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# COMMERCIAL VEGETABLE PEST Control Guide

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in cooperation with members of the Departments of Horticultural Science;  
Entomology, Fisheries, and Wildlife; and Plant Pathology and Physiology



UNIVERSITY OF MINNESOTA • AGRICULTURAL EXTENSION SERVICE



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Information about the control of insects, diseases, and weeds in commercial vegetable production is presented in this publication. Reference to commercial or trademarked materials does not imply endorsement by the Minnesota Agricultural Extension Service; failure to mention a product does not imply criticism.

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AGRICULTURAL EXTENSION SERVICE, UNIVERSITY OF MINNESOTA

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# Commercial Vegetable Pest Control Guide

Recommendations in this guide are based on current state and federal registrations and tolerances set by the Food and Drug Administration. Directions given in this guide and on current container labels should be read, understood, and followed carefully in order to control pests and diseases effectively without causing excessive residues to remain on the crops. The following information is up to date at the time of this printing. Information regarding any changes during the 1966 season will be made available to all commercial growers.

## Rates of Application for Insecticides and Fungicides

Sometimes small amounts of insecticides or fungicides are listed in terms of tablespoons and teaspoons. These always mean level measure—not rounded or heaping.

Recommendations may be given in terms of pounds or gallons of commercial preparation or as pounds of actual chemical per acre. "Pounds actual" means the equivalent of 100-percent chemical. For example: 2 pounds of 50-percent DDT wettable powder contain 1 pound of actual DDT; 4 pounds of a 25-percent wettable powder contain 1 pound of actual insecticide; and 20 pounds of a 5-percent dust contain 1 pound of actual insecticide.

If you are preparing sprays that contain emulsifiable concentrates, read the label to determine how many pounds of insecticide are in each gallon of concentrate. For example, 25-percent DDT emulsifiable concentrate contains 2 pounds of actual DDT per gallon. If you wish to apply 1 pound of actual DDT per acre, decide on the amount of liquid you want to apply per acre (probably 50 to 100 gallons, depending on your sprayer) and add  $\frac{1}{2}$  gallon of 25-percent DDT concentrate to the amount of water needed for 1 acre.

Most insecticides and fungicides can be mixed. Read the label instructions for specific combinations.

For additional information on fungicides see Minnesota Extension Bulletin 312, "Fungicides, Bactericides, and Nematocides."

## Precautions

All chemicals are potentially hazardous and should be used carefully. Follow exactly the directions, precautions, and limitations given on the labels of chemical containers and in this publication. Store all chemicals in a safe place where children, pets, and livestock cannot reach them. Do not reuse empty pesticide containers. Avoid inhaling fumes and dust from pesticides, or spilling them. If chemicals are accidentally spilled, remove contaminated clothing and thoroughly wash the skin with soap and water immediately. Always wash thoroughly and change clothing after completing a spraying or dusting job.

Some of the pesticides, such as demeton (Systox), disulfoton (Di-Syston), endrin, parathion, mevinphos (Phosdrin), phosphamidon, and phorate (Thimet) are highly toxic and must be handled with special care. Observe the following rules:

1. Avoid drift from the application to adjacent areas occupied by humans or livestock or to bodies of water.
2. Persons loading or mixing should wear goggles, an approved respirator, and latex rubber gloves. Aerial operators should have a ground crew to load and not do the job themselves.
3. Pour chemicals at a level well below the face in order to avoid splashing or spilling onto the face or into the eyes.
4. Have plenty of soap and water on hand to wash contaminated skin in the event of spilling.
5. Change clothing and bathe after the job is completed.
6. Know the insecticide, its symptoms, and a physician who can be called quickly. In case symptoms appear (contracted pupils, blurred vision, nausea, severe headache, dizziness) stop operations at once and contact a physician.

## Minnesota Poison Information Centers

These centers have been established by the Minnesota Department of Health to provide physicians with information about pesticides and common household poisons, their antidotes, and treatments. Most of these centers operate on a 24-hour basis.

Town	Poison Information Centers	Telephone
Bemidji	Bemidji Hospital	751-5430
Brainerd	St. Joseph's Hospital	2861
Crookston	Bethesda Hospital St. Francis Hospital	281-4682 281-2490
Duluth	St. Luke's Hospital, 915 E. 1st Street	727-6636
Fargo, N.D.	St. Luke's Hospital	235-3161
Fergus Falls	Lake Region Hospital	736-5475 Night 736-3255
Mankato	Immanuel Hospital	628-1605
Marshall	Lewis Weiner Memorial Hospital	532-2263
Minneapolis	State Health Department, Division of Special Health Services Abbott Hospital, 110 E. 18th St. Fairview Hospital, 2312 S. 6th St.	339-7751 Night 339-1411 339-8414 Extension 226 332-0282 Extension 331

Town	Poison Information Centers	Telephone
Minneapolis	Hennepin County General Hospital, 619 S. 5th Street	330-3930
	North Memorial Hospital, 3220 Lowry Avenue N.	588-9451
	Northwestern Hospital, 810 E. 27th Street	332-7266
Morris	Stevens County Memorial Hospital	1191
Rochester	St. Mary's Hospital	282-4425 Extension 591
St. Cloud	St. Cloud Hospital	251-2700
St. Paul	Bethesda Hospital, 559 Capitol Blvd.	227-8611
	Ramsey County General Hospital, 640 Jackson	223-0353 Extension 217
	St. John's Hospital, 403 Maria Avenue	776-8595 Extension 351
	St. Joseph's Hospital, 69 W. Exchange	222-2861
	St. Luke's Hospital, 300 Pleasant Avenue	222-6644
	Children's Hospital, 311 Pleasant Avenue	227-6521
Virginia	Virginia Municipal Hospital	741-3340
Willmar	Rice Memorial Hospital	235-4543
Worthington	Worthington Memorial Municipal Hospital	376-4141 Night 376-4142

## Chemical Residues

Safe levels, or tolerances, for residues of chemicals in or on agricultural commodities have been set by the Food and Drug Administration. Crops containing residues in excess of the tolerance are subject to seizure.

Recommendations and label directions usually specify rates, methods, and times of application which will cause no residues, or residues within the established tolerances. Therefore, the limitations such as rates of applications, number of applications, and

minimum time intervals between treatment and harvest must be followed very closely. Do not use a higher rate or dosage than that given in the recommendations or on the labels; do not apply a chemical closer to harvest than the recommended time interval; do not use a chemical on a crop not listed on the label or included in this publication.

Keep a record of *all* chemical applications.

Recommendations for use of chemicals given herein are for field use only except where otherwise specified.

## Seedbed Fumigation for Plant Disease and Weed Control

Annual weed seeds and plant disease organisms have been successfully controlled prior to seeding by steam sterilization or fumigation with methyl bromide, SMDC (Vapam), DMTT (mylone), or chloropicrin. The period after treatment before crops can be safely planted will vary depending on moisture and temperature conditions. Fall treatment is often preferable, especially for early spring seeding.

Manufacturers' directions must be followed closely for safety and satisfactory results when using these fumigants. Soil must be worked up before treating. Crop residues must be well rotted or removed. Soils must be moist and in a good state of tilth at time of treating for best results. Do not disturb the soil below the depth of treatment after treating or the beneficial results will likely be lost.

Weed seeds present in the surface soil can also be killed by applying 50 to 75 pounds of granular calcium cyanamid per 1,000 square feet to a warm, moist soil and working it in to a depth of 2 to 3 inches. Areas treated with the latter chemical cannot be seeded for 3 to 6 weeks.

See table below for specific chemicals and approved uses for soil fumigation.

### Formaldehyde

Formaldehyde is a good general purpose soil fumigant. A tight cover of some kind is necessary to con-

### Kinds of Soil Fumigants

Chemical name	Some trade names	Pests controlled	Remarks and limitations
chloropicrin trichloronitro methane	Picfume Larvacide	All in soil	All crops. Maximum: 1,021 lb. actual per acre. Pre-plant soil fumigation only. Aerate for 7 to 14 days prior to planting. Field fumigation, greenhouse, nursery, and seedbeds.
O-2, 4-dichlorophenyl O, O-diethyl phosphorothioate	VC-13	Nematodes	Corn, cucumbers, peppers, squash, and tomatoes. 112.5 lb. actual per acre. Preplanting soil application only; allow at least 14 days between treating and planting. Do not treat more than once a year. Onions, 2 lb. actual per acre granular formulations applied in furrow at planting time. Do not use on green or spring onions. Beans (green and lima), muskmelons, peppers, and tomatoes; 15.5 lb. actual per acre. Apply immediately before planting.

