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**WEED, INSECT,
AND DISEASE**

CONTROL

**GUIDE FOR COMMERCIAL
VEGETABLE GROWERS**



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Agricultural Extension Service • University of Minnesota

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1969 Weed, Insect, and Disease Control Guide for Commercial Vegetable Growers

The status of several pesticides registered on a "no residue" basis or with a zero residue tolerance is uncertain for the 1969 season. The pesticides registered on this basis are marked with an asterisk (*). By the end of 1970, all of these chemicals either will be registered with a finite tolerance or the registration will be cancelled. Growers and other users are urged to check the current status of those materials marked with an asterisk (*) before applying them.

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 1968 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 measures—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 Agricultural 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. Wear goggles, an approved respirator, and latex rubber gloves when loading or mixing pesticides. Aerial operators should have a ground crew to do loading.
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, the symptoms of overexposure to it, 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	339-7751 Night 339-1411
	Abbott Hospital 110 E. 18th St.	339-8414 Extension 226
	Fairview Hospital, 2312 S. 6th St.	332-0282 Extension 331
	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 spe-

cify rates, methods, and times of application that 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 intervals, and 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.

FARM SPRAYER CALIBRATION AND ADJUSTMENT

Uniform application of spray chemicals is essential for effective weed control. A small variation in the rate of application may result in poor kill of the weeds or injury to the crop, thereby causing a loss of time, effort, and money.

Rates in this bulletin are in terms of active ingredient or acid equivalent per acre treated. Rate per acre in the treated area should be the same for broadcast as for band applications. But proportionately less material is used per crop acre with band than broadcast applications. For example, a 3 pound per acre rate requires 3 pounds of material per crop acre with broadcasting but only half as much per crop acre (1½ pounds) if a 15-inch band is treated on rows spaced 30 inches apart.

To determine how much liquid a sprayer applies per acre:

1. Check the output of all nozzles for a set time to make sure that all nozzles discharge at the same rate.

2. Start with a full tank of clean water and have the pressure adjusted as you will use it in the field (usually 20 to 40 pounds).

3. Drive exactly ¼ mile (40 rods) (660 feet) 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.

4. Refill the tank, carefully measuring the amount of liquid required. (If water spillage from a full tank is a problem, you can use a calibrated stick to measure amount of liquid used.)

To calculate broadcast application rate:

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

Example: If 2½ gallons were used in ¼ mile and the width covered by the boom is 24 feet, multiply 2½ by 66 and divide by 24. The result is 6.9 gallons per acre.

Calculate the band application rate (volume per acre applied to the area within the band that is sprayed) as follows.

$$\frac{\text{Number of gallons used} \times 66}{\text{Band width in feet} \times \text{Number of bands}} = \text{gallons per acre}$$

Example: If 1½ gallons were used in ¼ mile and the sprayer applied four bands 15 inches (1¼ feet) in width, multiply 1½ × 66 and divide by 1¼ × 4. The result is 19.8 gallons per acre. This is the volume per acre applied to the area within the band that is sprayed.

To determine the amount of herbicide formulation to use per acre sprayed:

1. Determine the number of pounds of acid equivalent or active ingredient suggested per acre for your situation. Use acid equivalent if it appears on the label. Otherwise, use active ingredient.

2. For dry materials, divide the number of pounds of active ingredient or acid equivalent desired by the percent of active ingredient or acid equivalent in the commercial product to determine the number of pounds of material to apply per acre. **Example:** If 3 pounds of active ingredient are required and the commercial product is an 80-percent active ingredient powder, divide 3 by .8 (3.75 pounds of commercial powder per acre).

For liquids, determine the volume of commercial product to apply per acre to get the proper amount of acid equivalent or active ingredient per acre. **Example:** If ½ pound of acid equivalent is required per acre, and the commercial product contains 4 pounds acid equivalent per gallon, then 1 quart contains 1 pound acid equivalent; 1 pint contains ½ pound acid equivalent.

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. This will give you 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. This will give the amount of herbicide to be used per tank.

CALIBRATION OF A GRANULAR APPLICATOR

1. Determine the number of pounds of active ingredient or acid equivalent suggested per acre for your situation.

2. Divide the number of pounds of active ingredient or acid equivalent desired by the percentage of active ingredient or acid equivalent in the commercial material to determine the number of pounds of the material to apply per acre.

3. Consult the manufacturer's recommendation for an approximate setting. Adjust the setting on each hopper.

4. Select an area for a test run, preferably in the field to be treated, so that speed and traction conditions are constant. Measure off a distance of 660 feet (40 rods).

5. Fill hoppers and attach a suitable container (sack,

pail, etc.) to each hopper spout to catch granules from each hopper.

6. Put machine in gear and drive the measured distance at the same speed that will be used when applying the chemical.

7. Weigh the material collected from each hopper. Multiply this weight in pounds by 66 and divide by the band width (in feet). This will give the pounds of granular material applied per acre on the area treated. In equation form:

$$\frac{\text{Weight of granules in pounds} \times 66}{\text{Band width in feet}} = \text{Pounds of granules applied per acre}$$

8. Readjust machine output and repeat the calibration process until the desired amount is obtained from each hopper.

Weights and Measures

1 pound = 16 ounces; 454 grams.

1 gallon = 4 quarts; 8 pints; 128 fluid ounces; 256 level tablespoonsful; 3,785 cubic centimeters (milliliters.)

