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Chemical Weed Control for Horticultural Crops
Michigan State University Cooperative Extension Service
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CHEMICAL WEED CONTROL

**For
Horticultural
Crops**

MICHIGAN STATE UNIVERSITY
Cooperative Extension Service • East Lansing

CHEMICAL WEED CONTROL

For Horticultural Crops

By S. K. Ries, H. K. Bell, H. D. Davidson and R. P. Larsen
Department of Horticulture

Weeds compete with your food crops for water, light, nutrients, and space. Weeds cut down yields and may cause a total loss of crop. Weeds harbor insects and diseases as well as damage the quality of the harvested product. Weeds reduce crop values for the United States an estimated 4 to 5 billion dollars each year; this loss is greater than that caused by diseases and insects combined.

Principles of Chemical Weed Control

Chemical weed control is not a gamble—it is a sound, economical practice. To get good control, follow these basic principles.

1. **Weeds are killed most easily when the weather favors weed-seed germination and rapid plant growth.** Crop plants are also most easily injured under these conditions. The chemicals recommended, however, are designed to kill weeds, but not crops, under conditions favorable for plant growth. Poor results from pre-emergence sprays often are due to the lack of enough soil moisture after spraying to activate the chemicals or to bring about weed-seed germination in the surface soil.

2. **Chemicals recommended for selective weed control kill best when weed seeds are germinating or when plants are young.** With the exception of 2,4-D, chemicals used at the recommended rates will not kill older plants.

3. **Use the recommended rate of application.** The selectivity of chemicals for crop plants (killing weeds and not the crop) occurs only when the amount of chemicals applied falls within certain ranges. The greater the range of tolerance of a crop plant, the better the chemical is for weed control, provided the chemical will kill weeds throughout this range. No crop plant is completely resistant to herbicide injury.

4. **Do not disturb the soil in the crop row after applying chemicals.** Cultivate the crop, but be careful not to throw soil into the row. If you disturb the area near the plants, you destroy the chemical layer.

This may also bring weed seeds to the surface, where they germinate.

5. **Rates differ with soil type.** In general, use the lower recommended rates on light or sandy soils. Rates recommended for mineral soils may not be effective on muck soils. For instance, no practical concentration of NPA will effectively control weeds in cucumbers grown on muck soil.

6. **Know your weed species.** This is important because several chemicals are effective on certain species only. For instance, at the recommended rates, CIPC will kill purslane, chickweed, and smartweed, but not lambs quarter or pigweed. If only these last two are present, CIPC will appear ineffective.

7. **Know the chemical's limitations.** These appear on the product label. Read it carefully. Below is the type of information given on labels.

DNBP should not be used in sprayers which have contained copper unless the sprayer is thoroughly cleaned, because the copper will react with the DNBP to form a substance which will clog screens.

Monuron is sold as a wettable powder; the spray solution must be stirred constantly to be sure the chemical stays in suspension—evenly mixed in the water.

Sesone is effective only if it is applied before weed seedlings are more than one-fourth inch high.

8. **Be careful of wind drift and volatility.** Use only low-volatile forms of 2,4-D on vegetable and fruit farms. Be careful not to spray herbicides near sensitive crops such as grapes and tomatoes.

Weed Sprayers

You can use many types of sprayers to apply chemicals for weed control. You do not need to buy expensive, high-gallonage, high-pressure spray equipment. A complete weed-control sprayer should have the following features:

1. A pump which is inexpensive and easily replaced, which wettable powders will not damage, and with a minimum capacity of 4 gallons per minute.

2. Solution agitation (stirring), either mechanical or by using a bypass from the pump. If a power-takeoff sprayer does not provide agitation, add a bypass to a galvanized tee between the pump and pressure gauge. In this case, a separate valve on the bypass line will regulate pressure. If the pump does not have enough capacity for agitation under specific spraying conditions, provide it by using both the next lower tractor gear and nozzle tips with a smaller orifice.

