

Weed Control

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in

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 can injure nearby crops; therefore, do all spraying on calm days.
5. A hood or shield built over the boom will help to 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 in Field Crops

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THE MAIN REASON for cultivating crops is to control weeds. Chemicals (herbicides) often control weeds at a considerable saving 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

A large number of chemical weed-killers are now available. Selective control of weeds in crops may be obtained by either foliage sprays (post emergence) or application of the chemicals to the soil either as pre-planting or pre-emergence sprays.

Pre-planting and pre-emergence sprays are available for corn, potatoes, field beans, soybeans, sugar beets, alfalfa, and birdsfoot trefoil.

Pre-planting sprays sometimes are applied to the weed before plowing (quackgrass).

Pre-emergence sprays are applied after planting but before the crop appears above ground.

Some advantages of pre-emergence herbicide applications are:

- (1) Generally better weed control than with post-emergence applications;
- (2) Less chance of damage to the crop, compared to post-emergence 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 pre-emergence herbicide applications are:

(1) Pre-emergence applications are generally ineffective under dry soil conditions. Some pre-emergence 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 pre-emergence herbicide applications.

(4) Planting operations may be slowed somewhat when herbicides are applied at planting time.

Post-Emergence sprays, applied after the crop has emerged, are available for corn, small grains, small seeded legumes 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. Post-emergence sprays are usually more effective (though also more injurious to the crop) at high temperatures.

The ester forms of 2,4-D are not recommended for post-emergence use on corn because they are volatile (produce vapors) and may injure the corn. The ester forms vary in volatility, and the possibility of injury to corn varies with temperature and humidity conditions. Post-emergence applications of 2,4-D ester in Michigan have resulted in increased stalk lodging and reduced yields in some years.

The amine form of 2,4-D is recommended for post-emergence use because it has little or no volatility and is least likely to damage the crop.

Where corn growers insist on using 2,4-D esters post-emergence despite the risks involved, the low volatile form should be used at $\frac{1}{4}$ pound acid equivalent per acre. Drop nozzles should always be used when corn is more than 6 to 8 inches tall.

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. Pre-emergence applications will generally give better weed control than post-emergence 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 pre-emergence herbicides, do not cultivate for at least 3 weeks after pre-emergence spraying unless weeds appear that are resistant to the chemical. In the case of atrazine on corn, rotary hoe or cultivate shallow if weeds appear and dry weather persists for 2 weeks after herbicide application. Delay cultivation after post-emergence 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 seeds and fertilizers.

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-gallon 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 CE-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 which has a minimum capacity of 4 gallons 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 pounds 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.

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 (as for field beans or soybeans), 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.)

Sprayer Calibration

Be sure to apply the correct amount of material per acre. To do this, you must know how much liquid the sprayer is delivering per acre at a given speed and pressure. To calibrate your sprayer:

1. Fill the spray tank with water only.

2. Spray a measured area at a fixed speed and a fixed pressure (4 miles per hour and 40 pounds suggested).

3. Measure the amount of liquid required to fill the tank.

4. Divide this amount (in 3 above) by portion of an acre sprayed to find the gallons applied per acre. (Width of boom coverage times feet traveled gives square feet of area covered. This figure divided by 43,560 gives the portion of an acre covered.)

5. Mix the amount of material recommended per acre with the number of gallons the sprayer uses per acre (the answer in 4 above).

Cleaning Sprayers

Keep weed sprayers clean. Where pre-emergence 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 gallons of water:

1. 1 gallon household ammonia (allowed to stand in sprayer overnight).

2. 5 pounds of sal soda.

3. 8 pounds trisodium phosphate.

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 gallons per acre and a spraying pressure of 35 to 40 pounds is recommended. A minimum of 10 gallons 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 20 gallons per acre. Thirty to 40 gallons of spray per acre should be used when spraying

quackgrass with atrazine or dalapon. Twenty-five to 40 gallons of spray per acre should be used when applying DNBP for weed control.

Some herbicides are available in a number of different formulations and concentrations. For this reason the recommended rates in Table 1 are given as pounds of active ingredients per acre. Thus when a liquid formulation contains 4 pounds of active ingredient (or acid equivalent) per gallon, one pint will provide $\frac{1}{2}$ pound of active ingredient, or one quart will provide 1 pound of active ingredient.

