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# WEED CONTROL IN FIELD CROPS

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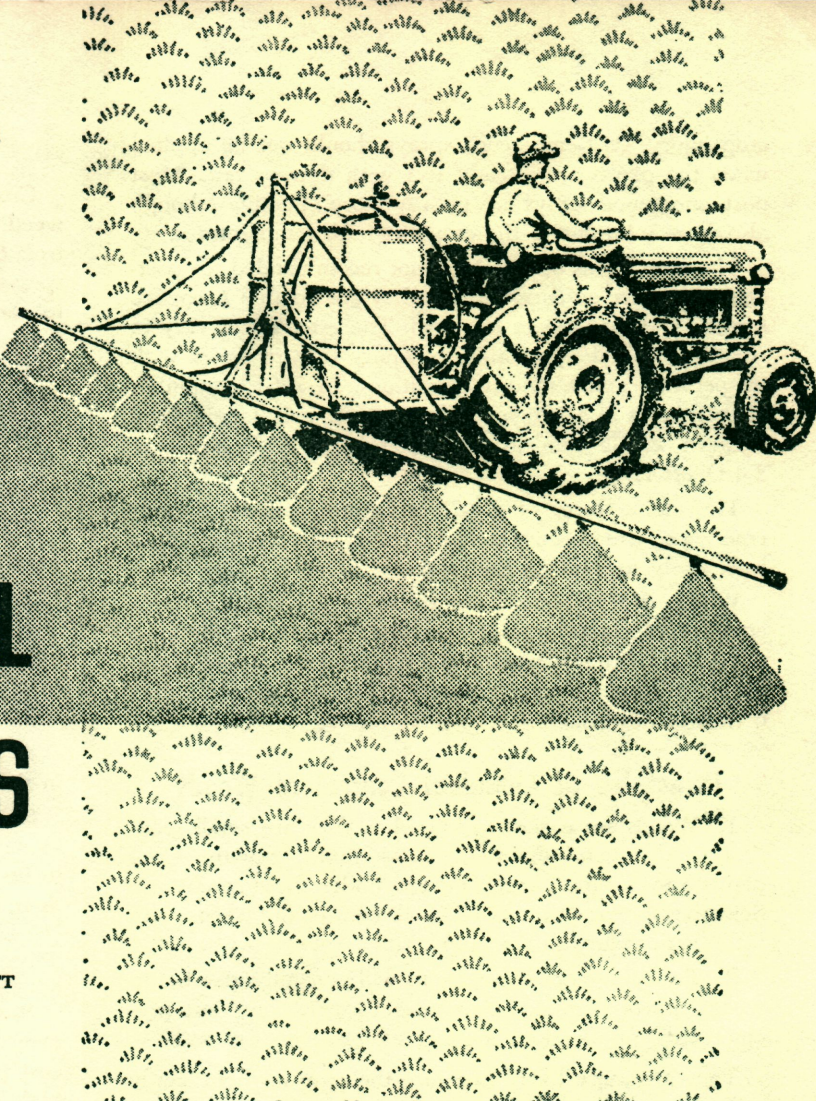
**T**HE MAIN REASON for cultivating crops is to control weeds, although some cultivation may be desirable under certain conditions even where weeds are not a problem. Chemicals (herbicides) often can control weeds at a considerable saving. In some cases, herbicides control weeds that cannot be controlled by normal tillage practices. However, tillage is the only practical control measure in some situations.

## Cultural Control

Minimum tillage methods of seedbed preparation can aid in control of annual weeds. The loose soil surface left by these methods makes for a dry topsoil layer which discourages 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 duck-foot 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 not too wet.

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 rootstocks 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 chemical 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.

*Post-emergence sprays*, applied after the crop has emerged, are available for corn, small grains and small seeded legumes but not for field beans, soybeans or sugar beets. Post-emergence sprays have the advantage of use in emergencies since they are not applied until the weeds are up. They are usually cheaper per acre but in many cases are not effective on grassy weeds. 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. Most 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 fumes) and may injure the corn. The ester forms vary in volatility, and the possibility of injury to corn varies with temperature and humidity conditions. In 1961, a number of corn fields in Michigan had increased stalk lodging and reduced yields due to post-emergence applications of 2,4-D ester.

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, but pre-emergence applications are not effective on dry soil.

They are more likely to injure the crop on light sandy soils than on heavier loams or clay loams. Injury on sandy soils is greatest when spraying is followed by heavy rains.

Pre-emergence sprays are more effective when used against annual grassy weeds than are post-emergence sprays with the same chemical.

If made as full coverage, pre-emergence sprays usually can eliminate two cultivations, giving free time for other pressing work. This may also be a decided advantage when the soil is too wet to cultivate. In most cases one cultivation will be necessary.

3. Time of spraying and rate of application 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 and will be damaged if too much chemical is used.