1 tablespoon = 3 teaspoonsful; one-half fluid ounce; 14.8 milliliters.

1 acre = 43,560 square feet; 160 square rods; an area 208.7 feet square; an area 16½ feet wide and one-half mile long.

1 mile = 5,280 feet; 1,760 yards; 320 rods.

1 rod = 5½ yards; 16½ feet.

CALIBRATION OF AIRCRAFT SPRAY EQUIPMENT

$$\text{Acres covered} = \frac{\text{Length of Swath in miles} \times \text{Width in feet}}{8.25}$$

$$\text{Acres per minute} = \frac{2 \times \text{Swath width} \times \text{mph}}{1,000}$$

$$\text{Gallons per minute} = \frac{2 \times \text{Swath width} \times \text{mph} \times \text{Gallons per acre}}{1,000}$$

Delivery rating of the nozzle system should be checked in the spray nozzle manual of the nozzle manufacturer.

Keep in mind the orifice size, core size, pressure and spraying speed.

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.

Manufacturer's 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 be-

low 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 the table below for specific chemicals and approved uses for soil fumigation. See page 7 for formaldehyde seedbed treatment.

Kinds of Soil Fumigants

Chemical name	Some trade names	Pests controlled	Remarks and limitations
chloropicrin (trichloronitro methane)	Picfume Larvacide	All in soil	These chemicals must be used according to label directions. Refer to label for all uses.
* O-2, 4-dichlorophenyl O, O-diethyl phosphorothioate	VC-13	Nematodes	
dichloropropenes	Telone	Nematodes	
1, 3-dichloropropene dichloropropane (DD)	D-D Vidden-D	Nematodes	
1, 3-dichloropropene ethylene dibromide	Dorlone	Nematodes	
* 3, 5-dimethyltetrahydro-1, 3, 5, 2H-thiadiazine-2-thione (DMTT)	Mylone	Seed Weed Nematodes Fungi	
ethylene dibromide (EDB)	Dowfume W-85, Dorlone (in part), Bromofume 85, Nemex 85, Soilfume 60-40	Nematodes Soil insects	
sodium-n-methyl dithiocarbamate dihydrate	Vapam VPM	Seed Weed Nematodes Fungi	
methyl isothiocyanate and chlorinated hydrocarbons	Vorlex	Seed Weed Nematodes Fungi	

* No finite tolerances established. See page 3.

Formaldehyde Seedbed Treatment

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

HERBICIDE MIXTURES

It is legal to use a mixture of herbicides, providing each chemical in the mixture is cleared for use on the particular crop concerned. However, the user assumes the responsibility for freedom from residues if such mixtures are not registered as mixtures. The registration of the individual parts does not constitute registration of the mixture.

A mixture of two or more herbicides often can increase the number of weeds controlled in a crop. In the following tables, some of these mixtures are indicated for certain vegetable crops for which using only one chemical gives limited success.

1969 Herbicide, Insecticide, and Fungicide Recommendations for Vegetable Crops

Asparagus

Weeds	Chemical†	Remarks and limitations
SEEDBEDS		
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.
ESTABLISHED BEDS		
	EPTC 3 lb. (2 qt. Eptam)	Apply when beds are being worked before or after cutting season. Do not apply within 7 days of harvest.
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.
Insects		
Asparagus beetles		
	carbaryl (Sevin) 1 lb. (1¼ lb. 80% WP)	1 day. Do not repeat within 3 days.
	malathion 20 ounces (2 pt. 5 lb. EC)	1 day.
	methoxychlor 1 lb. (2 lb. 50% WP)	3 days.

† 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.

* No finite tolerances established. See page 3.

Asparagus (continued)

Diseases	Chemical†	Remarks and limitations
Rust	Resistant varieties	Grow resistant varieties such as Mary and Martha Washington, Faribo Hybrid, and Waltham Washington. Destroy volunteer asparagus plants in vicinity. Do not allow fern growth in field until after harvest.
	Spray in field, use label directions * maneb zinc ion plus maneb zineb	Only on fern growth after spears are harvested.

Beans

Weeds	Chemical†	Remarks and limitations
Snap Beans		
Annual weeds	EPTC 3 lb. (2 qt. Eptam)	Incorporate thoroughly into top 2 inches of soil.
	trifluralin 1/2 to 3/4 lb. (1 to 1 1/2 pt. Treflan)	Preplanting soil application. Incorporate with soil immediately. Use lower rate on light soils. Plant crop immediately or within 3 weeks after application. Do not graze or feed forage from treated fields to livestock.
	Mixture of EPTC 1 1/2 lb. (1 qt. Eptam) and trifluralin 1/2 lb. (1 pt. Treflan)	Preplanting soil application. Incorporate with soil immediately. Use lower rate on light soils. Plant crop immediately or within 3 weeks after application. Do not graze or feed forage from treated fields to livestock.
Annual grasses	CDAA 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.
Lima Beans		
	trifluralin 3/4 lb. (1 1/2 pt. Treflan)	Preplanting soil application. Incorporate with soil immediately. Plant crop immediately or within 3 weeks after application. Do not graze or feed forage from treated fields to livestock.
Annual weeds	amiben 4 lb. (8 qt. Vegiben or Amiben) alone or mixed with CDAA 2 lb. (2 qt. 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.