Granular Formulations

Herbicides are available in granular form by 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 non-uniform distribution of the granules or to formulations with too high a concentration, resulting in inadequate volume for uniform distribution. At least 30 pounds of granules per acre (overall coverage) is required for uniform distribution with equipment presently available.

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.

Soil Residues

With the advent of pre-plant and pre-emergence 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 it 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 the "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 pounds per acre has been applied; exceptions have been on oats, sugar beets and field beans. There is more likely to be a problem with soil residues in a season of limited rainfall and cool temperatures, due to the slow dissipation of the herbicide.

In situations where corn follows corn, a soil residue problem may develop if atrazine is used in two or more consecutive years. When corn is grown 2 or 3 years consecutively, herbicides other than atrazine, such as 2,4-D, Lasso, Bladex, or Sutan should be used on the last year of corn.

When one intends to plant wheat after corn the same year, it is safer to reduce the rate of atrazine on corn to 1 pound per acre. Band application of atrazine is recommended where a cover crop is to be seeded in corn; the cover crop can be established between the bands.

TABLE 1. CHEMICALS FOR WEED CONTROL IN FIELD CROPS

Rates are expressed in pounds of active ingredient per acre for the area actually sprayed; rates in parentheses are expressed as pounds or liquid measure of product unless otherwise noted.

All agricultural chemicals should be applied in accordance with regulations and the Federal Insecticide, Fungicide, and Rodenticide Act as to rates, timing and crops for which they may be used. The chemicals listed in this guide conform with these regulations.

Weed Control Guide For Corn

WEED PROBLEM	CHEMICAL	RATE	REMARKS AND LIMITATIONS
Preplant — Mineral Soils			
Annual broadleaves Annual grasses (including fall panicum, witchgrass and crabgrass)	butylate + atrazine (Sutan Plus AAtrex 80W)*	3 + 1 (2 qts. + 1½ lb.)	— Must be incorporated or mixed into top 2 to 3 inches of soil immediately after application. — Usually obtain season-long control. — For good control of nutsedge, increase rate of butylate to 4 pounds per acre. — Do not use on seed fields.
Annual broadleaves Annual grasses (except green foxtail, fall panicum, witch- grass and crabgrass)	atrazine (AAtrex 80W)	2 (2½ lb.)	— Usually obtain season-long control. — Do not plant small grain, small seeded forages, sugarbeets, field beans or vegetable crops the year following corn. — Rates of 2.5 to 3 pounds per acre may be necessary on soils high in organic matter (5-8%). — Residues more likely to persist if soil conditions are cool and dry. — Incorporation is not necessary.
Nutsedge	butylate (Sutan Plus)	4 (¾ gal.)	— Incorporate, to depth of 2 to 3 inches. — Control of late-season grasses.
Preemergence — Mineral Soils			
Annual broadleaves Annual grasses (including fall panicum, witchgrass and crabgrass)	atrazine + alachlor (AAtrex 80W + Lasso)	1 + 2 (1¼ lb. + 2 qt.)	— For fair to good control of nutsedge—increase rate of Lasso to 3 pounds per acre. — Will be more effective preplant especially on nutsedge in these areas where soils tend to be dry. — 2½ qts. per acre of Lasso should be used for more effective fall panicum control.
	cyanazine + alachlor (Bladex* + Lasso)	1¼ + 2 (1½ lb. + 2 qt.)	— No residue carry-over. — Can be used where residue problems have existed with atrazine.
	dicamba + alachlor (Banvel + Lasso)	¾ + 2 (¾ pt. + 2 qt.)	— Injury may occur on sandy and loamy sand soils. — Longevity of broadleaved weed control is limited.
	atrazine + simazine (AAtrex 80W + Princep)	1 + 2 (1¼ + 2½ lb.)	— Corn must be grown a second year as residue will result. — Rainfall necessary for effective early control.
	cyanazine (Bladex)	2½ (3¼ lb.)	— No residue carry-over. — Poor control of pigweed.
Annual broadleaves Annual grasses (except green foxtail, fall panicum, witch- grass and crabgrass)	atrazine (AAtrex 80W)	2 (2½ lb.)	— Usually obtain season-long control. — Do not plant small grain, small seeded forages, sugarbeets, field beans or vegetable crops the year following corn. — Rates of 2.5 to 3 pounds per acre may be necessary on soils high in organic matter (5-8%). — Residues more likely to persist if soil conditions are cool and dry.