4. Do no cultivating for at least 3 weeks after pre-emergence spraying unless weeds appear that are resistant to the chemical. Delay cultivation after post-emergence spraying 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 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 right 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 refill 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 travelled gives square feet of area covered. This figure over 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 (allow to stand in sprayer overnight).
2. 5 pounds sal soda.
3. 8 pounds trisodium phosphate.

### Amounts of Chemicals for Weed Control

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 depends on the equipment available. Generally, a volume of 10 to 40 gallons per acre and a spraying pressure of 20 to 40 pounds will be satisfactory.

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 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 spray. This generally has been due to either inadequate 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 sprayer should be accurately calibrated.

1. Read the 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.

### 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 simazine, and more recently atrazine, have 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 oats and sugar beets 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. 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, some herbicide other than atrazine, such as 2,4-D or Randox-T, 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  $1\frac{1}{2}$  pounds 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.

### Giant Foxtail

Giant foxtail is a new, potentially serious weed in Michigan. Specimens have been identified from four counties, primarily from central Michigan, but it is suspected that infestations are present in other counties. This weed has been a serious problem in Illinois for a number of years and more recently has spread throughout Indiana.

Giant foxtail resembles green foxtail (pigeongrass), but it makes more vigorous growth and will grow four to six feet tall. Like green and yellow foxtail, it is an annual weed. Seed heads may be four to eight inches long. Identifying characteristics include the large, drooping seed heads and fine hairs on the upper surfaces of the leaves.

This weed is a prolific seed producer. A single head may have over 1,000 seeds and one plant over 20 heads; thus producing as many as 20,000 seeds per plant. Highly competitive, it may reduce corn and soybean yields as much as 25 per cent.

Control measures include the use of pre-emergence

herbicides in corn and beans or timely cultivation when the weed seedlings are small. For more detailed information on control of giant foxtail, check with your County Extension Office or write to the Department of Crop Science, Michigan State University.

## TABLE 1. CHEMICALS FOR WEED CONTROL IN FIELD CROPS

Rates are expressed in pounds of active ingredients per acre for the area actually sprayed, 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 recommendations given here conform with these regulations.

CROP	Chemical	Rate	Time of Application	Weeds Controlled	Remarks
CORN (MINERAL SOILS)	Atrazine	2	Pre-emergence	Annual grasses and annual broad-leaved weeds	Usually obtain season-long weed control. Cultivation may not be necessary with an over-all spray application. But if dry weather persists for 2 weeks after application, cultivate to control weeds. Band application reduces herbicide cost. May be applied within 10 days after planting and will control small weeds. Do not plant sugar beets or vegetable crops the year following corn. See page 3 for the discussion on soil residues when atrazine is used 2 or more years consecutively.
	2,4-D (Low volatile ester or oil soluble amine)	1½	Pre-emergence	Most annuals	Do not use on sandy soils. Avoid cultivation as long as possible. Usually obtain weed control for 4-6 weeks. Does not control smartweed; sometimes ineffective on annual grasses. Use oil soluble amine where sensitive crops are in the area or esters are prohibited.
	CDA + TCBC (Randox-T)	4½ qts.	Pre-emergence	Annual grasses and annual broad-leaved weeds	Avoid cultivation as long as possible. Band spraying will reduce herbicide cost. Usually obtain weed control for 4-6 weeks. Do not plant field beans, sugar beets, or vegetable crops the year following corn sprayed with Randox-T. Works effectively on soils with high organic matter.
	2,4-D (amine)	¾	Post-emergence Corn up to 6-8 inches tall	Broad-leaved annuals only	For corn taller than 6-8 inches and up to 18 inches, use drop nozzles. 2,4-D esters are <i>not</i> recommended for post-emergence application because of the greater possibility of damage to corn and other crops when they are used.
CORN (ORGANIC SOILS)	CDA (Randox)	4	Pre-emergence	Annual grasses	Avoid cultivation as long as possible. Band spraying will reduce herbicide cost. Usually obtain weed control for 4-6 weeks. Spray post-emergence with 2,4-D amine to control broad-leaved annuals.
	2,4-D (amine)	¾	Post-emergence Corn up to 6-8 inches tall	Broad-leaved annuals only	For corn taller than 6-8 inches and up to 18 inches, use drop nozzles, 2,4-D esters are <i>not</i> recommended for post-emergence application because of the greater possibility of damage to corn and other crops when they are used.
	Atrazine	3	Early post-emergence	Annual grasses and annual broad-leaved weeds	Apply 8-10 days after planting when weeds are less than one inch tall. Band application will reduce herbicide cost. Do not plant sugar beets or vegetable crops the year following corn.
CORN (QUACKGRASS CONTROL)	Amitrole-T (Amitrol-T) (Cytrol) plus Atrazine	2 plus 2	Pre-plow  Pre-emergence	Quackgrass and annual weeds	Apply Amitrole-T in fall or spring when quackgrass is 4-8 inches tall. Plow 7-10 days later. If freezing weather occurs 7-10 days after fall application, fall plowing will not be necessary. Plant corn and apply atrazine per pre-emergence instructions above. Do not plant sugar beets or vegetable crops the year following corn. See Extension Folder F-312 on Quackgrass Control for more details.
	Atrazine	4	Pre-plow	Quackgrass	When stand of quackgrass is heavy, apply in the fall. Otherwise apply in spring when quackgrass is 4-8 inches tall. Wait at least 10 days to plow. Can split application to apply 2# pre-plow and 2# pre-emergence; this will give control of annual weeds also. When a total of 4# of atrazine is used, <i>corn must be grown 2 consecutive years</i> . See folder on Quackgrass Control for more details.
BARLEY AND WHEAT  (WITHOUT SEEDINGS)	2,4-D (amine)	¾	Fully tillered	Broad-leaved annuals	Use when grain is fully tillered but before the boot stage. Grain is usually 6-8 inches tall at this stage. Do not apply in the fall.
	2,4-D (ester)	¾	Fully tillered	Perennials	Use only when bindweed, wild onion, and various thistles are present. Apply after fully tillered but before the boot stage.