Insects	Chemical†	Remarks and limitations
Aphids		
	dimethoate (Cygon) 1/2 lb. (1 1/2 pt. 2.67 lb. EC)	NTL beans; do not feed treated forage to livestock.
	malathion 1 to 1 1/2 lb. (1 1/2 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.
	disulfoton (DiSyston) 2 lb. (20 lb. 10% G)	Soil treatment at planting time.
	diazinon 1/2 lb. (1 lb. 50% WP)	7 days for beans; 4 days for forage. Do not apply more than once per season.
Bean leaf beetle		
	carbaryl (Sevin) 1 lb. (1 1/4 lb. 80% WP)	NTL. Do not feed treated vines to livestock.
	methoxychlor 1 lb. (2 lb. 50% WP, 2 qt. 2 lb. EC)	7 days (green beans). 1 day (dry beans).
Potato leafhopper		
	dimethoate (Cygon) 1/4 lb.	7 days.
	carbaryl (Sevin) 1 lb.	NTL.
	disulfoton (DiSyston) 1 lb.	In furrow below seed.
	malathion 1 to 1 1/2 lb. (1 1/2 to 2 pt. 5 lb. EC, 4 lb. 25% WP)	1 day.
	methoxychlor 1 lb. (2 lb. 50% WP)	7 days (green beans). 1 day (dry beans).

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

* No finite tolerances established. See page 3.

Beans (continued)

Insects	Chemical†	Remarks and limitations
Spider mites	*dicofol (Kelthane) ½ lb. (1½ lb. 35% WP) malathion ¾ to 1 lb. (1½ pt. 5 lb. EC, 3 to 4 lb. 25% WP)	7 days; do not feed treated vines. 1 day.
Seed corn maggot, wireworms	*dieldrin, *heptachlor, or lindane, 1 oz. per bu.	Seed treatment only.
Diseases	Chemical†	Remarks and limitations
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	Ziram 2 lb. : 100 gal. water and spreader sticker Ferbam 3 lb. : 100 gal. water Sprays for bacterial blight control * Streptomycin formulations Basic copper sulfate and chlorides	Do not use home-grown seed; it may be infected with disease organisms. Plant healthy certified seed. Use a 3- to 5-year crop rotation. Protective sprays should be started early before blight symptoms appear and applied at 10-day intervals. If symptoms of blight appear spray the affected plants and those surrounding the immediate area for a distance of 50 feet. Not over 400-p.p.m. concentration. Apply only on seed crop or before pods appear on table beans. Do not feed treated vines to livestock. Not over 4 lb. metallic copper equivalent per acre per application. NTL.

Beets

Weeds	Chemical†	Remarks and limitations
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	Pyrazon 4 lb. (5 lb. pyramin) Mixture of TCA 8 lb. (10 lb. 79% sodium TCA) and Pyrazon 4 lb. (5 lb. pyramin)	Preemergence or immediately after beets emerge and before weeds have 2 leaves.
Diseases	Chemical†	Remarks and limitations
Seed rot, damping off	Seed treatment: captan or chloranil	Use label directions. Do not use treated seed for food or feed.

Cabbage, Broccoli, Cauliflower, Brussels Sprouts

Weeds	Chemical†	Remarks and limitations
Annual weeds	trifluralin ¾ lb. (1½ pt. Treflan) trifluralin 1 lb. (2 pt. Treflan) DCPA 8 lb. (10 lb. Dacthal) nitrofen 6 lb. (3 gal. TOK E-25) CDAA 4 lb. (4 qt. Radox) CDAA 6 lb. (6 qt. Radox)	Preplanting soil incorporation. Pretransplant soil incorporation. Transplant crop immediately to 3 weeks after treatment. At time of seeding or immediately after transplanting. All except Brussels sprouts. Preemergence. OR Postemergence. Apply within 2 weeks after emergence when weeds are in seedling stage. OR Post transplant. Apply within 2 weeks after setting crop when weeds are in seedling stage. For cabbage only. Apply at time of seeding. Directed spray to transplanted cabbage 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.

* No finite tolerances established. See page 3.

Cabbage, Broccoli, Cauliflower, Brussels Sprouts (continued)

Insects	Chemical†	Remarks and limitations
Cabbage maggot	chlordane 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 chlordane 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) Applied as a furrow drench.	
Cabbageworm, loopers	toxaphene 3 lb. (30 lb. 10% D, 1/2 gal. 6 lb. EC)	Before heading only. Toxaphene and DDT (3:1) is useful for cabbageworm and toxaphene and parathion (3:1/2) is useful for loopers.
	<i>Bacillus thuringiensis</i> (Bakthane, Thuricide) as labelled	NTL.
	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. 14 days for Brussels sprouts and cauliflower.
	aziphosmethyl (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.
	methyl parathion and/or parathion 1/4 lb. (1 lb. 25% WP)	7 days.
	Perthane 1 lb. (2 lb. 50% WP) mevinphos (Phosdrin) 1/2 lb. (1 qt. 2 lb. EC)	At least 3 days before harvest. 1 day for broccoli, cabbage; 3 days for cauliflower and Brussels sprouts.
	* trichlorfon (Dylox) 1/2 to 1 lb. (1 to 2 lb. 50% soluble powder)	21 days.
NOTE: 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.
	carbaryl (Sevin) 1 1/2 lb.	3 days.
	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.
	aziphosmethyl (Guthion) 3/4 lb.	21 days.
	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: 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.