3. 50-mesh screens for suction line and nozzles. Wettable powders will not go through the 100-mesh screens which are sometimes provided.

4. A spray boom with nozzles which may be adjusted for distance between nozzles on the boom and for height above the ground. This is especially important for band spraying.

5. A gauge which measures pressure accurately up to 100 pounds per square inch.

6. Flat fan nozzles. The best nozzle size for general use is equivalent to an 8004 Teejet. For most work, a wide-angle nozzle—73 or 80 degrees—is best because the boom can be held close to the ground to reduce drift. This is most important when it is windy.

7. For tree fruit and nurseries, a single nozzle can be used to cover an 8 foot strip, Mount Spraying Systems TOC 16 tip in a Type 4183 B fixed 45° angle nozzle mounted 16 inches above the soil level. Using a pressure of 40 P.S.I. and driving 2 mph, this will deliver approximately 50 gallons of spray per acre. Driving 3 mph this will deliver 30 gallons per acre. Use this nozzle under these conditions only.

Sprayer Calibration

One of the most important factors in effective weed spraying is accurate calibration — determining the amount of spray material applied per acre. A range of 20 to 60 gallons per acre, at a pressure of 20 to 60 pounds per square inch, is satisfactory.

Adjust the boom height so that the spray overlaps about a third at ground level for pre-emergent spraying or at the top of the weeds for post-emergent spraying. For overall spraying, this places the nozzles about 18 to 20 inches apart on the boom and 18 to 20 inches from the sprayed surface. A good way to calibrate a sprayer is to:

1. Fill the spray tank with water only.
2. Spray a measured area, in a field if possible, at a fixed tractor speed and pressure gauge setting. **Be sure to allow for partial coverage if bands are used.**
3. Measure the amount of water needed to refill the tank.
4. Divide this amount by the fraction of an acre sprayed to get the gallons applied per acre.
5. Mix the amount of chemical desired per acre with water to give this much spray material.

For example, if 10 gallons were applied on one-fourth acre, the volume of spray material applied would be 40 gallons per acre. If you change the tractor speed or gear, pressure setting, nozzle size, or number of nozzles, the amount of liquid applied per acre will be different and recalibration will be necessary.

Band Application

Since weeds in the crop row are usually the hardest to control, it may cost up to 80 percent less to spray herbicides in a band over the row rather than to cover the whole area.

If you use band applications, adjust for the area actually sprayed and not for the total acres in the field. For example, suppose the recommendation for a chemical is 4 pounds per acre, and 12-inch strips are sprayed over 36-inch rows. Only one-third of the ground area will be covered with spray material, so only 1½ pounds of chemical (one-third of 4 pounds) will be required per acre. 4 pounds of chemical will then cover 3 acres of the crop.

To adjust the sprayer for band application, place the boom so that there is one nozzle over each row and plug the nozzles between rows. This is not always easy with standard booms, but you can buy adjustable booms or adapters.

Cleaning Weed Control Sprayers

It is important to keep weed control sprayers clean. This is especially true if you use them to spray more than one crop or to apply fungicides and insecticides. **Do not use a sprayer to apply insecticides and fungicides if the sprayer has contained 2,4-D.**

In cleaning a sprayer, it is important that you thoroughly rinse the whole sprayer with water, inside and out, including boom, hoses and nozzles, both before and after cleaning. Partially fill the sprayer with water before you add the cleaning agent. Keep the pump running so that the cleaning solution will circulate throughout the sprayer. Corrosive cleaning agents should not stand in the tank or spray system for more than 2 hours.

When you are using only pre-emergence sprays, a good rinsing with water is enough. For other spraying purposes, remove weed-killers from sprayers by adding 1 gallon of household ammonia or 5 pounds of sal soda to 100 gallons of water. Allow this solution to stand in the sprayer for at least 2 hours. Drain it out

through the boom and nozzles, and rinse the sprayer with water. Do not let spray solutions stand in the tank overnight.