*NOTE: AAtrex 80W, Bladex, and Princep are available in liquid (flowable form): 1 lb. active ingredient = 1¼ lb. 80W = 1 qt. of 4L, or WDS.

Weed Control Guide For Corn

WEED PROBLEM	CHEMICAL	RATE	REMARKS AND LIMITATIONS
Nutsedge	alachlor (Lasso)	3 (3 qt.)	— Under conditions of limited rainfall, shallow incorporation (2 to 3 inches) may improve control of nutsedge and late-season grasses.
Pigweed Annual grasses (including panicum, witchgrass and crabgrass)	alachlor (Lasso)	2 (2 qt.)	— Fair to good control of nutsedge at 3 pounds per acre. — Follow with 2,4-D amine postemergence for control of annual broadleaved weeds. — Application may be made preplant. — (See remarks under "nutsedge control").

Postemergence — Mineral Soils

Broadleaves only	2,4-D amine	$\frac{1}{2}$	— Corn up to 6 inches tall. — For corn over 6 to 8 inches use drop nozzles. — Ester formulation will cause more crop injury. — Not effective on smartweed. — Hybrids vary in tolerance.
Velvet leaf, jimson weed, smartweed, wild buckwheat, Canada thistle	dicamba (Banvel)	$\frac{1}{4}$ lb. ($\frac{1}{2}$ pt.)	— <i>USE EXTREME CAUTION.</i> — Drift to nearby sensitive crops is a hazard. — Corn up to 6 inches. — Above 6 inches use drop nozzles.
Broadleaves Annual grasses (except green foxtail, fall panicum, witchgrass and crabgrass)	atrazine + crop oil (AAtrex 80W + Oil)	2 + 1 gal. (2 $\frac{1}{2}$ lb. + 1 gal.)	— Emergency use. — Grasses must be less than 1 $\frac{1}{2}$ inches tall. — Timing of application is critical to get best results.
	atrazine + emulsifier concentrate (AAtrex 80W + Emulsifier Concentrate)	2 + 1 qt. (2 $\frac{1}{2}$ lb. + 1 qt.)	— Use a high grade non-phytotoxic 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 grasses Annual broadleaves	cyanazine (Bladex)	2.4 (3 lb.)	— Apply before grasses are 1 $\frac{1}{2}$ inches tall. — Apply before corn is 4 inches tall. — Some temporary setback or stunting of corn may occur especially in sandy soils.
Annual broadleaves Annual grasses (except fall panicum)	cyprazine (Outfox)	$\frac{3}{4}$ (3 qts.)	— Grass control is only fair. — Apply before corn is 10 inches tall. — Apply when broadleaves are less than 2-4 inches and grasses less than 1 $\frac{1}{2}$ inches. — Some foliage injury may occur. — Residue is similar to atrazine at comparable rates.
Annual broadleaves and grasses	ametryne (Evik + Surfactant)	1.6 (2 lb. + 1 pt.)	— Emergency use. — Caution—Keep off corn foliage. — Use drop nozzles or directed spray.
Nutsedge	atrazine (AAtrex 80W) + Oil or Emulsifier Concentrate	2 (2 $\frac{1}{2}$) + 1 gal. or 1 qt.	— Apply when nutsedge is 2 inches tall and repeat 2 weeks later. On muck soils the repeat applications should be at 1 pound per acre plus 1 gallon of oil at 1 week intervals after the initial treatment.

Preemergence — Organic Soils

Annual grasses	propachlor (Ramrod)	5 (8 lb.)	— Must follow with a postemergence treatment for control of broadleaved weeds.
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Postemergence — Organic Soils

Annual broadleaves Annual grasses (except fall panicum,	atrazine + crop oil (AAtrex 80W + Crop Oil)	3 + 1 gal. (3.75 lb. + 1 gal.)	— Emergency use. — Grasses should be less than 1 $\frac{1}{2}$ inches tall. — Timing of application is critical to get best results.
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Weed Control Guide For Corn