CROP	Chemical	Rate	Time of Application	Weeds Controlled	Remarks
OATS (WITHOUT SEEDINGS)	2,4-D (amine)	¾	Fully tillered	Broad-leaved annuals	Grain is usually at proper stage for spraying when 6-8 inches tall. Some yield reduction may occur but generally less than caused by weeds.
	MCPA	¾	Fully tillered	Broad-leaved annuals	Less injurious than 2,4-D.
SMALL GRAINS SEEDED TO LEGUMES	MCPA	¾	Spring	Broad-leaved annuals	Spray when grains are 6-8 inches high. A canopy of grain and weeds over the seeding will reduce possibility of injury to alfalfa. Sweet clover is very sensitive to MCPA.
	DNBP (Premerge) (Sincox PE)	¾	Spring	Broad-leaved annuals	Spray when grains are 6-8 inches tall.
	4-(2,4-DB) (Butoxone) (Butyrac 118)	1	Spring	Broad-leaved annuals	Spray when grains are 6-8 inches high.
ALFALFA, TREFOLI AND CLOVER SEEDINGS WITHOUT SMALL GRAIN COMPANION CROPS	EPTC (Eptam)	3	Before planting	Annuals	Work into soil immediately after application. Seed may be planted immediately after this operation. Do not use when grass is seeded with legumes.
	4-(2,4-DB) (Butoxone) (Butyrac 118)	1	Post-emergence Seedlings in 2-3 leaf stage	Broad-leaved annuals	Can use if broad-leaved annual weed problem develops after use of EPTC.
ALFALFA (ESTABLISHED STAND)	MCPA	¾	Late fall	Yellow rocket Broad-leaved winter annuals	Do not apply in the fall of the year the alfalfa is seeded. Spray after killing frost (legumes dormant).
RED CLOVER (CURRENT YEAR SEEDING)	MCPA	¾	Late fall	Yellow rocket Broad-leaved winter annuals	Spray after killing frost (legumes dormant).
HAY & PASTURE (LEGUME OR GRASS)	4-(2,4-DB) ester (Butoxone) (Butyrac 118)	1	Early April	Hoary alyssum Broad-leaved annuals	Spray when hoary alyssum seedlings are in two to four leaf stage. Do not graze or harvest for forage for 30 days after spraying.
PASTURES (GRASS)	2,4-D (ester)	1	Fall or spring	Biennials and perennials	
PASTURE (LEGUMES)	2,4-D (ester)	1	Late fall	Perennials	Legumes may be injured or killed. Spot spray patches. Spray after killing frost in fall (legumes dormant).
FIELD BEANS	DNBP (Premerge) (Sincox PE)	4¾	Pre-emergence	Annuals	Material is not effective when soil is dry. Beans will be injured if sprayed post-emergence. Band spraying will reduce cost.
	EPTC (Eptam)	3	Before planting	Annuals	Work into soil immediately after application.
SOYBEANS	Amiben	3	Pre-emergence	Annuals	Band application will reduce cost. Use 4# per acre on muck soil.
	DNBP (Premerge) (Sincox PE)	4¾	Pre-emergence	Annuals	Material is not effective when soil is dry. Beans will be injured if sprayed post-emergence. Band spraying will reduce cost.
	NPA (Alanap 3)	4	At planting	Annuals	Not effective on muck or highly organic mineral soil. Band spraying will reduce cost. If smartweed is a problem, apply 2# NPA plus 2# CIPC per acre.
POTATOES	DNBP	4¾	Pre-emergence	Annuals	Level field before spraying.
	DNBP (Premerge) (Sincox PE) plus Dalapon	3 plus 2¾	Pre-emergence	Annual grasses and annual broad-leaved weeds	Level field before spraying.
	2,4-D (ester) plus Dalapon	1 plus 2¾	Before emergence	Annual grasses and annual broad-leaved weeds	Do not use on fields grown for certification.
	EPTC (Eptam)	4	Before planting	Annuals	Work into soil immediately after application. If nutgrass is a problem, use 6 pounds per acre.
	Diuron (Karmex)	¾	Pre-emergence	Annuals	
	Dalapon (Dowpon)	10	Spring-on quackgrass	Quackgrass	Spray when quackgrass is 4 to 6 inches tall, wait one week before plowing. Use in 30-40 gallons of water per acre. Control of quackgrass will be reduced when heavy stand of rye cover is present.