* No finite tolerances established. See page 3.

Cabbage, Broccoli, Cauliflower, Brussels Sprouts (continued)

Diseases	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 7	
Seed rot, damping off	Seed treatment; captan or chloranil	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— $\frac{1}{2}$ to $\frac{3}{4}$ pt. per plant PCNB dust 60 lb. actual per acre broadcast or 40 lb. actual per acre band or row application	Plant in noninfested soil if possible. High rate for heavy infestations and muck soils. May be mixed with insecticides in transplant water. Broadcast dust and mix thoroughly in soil before planting.
Mosaic (internal spotting of cabbage head)	Control aphids that spread the virus	

Carrots

Weeds	Chemical†	Remarks and limitations
Annual weeds	Stoddard Solvent 20 to 100 gal.	Delayed preemergence and postemergence before taproot is $\frac{1}{4}$ 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)	Preemergence. Apply to crop planted $\frac{1}{2}$ inch deep. Do not plant to other crops within 4 months after treatment. Do not apply to sandy soils.
	linuron 1 lb. (2 lb. Lorox)	Postemergence. Apply when carrots are 2 to 6 inches tall. Do not replant to other crops within 4 months after treatment. Do not apply to sandy soils.

Insects	Chemical†	Remarks and limitations
Leafhoppers	carbaryl (Sevin) 1 lb. (1 $\frac{1}{4}$ lb. 80% WP) methoxychlor 2 lb. (1 gal. 2 lb. EC) malathion $\frac{3}{4}$ lb. (1 pt. 5 lb. EC)	NTL. 14 days. 7 days.

Diseases	Chemical†	Remarks and limitations
Seed rot, damping off	Seed treatment: captan or chloranil	Follow hot-water treatment for bacterial blight after seed is dry.
Bacterial blight and leaf spot	Spray in field: fixed copper—use label directions maneb—use label directions zinc ion plus maneb—use label directions zineb—use label directions	7- to 10-day intervals. NTL. NTL. Not later than 7 days before harvest. Do not use tops for food or feed. Not later than 7 days before harvest if tops are to be used for food or feed.
Aster yellows virus	control six-spotted leafhoppers that spread the virus (see above)	

† 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.

* No finite tolerances established. See page 3.

Corn, Sweet

Weeds	Chemical†	Remarks and limitations
Annual weeds	propachlor 4 to 5 lb. (6 to 7.5 lb. Ramrod 65W)	Preemergence.
	atrazine 1 to 4 lb. (1¼ to 5 lb. Aatrex 80W)	Pre- or post-emergence. Use 1 to 2 lbs. on sandy soils and 4 lbs. on heavier soils or soils high in organic matter. Do not apply later than 3 weeks after planting. Do not plant sugar beets, vegetables, spring seeded small grains or small seeded legumes the year following atrazine application or injury may occur. Toxic residues are more likely to persist if soil moisture or temperature are low.
	Mixture of atrazine ½ to 1½ lb. (2/3 to 1¾ lb. Aatrex 20W) and linuron ½ to 1½ lb. (1 to 3 lb. Lorox)	Preemergence. Do not apply after sweet corn is up or severe injury will occur. Injury may occur on low organic, coarse textured soils.
	Mixture of atrazine 1 to 1½ lb. (1¼ to 1¾ lb. Aatrex 80W) and propachlor 2 to 3¾ lb. (3 to 5¾ lb. Ramrod 65W)	Preemergence.
Broad-leaved weeds	Mixture of atrazine 1 to 3 lb. (1¼ to 3¾ Aatrex 80W) and 1 to 2 gals of special oil with an emulsifier	Early postemergence. Apply within 3 weeks of planting while weeds are less than 1½ inches tall. Use only oils labeled for this purpose.
	2,4-D amine ½ lb. 2,4-D ester ¼ lb.	Apply after corn emergence. Can use to 18-inch stage of corn, but use drop nozzels.
Insects	Chemical†	Remarks and limitations
Seed corn maggot, corn seed beetle, wireworms	*aldrin, *dieldrin, heptachlor, lindane	1 oz. per bushel as seed treatment only.
European corn borer	carbaryl (Sevin) 1 to 2 lb. (1¼ to 1½ lb. 80% WP)	NTL.
	diazinon 1 to 2 lb. (7 to 14 lb. 14% G)	NTL. Corn, at least 10 days before feeding forage.
	<i>Bacillus thuringiensis</i> as labeled	NTL.
	EPN ¼ lb. granular EPN ½ lb. spray	First brood only. 14 days.
<p>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.</p> <p>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.</p>		
Corn earworm	diazinon 1½ lb.	Apply to ear zone at 2- to 3-day intervals until silks dry. 2 days.
	carbaryl (Sevin) 1½ lb.	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	diazinon 14% G	See Entomology Fact Sheet 14, <i>Controlling Corn Rootworms</i> .
	phorate (Thimet) 10 to 15% G Dyfonate 10% G	Apply in 4- to 7-inch band on the row at planting time, cover with ½ to 1½ inches of soil, at the rate of 1 lb. actual toxicant per 13,068 ft. of row. (1 lb. per acre on 40-inch rows.)
Cutworms	carbaryl (Sevin) 1 lb. toxaphene 2 lb.	Apply to soil as needed. Do not feed treated ensilage to livestock within 4 weeks of slaughter. Do not feed to dairy animals. No limitations on grain.
Sap beetles	Follow thorough corn earworm and second brood corn borer control to help control beetles directly and to help prevent their entrance into ear tips by controlling worm damage.	

