 1 qt	2½ lb or 2 qt + 1 gal or 1 qt	— Emergency use. — Grasses must be less than 1½ in. tall. — Timing of application is critical to get best results. — Use a high grade nonphytotoxic crop oil or crop oil-emulsifier concentrate specified for this purpose. — Surfactants used in place of crop oil or concentrate are somewhat less effective. — Greater chance for residue since treatment is later in season.
Velvetleaf, jimsonweed, smartweed, wild buck- wheat, Canada thistle	dicamba (<i>Banvel</i>)	¼	½ pt	— Do not add <i>Banvel</i> or 2,4-D as injury may occur. — USE EXTREME CAUTION. — DRIFT TO NEARBY SENSITIVE CROPS IS A HAZARD. — For corn over 6 to 8 in. use drop nozzles. — Use pressure less than 20 psi. — Do not apply if soybeans in the vicinity are over 10 in. tall or have begun to bloom.
Nutsedge	atrazine + crop oil or emulsifier concentrate	2 + 2 See Remarks + 1 gal or 1 qt	2½ lb or 2 qt + 1 gal or 1 qt	— Apply 2 lb of atrazine per acre when nutsedge is 2 in. tall, and apply 2 lb atrazine per acre 2 weeks later. On muck soils, the two repeat applications should be applied at 1 lb per acre plus 1 gal of oil or 1 qt of concentrate at 1-week intervals after the initial treatment.
Nutsedge Canada thistle	bentazon (<i>Basagran</i>)	¾ + ¾ See Remarks	1½ pt + 1½ pt	— TWO ¾ lb APPLICATIONS REQUIRED FOR BEST NUTSEDGE AND CANADA THISTLE CONTROL. — Controls only specific broadleaves. — Check label for specific rate at proper weed growth stage.
Preemergence — Organic Soils				
Annual grasses	propachlor (<i>Ramrod</i> or <i>Bexton</i>)	5	8 lb	— Must follow with a postemergence treatment for control of broadleaved weeds.
Postemergence — Organic Soils				
Annual broadleaves Annual grasses (except fall panicum, green foxtail, witchgrass and crabgrass)	atrazine + crop oil or emulsifier concentrate	3 + 1 gal or 1 qt	3¾ lb or 3 qt + 1 gal or 1 qt	— Emergency use. — Grasses should be less than 1½ in. tall. — Timing of application is critical to get best results. — Use a high-grade, nonphytotoxic crop oil or crop oil-emulsifier concentrate specified for this purpose. — Surfactants used in place of crop oil or concentrate are somewhat less effective. — Greater chance for residue since treatment is later in season.

Annual broadleaves	2,4-D* amine	½	1 pt*	— For corn over 6 to 8 in., use drop nozzles. — Ester formulations will cause more corn injury and are not recommended. — Not effective on smartweed. — Hybrids vary in tolerance.
Velvetleaf, jimsonweed, smartweed, wild buckwheat, Canada thistle	dicamba (<i>Bancel</i>)	¼ lb	½ pt	— USE EXTREME CAUTION. — DRIFT TO NEARBY SENSITIVE CROPS IS A HAZARD. — For corn over 6 to 8 in., use drop nozzles. — Use pressure less than 20 psi. — Do not apply if soybeans in the vicinity are over 10 in. tall or have begun to bloom.
Nutsedge Canada thistle	bentazon (<i>Basagran</i>)	¾ + ¾ See Remarks	1½ pt + 1½ pt	— TWO ¾ lb APPLICATIONS REQUIRED FOR BEST NUTSEDGE AND CANADA THISTLE CONTROL. — Controls only specific broadleaves. — Check label for specific rate at proper weed growth stage.
Nutsedge	atrazine (commercial product)* + crop oil or emulsifier concentrate	2 + 1 + 1 See Remarks + 1 gal or 1 qt	2½ lb or 2 qt + 1 gal or 1 qt	— Apply 2 lb atrazine per acre when nutsedge is 2 in. tall, and apply two repeat applications at 1 lb per acre plus 1 gal of oil or 1 qt concentrate at 1-week intervals after the initial treatment.

Quackgrass

Quackgrass	atrazine (commercial product)*	4	5 lb or 4 qt	— When stand of quackgrass is heavy, apply in fall. — Otherwise apply in spring when quackgrass is 4 to 8 in. tall. — Wait at least 10 days to plow. — Split application; apply 2 lb per acre preplow and 2 lb per acre preemergence to give control of annual weeds also. — When a total of 4 lb of atrazine is used, corn must be grown two consecutive years.
	atrazine (commercial product)* + EPTC with protectant (<i>Eradicane</i>)	1 + 6	1½ lb or 1 qt + 3½ qt	— Incorporate to a depth of 4 to 5 in. immediately after application with a disk, 2 times in opposite directions. — Quackgrass control with no soil residue or carry-over.

No-Till

See Extension Bulletin E-907, *No-Till Corn*: 4 WEED CONTROL. Many of the above preemergence herbicides are labeled for no-till application in combination with paraquat. Check specific label recommendation for herbicide rates.