WEED PROBLEM	CHEMICAL	RATE	REMARKS AND LIMITATIONS
green foxtail, witch-grass and crabgrass)	atrazine + emulsifier concentrate (AAtrex 80W + Emulsifier Concentrate)	3 + 1 qt. (3.75 lb. + 1 qt.)	— Use a high grade non-phytotoxic 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	$\frac{1}{2}$	— Corn up to 6 inches tall. — For corn over 6 to 8 inches use drop nozzles. — Ester formulation will cause more corn injury. — Not effective on smartweed. — Hybrids vary in tolerance.
Nutsedge	atrazine (AAtrex 80W) + Oil or Emulsifier Concentrate	2 (2 $\frac{1}{2}$) + 1 gal. or 1 qt.	— Apply when nutsedge is 2 inches tall and repeat 1 week later. The repeat applications should be at 1 pound per acre plus 1 gallon of oil at 1 week intervals after the initial treatment.

Perennial Grasses

Quackgrass	atrazine (AAtrex 80W)	4 (5 lb.)	— When stand of quackgrass is heavy, apply in fall. Otherwise apply in spring when quackgrass is 4 to 8 inches tall. — Wait at least 10 days to plow. — Split application to apply 2 pounds pre-plow and 2 pounds preemergence; this will give control of annual weeds also. — When a total of 4 pounds of atrazine is used, <i>corn must be grown 2 consecutive years.</i>
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Weed Control Guide For Soybeans

Preplant

Annual grasses Annual broadleaves (except ragweed, mustard and smartweed)	trifluralin (Treflan)	$\frac{3}{4}$ (1 $\frac{1}{2}$ pt.)	— Incorporate or mix thoroughly into top 2 or 3 inches of soil within 4 to 8 hours after application. — On sandy and sandy loam soils low in organic matter use $\frac{1}{2}$ pound 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 (Cobex)	$\frac{1}{2}$ (1 pt.)	— Incorporate or mix thoroughly into top 2-3 inches of soil within 4-8 hours after application.

Preplant Followed By Preemergence

Annual grasses Annual broadleaves	trifluralin or dinitramine (Treflan or Cobex)	$\frac{1}{2}$ (1 pt.)	
	FOLLOWED BY chloramben (Amiben)	2 (4 qt.)	— All applied preemergence.
	dinoseb (Premerge or Sinox PE)	4 $\frac{1}{2}$ (1 $\frac{1}{2}$ gal.)	
	fluorodifen (Peforan or Soyex)	3 (1 gal.)	— Some control of jimson weed.
	metribuzin (Sencor)	$\frac{3}{4}$ ($\frac{3}{4}$ lb.)	— Some control of jimson weed and cocklebur.
	linuron (Lorox)	$\frac{1}{2}$ (1 $\frac{1}{2}$ lb.)	
	chlorobromuron (Bromex or Maloran)	1 (2 lb.)	

Weed Control Guide For Soybeans

WEED PROBLEM	CHEMICAL	RATE	REMARKS AND LIMITATIONS
Preemergence			
Annual broadleaves Annual grasses	chloramben (Amiben)	3 (6 qts.)	— May be necessary to rotary hoe if rainfall does not occur within 4 to 5 days after application.
	linuron (Lorox)	1½ (3 lb.)	— Don't use on coarse textured soils, or sandy soils or on soils with less than 2.5% organic matter. — Some control of velvet leaf. — Plant soybeans at least 1¼ inches deep.
	fluorodifen (Peforan or Soyex)	4½ (6 qt.)	— Good control of jimson weed.
	linuron + alachlor (Lorox + Lasso)	¾ + 2 (1½ lb. + 2 qt.)	— Better crop tolerance than Lorox alone at 1½ pounds on sandy and sandy loam soils low in organic matter.
	chloramben + linuron (Amiben + Lorox)	2 + 1 (4 qts. + 2 lb.)	— Better crop tolerance than Lorox alone at 1½ pounds on sandy and sandy loam soils low in organic matter.
	chloramben + alachlor (Amiben + Lasso)	2 + 2 (4 qts. + 2 qts.)	— Preferred on sandy soils low in organic matter where injury has been a problem.
	metribuzin (Sencor)	½ (1 lb.)	— Some injury may occur on sandy soils or with high rainfall. — Only fair control of annual grasses. — Control of cocklebur and jimson weed.
	metribuzin + alachlor (Sencor + Lasso)	¾ + 2 (¾ lb. + 2 qt.)	— Some control of cocklebur and jimson weed. — Better grass control than Sencor alone.
	dinoseb + amiben (Dynoram)	3 + 1½ (6 qt.)	
	chlorbromuron (Bromex or Maloran)	2 (4 lb.)	— Plant soybeans at least 1¼ inches deep. — Don't use on sands, loamy sands or soils less than 2% organic matter.
	chlorbromuron + alachlor (Bromex or Maloran + Lasso)	1 + 2 (2 lb. + 2 qt.)	— Follow directions for Maloran and Lasso used separately.