† 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.

* No finite tolerances established. See page 3.

Corn, Sweet (continued)

Diseases	Chemical†	Remarks and limitations
Seed rot, damping off	Seed treatment: captan, chloranil, *Dexon, dichlone, or *thiram	Do not use treated seed for food or feed. Follow label directions.

Cucumbers, Melons, Pumpkins, Squash

Weeds	Chemical†	Remarks and limitations
Cucumbers and Melons	bensulide 5 to 6 lb. (5 to 6 qt. Prefar)	Preplant soil incorporation once per year. Do not plant to any crop for 18 months after treatment except those specified on the label.
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.
Pumpkins and Squash	Amiben 3 to 4 lb. (6 to 8 qt. Amiben or Vegiben or 30 to 40 lb. granular Amiben or Vegiben)	Preemergence. Use lower rate on lighter soils.
Annual weeds		
For Summer Squash only	bensulide 5 to 6 lb. (5 to 6 qt. Prefar)	Preplant soil incorporation once per year. Do not plant to any crop for 18 months after treatment except those specified on the label.

Insects	Chemical†	Remarks and limitations
NOTE: 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.
	endosulfan (Thiodan) ½ to 1 lb.	NTL.
	methoxychlor 1 lb. (10 lb. 10% D or 2 lb. 50% WP)	1 day.
Aphids	diazinon ½ lb. (1 lb. 50% WP)	7 days.
	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)	NTL.
	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.

Diseases	Chemical†	Remarks and limitations
Seed rot, damping off	Seed treatment: captan or chloranil	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.		Crop rotation: At least 2 intervening years of other unrelated crops.

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* No finite tolerances established. See page 3.

Cucumbers, Melons, Pumpkins, Squash (continued)

Diseases	Chemical†	Remarks and limitations
Angular leaf spot on cucumbers. Anthracnose on cucumbers and melons. Black rot on pumpkins and squash. Scab on cucumbers and melons (continued)	Spray or dust in field captan 50% WP—use label directions Fixed copper—use label directions folpet—use label directions maneb—use label directions. zineb—use label directions zinc ion maneb—use label directions	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 such as SMR-15, SMR-18, and Spartan Dawn pickle types. NTL. NTL. NTL. NTL. NTL. NTL on cucumbers and melons. Do not use 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 7.

Lettuce

Weeds	Chemical†	Remarks and limitations
Annual weeds	bensulide 5 to 6 lb. (5 to 6 qt. Prefar) CDEC 4 lb. (4 qt. Vegidex)	Preplant soil incorporation once per year. Do not plant to any crop for 18 months after treating except those specified on the label. Preemergence.
Insects	Chemical†	Remarks and limitations
Leafhoppers	carbaryl (Sevin) 1 to 1½ lb. (¼ to 1½ lb. 80% WP) malathion 1¼ lb. (1 qt. 5 lb. EC) methoxychlor 1½ to 2 lb. (3 to 4 lb. 50% WP) mevinphos (Phosdrin) ¼ lb. (1 pt. 2 lb. EC) Perthane 1 lb. (2 lb. 50% WP)	3 days for head lettuce; 14 days for leaf lettuce. 7 days for head lettuce; 14 days for leaf lettuce. 14 days. 2 days. 4 days.
Greenhouse pests	parathion 10% areosol 1 lb. per 50,000 cu. ft. malathion 15% aerosol 1 lb. per 50,000 cu. ft.	21 days. 10 days.
Diseases	Chemical†	Remarks and limitations
Seed rot, damping off	Seed treatment: captan or chloranil	Use label for directions. Do not use treated seed for food or feed.
Aster yellows virus	Control six-spotted leafhoppers (see above)	
Head lettuce only Bottom rot (Rhizoctonia) Drop (Sclerotinia)	PCNB	Three applications of 2.25 lb. actual spaced 10 days apart. For use in cool climate areas. First application when plants are 2-3 inches high.

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* No finite tolerances established. See page 3.

Onions

Weeds	Chemical†	Remarks and limitations
Annual weeds	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.
Insects	Chemical†	Remarks and limitations
Onion maggot	Dasanit ½ ounce per 1,000 ft. row or 1 lb. per acre carbophenothion (Trithion) 2 lb. in the furrow (8 lb. 25% WP) diazinon 1 lb. in the furrow (2 lb. 50% WP) or 14 to 28 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. 0.6 to 0.8 oz. per 1,000 ft. row in mineral soil and 1.1 oz. per 1,000 ft. row in mulch soils. In sufficient water to drench furrow. Broadcast and work into soil before planting.
Onion thrips, six-spotted leafhopper	diazinon ½ lb. (1 lb. 50% WP) malathion ¾ lb. (3 lb. 25% WP 1½ pt. 5 lb. EC)	Not for green onions. 10 days. 3 days.
Diseases	Chemical†	Remarks and limitations
Seed rot, damping off	Seed treatment: captan, chloranil, 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 OR nabam, 1 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 maneb—follow label directions zineb—follow label directions zinc ion maneb	Spray weekly starting June 1. Use a spreader-sticker. NTL. Not later than 7 days before harvest on green onions. 7 days. Do not apply to exposed bulbs.
Aster yellows virus		Control six-spotted leafhoppers.
Bulb rot	captan	Postharvest dip or spray. See page 7.