WEED CONTROL GUIDE FOR SOYBEANS

Preplant

Weed Controlled	Herbicide	Rate lb/A a.i. %	Formulation/A *	Remarks and Limitations
Annual grasses Annual broadleaves (except ragweed, mustard and smartweed)	trifluralin (<i>Treflan</i>)	%	1½ pt	— Incorporate or mix thoroughly into top 2 or 3 in. of soil within 4 to 8 hr after application. — On sandy and sandy loam soils low in organic matter, use ½ lb (1 pt) per acre. — Most effective control if application is made 10 days to 2 weeks ahead of planting and field reworked just prior to planting.
	dinitramine (<i>Cobex</i>)	½	2 pt	— Incorporate or mix thoroughly into top 2 to 3 in. of soil within 24 hr after application.
	profluralin (<i>Tolban</i>)	1	2 pt	— Incorporate thoroughly in top 2 to 3 in. of soil within 4 hr of application. — Use ¾ lb per acre (1½ pt) on coarse-textured soils low in organic matter.
	fluchloralin (<i>Basalin</i>)	1	2 pt	— Incorporate within 8 hr of application in top 1 to 2 in. — May apply 6 to 8 weeks before planting.
	pendimethalin (<i>Prowl</i>)	1	2 pt	— Incorporate in top 2 to 3 in. — Incorporate within 168 hr (7 days) unless rainfall occurs (¼ to ½ in.).
Annual grasses Annual broadleaves	Combine any of the above dinitroanilines with metribuzin (<i>Sencor</i> or <i>Lexone</i>)*	%	¾ lb or ¾ pt	— Some control of jimsonweed, velvetleaf and cocklebur. — See specific remarks for each dinitroaniline herbicide. — Reduce rate if soil pH is above 7.0.
	Combine any of the above dinitroanilines with chloramben (<i>Amiben</i>)	2	1 gal	— See specific remarks for each dinitroaniline herbicide. — Increased mustard and ragweed control over dinitroaniline alone.

Preplant Followed by Preemergence

Dinitroanilines as listed above applied preplant incorporated

Annual broadleaves Annual grasses	FOLLOWED BY: chloramben (<i>Amiben</i>)	2	1 gal	— Applied preemergence.
	dinoseb (<i>Premerge</i> or <i>Sinox PE</i>)	4½	1½ gal	— Applied preemergence.
	metribuzin (<i>Sencor</i> or <i>Lexone</i>)*	%	¾ lb or ¾ pt	— Applied preemergence. — Some control of jimsonweed and cocklebur. — Reduce rate if soil pH is above 7.0.
	linuron (<i>Lorox</i>)	%	1½ lb	— Applied preemergence.

Preemergence

Annual broadleaves Annual grasses	chloramben (<i>Amiben</i>)	3	1½ gal	— May be necessary to rotary hoe if rainfall does not occur within 4 to 5 days after application.
	linuron (<i>Lorox</i>)	1½	3 lb	— Don't use on coarse-textured sandy or loamy sand soils or on soils with less than 2.5% organic matter. — Some control of velvetleaf. — Plant soybeans at least 1¾ in. deep.
	linuron (<i>Lorox</i>) + alachlor (<i>Lasso</i>)	¾ + 2	1½ lb + 2 qt	— Better crop tolerance than <i>Lorox</i> alone at 1½ lb per acre on sandy and sandy loam soils low in organic matter.
	chloramben (<i>Amiben</i>) + linuron (<i>Lorox</i>)	2 + 1	1 gal + 2 lb	— Better crop tolerance than <i>Lorox</i> alone at 1½ lb per acre on sandy and sandy loam soils low in organic matter.
	chloramben (<i>Amiben</i>) + alachlor (<i>Lasso</i>)	2 + 2	1 gal + 2 qt	— Preferred on sandy soils low in organic matter where injury has been a problem.
	metribuzin (<i>Sencor</i> or <i>Lexone</i>)*	½	1 lb or 1 pt	— Some injury may occur on sandy soils or with high rainfall. — Only fair control of annual grasses. — Control of cocklebur and jimsonweed. — Reduce rate if soil pH is above 7.0.
	metribuzin (<i>Sencor</i> or <i>Lexone</i>)* + alachlor (<i>Lasso</i>)	¾ + 2	¾ lb or ¾ pt + 2 qt	— Some control of cocklebur and jimsonweed. — Better grass control than <i>Sencor</i> or <i>Lexone</i> alone. — Reduce <i>Sencor</i> or <i>Lexone</i> rate if soil pH is above 7.0.
	alachlor (<i>Lasso</i>) + naptalam + dinoseb (<i>Dyanap</i>)	2 + 6 qt	2 qt + 6 qt	— Apply 3 days after planting and before soybean leaves open.