**Kinds of Soil Fumigants (continued)**

Chemical name	Some trade names	Pests controlled	Remarks and limitations
dichloropropenes	Telone	Nematodes	All vegetable crops. Preplant soil fumigant. Allow 2 to 3 weeks between treatment and planting, or until odor has left soil. Customary 120 to 202 lb. per acre. Maximum 480 lb. per acre for muck soils. Do not treat extremely heavy soils.
1, 3-dichloropropene dichloropropane (DD)	D-D Vidden-D	Nematodes	Vegetable crops. Customary 150 to 250 lb. per acre. Maximum 600 lb. per acre muck soils. Preplant soil treatment. Wait 1 week before planting for each 10 gal. per acre applied—longer in case of heavy rains or temperatures below 60° F. Do not treat extremely heavy soils. Do not apply near living plants.
1, 3-dichloropropene ethylene dibromide	Dorlone	Nematodes	Same as for ethylene dibromide given below.
3, 5-dimethyltetrahydro-1, 3, 5, 2H-thiadiazine-2-thione (DMTT)	Mylone	Seed Weed Nematodes Fungi	Seedbed treatment: all crops. 348 lb. actual per acre. Soil fumigant use only. Allow 2 to 3 weeks interval between treatment and planting (longer if soil temperature is less than 60° F. or if soil is very moist).
ethylene dibromide (EDB)	Dowfume W-85, Dorlone (in part), Bromofume 85, Nemex 85, Soilfume 60-40	Nematodes  Soil insects	Asparagus, string beans, lima beans, broccoli, carrots, cauliflower, sweet corn, cucumbers, lettuce, melons, parsnips, peppers, squash, and tomatoes: 36 to 108 lb. actual per acre. Allow 1 to 3 weeks to lapse between time of application and planting. Beets, cabbage, celery, peas: 36 to 77 lb. actual per acre. Allow 1 to 2 weeks to lapse between time of application and planting. Cucurbits: 36 to 54 lb. actual per acre. Allow 1 to 2 weeks to lapse between time of application and planting. Seedbeds: 72 lb. actual per acre. Allow 1 to 2 weeks to lapse between time of application and planting.
methyl bromide	MC-2	Seed Weed Nematodes Fungi	Greenhouse, plantbed, coldframe, and raised bench: Soil fumigation. 2.0 lb. actual per 100 sq. ft. Preplanting soil fumigation. Expose to fumigation for 48 hours. Aerate for 3 days before seeding or 7 days before setting transplants. 1.0 lb. actual per cu. yd. of loose soil. Preplanting soil fumigation. Expose to fumigation for 24 hours. Aerate for 3 days before seeding or 6 days before setting transplants.
sodium-n-methyl dithiocarbamate dihydrate	Vapam VPM	Seed Weed Nematodes Fungi	Soil fumigant use (any crop may be grown on the treated soil). 120 to 543 lb. actual per acre by shallow injection. 690 lb. actual per acre by flood irrigation, sprinkler, or drench application. Cultivate 5 to 7 days after application. Do not plant for 7 days after treatment on light soils, 14 days on heavy soils. Allow 30 days if soil is below 60° F. Vegetable plantbeds: 490 lb. actual per acre. Cultivate 5 to 7 days after application. Do not plant within 14 to 21 days after fumigation.
methyl isothiocyanate and chlorinated hydrocarbons	Vorlex	Seed Weed Nematodes Fungi	25 to 60 gallons per acre (see label). Preplanting soil treatment. Expose to fumigation for 4 days and aerate for an additional 7 days for each 23 pounds per acre used.

fine the gas for 3 or 4 days following treatment. Crop residue must be removed and the soil loosened to plow depth. Mix 1 gallon of 37-percent commercial formalin (formaldehyde) with 50 gallons of water. Apply to soil at a rate of 1 gallon of the mixture per square foot of area. Apply slowly and evenly to the area.

At least 2 weeks of drying weather are required following treatment before plants can be safely planted. Aeration of the soil by tillage may be necessary to clear the chemical from the soil. Early fall treatment is preferable in most cases and is necessary for early planting in the spring. Therefore, it is necessary to plan ahead to have the area open by late summer for the treatment.

### Postharvest Dip or Spray

A postharvest dip or spray may be used on green or bulb onions, muskmelons, cucumbers, and potatoes being prepared for market. The maximum permissible dosage is a dip in a 0.12-percent suspension of captan fungicide for onions and potatoes and a 0.25-percent suspension for cucumbers and muskmelon. This dosage figures out to 2 pounds and 4 pounds, respectively, of captan 50-percent wettable powder per 100 gallons of water. Special formulations of captan are also available for this purpose. This treatment has been found to reduce certain types of rotting.

### Sprayer Calibration and Adjustment

Uniform application of spray chemicals is essential to control weeds. A small variation in the rate of application may fail to kill the weeds or may injure the crop, thereby causing a loss of time, effort, and money.

A simple method for determining the amount of liquid a sprayer applies per acre is as follows:

1. Start with a full tank of clean water and have the pressure adjusted as you will use it in the field (usually 30 to 40 pounds).

2. Drive exactly  $\frac{1}{8}$  mile (40 rods) in a field at the speed you will use when spraying—usually 4 to 5 miles per hour. Mark the throttle setting or speed indicator reading and maintain the same speed when spraying.

3. Refill the tank, carefully measuring the amount of liquid required.

4. Calculate the application rate as follows:

$$\frac{\text{Number of gallons used} \times 66}{\text{Boom width covered, in feet}} = \text{gallons per acre}$$

**Example:** If  $2\frac{1}{2}$  gallons is used in  $\frac{1}{8}$  mile and the width covered by the boom is 24 feet, multiply  $2\frac{1}{2}$  by 66 and divide by 24. The result is 6.9 gallons per acre.

$$\frac{2.5 \times 66}{24} = \frac{165}{24} = 6.9 \text{ gallons per acre}$$

Here is the way to determine the amount of herbicide to put in the tank:

1. Divide the number of gallons the tank will hold by the number of gallons your sprayer applies per acre to find the number of acres one filling will spray.

2. Multiply the number of acres the tank will spray by the amount of herbicide to be used per acre to find the amount of herbicide to be used per tank.

**Example:** If the tank holds 55 gallons and the sprayer applies 6.9 gallons per acre, one tank will spray 8.0 acres (55 divided by 6.9 equals 8.0). If 1 pint of spray material is required per acre, 8.0 pints would be required for each tankful. That is, 1 pint per acre  $\times$  8 acres = 8.0 pints per tankful.

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*We strongly urge that recommended practices on seed treatment and crop rotation given in this guide be followed carefully. Failure to do so may result in crop failure or severe loss. In many cases nothing can be done to control some diseases after the crop is planted.*

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**1966 Insecticide, Fungicide, and Herbicide Recommendations for Vegetable Crops**

**Asparagus**

Insects	Chemical*	Remarks and limitations
Asparagus beetles	carbaryl (Sevin) 1 lb. (1¼ lb. 80% WP)	1 day. Do not repeat within 3 days.
	DDT 1 lb. (2 lb. 50% WP, 2 qt. 2 lb. EC)	After cutting season only.
	malathion 20 ounces (2 pt. 5 lb. EC)	1 day.
	methoxychlor 1 lb. (2 lb. 50% WP)	3 days.
Diseases	Chemical*	Remarks and limitations
Rust	Resistant varieties	Grow resistant varieties such as Mary and Martha Washington, Hybrid, and Waltham Washington. Destroy volunteer asparagus plants in vicinity.
	Spray in field, use label directions maneb zinc ion maneb zineb	Only on fern growth after spears are harvested.
Weeds	Chemical*	Remarks and limitations
<b>SEEDBEDS</b>		
Annual weeds	monuron 1¼ lb. (1½ lb. Telvar) amiben 3 lb. (6 qt. Vegiben or Amiben) Stoddard Solvent 40 gal.	Immediately after seeding. Immediately after seeding. Delayed preemergence when weeds are 1 to 2 inches tall.
Annual broad-leaved weeds	2,4-D sodium salt 1 lb.	Postemergence to young seedlings.
<b>ESTABLISHED BEDS</b>		
Annual weeds	Monuron 1 to 3 lb. (1¼ to 3¾ lb. Telvar)	After disking and before spears appear in spring, and/or after postharvest disking before weeds appear.
	simazine 2 to 4 lb. (2½ to 5 lb. Simazine)	After disking and before spears appear in spring, and/or after postharvest disking before weeds appear.
Annual broad-leaved weeds (suppresses Canada Thistle)	2,4-D sodium salt 2 lb.	Follow a cutting or postharvest; apply to emerged weeds
Quackgrass	dalapon 7½ lb. (10 lb. Dowpon)	Before cutting and again 3 to 4 weeks later if needed.