Parsley

Weeds	Chemical†	Remarks and limitations
Annual weeds	nitrofen 6 lb. (3 gal. TOK E-25)	Preemergence or postemergence. Apply within 2 weeks after crop emergence.

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* No finite tolerances established. See page 3.

Parsnips

Weeds	Chemical†	Remarks and limitations
Annual weeds	Stoddard Solvent 20 to 100 gal. linuron 1½ lb. (3 lb. Lorox)	Delayed preemergence and postemergence. Do not apply after 5-leaf stage. Preemergence. Apply to crop planted ½ inch deep. Do not apply to other crops within 4 months after treatment. Do not apply on light soils. Do not use tops for livestock feed.
Insects		
Aster (six-spotted) leafhopper	(see carrots)	

Peas

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 PE)	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 ¼ to ⅜ lb. MCPB sodium salt ½ lb.	Postemergence. Apply in at least 15 gallons of water. Apply before flowering stage. Postemergence. Apply in at least 15 gallons of water. Apply before flowering stage.
Annual weeds and thistle buds	dalapon ¾ lb. (1 lb. Dowpon) mixed with MCPA ¼ to ⅜ lb. or with MCPB ½ 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.
Insects		
Pea aphid	diazinon ½ lb. (1 lb. 50% WP) dimethoate (Cygon) 3 oz. demeton (Systox) ¼ lb. disulfoton DiSyston) 1 lb. 2½ lb. malathion 1 lb. (1½ pt. 5 lb. EC, 4 lb. 25% WP) mevinphos (Phosdrin) 0.2 lb. (1 pt. 2 lb. EC) naled (Dibrom) 1 to 2 lb. (1 to 2 pt. 8 lb. EC) parathion ¼ to ½ lb. (1 to 2 pt. 2 lb. EC)	Do not feed vines within 1 day or cut hay for 4 days after treatment. No waiting period for harvesting peas. NTL. Do not feed or graze vines if mobile viner is used. Do not feed or graze within 21 days after treatment if stationary viner is used. 21 days. In furrow at planting. Side dress — 50 days. 3 days, 7 days for forage. 1 day. 4 days. 10 days.
Diseases		
Seed rot, damping off	Seed treatment: captan, chloranil, *Dexon, dichlone, 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.

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* No finite tolerances established. See page 3.

Peppers

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.
Diseases	Chemical†	Remarks and limitations
Seed rot, damping off	Seed treatment: captan or chloranil	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.
	fixed copper—use label directions. (Preferred for control of bacterial diseases)	NTL.
	maneb—use label directions	NTL.
	zineb—use label directions	NTL.

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* No finite tolerances established. See page 3.

Sprout Inhibition of Potatoes

Maleic hydrazide is effective as a potato sprout inhibitor when applied at 2 to 3 pounds per acre ($\frac{2}{3}$ 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°-55° F. 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.

TCNB (Fusarex) is now approved as a postharvest application to inhibit sprouting of potatoes in storage. Apply as a dust at the rate of 0.01 pound actual TCNB per 100 pounds (1 pound Fusarex per 600 pounds) of potatoes as they are placed in storage. Do not feed treated potatoes to livestock.

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 sooner than 7 days before harvest or applied 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.

Paraquat at $\frac{1}{2}$ pound (1 quart Paraquat) per acre may be applied as a preharvest vine killer for potatoes. Do not apply within 3 days before harvest. Paraquat also may be applied as a split application at intervals of 5 or more days. It should not be used on muck or peat soils. Do not allow livestock to graze on treated fields.

DNBP at 1¼ to 2½ pounds (1 to 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. A split application of DNBP at 1¼ pounds (1 quart Dow General or Sinox General) may be made 7 to 10 days apart. 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) also can 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 of Potatoes

A 1-percent dust of the isopropyl ester 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. Do not apply more than 1.12 ounces per acre.

Potatoes

Weeds	Chemical†	Remarks and limitations
Annual weeds	EPTC 3 to 6 lb. (2 to 4 qt. Eptam) or 30 to 60 lb. 10% granular	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. Must be incorporated into soil.
	linuron 2 lb. (4 lb. Lorox)	Preemergence. Apply after planting or immediately after drag-off and hilling. Plant crop at least 2 inches deep. Do not replant to other crops within 4 months after treatment.
	diphenamid 6 lb. (7½ lb. Dymid 80W or 12 lb. Enide)	Preemergence. Apply immediately after planting or immediately after drag-off.
	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 or drag-off or last cultivation up to 9 weeks after planting.
	trifluralin 1 lb. (1 qt. Treflan)	Preemergence or post planting soil incorporation. Apply up to or immediately after drag-off. Do not graze or feed forage from treated fields.
Wild oats	paraquat 1 lb. (½ gal. Paraquat)	Postplanting. Apply before 50 percent of crop has emerged.
	diallate 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 4 lb. (5 lb. Dowpon)	Postemergence. Apply as a directed spray after last cultivation. Use vine lifters. Do not apply to red-skinned varieties.
	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 and quackgrass retardation	dalapon 3 lb. (3½ lb. Dowpon) alone or mixed with DNBP amine 3 to 6 lb. (4 to 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.