Copper may interfere with the effectiveness of herbicides, especially DNBP. To remove copper residues from the tank, add 1 gallon of vinegar or commercial acetic acid to each 100 gallons of water; allow it to stand in the sprayer for 2 hours only. Drain the sprayer immediately and rinse thoroughly with water.

Warning

Suggestions in this folder are based on data obtained from 2 or more years of trials. Use of these chemicals and methods, however, depends on registration of the products by the Food and Drug Administration. Growers are warned not to use a chemical on a food crop for which the compound is not registered; to do so will lead to confiscation of the crop if a residue is found on produce in either the fresh market or processed crop.

Labels of registered compounds will show the amount of residue, if any, permitted by current regulations on specific crops. Do not use any herbicide unless the label states that the chemical may be used on the specific crop to be sprayed.

READ THE LABEL

Common Equivalents

- 1 acre = 43,560 square feet or 160 square rods
- 1 square rod = 272 square feet
- 1 cup = 16 tablespoons
- 1 tablespoon = 3 teaspoons

Common Names and Trade Names

allyl alcohol	Bedrench, Allyl Alcohol
amitrole	Amino Triazole, Weedazol
amitrole-T	Cytrol, Amitrole-T
atrazine	Atrazine
CDA	Randox
CDEC	Vegelex
CIPC	Chloro IPC
dalapon	Dowpon
diuron	Karmex
DNBP	Sinox PE, Premerge
endothal	Endothal
EPTC	Eptam
EXD	Herbisan 5
methyl bromide	Methyl Bromide MC-2, Pest-master
monuron	Telvar
mylone	Mylone
NPA	Alanap-3
sesone	Sesone
simazine	Simazine
vapam	Vapam, VPM

1962 SUGGESTIONS FOR CHEMICAL WEED CONTROL IN HORTICULTURAL CROPS

ALWAYS READ THE LABEL ON THE CONTAINER

Rates Given Are for Pounds of Active Ingredients per Acre Actually Covered with Spray Material

	Chemical	Rate per acre actually sprayed	Time of application (In relation to crops)	Weeds controlled	Remarks and limitations
Asparagus	monuron	1-2 lb.	After discing in the spring and again after the cutting season.	Annuals	May apply during harvest period. Total dosage not to exceed 6 lb. per acre per year.
	dalapon	10-20 lbs.	In or at the end of the cutting season.	Quackgrass	Sprays made during the cutting season should be made immediately after cutting.
Beans (Snap and Lima)	DNBP	3-4 lbs.	Just before emergence to crook stage of beans.	Annuals	Apply no later than crook stage.
Beans (Snap)	EPTC	3-4 lbs.	1 to 2 days before planting.	Annuals	Harrow into top 2 inches of soil before planting.
Beets	Endothal	4 lbs.	At planting	Annuals	Pre-emergence only. Irrigate after application if possible.
Cabbage, Broccoli and Cauliflower	CDEC	4 lbs.	At planting or immediately after transplanting.	Annuals	If post-emergence direct the spray at base of plant. Irrigate after application if possible.

Carrots, Parsnips and Dill	stoddard solvent	40-75 gal.	After two true leaves have formed.	Annuals except ragweed	Spray when weeds are not more than two inches high. Carrots should not be thicker than a lead pencil. Spray on cloudy days or in evening before dew formation. Don't spray within 42 days of harvest.
Carrots	CIPC	4 lbs.	At planting.	Annuals	Pre-emergence only, will not control ragweed.
Celery	CDEC	4 lbs.	2 to 4 days after transplanting.	Annuals	Apply as a directed spray no later than 4 days from transplanting. Irrigate after application.
	stoddard solvent	40-75 gal.	In plant bed.	Annuals	In seed bed only.
	CIPC and CDEC	2 lbs. plus 2 lbs.	2 to 4 days after transplanting.	Annuals	Mix in tank. Irrigate after application.
Lettuce	CDEC	4 lbs.	At planting.	Annuals	Pre-emergence only. Irrigate after application.
Mint (Row)	DNBP	3 lbs.	Before mint emerges.	Annuals	Delay cultivation 3-6 weeks.
(Meadow)	DNBP	4½ lbs.	Before mint emerges.	Annuals	
Onions (Seeded)	Note—Calibrate carefully for both herbicide and banded insecticide rates. An excess of either chemical will increase possibility of injury.				
	EXD	5-10 lbs.	Either before or after come up.	Annuals	On post-emergence applications, use a shield so that only bottom 1 or 2 inches is sprayed. Apply no later than 21 days before harvest.