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A*	Remarks and Limitations
Postemergence				
Annual broadleaves (including cocklebur, velvetleaf and jimsonweed)	bentazon (<i>Basagran</i>)	$\frac{3}{4}$	1 $\frac{1}{2}$ pt	— No activity from <i>Basagran</i> preemergence. — Rate for nutsedge should be increased to 1 lb per acre if only 1 treatment is made.
Nutsedge	bentazon (<i>Basagran</i>)	$\frac{3}{4}$ + $\frac{3}{4}$	1 $\frac{1}{2}$ pt + 1 $\frac{1}{2}$ pt	— Treat when nutsedge is 3 to 4 in. and again 10 days later. — See nutsedge remarks under Special Weed Problems.
Special Weed Problems				
Velvetleaf	pendimethalin (<i>Prowl</i>)	1	1 qt	— Preplant incorporated.
	+ chloramben (<i>Amiben</i>)	+	+	— Only fair control.
	+ metribuzin (<i>Sencor</i> or <i>Lexone</i>)*	2	4 qt	— Some soybean injury may occur.
		+	+	
Jimsonweed	metribuzin (<i>Sencor</i> or <i>Lexone</i>)*	$\frac{1}{2}$	$\frac{3}{4}$ lb or $\frac{3}{4}$ pt	— Preemergence. — Fair to good control. — Some soybean injury may occur.
Nutsedge	alachlor (<i>Lasso</i>)	3	3 qt	— Preemergence. — Some early distortion may be observed on soybean leaves. — Shallow incorporation will improve control under conditions of limited moisture.
	bentazon (<i>Basagran</i>)	$\frac{3}{4}$ + $\frac{3}{4}$ See Remarks	1 $\frac{1}{2}$ pt + 1 $\frac{1}{2}$ pt	— TWO $\frac{3}{4}$ -lb APPLICATIONS REQUIRED FOR BEST NUTSEDGE CONTROL. — Postemergence. — Treat when nutsedge is 3 to 4 in. and again 10 days later.

WEED CONTROL GUIDE FOR SMALL GRAINS

Barley and Wheat (without legume seedings)

Annual broadleaves	2,4-D* (amine)	$\frac{1}{2}$	1 pt*	— Use when grain is fully tillered but before the boot stage (grain is usually 6 to 8 in. tall at this stage). — Do not apply in the fall.
Perennials (bindweed, thistles)	2,4-D* (ester)	$\frac{3}{4}$	1 $\frac{1}{2}$ pt*	— Use when grain is fully tillered but before the boot stage. — Control is limited. — Injury may occur. — Some control of wild onion and wild garlic.

dicamba (<i>Banvel</i>)	$\frac{1}{4}$	$\frac{1}{2}$ pt	— Some control of wild onion and wild garlic. — Injury may occur on some varieties of wheat—Tecumseh, Abe, Arthur—do not use on these varieties.
dicamba (<i>Banvel</i>) + 2,4-D*	$\frac{1}{4}$ + $\frac{1}{2}$	$\frac{1}{2}$ pt + 1 pt*	— Injury may occur on some varieties of wheat—Tecumseh, Abe, Arthur—do not use on these varieties.

Oats without Legume Seedings

Annual broadleaves	2,4-D* (amine)	%	$\frac{3}{4}$ pt*	— Use when grain is fully tillered but before boot stage. — Some yield reduction may occur but generally less than caused by weeds.
	MCPA*	%	$\frac{3}{4}$ pt*	— Less injurious than 2,4-D. — Less effective than 2,4-D. — Use when grain is tillering but before the boot stage.

Small Grains Seeded to Legumes

Annual broadleaves	MCPA*	%	$\frac{3}{4}$ pt*	— Use when grain is tillering but before the boot stage. — A canopy of grain and weeds over the seeding will reduce possibility of injury to alfalfa. — Sweet clover is very sensitive to MCPA.
	dinoseb (<i>Premerge</i> or <i>Sinox PE</i>)	$\frac{3}{4}$	1 qt	— Use when grain is fully tillered but before the boot stage.
	4-(2,4-DB) (<i>Butoxone</i> or <i>Butyrac 200</i>)	1	2 qt*	— Use when grain is fully tillered but before the boot stage.

WEED CONTROL GUIDE FOR FORAGES

Alfalfa, Trefoil and Clover Seedings

(without small grain companion crops)

Annual broadleaves Annual grasses	EPTC (<i>Eptam</i>)	3	$3\frac{1}{2}$ pt	— Work into soil immediately after application. — Seed may be planted immediately after this operation. — Do not use when grass is seeded with legumes.
	benefin (<i>Balan</i>)	$1\frac{1}{2}$	3 qt	— See remarks above for EPTC.
Annual broadleaves	4-(2,4-DB) (<i>Butoxone</i> or <i>Butyrac 200</i>)	1	2 qt*	— Postemergence, alfalfa seedlings in 2-3 trifoliolate leaf stage. — Can use if annual broadleaf problem develops after using <i>Eptam</i> or <i>Balan</i> .