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

* No finite tolerances established. See page 3.

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

Insecticides for Potatoes

Use of systemic insecticides at planting time. 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. Disulfoton may be side-dressed but not within 75 days of harvest. Apply phorate only at planting time.

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 has 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. Disulfoton or phorate may help reduce wireworm. Do not use aldrin, dieldrin, or heptachlor as soil treatments for potatoes. Dyfonate or diazinon at 4 pounds per acre as a preplant treatment may help reduce wireworm damage.

Potatoes (continued)

Insects	Chemical†	Remarks and limitations
Aphids	*azinphosmethyl (Guthion) ½ lb.	7 days.
	dimethoate (Cygon) ¼ lb.	NTL.
	endosulfan (Thiodan) ¾ lb.	NTL.
	malathion ¾ lb.	NTL.
	*oxydemetonmethyl (Meta-Systox-R) ¼ lb.	7 days.
	phosphamidon (Dimecron) ½ lb.	7 days.
Colorado potato beetle	*carbaryl (Sevin) 1½ lb.	NTL.
	*azinphosmethyl (Guthion) ½ lb.	7 days.
	endosulfan (Thiodan) ¾ lb.	NTL.
Potato flea beetles	*toxaphene ¾ lb.	NTL.
	*carbaryl (Sevin) 1½ lb.	NTL.
	DDT 1 lb.	NTL.
	*azinphosmethyl (Guthion) ½ lb.	7 days.
	*naled (Dibrom) 1½ lb.	NTL.
Potato leafhopper	*Phosphamidon (Dimecron) ¼ lb.	7 days.
	demeton (Systox) ¼ lb.	21 days.
	carbaryl (Sevin) 1½ lb.	NTL.
	dimethoate (Cygon) ¼ lb. (¾ pt. 2.67 lb. EC)	7 days.
	DDT 1 lb.	NTL.
	malathion ¾ lb.	NTL.
	*oxydemetonmethyl (Meta-Systox-R) ¼ lb.	7 days.
	parathion ¼ lb.	5 days.

For use in the home garden, carbaryl (Sevin) is recommended for the control of chewing insects. Malathion will give control of aphids (plant lice), and either carbaryl (Sevin) or malathion may be used against leafhoppers.

Diseases	Chemical†	Remarks and limitations
Seed-piece decay		Keep seed storage temperatures at 40° F. during winter. In spring, warm seed to 60-70° F. for 1½-2 weeks before planting. Whole seed may be treated with a mercury fungicide (Semesan BelS). Cut seed may be treated with an organic fungicide (captan, maneb, Polyram, or zineb). Plant immediately in moist, warm soil, above 50° F.

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

* No finite tolerances established. See page 3.

Potatoes (continued)

Diseases	Chemical†	Remarks and limitations
Seed-piece decay (continued)	Seed-piece treatment: captan 7.5% captan 7.5% plus streptomycin 1% maneb 7.5% maneb 7.5% plus streptomycin 1% Polyram—0.11 lb. actual as dust per 100 lb. seed	Dip or dust cut potatoes, 0.5 lb. actual per bushel. Dip seed pieces or whole tubers. 1.0 lb. per 10 gal. water. These dusts should be applied with a drum-type dust treater. Application using other devices may give poor coverage and increase the chance of personal contamination with the fungicide.
	zineb 7.5% zineb 7.5% plus streptomycin 1%	Not over 0.15 lb. actual as a dust per 100 cut or whole seed pieces or 1 lb. actual per 50 gal. water. Seep piece dip.
Blackleg	Seed-piece treatment	Avoid infected seed potatoes. Warm seed before planting and plant in warm soil.
	* 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.
Purple top wilt	Spray for leafhoppers (see above)	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.
Late blight and early blight	Difolatan 4 Flowable (see label)	Do not apply more than label recommendation or plant injury may occur.
	Fixed copper (see label) Duter nabam plus zinc sulfate maneb 80% WP 1½ to 2 lb. per acre maneb zinc ion complex (see label) Polyram (see label) Dust formulations of some of the above materials are also available. These are usually 6% to 8% and applied at rates between 20 and 40 lb. per acre.	
Tuber rot postharvest	captan	Postharvest dip or spray. See page 7.
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. Warm seed before planting and plant in warm soil.
Rhizoctonia	Terrachlor (see label)	Used as soil treatment, either broadcast or in furrow.

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Radishes

Insects	Chemical†	Remarks and limitations
Cabbage maggot	chlordane 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.
Flea beetle	diazinon 1 lb. (2 lb. 50% WP)	Furrow drench treatment at planting time.
	carbaryl (Sevin) 1 lb. (2 lb. 50% WP, 1¼ lb. 80% WP)	3 days.
	diazinon ½ lb. (1 lb. 50% WP)	10 days.
	malathion 1 lb. (1½ pt. 50% EC)	7 days.
	methoxychlor 1 to 1½ lb. (2 to 3 lb. 50% WP)	7 days.
Diseases	Chemical†	Remarks and limitations
Seed rot and damping off	Seed treatment: chloranil	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 (forcing under glass)	NTL. 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.	Broadcast and incorporate into upper 2 or 3 in. of soil. Lower rates may be applied in the row at seeding time.
Flea beetles	methoxychlor 1 lb. (2 lb. 50% WP)	7 days for rutabagas if tops are not used.
	carbaryl (Sevin) 1½ lb.	14 days.
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: *chloranil	Use label directions. Do not use treated seed for food or feed.