**Beans**

Insects	Chemical*	Remarks and limitations
Aphids	dimethoate (Cygon) ½ lb. (1½pt. 2.67 lb. EC)	30 days; do not feed treated forage to livestock.
	malathion 1 to 1½ lb. (1½ to 2 pt. 5 lb. EC)	1 day.
	phorate (Thimet) 2 lb. (20 lb. 10% G)	Apply in furrow but not in contact with seed. 60 days for forage. The systemics phorate and disulfoton also help control leafhoppers and mites.
	disulfoton (Di-Syston) 2 lb. (20 lb. 10% G)	Soil treatment at planting time.

\* Abbreviations used in tables: **NTL**—no time limitations, **EC**—emulsifiable concentrate, **D**—dust, **G**—granules, and **WP**—wetable powder. Dosages of insecticides are actual chemical per acre, with some examples.

### Beans (continued)

	Chemical*	Remarks and limitations
Bean leaf beetle	carbaryl (Sevin) 1 lb. (1¼ lb. 80% WP) DDT 1 lb. (2 lb. 50% WP, 10 lb. 10% D)	NTL. Apply lightly. 7 days. Do not feed treated vines to livestock.
Potato leafhopper	methoxychlor 1 lb. (2 lb. 50% WP, 2 qt. 2 lb. EC) DDT ¾ lb. (1½ lb. 50% WP, 7½ lb. 10% D) malathion 1 to 1½ lb. (1½ to 2 pt. 5 lb. EC, 4 lb. 25% WP)	7 days (green beans). 1 day (dry beans). 7 days; apply lightly. 1 day.
Spider mites	methoxychlor 1 lb. (2 lb. 50% WP) dicofol (Kelthane) ½ lb. (2½ lb. 18½% WP) malathion ¾ to 1 lb. (1½ pt. 5 lb. EC, 3 to 4 lb. 25% WP)	7 days (green beans); 1 day (dry beans). 7 days; do not feed treated vines. 1 day.
Seed corn maggot, wireworms	aldrin, dieldrin, heptachlor, or lindane, 1 oz. per bu.	Seed treatment only.
<b>Diseases</b>	<b>Chemical*</b>	<b>Remarks and limitations</b>
Seed rot, damping off	Seed treatment: captan, chloranil, Dexon, dichlone, or thiram	Do not use treated seed for food or feed.
Anthracnose and bacterial blight		Do not use home-grown seed; it may be in- fected with anthracnose or bacterial blight. Use 3-year crop rotation. Do not cultivate when plants are wet.
<b>Weeds</b>	<b>Chemical*</b>	<b>Remarks and limitations</b>
<b>Snap Beans</b>		
Annual weeds	EPTC 3 lb. (2 qt. Eptam)	Incorporate thoroughly into top 2 inches of soil.
Annual grasses	CDA 4 lb. (4 qt. Randox)	Immediately after seeding.
Annual weeds	DNBP amine 6 to 9 lb. (8 to 12 qt. Premerge or Sinox PE) DNBP amine 3 to 4 lb. (4 to 6 qt. Premerge or Sinox PE)	Immediately after seeding. Do not apply to light sandy soil. If delayed, apply just before emergence.
<b>Lima Beans</b>		
Annual weeds	amiben 4 lb. (8 qt. Vegiben or Amiben) alone or mixed with CDA 2 lb. (2qt. Randox) or with DNBP amine 3 to 6 lb. (4 to 8 qt. premerge or Sinox PE)	Immediately after seeding. Do not feed plant parts to livestock.

### Beets

Diseases	Chemical*	Remarks and limitations
Seed rot, damping off	Seed treatment: captan, chloranil, Dexon, dichlone, thiram	Use label directions. Do not use treated seed for food or feed.
Black root		Promote vigorous growth of young plants with good seedbed preparation and bal- anced soil fertility. Crop rotation is im- portant; however, the disease may be as severe when beets follow beans or alfalfa as when beets follow beets.
<b>Weeds</b>	<b>Chemical*</b>	<b>Remarks and limitations</b>
Annual grasses	TCA 8 lb. (10 lb. 79% sodium TCA)	Apply 2 days before emergence. Do not use treated tops for food. Less effective on muck soils.
Annual weeds	pyramin 4 lb. (5 lb. Pyrazon)	Preemergence or immediately after beets emerge and before weeds have 2 leaves.

\* Abbreviations used in tables: **N**T**L**—no time limitations, **E**C—emulsifiable concentrate, **D**—dust, **G**—granules, and **W**P—wetable powder. Dosages of insecticides are actual chemical per acre, with some examples.



### Cabbage, Broccoli, Cauliflower, Brussels Sprouts

Insects	Chemical*	Remarks and limitations
Cabbage maggot	chlordan 5 lb. (50 lb. 10% G, 12 lb. 40% WP)	May be applied as emulsion, wettable powder, granules, in fertilizer mix, or in transplant solutions. Broadcast soil application before planting into surface 3 or 4 inches of soil. May also be used as furrow treatment at half rate. In transplant solution use 4 oz. actual chlordan per 50 gal. of solution and apply 300 gal. per acre (2/3 cup per plant).
	diazinon 2 to 3 lb. (4 to 6 lb. 50% WP, 15 to 20 lb. 14% G)	
Cabbageworm, loopers	DDT 1 lb. (10 lb. 10% D, 2 lb. 50% WP)	Before heading only.
	toxaphene 1 1/2 to 2 lb. (15 to 20 lb. 10% D, 1/4 to 1/2 gal. 6 lb. EC)	Before heading only.
	Bacillus thuringiensis (Bakthane, Thuricide) as labelled	N.T.L.
	diazinon 1/2 lb. (1 lb. 50% WP)	7 days for cabbage; 5 days for broccoli, cauliflower.
	naled (Dibrom) 1 lb. (1 pt. 8 lb. EC)	4 days.
	endosulfan (Thiodan) 3/4 lb. (1 1/2 qt. 2 lb. EC)	7 days for broccoli and cabbage; before curds begin to form for cauliflower.
	azinphosmethyl (Guthion) 1/2 to 3/4 lb. (2 to 3 lb. WP, 3 to 4 pt, 1 1/2 lb. EC)	21 days for cabbage; 15 days for broccoli, cauliflower; 7 days for brussels sprouts.
	parathion 1/4 lb. (1 lb. 25% WP)	7 days.
	Perthane 1 lb. (2 lb. 50% WP)	At least 3 days before harvest.
	mevinphos (Phosdrin) 1/2 lb. (1 qt. 2 lb. EC)	1 day for broccoli, cabbage; 3 days for cauliflower, brussels sprouts.
	trichlorfon (Dylox) 1/2 to 1 lb. (1 to 2 lb. 50% soluble powder)	21 days.
<b>Note:</b> Loopers should be controlled when they are still small. Fully grown loopers are very difficult to control.		
Flea beetles	DDT 1 lb. (2 lb. 50% WP, 10 lb. 10% D)	Before heading only.
	methoxychlor 1 1/2 lb. (3 lb. 50% WP)	3 days for cabbage; 7 days for cauliflower; 14 days for broccoli, brussels sprouts.
	endosulfan (Thiodan) 3/4 lb. (1 1/2 qt. 2 lb. EC)	7 days.
Aphids	toxaphene 1 lb.	Before heading only.
	demeton 1/2 lb. (2 pt. 2 lb. EC)	21 days.
	diazinon 1/2 lb. (1 lb. 50% WP)	7 days for cabbage; 5 days for broccoli, cauliflower.
	naled (Dibrom) 1 lb. (1 pt. 8 lb. EC)	4 days.
	disulfoton (Di-Syston) 1 lb. as granules	One application per season to the furrow or as a side dressing. 42 days cabbage; 40 days cauliflower; 14 days broccoli; 30 days brussels sprouts.
	endosulfan (Thiodan) 3/4 lb. (1 1/2 qt. 2 lb. EC)	7 days.
	malathion 1/2 to 3/4 lb. (3/5 to 1 pt. 5 lb. EC)	7 days.
	mevinphos (Phosdrin) 1/4 lb. (1 pt. 2 lb. EC)	1 day broccoli, cabbage; 3 days cauliflower, brussels sprouts.