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A*	Remarks and Limitations
Alfalfa (Established Stand)				
Yellow rocket and broad-leaved winter annuals	MCPA*	½	1 pt*	— Late fall. — Apply after killing frost; legumes dormant. — Do not apply in the fall of the year the alfalfa is seeded.
	simazine (<i>Princep</i>)*	1 ½	1 ½ lb	— For fall application on established (1 year) alfalfa. — Will control winter annuals: yellow rocket, henbit, chickweed, peppergrass, shepardspurse and downy brome. — Forage grasses will be injured or killed. — Some injury to alfalfa may occur on sands and loamy sands low in organic matter. — Use 2 lb <i>Princep</i> on fine textured soils with 4 to 6% organic matter. — Some control of seedling white cockle.
Hoary alyssum Annual broadleaves	4-(2,4-DB) ester (<i>Butoxone</i> or <i>Butyrac 200</i>)	1	2 qt	— Early April. — Spray when hoary alyssum seedlings are in two to four leaf stage. — Do not graze or harvest for forage for 30 days after spraying.
Quackgrass	pronamide (<i>Kerb</i>)	1 ½	3 lb	— Apply in late fall when soil temperatures are below 60° F.
Red Clover (current year seeding)				
Yellow rocket and broad-leaved winter annuals	MCPA*	½	1 pt*	— Spray after killing frost; legumes dormant.
Grass Pasture				
Biennials and Perennials	2,4-D* (ester)	1	1 qt*	— Apply in fall or spring.
Legume Pasture				
Perennials	2,4-D* (ester)	1	1 qt*	— Legumes may be injured or killed. — Spot spray patches.

WEED CONTROL GUIDE FOR FIELD BEANS

Preplant

Annual broadleaves (including nightshade) Annual grasses	alachlor (<i>Lasso</i>) + chloramben (<i>Amiben</i>)	2 + 1½	2 qt + 3 qt	— <i>Amiben</i> may be applied with <i>Lasso</i> as a tank mix or as an overlay treatment preemergence. — Check label for use on coarse-textured soils low in organic matter.
Annual broadleaves (except ragweed, smartweed, mustard and nightshade) Annual grasses	trifluralin (<i>Treflan</i>) or dinitramine (<i>Cobex</i>) or profluralin (<i>Tolban</i>)	¾ or ½ or 1	1½ pt or 2 pt or 2 pt	— Incorporate within 4 to 8 hr after application with disk, springtooth harrow or other tool to thoroughly mix in the top 2 to 3 in. by incorporating twice in different directions. — On light soils (sandy and sandy loam) low in organic matter use ½ lb <i>Treflan</i> , ¾ lb <i>Cobex</i> or ¾ lb <i>Tolban</i> .
Annual broadleaves (except nightshade) Annual grasses	EPTC (<i>Eptam</i>) + trifluralin (<i>Treflan</i>) or dinitramine (<i>Cobex</i>) or profluralin (<i>Tolban</i>)	2¼ + ½ or ¾ or ¾	1½ qt + 1 pt or 1½ pt or 1½ pt	— Incorporate immediately after application. — Use where longer periods of control are desired and a broader spectrum of weed control is needed.
Annual broadleaves (including nightshade) Annual grasses	EPTC (<i>Eptam</i>) + chloramben (<i>Amiben</i>) + trifluralin (<i>Treflan</i>) or dinitramine (<i>Cobex</i>) or profluralin (<i>Tolban</i>)	2¼ + 2 + ½ or ¾ or ¾	1½ qt + 4 qt + 1 pt or 1½ pt or 1½ pt	— Incorporate immediately after application. — Rainfall isn't as critical for activation of <i>Amiben</i> as when it is surface applied. — Rate of <i>Amiben</i> may be reduced to 3 qt if nightshade is not present.

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A*	Remarks and Limitations
Annual broadleaves (except nightshade) Annual grasses	EPTC (<i>Eptam</i>)	3	3½ pt	— Incorporate immediately after application with disk, springtooth harrow or other tool. Thoroughly mix in the top 2 to 3 in. by incorporating twice in different directions. — On light soils (sandy and sandy loam) low in organic matter, rate should be reduced to 2 lb per acre. — Some injury has occurred. — Longevity of control, especially pigweed, is limited.

Preplant Followed by Preemergence

Annual broadleaves (including nightshade) Annual grasses	EPTC (<i>Eptam</i>) + trifluralin (<i>Treflan</i>) or dinitramine (<i>Cobex</i>) or profluralin (<i>Tolban</i>)	2¼ + ½ or ¾ or ¾	1¼ qt + 1 pt or 1½ pt or 1½ pt	— PREPLANT. — Refer to remarks for <i>Eptam</i> under Preplant. — Refer to remarks for <i>Treflan</i> , <i>Cobex</i> or <i>Tolban</i> under Preplant.
FOLLOWED BY:				
	chloramben (<i>Amiben</i>) or dinoseb (<i>Premerge</i> or <i>Sinox PE</i>) or chloramben (<i>Amiben</i>) + dinoseb (<i>Premerge</i> or <i>Sinox PE</i>)	2 or 4½ or 1 + 3	4 qt or 6 qt or 2 qt + 4 qt	— Effectiveness depends on adequate rainfall after treatment. — Preemergence.

Postemergence

Annual broadleaves	bentazon (<i>Basagran</i>)	¾	1½ pt	— Controls only certain broadleaves. — Check label for specific rate at proper weed growth stage.
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WEED CONTROL GUIDE FOR SUNFLOWERS

Preplant

Annual grasses Annual broadleaves (except ragweed, smart-weed, mustard and night-shade)	trifluralin (<i>Treflan</i>)	$\frac{3}{4}$	1 $\frac{1}{2}$ pt	— Refer to remarks under Field Beans.
	dinitramine (<i>Cober</i>)	$\frac{1}{2}$	2 pt	— Refer to remarks under Field Beans.
	profluralin (<i>Tolban</i>)	1	2 pt	— Refer to remarks under Field Beans.