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* No finite tolerances established. See page 3.

Spinach

Weeds	Chemical†	Remarks and limitations
Annual weeds	cycloate 3 to 4 lb. (½ to 2/3 gal. Ro-neet or 30 to 40 lb. 10% granular)	Preplanting. Must be incorporated into soil. Use on mineral soils only. Use lower rate on sandy soils.
	CIPC 2 lb. (2 qt. Chloro-IPC)	Preemergence.
	CDEC 4 lb. (1 gal. liquid Vegidex or 20 lb. of 20% granular)	Preemergence. Within 30 days prior to emergence. Do not apply within 30 days of harvest. Do not apply to muck soils.
	CDEC 4 lb. (20 lb. of 20% granular Vegidex)	Postemergence. Apply within 30 days after emergence. Repeat 30 days later. Do not apply within 30 days before harvest. Do not apply to muck soils.
Insects	Chemical†	Remarks and limitations
Leaf miner	diazinon ½ lb. (1 lb. 50% WP)	10 days.
	malathion 20 oz. (2 pt. 5 lb. EC) or 2 lb. 25% WP per 100 gal. water	7 days.
	dimethoate (Cygon) ¼ lb.	14 days.
Diseases	Chemical†	Remarks and limitations
Damping off	captan 50% WP	Spray 5 to 7 lb. in 25 to 30 gal. of water into the furrow at planting time.
	captan 10% dust	Apply 25 to 30 lb. into furrow at planting time.

Tomatoes

Weeds	Chemical†	Remarks and limitations
Annual weeds	trifluralin 1 lb. (1 qt. Treflan)	Preplanting. Incorporate into soil. Transplant crop within 3 weeks after treatment.
	pebulate 4 lb. (2/3 gal. Tillam or 40 lb. 10% granular)	Preplanting. Incorporate into soil.
	diphenamid 6 lb. (7½ lb. Dymid or 12 lb. Enide)	Preplanting. Apply within 14 days before direct seeding. OR Preemergence. Apply to direct seeded crop. OR Post transplanting. Apply within 1 month after transplanting or seeding.
	CDA 6 lb. (30 lb. granular Randox)	Post transplanting. Apply within 2 days after transplanting.
	amiben 4 lb. (8 qt. Amiben or 40 lb. granular Vegiben)	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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* No finite tolerances established. See page 3.

Tomatoes (continued)

Insects	Chemical†	Remarks and limitations
Aphids, Aster (six-spotted) leafhoppers	diazinon 1/2 lb. (1 lb. 50% WP)	1 day.
	disulfoton (Di-Syston) 6 oz. 2% G per 50 ft. row, 10 lb. 10% G per acre	Apply to seed furrow. Do not contact seed or use as a soil treatment before transplanting.
	malathion 1/2 lb. (2 lb. 25% WP 1/2 pt. 5 lb. EC)	3 days.
	malathion 0.15 lb. actual per 50,000 cu. ft. as aerosol	For greenhouse tomatoes—15 hours.
	parathion 1/4 lb. (1 pt. 2 lb. EC)	10 days.
	parathion 0.1 lb. actual per 50,000 cu. ft. as aerosol	For greenhouse tomatoes—10 days.
	mevinphos (Phosdrin) 1/4 lb. (1 pt. 2 lb. EC)	1 day.
	endosulfan (Thiodan) 1/2 lb. (1 qt. 2 lb. EC)	1 day.
	phorate (Thimet) 1 lb. (10 lb. 10% G)	Furrow or soil treatment at planting. One application per season.
Flea beetles	methoxychlor 1 lb. (2 lb. 50% WP)	1 day.
	toxaphene 2 lb. (1/3 gal. 6 lb. EC)	3 days.
Cutworms	chlordane 2 to 5 lb.	Soil treatment at planting.
Fruit flies (for processing)	Dust fruit and hampers with synergized pyrethrins. Avoid crushing or cracking fruit. .01 lb. per ton of fruit.	
Diseases	Chemical†	Remarks and limitations
Bacterial spot, bacterial speck, bacterial canker	Hot-water seed treatment 122° F. for 25 min.	Cool and dry seed thoroughly. Crop rotation and sanitation are necessary also.
	Fumigation of seedbed soil	See section on seedbed fumigation, page 5.
	Fumigation of all wood and other equipment: formaldehyde 37%, 1 part to 20 parts water.	Dip or spray all equipment used the previous season.
	Spray or dust in field. Fixed copper—use label directions.	7- to 10-day intervals. No time limitations. Early season applications are most important. Burning may result from spraying very young and tender plants.
Rhizoctonia	PCNB—not over 0.5 pt. of 0.2% solution per plant (about 2 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.
	Soil drench—captan 50% WP 1 to 2 lb. per 100 gal. water	Immediately after planting. For both field and greenhouse.
Late blight, early blight, septoria leaf spot	Spray or dust in field:	Use label directions for all fungicides. Burning may result from spraying very young and tender plants. Use locally grown plants.
	maneb	NTL.
	Polyram	NTL.
	zinc ion plus maneb	NTL.
	zineb	NTL.
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 Aster (six-spotted) leafhoppers. Early season control is most important. (see above)	

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