\* Abbreviations used in tables: **N.T.L.**—no time limitations, **EC**—emulsifiable concentrate, **D**—dust, **G**—granules, and **WP**—wetable powder. Dosages of insecticides are actual chemical per acre, with some examples.

### Cabbage, Broccoli, Cauliflower, Brussels Sprouts (continued)

Insects	Chemical*	Remarks and limitations
Black rot, blackleg	Hot-water seed treatment 122° F. Cabbage: 25 minutes; broccoli and cauliflower: 20 minutes	Dry seed thoroughly. Crop rotation and sanitation are also necessary.
Seedbed diseases	See section on seedbed fumigation, page 4	
Seed rot, damping off	Seed treatment: captan, chloranil, dichlone, thiram	Follow hot-water treatment after seed is dry. Do not use treated seed for food or feed.
Club root	PCNB 75% WP 2 to 6 lb. per 100 gal. transplant water—½ to ¾ pt. per plant	Plant in noninfested soil if possible. High rate for heavy infestations and muck soils. May be mixed with insecticides in transplant water.
	PCNB dust 60 lb. actual per acre broadcast or 40 lb. actual per acre band or row application	Broadcast dust and mix thoroughly in soil before planting.
Mosaic (internal spotting of cabbage head)	Control aphids that spread the virus	

Weeds	Chemical*	Remarks and limitations
Annual weeds	DCPA 8 lb. (10 lb. Dacthal)	At time of seeding or immediately after transplanting.
	CDAA 4 lb. (4 qt. Radox)	For cabbage only. Apply at time of seeding.
	CDAA 6 lb. (6 qt. Radox)	Directed spray to transplanted cabbage only.

### Carrots

Insects	Chemical*	Remarks and limitations
Leafhoppers	carbaryl (Sevin) 1 lb. (1¼ lb. 80% WP)	NTL.
	DDT 2 lb. (20 lb. 10% dust, 1 gal. 2 lb. EC)	3 or 4 applications at 7-day intervals beginning soon after carrots emerge. Do not use tops.
	malathion ¾ lb. (1 pt. 5 lb. EC)	7 days.

Diseases	Chemical*	Remarks and limitations
Seed rot, damping off	Seed treatment: captan, chloranil, dichlone, or thiram	Follow hot-water treatment for bacterial blight after seed is dry.
Bacterial blight and leaf spot	Hot-water seed treatment 122° F. for 15 min.	Dry seed thoroughly. Crop rotation at least 1 year and sanitation are necessary.
	Spray in field: fixed copper—use label directions	7- to 10-day intervals. NTL.
	maneb—use label directions zineb—use label directions	NTL.
Aster yellows virus	Control six-spotted leafhoppers that spread the virus	Not later than 7 days before harvest if tops are to be used for food or feed.

\* Abbreviations used in tables: NTL—no time limitations, EC—emulsifiable concentrate, D—dust, G—granules, and WP—wetable powder. Dosages of insecticides are actual chemical per acre, with some examples.

### Carrots (continued)

Weeds	Chemical*	Remarks and Limitations
Annual weeds	Stoddard Solvent 20 to 100 gal.	Delayed preemergence and postemergence before taproot is ¼ inch in diameter. Most effective if weeds are small, air still, and humidity high. Crop injury may occur when temperature exceeds 75° F.
Annual weeds	linuron 2 lb. (4 lb. Lorox) linuron 1 lb. (2 lb. Lorox)	Preemergence. Do not apply to sandy soils. Postemergence when carrots are 2 to 6 inches tall. Do not apply to sandy soils.

### Corn, Sweet

Insects	Chemical*	Remarks and limitations
Seed corn maggot, corn seed beetle, wireworms.	aldrin, dieldrin, heptachlor, lindane	1 oz. per bushel as seed treatment.
European corn borer	DDT 1 lb. (10 lb. 10% G or 20 lb. 5% G) emulsion 1½ lb. (3 qt. 25% EC) endrin ¼ lb. (1 to 1½ pt. 1.6 lb. EC) (granules or emulsions) carbaryl (Sevin) 1 to 2 lb. (1¼ to 1½ lb. 80% WP)	Do not feed or ensile treated stalks, leaves, and husks. 45 days. NTL.
		For first brood make first treatment when about 25% of the plants show evidence of recent leaf feeding (shot-holing) in the whorl leaves within 2 weeks of tassel emergence. This is about 10 to 14 days after egg hatch begins. One or two additional applications at 5- to 7-day intervals may be needed. For second brood treat at the time of egg hatch (mid to late August). Direct spray at ear zone. Additional treatments should be made at 5- to 7-day intervals.
Corn earworm	diazinon 1 to 1½ lb. (2 to 2½ qt. 25% EC) (1 to 1¼ qt. 50% EC "AG 500")	Apply to ear zone at 2- to 3-day intervals until silks dry. 2 days.
Corn earworm	carbaryl (Sevin) 1 to 2 lb. (1¼ to 1½ lb. 80% WP)	NTL. Apply to ear zone at 2- to 3-day intervals until silks begin to dry. Carbaryl is toxic to bees; do not apply as dust to pollinating corn; avoid treating corn while bees are in the field.
Corn rootworm	aldrin ½ to 1 lb. (WP, EC, or G) heptachlor ½ to 1 lb. (WP, EC, or G)	Soil treatment before or at planting time. ½ lb. rate for row and 1 lb. rate for broadcast application. Incorporate into soil surface. <b>Caution:</b> The use of aldrin or heptachlor as a soil treatment may result in detectable residues on or in the plants in some cases, and may also carry over in the soil resulting in residue problems in following crops; especially root crops. See Entomology Fact Sheet 14, "Controlling Corn Rootworms." For resistant northern or western rootworms use diazinon, phorate, or parathion in granular form at 1 lb. actual chemical per acre applied in the furrow.

\* Abbreviations used in tables: NTL—no time limitations, EC—emulsifiable concentrate, D—dust, G—granules, and WP—wetable powder. Dosages of insecticides are actual chemical per acre, with some examples.



### Corn, Sweet (continued)

Diseases	Chemical*	Minimum days before harvest
Seed rot, damping off	Seed treatment: captan, chloranil dichlorone, or thiram	Do not use treated seed for food or feed. Follow label directions.
Smut		Hybrids differ somewhat in susceptibility. Avoid those that are highly susceptible. Percentage of smutted ears is often higher at low plant populations and high fertility levels. Plant as high a population as possible that will give adequate ear size and good yield. Incidence of smut varies with planting date. Therefore, by having several plantings each year, the entire crop would rarely be heavily infected.

  

Weeds	Chemical*	Remarks and limitations
Annual weeds	atrazine (4 lb., 1¼ to 5 lb. 80% atrazine)	Pre- or postemergence. Do not apply later than 3 weeks after planting. Use the higher rate on heavy soil. <b>Caution:</b> Atrazine could injure other crops sown in the fall or following spring. It may be advisable to plant corn the second year.
Broad-leaved weeds	DNBP amine 1 to 3 lb. (2 to 4 qt. Premerge or Sinox PE) 2,4-D amine ½ lb. 2,4-D ester ¼ lb.	Apply shortly after emergence at spike stage. Apply after corn emergence. Can use to 18-inch stage of corn, but use drop nozzles.
Annual grasses	dalapon 1½ lb. (2 lb. Dowpon)	Postemergence directed spray. Use corn leaf lifters. Can be mixed with 2,4-D to control all annual weeds.