Preemergence

Annual grasses Annual broadleaves	chloramben (<i>Amiben</i>)	2	1 gal	— Do not graze or feed sunflower forage from <i>Amiben</i> -treated areas. — <i>Amiben</i> may follow preplant treatments.
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WEED CONTROL GUIDE FOR POTATOES

Quackgrass	dalapon (<i>Dowpon M</i> or <i>Basfapon</i>)	10	13 $\frac{1}{2}$ lb	— Spray in spring when quackgrass is 4 to 6 in. tall. Wait one week before plowing. — Use in 30 to 40 gal water per acre. — Control of quackgrass will be reduced when heavy stand of rye cover is present.
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Preplant Followed by Preemergence

Annual grasses Annual broadleaves	EPTC (<i>Eptam</i>)	4	4 $\frac{1}{2}$ pt	— Work into soil immediately after application. — Six lb per acre may be used if nutsedge is a problem. — Preplant incorporated.
	FOLLOWED BY: linuron (<i>Lorox</i>) or metribuzin (<i>Sencor</i> or <i>Lexone</i>)*	1 or $\frac{1}{2}$	2 lb or 1 lb or 1 pt	— Preemergence. — Treatment should be made prior to potato emergence and after weed emergence.

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A*	Remarks and Limitations
Early Preemergence Followed by Delayed Preemergence				
Annual grasses (especially barnyard-grass)	alachlor (<i>Lasso</i>)	2	2 qt	— If field leveling is necessary it should be done soon after planting. — Apply <i>early preemergence</i> —make application soon after planting. — <i>Lasso</i> is most effective on germinating grasses that have not emerged.
FOLLOWED BY:				
	metribuzin (<i>Sencor</i> or <i>Lexone</i>)*	½	1 lb or 1 pt	— Most effective on small <i>emerged</i> weeds.
	or			— Delayed preemergence.
	linuron (<i>Lorox</i>)	1	2 lb	
	or			
	dinoseb (<i>Premerge</i> or <i>Sinox PE</i>)	3	4 qt	
Delayed Preemergence				
Annual broadleaves Annual grasses	linuron (<i>Lorox</i>)	1 ½	3 lb	— Apply delayed preemergence; after weeds emerge but before potatoes emerge. — If field leveling is necessary, it should be done soon after planting to allow weed emergence before spraying.
	metribuzin (<i>Sencor</i> or <i>Lexone</i>)*	½	1 lb or 1 pt	— Refer to remarks under <i>Lorox</i> . — Use up to 1 lb active ingredient metribuzin on high organic muck soil.
Postemergence				
Annual broadleaves Annual grasses	metribuzin (<i>Sencor</i> or <i>Lexone</i>)*	¼	½ lb or ½ pt	— Do not make overall postemergence applications following 3 days of cool, wet or cloudy weather as crop injury may occur. — Do not use on early maturing varieties. — Do not use on red skin varieties. — Do not apply postemergence within 60 days of harvest. — Greater possibility of injury to potatoes when sprayed overall at 12- to 15-in. stages.

WEED CONTROL GUIDE FOR MINT

Row Mint and Meadow Mint

Annual broadleaves	terbacil (<i>Sinbar</i>)	1½	2 lb	— Apply preemergence only.
Annual grasses				— Rates may be reduced to 1 lb per acre if terbacil was used the previous year.
				— Do not plant any other crop except potatoes for two years following application.

WEED CONTROL GUIDE FOR SUGAR BEETS

Preemergence

Annual broadleaves	ethofumesate (<i>Nortron</i>)	2	5½ qt	— DO NOT ROTATE TO SOYBEANS OR ALFALFA THE FOLLOWING YEAR.
Annual grasses	+ pyrazon (<i>Pyramin</i>)	+ 3	+ 4 lb	— On sandy soil with less than 1½ % organic matter reduce <i>Nortron</i> rate to 1½ lb/A ai.
	+ TCA (<i>TCA</i>)	+ 6	+ 5 qt	— In order to get near 100% weed control it will, in most cases, be necessary to follow up with a postemergence application.
	pyrazon (<i>Pyramin</i>)	3	4 lb	— TCA should be included even if grasses aren't a problem, as better control of annual broadleaves will result.
	+ TCA (<i>TCA</i>)	+ 6	+ 5 qt	— In order to get near 100% weed control it will, in most cases, be necessary to follow up with a postemergence application.
				— For soils high in clay content or organic matter, the rate should be 4 lb <i>Pyramin</i> + 8 lb <i>TCA</i> .