Special Weed Problems

Velvet leaf	linuron (Lorox)	1½ (3 lb.)	— Preemergence. — Only fair control.
Jimson weed	fluorodifen (Peforan or Soyex)	4½ (6 qt.)	— Preemergence. — Only fair control.
	metribuzin (Sencor)	½ (1 lb.)	— Fair to good control.
Cocklebur	metribuzin (Sencor)	½ (1 lb.)	— Fair to good control.
Nutsedge	alachlor (Lasso)	3 (3 qt.)	— Preemergence. — Some early distortion may be observed on soybeans leaves. — Shallow incorporation will improve control under conditions of limited moisture.

Weed Control Guide for Small Grains and Legumes

WEED PROBLEM	CHEMICAL	RATE	REMARKS AND LIMITATIONS
Barley and Wheat (without seedings)			
Annual broadleaves	2,4-D (amine)	$\frac{1}{2}$	— Use when grain is fully tillered but before the boot stage (grain is usually 6 to 8 inches tall at this stage). — Do not apply in the fall.
Perennials	2,4-D (ester)	$\frac{1}{2}$	— Use only when bindweed, wild onion, and various thistles are present. — Use when grain is fully tillered but before the boot stage.
Oats, without seedings			
Annual broadleaves	2,4-D (amine)	$\frac{1}{4}$	— Use when grain is fully tillered but before the boot stage. — Some yield reduction may occur but generally less than caused by weeds.
	MCPA	$\%$	— Less injurious than 2,4-D. — Less effective than 2,4-D. — Use when grain is fully tillered but before the boot stage.
Oats Seeded to Legumes			
Annual broadleaves	MCPA	$\%$	— Use when grain is fully tillered 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 (Premerge or Sinox PE)	$\%$ (1 qt.)	— Use when grain is fully tillered but before the boot stage.
	4-(2,4 DB) ester (Butoxone or Butyrac 118)	$\%$ (3 pts.)	— Use when grain is fully tillered but before the boot stage.
Alfalfa, Trefoil and Clover Seedings (without small grain companion crops)			
Annual broadleaves	EPTC	3	— Work into soil immediately after application.
Annual grasses	(Eptam) (preplant)	(2 qt.)	— Seed may be planted immediately after this operation. — Do not use when grass is seeded with legumes.
Annual broadleaves	4-(2,4-DB) ester (Butoxone or Butyrac 118) (postemergence seedlings in 2-3 leaf stage)	$\%$ (3 pts.)	— Can use if annual broadleaf problem develops after using EPTC.
Alfalfa (Established Stand)			
Yellow rocket and broadleaved winter annuals	MCPA (late fall)	$\%$	— Do not apply in the fall of the year the alfalfa is seeded. — Apply after killing frost (legumes dormant).
	simazine (fall) (Princep)	$1\frac{1}{4}$ ($1\frac{1}{2}$ lb.)	— For fall application on established (1 year) alfalfa. — Will control winter annuals; yellow rocket, henbit, chick- weed, peppergrass, shepherd's purse 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. — 1.6 pounds on fine textured soils with 4 to 6% will give some effect on seedling white cockle.
Red Clover (current year seeding)			
Yellow rocket and broadleaved winter annuals	MCPA (fall)	$\%$	— Spray after killing frost legumes dormant.

Weed Control Guide for Small Grains and Legumes

WEED PROBLEM	CHEMICAL	RATE	REMARKS AND LIMITATIONS
Hay and Pasture (legume or grass)			
Hoary alyssum Annual broadleaves	4-(2,4-DB) ester (early April) (Butoxone or Butyrac 118)	1 (2 qts.)	— Spray when hoary alyssum seedlings are in two to four leaf stage. — Do not graze or harvest for forage for 30 days after spraying.
Pasture (Grass)			
Biennials and Perennials	2,4-D (ester) (fall or spring)	1	
Pasture (Legumes)			
Perennials	2,4-D (ester) (late fall)	1	— Legumes may be injured or killed. — Spot spray patches. — Spray after killing frost in fall (legumes dormant).