### Cucumbers, Melons, Pumpkins, Squash

Insects	Chemical*	Remarks and limitations
<b>Note:</b> Make light applications using dusts or wettable powders on cucurbits. These plants are injured by heavy treatments and by certain formulations.		
Cucumber beetles (striped and spotted)	carbaryl (Sevin) 1 lb. (1¼ lb. 80% WP)	NTL.
	DDT 1 lb. (10 lb. 10% purified grade dust or 2 lb. 50% WP)	5 days.
	endosulfan (Thiodan) ½ to 1 lb.	NTL.
	methoxychlor 1 lb. (10 lb. 10% D or 2 lb. 50% WP)	1 day.
Aphids	endosulfan (Thiodan) ½ lb. (1 qt. 2 lb. EC)	NTL.
	malathion ½ lb. (12 lb. 4% D)	1 day.
	parathion ¼ lb. (1 pt. 2 lb. EC)	15 days.
Squash bugs	Sabadilla 1 lb. (10 lb. 10% D)	
	carbaryl (Sevin) 1 lb. (1¼ lb. 80% WP)	NTL.
	parathion ¼ lb. (1 pt. 2 lb. EC)	15 days.
White grubs, wireworms	chlordane 2 to 5 lb. per acre	Soil treatment before planting only.

\* Abbreviations used in tables: **NTL**—no time limitations, **EC**—emulsifiable concentrate, **D**—dust, **G**—granules, and **WP**—wetable powder. Dosages of insecticides are actual chemical per acre, with some examples.

### Cucumbers, Melons, Pumpkins, Squash (continued)

Diseases	Chemical*	Remarks and limitations
Seed rot, damping off	Seed treatment: captan, chloranil, dichlone, or thiram	Use label directions. Do not use treated seed for food or feed.
Angular leaf spot on cucumbers. Anthracnose on cucumbers and melons. Black rot on pumpkins and squash. Scab on cucumbers and melons.	Spray or dust in field	Crop rotation: At least 2 intervening years of other unrelated crops. Washing of surface water from infested to clean ground will nullify the beneficial effects of crop rotation. Apply at weekly intervals during humid weather. Do not use maneb, zineb, or fixed copper on young plants before runners form. Maneb and zineb are good general fungicides for most diseases of these crops. Fixed copper is best for angular leaf spot (a bacterial disease). Captan and folpet are good fungicides for scab control above 50° F. The above fungicides may be used in various combinations, depending upon the diseases present, or they may be alternated. Plant resistant varieties like SMR-15, SMR-18, and Spartan Dawn pickle types.
	Captan 50% WP—use label directions	NTL.
	Fixed copper—use label directions	NTL.
	folpet—use label directions	NTL.
	maneb—use label directions	NTL.
	zineb—use label directions	NTL.
	zinc ion maneb—use label directions	Do not apply after fruit begins to form on cucumbers and squash. NTL on other vine crops.
Bacterial wilt		Control cucumber beetles.
Black rot, storage rot of pumpkin and squash	Spray in field as for anthracnose control.	Long rotations of unrelated crops are important. Handle carefully during harvesting and storing. Prevent damage to rind. Cure the rind at 75 to 85° F. for 2 weeks and store at 45 to 50° F.
Fruit rot, muskmelon and cucumber	captan	Postharvest dip or spray. See page 6.

Weeds	Chemical*	Remarks and limitations
<b>Cucumbers and Melons</b>		
Annual weeds	NPA 2 to 6 lb. (4 to 12 qt. Alanap)	Apply immediately after planting or transplanting or after clean cultivation. Do not use over 8 qt. postemergence regardless of soil type. Avoid use on early plantings when soil is cold.
<b>Pumpkins and Squash</b>		
Annual weeds	amiben 3 to 4 lb. (6 to 8 qt. Vegiben or Amiben)	Preemergence. Use lower rate on lighter soils.
	sodium PCP 10 to 12 lb. (Chlorophen or Weedbeads)	Preemergence.

\* Abbreviations used in tables: **N**T**L**—no time limitations, **E**C—emulsifiable concentrate, **D**—dust, **G**—granules, and **W**P—wettable powder. Dosages of insecticides are actual chemical per acre, with some examples.

## Lettuce

Insects	Chemical*	Remarks and limitations
Leafhoppers	carbaryl (Sevin) 1 to 1½ lb. (1¼ to 1½ lb. 80% WP)	3 days for head lettuce; 14 days for leaf lettuce.
	malathion 1¼ lb. (1 qt. 5 lb. EC)	7 days for head lettuce; 14 days for leaf lettuce.
	malathion 0.1 lb. actual per 50,000 cu. ft. as aerosol	For greenhouse lettuce. 10 days.
	methoxychlor 1½ to 2 lb. (3 to 4 lb. 50% WP)	14 days.
	mevinphos (Phosdrin) ¼ lb. (1 pt. 2 lb. EC)	2 days.
	Perthane 1 lb. (2 lb. 50% WP)	4 days.
Diseases	Chemical*	Remarks and limitations
Seed rot, damping off	Seed treatment: dichlone, captan, chloranil, or thiram	Use label directions. Do not use treated seed for food or feed.
Aster yellows virus		Control six-spotted leafhoppers.
Bottom rot (Rhizoctonia) Drop (Sclerotinia)	PCNB not over 22.5 lb. actual per acre	Band treatment when plants are 2 to 3 inches high. Use on head lettuce only. Not effective on muck. Do not use on greenhouse lettuce.
	PCNB not over 4.0 lb. actual per acre	Band treat when plants are 2 to 3 inches high. Use on head lettuce only. Repeat application once 10 days later (25 to 55 days preharvest).
Weeds	Chemical*	Remarks and limitations
Annual weeds	CDEC 4 lb. (4 qt. Vegidev)	Preemergence.

## Onions

Insects	Chemical*	Remarks and limitations
Onion maggot	carbophenothion (Trithion) 2 lb. in the furrow (8 lb. 25% WP)	
	diazinon 1 lb. in the furrow (20 lb. 5% G, 10 lb. 10% G, 7 lb. 14% G)	
	ethion 1 lb. in the furrow (12½ lb. 8% G, 20 lb. 5% G)	
	VC-13 1 lb. in the furrow (20 lb. 5% G)	Not for green onions.
Onion thrips, six-spotted leafhopper	DDT 1½ lb. spray, (3 qt. 2 lb. EC) to 3 lb. dust (30 lb. 10% D)	Not for green onions.
	diazinon ½ lb. (1 lb. 50% WP)	10 days.
	malathion ¾ lb. (3 lb. 25% WP 1½ pt. 5 lb. EC)	3 days.

\* Abbreviations used in tables: **N**T**L**—no time limitations, **E**C—emulsifiable concentrate, **D**—dust, **G**—granules, and **W**P—wetable powder. Dosages of insecticides are actual chemical per acre, with some examples.



### Onions (continued)

Diseases	Chemical*	Remarks and limitations
Seed rot, damping off	Seed treatment: captan, chloranil, dichlorone, or thiram	Use label directions. Do not use treated seed for food or feed.
Onion smut (formaldehyde method)	Formaldehyde 37% liquid 1.4 gal. per acre	The most complete control of onion smut can be expected with this method. Apply in 75 to 125 gallons of water per acre in the seed furrow at planting time. (Low rate for moist soil; high rate for dry soil). Use applicator on planter with a stream of solution running into each seed furrow in contact with seed. Calibrate carefully. An emulsifiable insecticide can be added to the dilute formaldehyde solution for maggot control.
Onion smut (seedbox treatment method)	thiram 75% ½ lb. per lb. of seed in planter box as a seed treatment or as granulated material mixed with insecticide	Do not use formulations containing oil. They have been found to interfere with germination when used at heavy rates.
Blast, downy mildew, purple blotch	Spray in field	Spray weekly starting June 1. Use a spreader-sticker.
	Dyrene—follow label directions	NTL. Not over 1.5 (spray) or 2.0 (dust) lb. actual per acre per application for green onions.
	Maneb—follow label directions	NTL.
	nabam plus zinc sulfate—follow label directions	Not later than 7 days before harvest on green onions.
	zineb—follow label directions	Not later than 7 days before harvest on green onions.
	zinc ion maneb	7 days. Do not apply to exposed bulbs.
Aster yellows virus		Control six-spotted leafhoppers.
Bulb rot	captan	Postharvest dip or spray. See page 6.

Weeds	Chemical*	Remarks and limitations
Annual weeds	DCPA 8 lb. (10 lb. Dacthal)	Preemergence, Mineral soils only.
	Mixture of CIPC 6 lb. (6 qt. Chloro IPC) and CDAA 6 lb. (6 qt. Radox)	Seeding to early loop stage. Avoid application at flag stage. Repeat when onions have three or more true leaves, using a directed spray to avoid damage to tops. Do not apply this combination within 45 days of harvest. On mineral soils do not use more than 4 lb. of CDAA (4 qt. Radox) per acre.