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A*	Remarks and Limitations
Postemergence				
Annual broadleaves (including smartweed)	desmedipham (<i>Betanex</i>)	½	3 pt	— Apply when the beets are in the 2-4 true leaf stage.
	+ phenamedipham (<i>Betanal</i>)	+	+	— When cultivating the unsprayed area, care should be taken so as to cut away a portion of the sprayed area on the first cultivation and don't roll fresh unsprayed soil back beyond the cut away point.
	+ endothal (H273)	½	1½ pt	— When temperature is 75° F or greater, apply in late afternoon or early evening.
				— Do not apply when plants are under stress such as temperatures above 85° F as injury may occur.
				— Add one qt. oil conc. per acre for hard to control large weeds or if plants are not vigorously growing.
Annual broadleaves (except smartweed)	desmedipham (<i>Betanex</i>)	¾	4½ pt	— Refer to remarks under <i>Betanex</i> + <i>Betanal</i> + H273.
	+ endothal (H273)	+	+	— More effective pigweed control.
		½	1½ pt	
	pyrazon (<i>Pyramin</i>)	2	2½ lb	— Apply when the beets are in the 2-4 true leaf stage.
	+ phenmedipham (<i>Betanal</i>)	+	+	— When cultivating the unsprayed area, care should be taken so as to cut away a portion of the sprayed area on the first cultivation and don't roll fresh unsprayed soil back beyond the cut away point.
		1	6 pt	— Maximum total amount of pyrazon that can be used for beets grown and processed in Michigan is 8 lb per acre (2 lb on a 7-in. band).
				— When temperature is 75° F or greater, apply in late afternoon or early evening.
				— Do not apply when plants are under stress such as temperatures above 85° F as injury may occur.
				— Add one qt. oil conc. per acre for hard to control large weeds or if plants are not vigorously growing.
				— Much better pigweed control than <i>Betanal</i> .
Annual broadleaves (except smartweed and wild buckwheat)	pyrazon (<i>Pyramin</i>)	2	2½ lb	— Refer to remarks under <i>Pyramin</i> + <i>Betanal</i> .
	+ desmedipham (<i>Betanex</i>)	+	+	
		¾	4½ pt	
	pyrazon (<i>Pyramin</i>)	2	2½ lb	
	+ dalapon (<i>Dowpon M</i> or <i>Basfapon</i>)	+	+	
	+ crop oil	1	1 gal	

Smartweed and buckwheat	endothal (H273)	$\frac{1}{2}$	$1\frac{1}{2}$ pt	— This herbicide can be added to any of the above post-emergence treatments to improve control of these species. — Volume based on 3 lb per gal formulation.
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WEED CONTROL GUIDE FOR GRAIN SORGHUM

Preemergence

Annual broadleaves	atrazine (commercial product) *	1	$1\frac{1}{4}$ lb or 1 qt	— Do not feed silage made from treated sorghum to producing dairy animals.
Annual grasses	+ propachlor (Ramrod or Bexton)	+ 3	+ $4\frac{1}{2}$ lb	— Note that <i>Ramrod</i> is 65% active. A commercial mix is available.
				— Not labeled for forage sorghum.

Postemergence

Annual broadleaves	2,4-D	$\frac{1}{3}$	$\frac{1}{2}$ qt*	— Apply when sorghum is 6 to 12 in. high. — Do not use unless weeds are a serious problem because injury may occur. — Not labeled for forage sorghum. — Hybrids vary in tolerance.
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TABLE 2—PERENNIAL WEEDS NON-SELECTIVE CONTROL

Quackgrass (for spring seeded crops)	dalapon (Dowpon M or Basfapon)	15	20 lb	— Apply in fall. — Fall plow 7 to 10 days after spraying if possible. — Land can be planted to spring sown crops. — Use 30 to 40 gal water per acre. — For quackgrass control in corn, potatoes and sugar beets, see specific crop.
Quackgrass (for fall seeded crops)	dalapon (Dowpon M or Basfapon)	10	$13\frac{1}{2}$ lb	— Apply in spring or early summer (prior to July). — Plow 7 to 10 days after spraying. — Land can be planted to alfalfa, wheat or winter barley. — Use 30 to 40 gal water per acre.
Quackgrass (prior to corn, soybeans, wheat, barley, oats, sorghum)	glyphosate (Roundup)	$1\frac{1}{2}$	2 qt	— Apply to actively growing quackgrass at least 10 to 14 in. tall. — Use 15 to 20 gal water per acre. — No soil residue. — Can plow or till 3 days after application and plant crop.
Canada thistle Field bindweed (prior to corn, soybeans, wheat, barley, oats, sorghum)	glyphosate (Roundup)	$1\frac{1}{2}$	2 qt	— Apply when thistle is near bud stage. — Field bindweed can be treated anytime, June to October. — Do not plow or till prior to treatment. — Poor control will result if application is made during times of poor growing conditions.