Weed Control Guide For Field Beans

Preplant

Annual broadleaves (except nightshade) Annual grasses	EPTC (Eptam)	3 (2 qt.)	— Incorporate immediately after application by disking or springtooth harrowing twice in different directions. — On light soils (sandy and sandy loam) low in organic matter rate should be reduced to 2 pounds per acre. — Some injury has occurred. — Longevity of control especially pigweed is limited.
Annual broadleaves (except ragweed, smartweed, mustard and nightshade) Annual grasses	trifluralin (Treflan)	$\frac{3}{4}$ (1½ pt.)	— Incorporate within 4-8 hours after application by disking or springtooth harrowing twice in different directions. — On light soils (sandy and sandy loam) low in organic matter use $\frac{1}{2}$ pound per acre.
Annual broadleaves (except nightshade) Annual grasses	EPTC + trifluralin (Eptam + Treflan)	$2\frac{1}{4} + \frac{1}{2}$ (1½ qt. + 1 pt.)	— Incorporate immediately after application. — Use where longer periods of control are desired along with a broader spectrum of weeds controlled.

Preplant Followed By Preemergence

Nightshade and other annual broadleaves Annual grasses	EPTC (Eptam)	$2\frac{1}{4}$ (1½ qt.)	— Follow remarks for Eptam under Preplant.
	trifluralin (Treflan)	$\frac{1}{2}$ (1 pt.)	— Follow remarks for Treflan under Preplant.
FOLLOWED BY			
	chloramben (Amiben)	2 (4 qt.)	— Effectiveness depends on adequate rainfall after treatment.
	dinoseb (Premerge and Sinox PE)	$4\frac{1}{2}$ (6 qt.)	— Effectiveness is somewhat limited depending on weather conditions.
	fluorodifen (Preforan or Soyex)	3 (4 qt.)	— Slight injury may occur. — Effectiveness depends on rainfall after treatment.
	chloramben (Amiben) + dinoseb (Premerge or Sinox PE)	1 + 3 (2 qt. + 1 gal.)	

Weed Control Guide For Field Beans

WEED PROBLEM	CHEMICAL	RATE	REMARKS AND LIMITATIONS
Preemergence			
Annual broadleaves Annual grasses	fluorodifen (Preforan or Soyex)	4 (5 qt.)	— Poor control of ragweed and barnyard grass. — Activity is limited unless rainfall is received within 4 to 5 days after application. — Some injury may occur.
	chloramben (Amiben)	2 (1 gal.)	— Rainfall needed within 4 to 5 days after application.

Weed Control Guide For Potatoes

Preplant			
Annual broadleaves Annual grasses	EPTC (Eptam)	4 ($\frac{1}{2}$ gal.)	— Work into soil immediately after application. — 6 pounds per acre may be used if nutsedge is a problem.
Preemergence			
Annual broadleaves Annual grasses	linuron (Lorox)	2 (4 lb.)	— Apply 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.
	dinoseb + dalapon (Premerge or Sinox PE + Dowpon or Basfapon)	3 + $2\frac{1}{2}$ (1 gal. + $3\frac{1}{2}$ lbs.)	— Refer to statements for linuron above.
	chlorobromuron (Bromex or Maloran)	2.4 (3 lb.)	— Same as Lorox above.
Quackgrass	2,4-D ester plus dalapon dalapon (Dowpon or Basfapon)	1 + $2\frac{1}{2}$ 10 (12 lb.)	— Do not use on fields grown for certification. — Refer to statements for Linuron above. — Spray in spring when quackgrass is 4 to 6 inches tall. Wait one week before plowing. — Use in 30 to 40 gallons of water per acre. — Control of quackgrass will be reduced when heavy stand of rye cover is present.

Weed Control Guide for Mint, Quackgrass Control, Fence Rows and Brush Control

Row Mint and Meadow Mint

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

Quackgrass (for spring seeded crops)	dalapon (Dowpon or Basfapon)	15	— 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 gallons of water per acre. — For quackgrass control in corn, potatoes, and sugarbeets, look under specific crop.
Quackgrass (for fall seeded crops)	dalapon (Dowpon or Basfapon)	10	— 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 gallons of water per acre.