### Parsnips

#### Insects

Six-spotted leafhopper (see carrots)

Weeds	Chemical*	Remarks and limitations
Annual weeds	Stoddard Solvent 20 to 100 gal.	Delayed preemergence and postemergence. Do not apply after 5-leaf stage.
	linuron 1½ lb. (3 lb. Lorox)	Preemergence. Do not apply on light soils. Do not use tops for livestock feed.

\* Abbreviations used in tables: **N**T**L**—no time limitations, **E**C—emulsifiable concentrate, **D**—dust, **G**—granules, and **W**P—wetable powder. Dosages of insecticides are actual chemical per acre, with some examples.

## Peas

Insects	Chemical*	Remarks and limitations
Pea aphid	diazinon 1 lb. (2 lb. 50% WP)	Do not feed vines within 1 day or cut hay for 4 days after treatment. No waiting period for harvesting peas.
	dimethoate (Cygon) 3 oz.	21 days.
	malathion $\frac{3}{4}$ to 1 lb. (1½ pt. 5 lb. EC, 3 to 4 lb. 25% WP)	3 days, 7 days for forage.
	mevinphos (Phosdrin) 0.2 lb. (1 pt. 2 lb. EC)	1 day.
	naled (Dibrom) 1 to 2 lb. (1 to 2 pt. 8 lb. EC)	4 days.
	parathion $\frac{1}{4}$ to $\frac{1}{2}$ lb. (1 to 2 pt. 2 lb. EC)	10 days.

Diseases	Chemical*	Remarks and limitations
Seed rot, damping off	Seed treatment: captan, chloranil, dichlorone, or thiram	Use label directions. Do not use treated seed for food or feed.
Root rot		Grow on clean land and use 5-year interval between crops of peas. A soil test for determination of degree of infestation by root-rot-causing fungi is useful for land selection.

Weeds	Chemical*	Remarks and limitations
Annual grasses	CDA 4 lb. (4 qt. Randox)	Preemergence.
Annual weeds	DNBP amine 1 to 3 lb. (1¼ qt. to 4 qt. Premerge or Sinox PI)	Postemergence. Apply when peas are 2 to 8 inches tall. Do not apply after flower buds are visible. Do not graze or feed forage within 40 days of treatment.
Broad-leaved weeds and thistle buds	MCPA amine or potassium salt $\frac{1}{4}$ to $\frac{3}{8}$ lb.	Postemergence. Apply in at least 15 gallons of water. Apply before flowering stage.
	MCPB sodium salt $\frac{1}{2}$ lb.	Postemergence. Apply in at least 15 gallons of water. Apply before flowering stage.
	2,4 DB $\frac{1}{2}$ lb.	Postemergence. Apply in at least 15 gallons of water. Apply before flowering stage. Do not graze or feed 2,4 DB-treated plants to livestock.
Annual weeds and thistle beds	dalapon $\frac{3}{4}$ lb. (1 lb. Dowpon) mixed with MCPA $\frac{1}{4}$ to $\frac{3}{8}$ lb., or with MCPB $\frac{1}{2}$ lb., or with 2, 4 DB $\frac{1}{2}$ lb.	Postemergence. Apply after peas have 4 to 6 nodes but before flowering. Will kill grasses to 3- to 4-leaf stage. Do not apply within 25 days of harvest. Do not feed treated vines to livestock.

## Peppers

Diseases	Chemical*	Remarks and limitations
Seed rot, damping off	Seed treatment: captan, chloranil, dichlorone, or thiram	Use label directions. Do not use treated seed for food or feed.
Leaf and fruit spots	Spray or dust in fields (7- to 10-day intervals) captan—use label directions	NTL. 6 lb. actual per acre plant bed treatment after seeds have germinated.

\* Abbreviations used in tables: **NTL**—no time limitations, **EC**—emulsifiable concentrate, **D**—dust, **G**—granules, and **WP**—wetable powder. Dosages of insecticides are actual chemical per acre, with some examples.

## Peppers (continued)

Diseases	Chemical*	Remarks and limitations
Leaf and fruit spots	fixed copper—use label directions. (Preferred for control of bacterial diseases)	NTL.
	maneb—use label directions	NTL.
	zineb—use label directions	NTL.
Weeds	Chemical*	Remarks and limitations
Annual weeds	trifluralin 1 lb. (1 qt. Treflan)	Preplanting. Must be incorporated into soil. Transplant crop immediately to 3 weeks after application.
	diphenamid 5 lb. (6 lb. Dymid, 10 lb. Enide)	Post transplanting. Apply within 1 month after transplanting.
	Amiben 3 to 4 lb. (30 to 40 lb. granular Vegiben or 6 to 8 qt. Amiben)	Post transplanting. Apply 3 to 5 days after transplanting before weeds appear—or 4 weeks after transplanting to clean cultivated soil—or immediately after final cultivation. Do not use on light sandy soils.

### Potatoes

#### Potatoes: Use of Systemic Insecticides at Planting

Either disulfoton (Di-Syston) or phorate (Thimet) may be applied at planting time to give almost full-season control of aphids, leafhoppers, and flea beetles. Late infestations may require foliage sprays or dusts of one of the other insecticides in late July or August. Apply 25 to 30 pounds of the 10-percent granules of phorate or disulfoton by means of a planter attachment. The granules should be placed in the fertilizer bands. Mixing the insecticide with the fertilizer in the fertilizer hoppers is not advisable. Disulfoton may be side-dressed but not within 75 days of harvest. Phorate should be applied at planting time only.

#### Potatoes: Control of Cutworms, White Grubs, and Wireworms

Use 2 to 5 pounds actual chlordane as a soil treatment before planting. The insecticide may be mixed with a broadcast fertilizer application or it may be sprayed on or applied as granules. Incorporate into the soil immediately after application. Use the higher rate for heavy clay or peat soils. These rates are for broadcast applications only. If potatoes are grown on the same field it is suggested that soil treatment be used not over once every 3 years. If aldrin, chlordane, or dieldrin have been applied more than once in the last 3 years, residues of these chemicals may have accumulated in the soil and it may be advisable to grow crops other than potatoes or other root crops in such fields for 2 or 3 years. The use of disulfoton or phorate may help reduce numbers of wireworms in some situations. Do *not* use aldrin, dieldrin, or heptachlor as soil treatments for potatoes.

### Potatoes, Foliage Treatment

Insects	Chemical*	Remarks and limitations
Colorado potato beetles, leafhoppers	azinphosmethyl (Guthion) ½ lb.	7 days.
	carbaryl (Sevin) 1 lb.	NTL.
	naled (Dibrom) 1 to 2 lb.	NTL.
Aphids, leafhoppers	demeton (Systox) ¼ lb.†	21 days.
	dimethoate (Cygon) ¼ to ½ lb. (1 to 1½ pt. 2.67 lb. EC)	7 days.
	malathion ¾ to 1 lb.	NTL.
	Meta-Systox ½ lb. (2 pt. 2 lb. EC)	7 days.
Colorado potato flea beetles	toxaphene 1 to 1½ lb.	NTL.
Fungus gnats and flies in storage	dichlorvos (DDVP) 1% space spray or aerosol	

\* Abbreviations used in tables: **NTL**—no time limitations, **EC**—emulsifiable concentrate, **D**—dust, **G**—granules, and **WP**—wetable powder. Dosages of insecticides are actual chemical per acre, with some examples.

† Highly toxic materials, see precautions on pages 3 and 4 or on the labels.