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A*	Remarks and Limitations
Common milkweed (prior to corn, soybeans, wheat, barley, oats, sor- ghum)	glyphosate (Roundup)	2¼	3 qt	— Apply when actively growing and most plants have reached late bud to flower stage. — Spot treatment in labeled crops.
Hempdogbane (prior to corn, soybeans, wheat, barley, oats, sor- ghum)	glyphosate (Roundup)	3	4 qt	— Apply when actively growing and most plants have reached late bud to flower stage.
Johnsongrass (prior to corn, soybeans, wheat, barley, oats, sor- ghum)	glyphosate (Roundup)	2¼	3 qt	— Apply when actively growing when most plants are in the boot to head stage, at least 18 in. tall.
Perennial broadleaves	silvex	2	2 qt	— Spray before crops are planted or after harvest. — Do not pasture area.
Cattail	dalapon (Dowpon M or Basfapon)	15	20 lb	— Apply in June or July. — Use 80 to 100 gal water. — Keep livestock out.
Poison ivy	amitrole†	2	1 gal	— Apply in June or July. — Spray when in full leaf.
Canada thistle Horse nettle	amitrole†	4	2 gal	— Apply in June or July. — Do not pasture.
Brush Most woody species	Mixture of 2,4,5-T‡ and 2,4-D* esters ("Brushkillers") foliage spray			— Apply in spring or summer. — Add one lb acid equivalent to 25 to 30 gal water (for small amounts, mix 2 Tbsp of 4 lb per gal acid equivalent material to 1 gal water). — Apply a drenching spray to foliage. — Best results obtained soon after maximum leaf-development in spring. — Best control of brush up to 8 ft. tall.
	Mixture of 2,4,5-T‡ and 2,4-D* ester in oil ("Brushkillers") Basal spray			— Apply any time when drifting isn't a problem. — Using a concentrate that contains 4 lb acid equivalent per gal, mix 1 pt of concentrate in 3 gal diesel or kerosene, or use 10 Tbsp of concentrate per gal. — Thoroughly wet the bark on the lower 18 in. of the brush.
				— Can use on small trees up to 6 in. in diameter. — Usually more effective than foliage sprays.
Brush Hard-to-kill species	2,4,5-T ester in oil basal spray			— Follow rates and instructions given above for basal spray with "Brushkiller."
Brush Most woody species	fenuron (pellets) (Dybar)			— Pellets may be spread by hand at 2 tsp per square yard.

†Amitrole may not be used on cropland areas.

‡2,4,5 T may not be used on cropland areas, on or around home lawn areas or on or around water areas.

TABLE 3—GLOSSARY OF CHEMICAL NAMES

COMMON NAME	TRADE NAME* AND MANUFACTURER	CONCENTRATION AND COMMERCIAL FORMULATIONS†
ALACHLOR	Lasso (Monsanto)	4 lb/gal L; 15% G
AMETRYN	Evik (Ciba-Geigy)	80% WP
ATRAZINE	Several (various)	80% WP; 4 lb/gal L
BENEFIN	Balan (Elanco)	1½ lb/gal L
BENTAZON	Basagran (BASF)	4 lb/gal L
BROMOXYNIL	Buctril (Chipman)	2 lb/gal L
	Brominal (Amchem)	
BUTYLATE + R-25788	Sutan Plus (Stauffer)	6.7 lb/gal L; 10% G
CHLORAMBEN	Amiben (Amchem)	10% G; 2 lb/gal L
CYANAZINE	Bladex (Shell)	80% WP, 4 L; 15% G
CYCLOATE	Ro-Neet (Stauffer)	6 lb/gal L; 10% G
DALAPON	Basfapon (BASF)	74% WSP
	Dowpon M (Dow)	
DESMEDIPHAM	Betanex (Nor-Am)	1.3 lb/gal L
DICAMBA	Banvel (Velsicol)	4 lb/gal L
DINITRAMINE	Cobex (U. S. Borax)	2 lb/gal L
DINOSEB	amine salt	3 lb/gal L
(DNBP)	oil soluble	5 lb/gal L
ENDOTHALL	Endothal, Herbicide	1.46 lb/gal L
	273 (Pennwalt)	3 lb/gal L; 5% G
ENDOTHALL (as a desiccant)	Des-i-Cate (Pennwalt)	0.52 lb/gal L
EPTC	Eptam (Stauffer)	7 lb/gal L; 10% G
EPTC plus R-25788	Eradicane (Stauffer)	6.7 lb/gal L
ETHOFUMESATE	Nortron (Fisons)	1½ lb/gal L
FLUCHLORALIN	Basalin (BASF)	4 lb/gal L
GLYPHOSATE	Roundup (Monsanto)	3 lb/gal L
LINURON	Lorox (DuPont)	50% WP
MCPA	Several (various)	Various L
METOLACHLOR	Dual (Ciba-Geigy)	6 lb/gal L
METRIBUZIN	Lexone, Lexone 4L (DuPont)	4 lb/gal L; 50% WP
	Sencor, Sencor 4 (Mobay)	
PARAQUAT	Ortho Paraquat (Chevron)	2 lb/gal L
PENDIMETHALIN	Prowl (American Cyanamid)	4 lb/gal L
PHENMEDIPHAM	Betanal (Nor-Am)	1.3 lb/gal L
PRONAMIDE	Kerb (Rohm + Hass)	50% WP
PROFLURALIN	Tolban (Ciba-Geigy)	4 lb/gal L
PROPACHLOR	Ramrod (Monsanto)	65% WP; 20% G
	Bexton (Dow)	
SIMAZINE	Princep (Ciba-Geigy)	80% WP; 4% G, 4 lb/gal L
TCA	TCA (various)	4.76 lb/gal L; 79.3% WSP
TERBACIL	Sinbar (DuPont)	4 lb/gal L; 80% WP
TRIFLURALIN	Treflan (Elanco)	4 lb/gal L; 5% G
2,4-D	Several (various)	L, G, various
2,4-DB	Butyrac (Amchem)	2 lb/gal L
	Butoxone (Chipman)	

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

†G—granular, L—liquid, WP—wetttable powder, WSP—water soluble powder.