	Chemical	Rate per acre actually sprayed	Time of application (In relation to crops)	Weeds controlled	Remarks and limitations
Onions	CDAA Liquid or granular	2-6 lbs.	Use these chemicals according to your weed problem. CDAA is particularly good for control of annual grasses, purslane and pigweed. CIPC is particularly good for control of purslane, chickweed and smartweed.		
	CIPC Liquid or granular	2-6 lbs.	Apply no more than 4 pounds per acre of either chemical or a combination of 3 plus 3 lbs. per acre of both chemicals just before, or as the onions emerge. Make a second application after 2 to 3 true leaves are formed and use a third and fourth application as needed. Several applications at these lower rates give more effective weed control and will not cause injury. Granular materials may be used if no weeds are present when applied. Use CIPC no later than 30 days before harvest and CDAA no later than 45 days before harvest.		
Peas	DNBP	1-2 lbs.	2-4 leaf stage.	Annuals	Use 1 pound when temperature 80° F., 1½ pounds when temperature 70° F. and 2 pounds when temperature 60° F. Do not apply after peas 6 inches high.
Potatoes	DNBP	3-6 lbs.	Just before come-up.	Annuals	Pre-emergence on muck or mineral soil.
	dalapon	3 lbs.	Just before emergence.	Annual grasses	Must apply before potatoes emerge.
Spinach	CDEC	4 lbs.	At planting on muck or mineral soils.	Annuals	Do not apply if temperatures are above 80° F. Irrigate after application if possible.

Squash and Pumpkins	CIPC	1-2 lbs.	At planting on mineral soils.	Annuals	Use 1 pound if temperature below 60° F., 2 pounds if temperature above 60° F.
	Chemical weed control not suggested.				
Sweet Corn	atrazine	2 lbs.	From 1-10 days after planting.	Annuals	Use 4 lbs. per acre on muck soil.
	simazine	2 lbs.	At planting only.	Annuals	Pre-emergence only. Use 4 lbs. per acre on muck soil.
Tomatoes (Direct Seeded)	Solan	4 lbs.	2-3 days before crop emerges	Annuals	Do not apply within 30 days of harvest.
Tomatoes (Transplanted)	Solan	4 lbs.	Two weeks after transplanting	Annuals	Apply before weeds are 2 inches high. Do not apply within 30 days of harvest.
	CDAA (Granular)	4-6 lbs.	Apply within 2 weeks of transplanting	Annuals, particularly grasses	Use granular formulation only. Apply before weeds emerge.

Fruits

Bearing & Non-Bearing Apples	simazine	4 lbs.	In spring before weeds emerge	Annuals	Trees must be established one year.
	diuron	3 lbs.	In spring before weeds emerge	Annuals	Trees must be established one year.