**Potatoes, Foliage Treatment (continued)**

Diseases	Chemical*	Remarks and limitations
Seed-piece decay	Plant immediately after cutting	In this case seed treatment may not be warranted.
	Seed-piece treatment: captan—use label directions	Dip or dust cut potatoes, 0.5 lb. actual per bushel.
	maneb—use label directions	Dip seed pieces or whole tubers. 1.0 lb. per 10 gal. water.
	zineb—use label directions	Not over 0.15 lb. actual per 100 lb. cut or whole seed pieces.
Blackleg	Seed-piece treatment	Avoid infected seed potatoes.
	Semesan BelS 1 lb. per 7½ gal. water, dip whole or cut seed potatoes, drain, and dry.	Injury is likely to result from the use of mercury materials if the tubers have sprouted before the treatment is applied. Plant immediately after treatment to avoid injury to seed pieces. Such treatments are recommended only if the seed lot used is believed to be infected with the bacterium that causes blackleg.
Scab	Resistant varieties	If possible, grow resistant varieties such as Cherokee, Tawa, Plymouth, Antigo, Norland, LaRouge, Norgold, and Superior. Do not apply manure or other forms of organic matter immediately before the potato crop. Apply organic matter at other times in the crop rotation. Do not apply lime to potato soils. Keep soil in acid condition if possible.
	Soil treatment: PCNB 20% dust—300 to 450 lb. per acre	Not over 196 lb. actual PCNB per acre broadcast before planting, or 65 lb. actual PCNB per acre row treatment before planting. The rate should be the same on the actual area treated whether broadcast or banded. Apply on mineral soil. Partial control of scab has been obtained on mineral soils, but not on muck. Dust must be thoroughly mixed with soil before planting. Rotary tillage or other special equipment is recommended. Potatoes can be planted immediately after treating. Treating and planting can be done in one operation.
Purple top wilt	Spray for leafhoppers	This is the aster yellows disease of potatoes. Control the six-spotted leafhopper. Leafhopper control during the first half of the growing season is most important.
Late blight	Spray or dust in field	Available recommended fungicides are protectants. They must be on the plant to prevent infection. They will not control the disease after infection has occurred. Plan on a 7- to 10-day interval of application and vary the application depending on weather conditions and presence of disease. During cool, moist periods the interval may be 4 to 5 days while during dry, hot weather the interval may be extended to about 15 days.

\* Abbreviations used in tables: **N**TL—no time limitations, **E**C—emulsifiable concentrate, **D**—dust, **G**—granules, and **W**P—wettable powder. Dosages of insecticides are actual chemical per acre, with some examples.

**Potatoes, Foliage Treatment (continued)**

Diseases	Chemical*	Remarks and limitations
Late blight	Bordeaux mixture (4-2-50)	NTL. Suggested as a final spray. Gives excellent disease control and has excellent residual properties. Causes hardening of some plants; therefore, its use should be restricted to late season application.
	copper-zinc-chromate 1½ to 2 lb. per 100 gal. or 20 to 25 lb. 6 to 8% D per acre	NTL.
	Difolatan 80-W 1 to 2 lb. per 100 gal. water	NTL.
	fixed copper—use label directions	NTL.
	nabam plus zinc sulfate—follow label directions	NTL.
	maneb 80% WP 1½ to 2 lb. per 100 gal. water or 6 to 8% dust at 25 to 40 lb. per acre	NTL.
	Polyram—follow label directions	NTL.
	zinc ion maneb (Dithane M-45)—follow label directions	NTL.
Early blight	zineb 65% WP 1½ to 2 lb. per 100 gal. water or 6 to 8% dust at 25 to 40 lb. per acre	Foliage application.
	Spray or dust in field	See late blight control.
Rhizoctonia canker, and stolon rot	PCNB soil treatment (10% dust) 250 lb. per acre broadcast or 125 lb. per acre on 18-inch band or 100 lb. row application at planting time	Mix thoroughly with soil before planting or during planting operation.
Tuber rot postharvest	captan	Postharvest dip or spray. See page 6.
Fusarium and verticillium wilt		Wilt disease is carried in tubers and in the soil. Crop rotation and certified seed use will help reduce losses. Do not spread cull potatoes on fields to be planted to potatoes in future years.
Weeds	Chemical*	Remarks and limitations
Annual weeds	EPTC 3 to 6 lb. (2 to 4 qt. Eptam)	Preplanting. Must be disked or cultivated into surface soil just before planting. Preemergence. Immediately after drag-off.
	EPTC 4 lb. (2½ qt. Eptam)	Apply as a directed spray just before last cultivation but not within 45 days of harvest. Preemergence. Apply immediately after planting or immediately after drag-off. Do not apply to sandy soils.
	linuron 2 lb. (4 lb. Lorox)	Preemergence. Apply immediately after planting or immediately after drag-off.
	diphenamid 6 lb. (7½ lb. Dymid 80W or 12 lb. Enide)	Preemergence. Apply just before potatoes emerge but after weeds appear.
	DNBP amine 3 to 6 lb. (4 to 8 qt. Premerge or Sinox PE)	Preemergence. Apply just before potatoes emerge but after weeds appear.
	2,4 D 2 lb.	Preemergence. Apply just before potatoes emerge but after weeds appear.
	DCPA 8 lb. (10 lb. Dacthal)	Preemergence. Apply immediately after planting.

\* Abbreviations used in tables: **NTL**—no time limitations, **EC**—emulsifiable concentrate, **D**—dust, **G**—granules, and **WP**—wetable powder. Dosages of insecticides are actual chemical per acre, with some examples.

### Potatoes, Foliage Treatment (continued)

Weeds	Chemical*	Remarks and limitations
Wild oats	DATC 2 lb. (2 qt. Avadex)	Preplanting. Must be incorporated into soil and planted within 3 weeks.
Quackgrass	dalapon 6 lb. (8 lb. Dowpon)	Spring preplanting treatment. Apply 4 days before plowing. Plant immediately after plowing.
	dalapon 10 lb. (12½ lb. Dowpon)	Fall application. Apply to growing quackgrass. Plow 10 to 20 days later or delay plowing until following spring. Dalapon must not be used on land to be planted to red-skinned varieties.
Annual grasses	dalapon 2¼ lb. (3 lb. Dowpon) alone or mixed with DNBP amine 6 lb. (8 qt. Premerge or Sinox PE) or 2,4-D 2 lb.	Preemergence. Apply just before potatoes emerge. Use dalapon where grasses are a major weed problem. Do not apply to red-skinned varieties.

#### Sprout Inhibition of Potatoes

Maleic hydrazide is effective as a potato sprout inhibitor when applied at 2 to 3 pounds per acre (¾ to 1 gallon MH 30) as an overall spray to the plants at the late full-bloom to post-bloom stage (tubers under the vine should be 1 to 2 inches in diameter). Potatoes from plants sprayed in this way can be stored at temperatures of 50 to 55 degrees Fahrenheit for as long as 8 months with little or no sprouting.

CIPC (Chloro-IPC) can be used to inhibit sprouting of potatoes already in storage. This chemical is distributed as a fine mist suspended in the airstream circulating around the potatoes. It is used at the rate of 1 pound CIPC (1 quart Chloro-IPC) per 1,000 bushels of potatoes. CIPC may be applied any time after the harvest wounds have healed (at least 2 weeks after harvest), and before sprouting has occurred. This treatment can be used on potatoes stored in bulk but not in burlap bags. Use custom application. Do not use herbicide type CIPC for this purpose.

Chemical sprout inhibitors should not be applied to seed potatoes.

#### Potato Vine Killers

Sodium arsenite is effective in killing potato vines when applied at the rate of 6 pounds per acre (1 gallon of material if it contains 6 pounds of arsenic trioxide). Apply in sufficient water to thoroughly cover the vines. A minimum of 20 gallons of water is suggested for ground equipment application. Sodium arsenite has FDA approval for rates up to 14.5 pounds of active material per acre (arsenic trioxide). It should not be applied closer than 7 days before harvest or ap-

plied to exposed tubers. Follow label precautions carefully. Keep livestock out of fields sprayed with sodium arsenite until the following spring. Do not spill in ponds or streams.

When using low volumes of water, the addition of a spreader-sticker at the rate of 1 pint per 100 gallons of material is advisable to assure uniform coverage.

Under extremely heavy vine conditions results have been improved with a split application of 2 to 3 quarts (6 pounds arsenic trioxide) 20 days before harvest, with a second application of 2 to 3 quarts (6 pounds arsenic trioxide) 14 days before harvest.

DNBP at 2½ pounds (2 quarts Dow General or Sinox General) may be applied in 5 gallons of fuel oil and 25 to 40 gallons of water per acre, depending on the density of vine growth. Application should be made 10 to 20 days before harvest. Complete coverage of vines is essential. Do not spray exposed tubers or graze livestock on treated areas.

DNBP amine at 2¼ pounds (3 quarts Premerge or Sinox PE) can also be used 10 to 20 days before harvest. Do not spray exposed tubers or graze livestock on treated areas.