TABLE 4—WEED RESPONSE TO HERBICIDES*

Herbicide	ANNUAL BROADLEAVES									ANNUAL GRASSES							PERENNIALS			
	Cocklebur	Jimsonweed	Lambsquarter	Nightshade (Black)	Pigweed (Redroot)	Ragweed	Smartweed	Velvetleaf	Wild mustard	Barnyardgrass	Crabgrass	Giant foxtail	Green foxtail	Yellow foxtail	Fall panicum	Witchgrass	Bindweed (field)	Canada thistle	Quackgrass	Yellow nutsedge
AMIBEN	P	P	G	G	E	E	G	P	F	F	F	F	F	F	F	F	N	N	N	N
ATRAZINE	F	F	E	E	G	E	G	F	E	G	P	F	F	G	P	P	P	P	G	F
ATRAZINE + OIL	G	G	E	G	E	E	G	G	E	F	P	F	G	G	P	P	P	G	G	G
BALAN	N	N	G	N	G	N	P	N	P	E	E	E	E	E	E	G	N	N	N	P
BANVEL	G	G	G	G	G	G	E	G	F	N	N	N	N	N	N	N	F	F	N	N
BASAGRAN	G	F	G	P	P	E	E	F	F	N	N	N	N	N	N	N	N	G	N	G
BASALIN	N	N	G	P	G	P	P	N	P	E	E	E	E	E	E	E	N	N	N	N
BETANAL	F	F	E	F	P	G	G	P	G	P	P	P	P	P	P	P	P	N	N	N
BETANEX	F	F	G	F	G	G	G	P	G	P	P	P	P	P	P	P	P	N	N	N
BLADEx	F	P	E	G	F	E	G	P	G	G	F	F	G	G	F	F	N	N	N	N
COBEX	N	N	G	P	G	P	P	N	P	E	E	E	E	E	E	E	N	N	N	N
DOWPON M, BASFAPON ..	N	N	N	N	N	N	N	N	N	G	F	G	G	G	G	G	N	N	G	P
DUAL	N	N	P	F	G	P	P	N	P	E	E	E	E	E	E	E	N	N	N	G
DYANAP	F	F	G	F	G	G	G	P	G	F	F	F	F	F	F	F	N	N	N	N
EPTAM	P	P	G	P	F	F	F	P	F	E	E	E	E	E	E	E	N	N	G	G
ERADICANE	P	P	G	P	F	F	F	P	F	E	E	E	E	E	E	E	N	N	G	G
EVIK	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	F	F	P	F
H-273	P	P	P	P	P	P	E	P	P	N	N	N	N	N	N	N	N	P	N	N
KERB	P	P	P	P	P	P	P	P	P	F	F	P	F	F	P	P	N	N	G	N
LESSO	N	N	P	G	G	P	P	N	P	E	E	E	E	E	E	G	N	N	N	G
LEXONE	G	F	E	N	E	E	E	F	E	F	F	F	G	G	F	F	N	N	N	N
LOROX	P	P	G	G	G	G	G	F	G	F	F	F	F	F	F	F	N	N	N	N
MCPA	F	F	G	G	G	G	G	F	G	N	N	N	N	N	N	N	P	F	N	N
MILOGARD	G	F	G	E	E	E	E	P	E	G	P	F	P	G	P	P	P	P	F	F
NORTRON	F	F	G	G	G	P	G	P	G	P	G	P	F	F	P	P	N	N	N	P
PREMERGE, SINOX PE	P	P	G	G	G	E	G	P	G	P	P	P	P	P	P	P	N	N	N	N
PRINCEP	G	F	E	E	E	E	G	F	E	G	F	F	F	G	P	P	P	P	F	F
PROWL	N	N	G	P	G	P	P	F	P	E	E	E	E	E	E	E	N	N	N	N
PYRAMIN	P	P	E	G	G	G	G	P	G	F	F	F	F	F	F	F	N	N	N	N
RAMROD, BEXTON	N	P	P	N	F	P	P	P	P	G	E	E	E	E	G	G	N	N	N	N
ROUNDUP	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	G	G	E	F
SENCOR	G	F	E	N	E	E	E	F	E	F	F	F	G	G	F	F	N	N	N	N
SILVEX	F	F	G	G	G	G	P	F	G	N	N	N	N	N	N	N	F	G	N	N
SUTAN PLUS	P	P	P	N	P	P	P	P	P	E	E	E	E	E	E	E	N	N	P	G
TCA	N	N	F	P	F	F	F	N	P	G	G	G	G	G	G	G	N	N	G	P
TOLBAN	N	N	F	P	G	N	P	N	P	E	E	E	E	E	E	E	N	N	N	N
TREFLAN	N	N	G	N	G	N	P	N	P	E	E	E	E	E	E	E	N	N	N	N
2,4-D AMINE	F	F	G	G	G	G	P	F	G	N	N	N	N	N	N	N	P	F	N	N
2,4-D ESTER	F	F	G	G	G	G	P	F	G	N	N	N	N	N	N	N	F	G	N	N
4-(2,4-DB)	P	P	G	F	G	F	P	F	F	N	N	N	N	N	N	N	P	P	N	N

P = Poor; F = Fair; G = Good; E = Excellent; N = None; — = Insufficient Information.

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