	Chemical	Rate per acre actually sprayed	Time of application (In relation to crops)	Weeds controlled	Remarks and limitations
Non-Bearing Cherries, Peaches, Apricots and Plums	amitrole-T	2 lbs.	Before bloom when quackgrass has 2-6 inches of new growth.	Quackgrass	Combine with simazine or diuron for control of all weeds.
	dalapon	8 lbs.	When quackgrass has 2-6 inches of new growth.	Quackgrass	Combine with simazine or diuron for control of all weeds. Do not apply on trees younger than 4 years.
	simazine	3 lbs.	In spring before weeds emerge	Annuals	Trees must be established one year.
	amitrole-T	2 lbs.	Before bloom when quackgrass has 2-6 inches of new growth.	Quackgrass	Combine with simazine for control of all weeds.
Blueberries	diuron	2 lbs.	Apply in spring when weed growth starts.	Annuals and Reed Canary grass.	Apply at least 60 days before harvest.
Brambles	diuron	2 lbs.	Before weeds appear in spring.	Annuals	Apply before brambles leaf out.
	DNBP	3 lbs.	Before weeds appear in spring.	Annuals	Apply in early spring or after harvest. Do not apply in fall when tip layering.

Grapes	diuron	2-4 lbs.	In spring before weeds emerge.	Annuals	Band treatment, use lower rates on lighter soils. Do not apply in vineyards less than 3 years old.
	simazine	3-6 lbs.	In spring before weeds emerge.	Annuals	Band treatment use lower rates on lighter soils. Do not apply in vineyards less than 3 years old.
Strawberries (new Planting)	sesone	3 lbs.	2 to 3 weeks after planting and after a few runners are well established.	Annuals	Apply to moist soil. Don't spray within 7 days of harvest.
Strawberries (established planting)	2,4-D	1 lb.	Apply immediately after last picking.	Annuals	Renovate immediately after harvest and then spray with 2,4-D (amine formulation) or sesone.
Nursery Stock— Apples (Liners of seedlings or clones)	simazine	1-2 lbs.	Apply in April to Weed free area.	Annuals	Use low rate on light soil.
	diuron	1-2 lbs.	Apply in April to Weed free area.	Annuals	Use low rate of light soil.
Nursery Stock— Peach Seed (Pre-emergence)	simazine	1-2 lbs.	Apply in April, before weeds and peach seedlings emerge.	Annuals	Band application. Use low rate on light soil.
	diuron	1-2 lbs.	Apply in April, before weeds and peach seedlings emerge.	Annuals	Band application. Use low rate on light soil.

Flowers and Ornamentals

	Chemical	Rate per acre actually sprayed	Time of application (In relation to crops)	Weeds controlled	Remarks and limitations
Gladiolus	DNBP	4-8 lbs.	Before emergence	Annuals	Use 4-pound rate on cormels. Do not use near other annual plants.
	DNBP	4-8 lbs. granular	Pre-spike.	Annuals	Must use granular form and cultivate before application.
	diuron	1 lb.	After planting	Annuals	Spray on weed free soil. Use lower rate on light soil.
Peonies	simazine	2-3 lbs.	After planting. Fall or spring before growth.	Annuals and Winter Annuals	Do not apply after emergence.
	diuron	1-2 lbs.	Fall or spring before growth	Annuals and Winter Annuals	Do not apply after emergence.
Roses	simazine	2-3 lbs.	Fall or spring.	Annuals and Winter Annuals	Apply to weed free soil before growth starts.
	simazine (granular)	4-6 lbs.	Fall or spring.	Annuals and Winter Annuals	Apply to weed free soil before growth starts.
Tulips, daffodils	DNBP	4-6 lbs.	Fall	Annuals and Winter Annuals	

	simazine	1-2 lbs.	Fall or spring before emergence.	Annuals and Winter Annuals	Do not apply after emergence.
Lining-out stock (evergreens and deciduous)	simazine	2 lbs.	Immediately after transplanting.	Annuals	Consult label for species not to spray. Apply to weed free soil. There is no need to direct spray. Band spray if cover crop is desired.
Established stock (evergreens and deciduous)	simazine	2-6 lbs.	In spring when there is 3 inches of new grass growth or any time planting is free of weeds.	Annuals and Quackgrass	Check label for species not to spray. Apply higher rate on heavier soils and where quackgrass is severe and spray if cover crop is desired.
Shade Trees	simazine plus amitrole-T	3-6 lbs. plus 1-2 lbs.	In spring when there is 3 inches of new quackgrass growth.	Annuals Quackgrass and other perennials	Direct the nozzles so that no spray strikes the foliage. Spray a band and cultivate between rows.
Transplants, Ivy and Ground Covers	simazine (granular)	4 lbs.	1 week after planting.	Annuals	Check label for species not to treat. Use accurate granular spreader.