CROP	Chemical	Rate	Time of Application	Weeds Controlled	Remarks
SUGAR BEETS	TCA	8	At planting	Annual grasses	Some broad-leaved weeds may be controlled.
	Endothal	4	At planting	Annuals	Especially effective on smartweed. Band application will reduce cost.
	Endothal plus TCA	5½ gals.	At planting	Annuals	Use where both annual grasses and annual broad-leaved weeds are a problem. Band application will reduce cost.
	Dalapon (Dowpon)	15	Fall-on quackgrass	Quackgrass	Use 30-40 gallons of water per acre. Plow 7-10 days after spraying, if possible.
ROW MINT	DNBP	3	Pre-emergence	Annuals	Delay cultivation 3-6 weeks.
MEADOW MINT	DNBP	4½	Pre-emergence	Annuals	
QUACKGRASS (FOR SPRING SEEDED CROPS)	Dalapon (Dowpon)	15	Fall		Fall plow 7 to 10 days after spraying, if possible. Land can be planted to spring sown crops. Use in 30-40 gallons of water per acre. For quackgrass control in corn, potatoes and sugar beets—see above under specific crop.
QUACKGRASS (FOR FALL SEEDED CROPS)	Dalapon (Dowpon)	10	Spring		Apply prior to July 1. Plow 7-10 days after spraying. Land can be planted to alfalfa, wheat, or winter barley. Use 30-40 gallons of water per acre.
FENCE ROWS, ROADSIDES, DITCHES	Silvex	2	Spring or fall	Broad-leaved perennials	Spray before crops are planted or after harvest. Do not pasture area.
	Dalapon (Dowpon)	15	June-July	Cattail	Use 80 to 100 gallons water, keep livestock out.
	Amitrole	2	June-July	Poison ivy	Spray when in full leaf.
	Amitrole	4	June-July	Canada thistle Horse nettle	Do not pasture.
BRUSH (IN PASTURES, FENCE ROWS, ROADSIDES, DITCHES)	Mixture of 2,4,5-T and 2,4-D esters ("Brushkiller") Foliage Spray		Spring or Summer	Most woody species	Add one pound acid equivalent to 25-35 gallons of water. For small amounts, mix 2 tablespoons of 4 pounds per gallon acid equivalent material to one gallon of 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.
	2,4,5-T ester Foliage spray		Spring or Summer	Hard-to-kill woody species	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."
	Mixture of 2,4,5-T and 2,4-D esters ("Brushkiller") in oil Basal Spray		Any time	Most woody species	Using a concentrate that contains 4 pounds acid equivalent per gallon, mix one pint of concentrate in 3 gallons of diesel fuel or kerosene, or use 10 tablespoons of concentrate per gallon. Thoroughly wet the bark on the lower 18 inches of the brush. Can use on small trees up to 6" in diameter. Usually more effective than foliage sprays. Can use in fall, winter, and spring, when susceptible crops are not present.
	2,4,5-T ester in oil Basal Spray		Any time	Hard-to-kill woody species	Follow rates and instructions given above for basal spray with "brushkiller."
	Fenuron (Dybar)		Any time	Most woody species	Pellets may be spread by hand—2 teaspoons per square yard.
SOIL STERILIZATION (ELIMINATION OF ALL VEGETATION-AROUND BUILDINGS, ETC.)	Amitrole-T plus Simazine	4 plus 10	Spring		Use this combination where weeds have emerged. For 1,000 square feet, use 6 tablespoons of Amitrole-T and 3 tablespoons of simazine.
	Simazine	12	Early spring		Best applied before or at time weeds emerge.
	Monuron (Telvar)	30	Spring		Do not apply near desirable trees or shrubs.
	Chlorea	400	Early spring		Do not apply near desirable trees or shrubs.
	Ureabor	400	Early spring		Do not apply near desirable trees or shrubs.