Weed Control Guide for Mint, Quackgrass Control, Fence Rows and Brush Control

WEED PROBLEM	CHEMICAL	RATE	REMARKS AND LIMITATIONS
Fence Rows, Roadsides, Ditches			
Perennial broadleaves	silvex	2	— Spray before crops are planted or after harvest. — Do not pasture area.
Cattail	dalapon (Dowpon or Basfapon)	15	— Apply in June or July. — Use 80 to 100 gallons water. — Keep livestock out.
Poison Ivy	amitrole*	2	— Apply in June or July. — Spray when in full leaf.
Canada thistle Horse nettle	amitrole*	4	— Apply in June or July. — Do not pasture. — Do not apply in water.
Brush Most woody species	Mixture of 2,4,5-T** and 2,4-D esters ("Brushkiller") foliage spray		— Apply in spring or summer. — Add one pound acid equivalent to 25 to 30 gallons of water (for small amounts, mix 2 tablespoons of 4 pounds per gallon acid equivalent material to one gallon water). — Apply a drenching spray to foliage. — Best results obtained soon after maximum leaf-development in spring but summer sprays are also effective. — Best control on brush up to 8 feet tall.
Brush Hard-to-kill woody species	2,4,5-T** ester foliage spray		— Apply in spring or summer. — Use for hard-to-kill species such as ash, brambles, oak and maple or for surviving plants after spraying with a mixture of 2,4,5-T and 2,4-D "Brushkiller." — Follow rates and instructions given above for "Brushkiller."
Brush Most woody species	Mixture of 2,4,5-T** and 2,4-D esters ("Brushkiller") in oil		— Apply any time when drifting isn't a problem. — Using a concentrate that contains 4 pounds acid equivalent per gallon, mix one pint of concentrate in 3 gallons of diesel or kerosene, or use 10 tablespoons of concentrate per gallon.
Brush Most woody species	Basal spray		— Thoroughly wet the bark on the lower 18 inches of the brush. — Can use on small trees up to 6 inches in diameter. — Usually more effective than foliage sprays.
Brush Hard-to-kill woody 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 — 2 teaspoons per square yard.

Weed Control Guide For Sugarbeets

Preemergence

Annual broadleaves Annual grasses	pyrazon + TCA (Pyramin + TCA)	3 + 6 (4 lb. + 6 lb.)	— TCA should be included even if grasses aren't a problem as better control of annual broadleaves will result. — 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 pounds Pyrazon + 8 pounds TCA.
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*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 and on or around water areas.

Weed Control Guide For Sugarbeets

WEED PROBLEM	CHEMICAL	RATE	REMARKS AND LIMITATIONS
Postemergence			
Annual broadleaves (except smartweed)	pyrazon + phenmedipham + Crop Oil	2 + 1 + 1 gal. (2.5 lb. +	— Application should be made when the beets are coming into the 2 true leaf stage.
Annual grasses	(Pyramin + Betanal plus Crop Oil)	6 pt. + 1 gal.)	— 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. — Maximum total amount of Pyrazon that can be used for beets grown and processed in Michigan is 8 pounds per acre (2 pounds on the band). — When temperature is 75°F or greater, spray in late afternoon or early evening. — Injury will occur under high temperatures.
Annual broadleaves (except smartweed and buckwheat)	pyrazon + dalapon + Crop Oil	2 + 2 + 1 gal.	— Follow instructions under Pyrazon + Betanal + Crop Oil.
Annual grasses	(Pyramin + Dowpon or Basfapon + Crop Oil)	(2.5 lb. + 2.5 lb. + 1 gal.)	
	Pyramin Plus	12 (pounds— of product)	— This is a premix combination of Pyrazon + Dalapon + a wetting agent. — Follow instructions under Pyrazon + Betanal + Crop Oil.
Smartweed and Buckwheat	H 273	½	— This herbicide can be added to any of the above post-emergence treatments to improve control of these species.
Quackgrass	dalapon (Dowpon + Basfapon)	15 (20 lbs.)	— Apply in fall. — Use 30 to 40 gallons of water per acre. — Plow 7 to 10 days after application if possible.