Potting Soil and Transplant Beds

	allyl alcohol	1-2 quarts per 100 Sq. feet	Several weeks before using	All weeds	Read the label.
	methyl bromide	1-2 lbs. per 100 Sq. feet	2-3 days before using.	All weeds	Read the label.

	Chemical	Rate per acre actually sprayed	Time of application (In relation to crops)	Weeds controlled	Remarks and limitations
	vapam	1-2 quarts per 100 Sq. ft.	Several weeks before using.	All weeds	Read the label.
	mylone	1-2 lbs. per 100 Sq. ft.	Several weeks before using.	All weeds	Read the label.

Quackgrass Control Before Growing Crop

	dalapon	10-20 lbs.	Sept. to Nov. 15.	Quackgrass	Apply when grass is at least 4 inches high. If quackgrass is low in vigor, apply nitrogen to stimulate growth 2 weeks before spraying.
	dalapon	10 lbs.	Spring when grass is at least 4 inches high.	Quackgrass	Wait at least five weeks before planting. Do not use in the spring before planting strawberries.
	amitrole-T	2-4 lbs.	Before August preferably in spring.	Quackgrass	Must wait 8 months before planting crops except corn, wait 10 days before planting corn.

	simazine	1-2 lbs.	Fall or spring before emergence.	Annuals and Winter Annuals	Do not apply after emergence.
Lining-out stock (evergreens and deciduous)	simazine	2 lbs.	Immediately after transplanting.	Annuals	Consult label for species not to spray. Apply to weed free soil. There is no need to direct spray. Band spray if cover crop is desired.
Established stock (evergreens and deciduous)	simazine	2-6 lbs.	In spring when there is 3 inches of new grass growth or any time planting is free of weeds.	Annuals and Quackgrass	Check label for species not to spray. Apply higher rate on heavier soils and where quackgrass is severe and spray if cover crop is desired.
Shade Trees	simazine plus amitrole-T	3-6 lbs. plus 1-2 lbs.	In spring when there is 3 inches of new quackgrass growth.	Annuals Quackgrass and other perennials	Direct the nozzles so that no spray strikes the foliage. Spray a band and cultivate between rows.
Transplants, Ivy and Ground Covers	simazine (granular)	4 lbs.	1 week after planting.	Annuals	Check label for species not to treat. Use accurate granular spreader.

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	mylone	1-2 lbs. per 100 Sq. ft.	Several weeks before using.	All weeds	Read the label.

Quackgrass Control Before Growing Crop

	dalapon	10-20 lbs.	Sept. to Nov. 15.	Quackgrass	Apply when grass is at least 4 inches high. If quackgrass is low in vigor, apply nitrogen to stimulate growth 2 weeks before spraying.
	dalapon	10 lbs.	Spring when grass is at least 4 inches high.	Quackgrass	Wait at least five weeks before planting. Do not use in the spring before planting strawberries.
	amitrole-T	2-4 lbs.	Before August preferably in spring.	Quackgrass	Must wait 8 months before planting crops except corn, wait 10 days before planting corn.

Poison Ivy, Canada Thistle, and Horse Nettle Control on Non-Crop Areas

	amitrole	2-4 lbs.	Spring or summer during active growth.		Apply when weeds are in full leaf but before flowers appear. Use lower rate on poison ivy.
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Soil Sterilization (For Elimination of all Herbaceous Vegetation)

	simazine plus amitrole	12 plus 4	When growth is active	All vegetation	Will last more than 2 years.
	monuron	20-40 lbs.	Any time.	All vegetation	Will last more than 2 years.
	simazine	10-15 lbs.	Any time.	All vegetation	Will last more than 2 years.