Vine killers may often cause browning of the stem end or vascular ring of tubers, especially where soil moisture is low at the time of vine-killing. This discoloration often disappears during the storage period.

#### Sprays for Color Improvement

A 1-percent dust of 2,4-D can be applied to potato vines to intensify red color and improve skin appearance. Application should be made in the prebud stage when plants are 7 to 10 inches high. A second application can be made 10 to 14 days later.

#### Radishes

Insects	Chemical*	Remarks and limitations
Cabbage maggot	chlordan 5 lb. (50 lb. 10% G)	Broadcast soil treatment once per year before planting. May be mixed with fertilizer; incorporate into surface 3 or 4 in. For row or furrow treatment use 1 lb. per acre.

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### Radishes (continued)

Insects	Chemical*	Remarks and limitations
	diazinon 1 to 2 lb. (10 to 20 lb. 10%G)	Furrow treatment at planting time or broadcast soil treatment before planting.
Flea beetle	carbaryl (Sevin) 1 lb. (2 lb. 50% WP, 1¼ lb. 80% WP) malathion 1 lb. (1½ pt. 50% EC) methoxychlor 1 to 1½ lb. (2 to 3 lb. 50% WP)	3 days. 7 days. 7 days.
Diseases	Chemical*	Remarks and limitations
Seed rot, damping off	Seed treatment: captan, chloranil, dichlone, or thiram	Use label directions. Do not use treated seed for food or feed.

### Rhubarb

Insects	Chemical*	Remarks and limitations
Rhubarb curculio	Handpick from plant. Control weeds, especially dock in which insects breed	Effective insecticides have not been registered for use on rhubarb.
Stalk borer	Control grassy and large-stemmed weeds. Spraying field margins with 1 lb. actual carbaryl (Sevin) may reduce problem	
Diseases	Chemical*	Remarks and limitations
Leaf spot	Spray with captan	N.T.L. Harvest stems having leaves with spots first. After frost in fall, remove all top growth and destroy. Badly wilted plants should be removed. Make new plantings on ground away from old planting.

### Rutabagas and Turnips

Insects	Chemical*	Remarks and limitations
Cabbage maggot	chlordane 2 to 5 lb.  diazinon ½ lb. (1 lb. 50% WP) diazinon 1 to 2 lb. (10 to 20 lb. 10% G)	Broadcast and incorporate into upper 2 or 3 in. of soil. Lower rates may be applied in the row at seeding time. Foliage spray to control flies. In the furrow at planting. 1 lb. rate may be followed with 1 lb. per acre drench over the row 1 month later.
Flea beetles	DDT 1 lb. (2 qt. 2 lb. EC, 10% D) methoxychlor 1 lb. (2 lb. 50% WP)	Do not use tops. 14 days if tops are used; 1 day for turnips, 7 days for rutabagas if tops are not used.
Diseases	Chemical*	Remarks and limitations
Black rot, and blackleg	Hot-water seed treatment 122° F. for 20 min.	Dry seed thoroughly. Crop rotation and sanitation are necessary also. Seedbed area should be changed or soil fumigated.
Seed rot, damping off of turnips	Seed treatment—captan, chloranil, dichlone, thiram	Use label directions. Do not use treated seed for food or feed.

\* Abbreviations used in tables: **N.T.L.**—no time limitations, **EC**—emulsifiable concentrate, **D**—dust, **G**—granules, and **WP**—wetable powder. Dosages of insecticides are actual chemical per acre, with some examples.

### Spinach

Insects	Chemical*	Remarks and limitations
Leaf miner	diazinon ½ lb. (1 lb. 50% WP) malathion 20 oz. (2 pt. 5 lb. EC) or 2 lb. 25% WP per 100 gal. water	10 days. 7 days.
Weeds	Chemical	Remarks and limitations
Annual weeds	CIPC 8 lb. (2 gal. chloro IPC) CIPC 6 lb. (1½ gal. Chloro IPC) CDEC 4 lb. (1 gal. liquid Vegedex or 20 lb. of 20% granular)  CDEC 4 lb. (20 lb. of 20% granular)	Preemergence—spring crop. Preemergence—fall crop. Preemergence. Within 30 days prior to emergence. Do not apply to muck soils. Do not apply within 30 days of harvest. Postemergence. Do not apply to muck soils. Do not apply within 30 days of harvest.

### Tomatoes

Insects	Chemical*	Remarks and limitations
Aphids, six-spotted leafhoppers	diazinon ½ lb. (1 lb. 50% WP) Di-Syston 6 oz. 2% G per 50 ft. row  malathion ½ lb. 2 lb. 25% WP ½ pt. 5 lb. EC) malathion 0.15 lb. actual per 50,000 cu. ft. as aerosol parathion ¼ lb. (1 pt. 2 lb. EC) parathion 0.1 lb. actual per 50,000 cu. ft. as aerosol mevinphos (Phosdrin) ¼ lb. (1 pt. 2 lb. EC) endosulfan (Thiodan) ½ lb. (1 qt. 2 lb. EC) phorate (Thimet) 1 lb. (10 lb. 10% G)	1 day. Apply to seed furrow. Do not contact seed or use as a soil treatment before trans- planting. 3 days. For greenhouse tomatoes—15 hours. 10 days. For greenhouse tomatoes—10 days. 1 day. 7 days. Furrow or soil treatment at planting. One application per season.
Flea beetles	DDT 1 lb. (2 lb. 50% WP, 2 qt. 2 lb. EC, 10 lb. 10% D) dieldrin ¼ lb. (1 pt. 1.5 lb. EC) methoxychlor 1 lb. (2 lb. 50% WP) toxaphene 2 lb. (½ gal. 6 lb. EC) chlordane 2 to 5 lb.	5 days. 7 days. 1 day. 3 days.
Cutworms		Soil treatment at planting.

Diseases	Chemical*	Remarks and limitations
Bacterial spot, bacterial speck, bacterial canker	Hot-water seed treatment 122° F. for 25 min. Fumigation of seedbed soil Fumigation of all wood and other equipment: formaldehyde 37%, 1 part to 20 parts water. Spray or dust in field. Fixed copper— use label directions.	Cool and dry seed thoroughly. Crop rota- tion and sanitation are necessary also. See section on seedbed fumigation, page 4. Dip or spray all equipment used the previ- ous season. 7- to 10-day intervals. No time limitations. Early season applications are most im- portant. Burning may result from spraying very young and tender plants.

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### Tomatoes (continued)

Diseases	Chemical*	Remarks and limitations
Rhizoctonia	PCNB—not over 0.5 pt. of 0.2% solution per plant (about ¼ lb. 75% WP per 100 gal).	Transplant water. For both field and greenhouse.
Seed rot, damping off	Seed treatment: captan, chloranil, dichlorone, or thiram	Follow hot-water treatment after seed is dry. Use label directions. Do not use treated seed for food or feed.
Late blight, early blight, septoria leaf spot	Soil drench—captan 50% WP 1 to 2 lb. per 100 gal. water Spray or dust in field:  maneb zineb copper-zinc-chromate Dyrene Polyram	Immediately after planting. For both field and greenhouse. Use label directions for all fungicides. Burning may result from spraying very young and tender plants. Use locally grown plants. NTL. NTL. NTL. NTL. Does not control late blight. Do not apply within 30 days of harvest.
Leaf spots on greenhouse plantings	Spray or dust maneb	Use label directions. To avoid damage do not use on tender, young plants.
Aster yellows		Control six-spotted leafhoppers. Early season control is most important.
Weeds	Chemical*	Remarks and limitations
Annual weeds	trifluralin 1 lb. (1 qt. Treflan)  CDAA 6 lb. (30 lb. granular Randox)  diphenamid 6 lb. (7½ lb. Dymid or 12 lb. Enide) amiben 4 lb. (8 qt. Amiben or 40 lb. granular Vegiben)	Preplanting. Incorporate into soil. Transplant crop within 3 weeks after treatment. Post transplanting. Apply within 2 days after transplanting. Post transplanting. Apply within 30 days after transplanting. Post transplanting. Apply 3 to 5 days after transplanting before weeds appear or 4 weeks after transplanting to clean cultivated soil. Do not use on light sandy soil.

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*Use Pesticides Safely*  
**FOLLOW THE LABEL**

U.S. DEPARTMENT OF AGRICULTURE