Weed Control Guide for Sorghum (Grain and Forage)

Preemergence

Annual broadleaves	propazine	2	— Do not use on sandy soils.
Annual grasses	(Milogard)	(2.5)	— Do not plant small grains, small seeded forages, sugarbeets, field beans or vegetable crops the following year.
	atrazine + propachlor	1 + 3	— Do not feed silage made from Ramrod treated sorghum to producing dairy animals.
	(AAtrex + Ramrod)	(1¼ + 4.5)	— Note that Ramrod is 65% active and AAtrex is 80%. A commercial mix is available.

Postemergence

Annual broadleaves	2,4-D	½	— Apply when sorghum is 4 to 12 inches high. — Do not use unless weeds are a serious problem because some injury may occur.
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EFFECTIVENESS OF MAJOR CORN HERBICIDES ON WEEDS IN MICHIGAN

	Pre-planting		Preemergence				Postemergence			
	Sutan Plus (AA-trex)	Fox-4 (AA-trex) (Bladex) (Ramrod)	Lasso	Barvel	2, 4-D (Blavell)	(AA-trex) + Oil	Outfox	Bladex		
Broadleaved Weeds										
Lambsquarter	P E	E E E	P P	G G	G G	E	E E			
Pigweed	P E	E E F	F G	G G	G G	E	E F			
Ragweed	P E	E E E	P P	G G	G G	E	E E			
Smartweed	P G	G G G	P P	G P	E G	G	G G			
Mustard	P E	E E G	P P	F G	F E	E	E G			
Velvet leaf	P F	F F P	P N	G F	G G	G	G G			
Jimson weed	P F	F F P	P N	P F	G G	G	G F			
Grasses										
Green foxtail	E G	F F G	E E	P N	N N	G	P E			
Yellow foxtail	E G	G G G	E E	P N	N N	G	F E			
Barnyard grass	E G	G G G	G E	P N	N F	F	F E			
Fall panicum	E P	P P F	G E	P N	N P	P	P G			
Crabgrass	E P	P P F	E E	P N	N P	P	P G			
Giant foxtail	E F	F F F	E E	P N	N F	F	P F			
Quackgrass	P G	G G N	P N	N N	N G	G	P P			
Nutsedge	G P	P P N	P G	N N	N G	G	P P			
Corn Tolerance	G E	E E G	G G	G F	F G	G	G F			

E - Excellent
 G - Good
 F - Fair
 P - Poor
 N - None

These ratings are based on field observations. Results will be influenced by unfavorable conditions and under some conditions control may be better or poorer than indicated.

Ramrod and Radox perform well on annual grasses on high organic matter soils.

EFFECTIVENESS OF MAJOR SOYBEAN HERBICIDES ON WEEDS IN MICHIGAN

	Pre-planting		Preemergence				Postemergence				
	Cobex	Treflan	Vernam	Amiben	Lorox	Lasso	Preforan	Sencor	Bronex or Maloran	Tenoran or Norex	2, 4-DB
Broadleaved Weeds											
Lambsquarter	G	G	F	G	G	P	E	E	G	F	P
Pigweed	G	G	F	E	G	G	E	E	G	F	P
Ragweed	P	N	P	E	G	F	F	E	G	F	P
Smartweed	P	P	P	G	G	P	G	E	G	P	P
Mustard	P	P	P	F	G	P	G	E	G	G	P
Velvet leaf	N	N	N	P	F	P	P	F	F	P	P
Jimson weed	N	N	N	P	P	N	F	F	P	P	P
Cocklebur	N	N	N	P	P	N	P	G	P	P	F
Black nightshade	F	N	N	G	G	G	C	N	G	P	N
Grasses											
Green foxtail	E	E	E	G	G	E	G	G	G	P	N
Yellow foxtail	E	E	E	G	G	E	G	G	G	P	N
Barnyard grass	E	E	E	F	F	E	F	F	F	P	N
Crabgrass	E	E	E	G	F	E	G	F	F	P	N
Quackgrass	N	N	N	N	N	N	N	N	N	N	N
Nutsedge	N	N	N	N	N	G	N	N	N	N	N
Soybean Tolerance	G	F	G	F	G	G	F	F	F	F	P

E - Excellent
 G - Good
 F - Fair
 P - Poor
 N - None

These ratings are based on field observations. Results will be influenced by unfavorable conditions and under some conditions control may be better or poorer than indicated.