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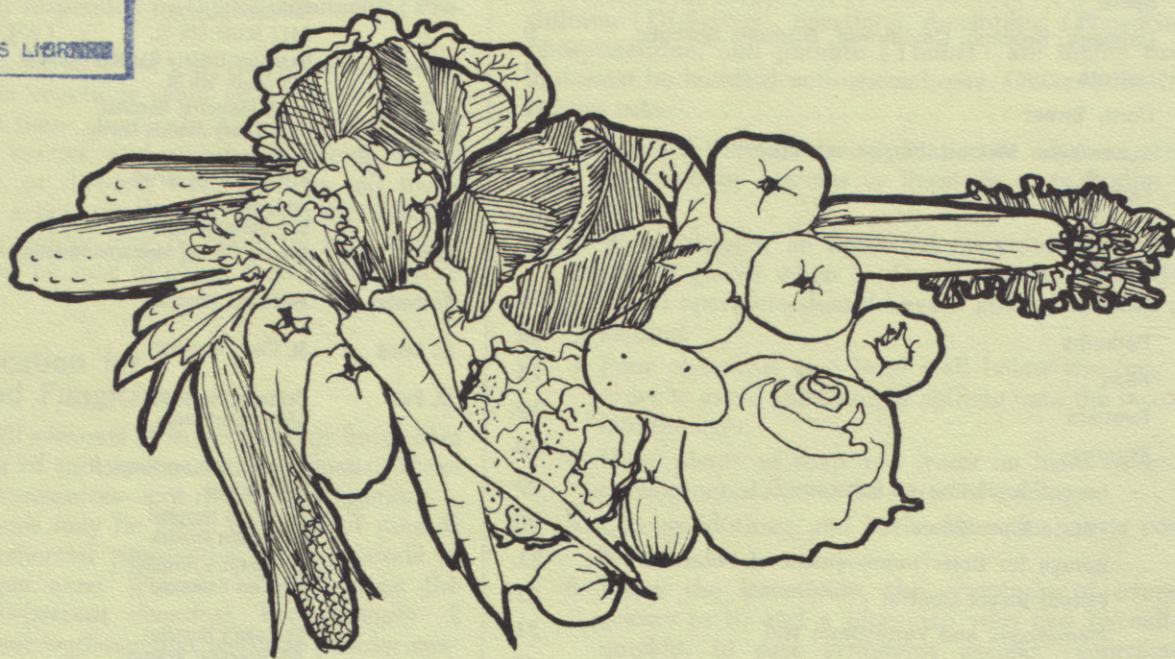
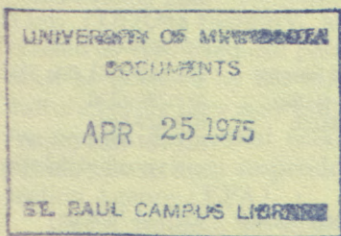
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1975
**WEED, INSECT,
AND DISEASE CONTROL**
**GUIDE FOR COMMERCIAL
VEGETABLE GROWERS**



Orrin C. Turnquist, John A. Lofgren, F. L. Pflieger, and Howard L. Bissonette

Agricultural Extension Service • University of Minnesota

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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.

City	Poison Information Centers	Telephone
Bemidji	Bemidji Hospital	218-751-5430 (Ext32)
Brainerd	St. Joseph's Hospital	218-829-2861 (Ext 211, 212)
Crookston	Riverview Hospital	218-281-4682 (Ext. 202, 276, 298)
Duluth	St. Luke's Hospital 915 East 1st St.	218-727-6636 (Ext 616, 617)
	St. Mary's Hospital 407 E. 3rd Street	218-727-4551 (Ext 359) Night Ext 291
Fargo	St. Luke's Hospital	701-237-8115
Fergus Falls	Lake Region Hospital	218-736-5475 (Ext. 222, 3 p.m.-7 a.m. and week-ends, Ext 244 7 a.m.-3 p.m.)
Mankato	St. Josephs Hospital	507-387-4031
Marshall	Lewis Weiner Memorial Hospital	507-532-2263 (Sta 31)
Minneapolis	Minnesota Poison Information Minn. Department of Health 717 Delaware St., S.E.	612-296-5276 612-929-6491 612-784-1869 (Night)
	Fairview Hospital 2312 South 6th St.	612-332-0282 (Ext 313)
	Hennepin County General Hospital 619 South 5th St.	612-384-7688 or 612-348-7981
	North Memorial Hospital 3220 Lowry Avenue North	612-588-0616 (Ext 341, 342, 346)
	Northwestern Hospital 810 East 27th Street	612-874-4000
(Fridley)	Unity Hospital 550 Osborne Road	612-786-2200 (Ext 221)
Morris	Stevens County Memorial Hospital	612-589-1313 Station 1
Rochester	Methodist Hospital	507-282-4461 Extension 5250
St. Cloud	St. Cloud Hospital	612-251-2700 (Ext 151) Night Ext 221
St. Paul	Bethesda Hospital 559 Capitol Blvd.	612-227-8611 Ext 301, 302 or 612, 224, 91, 21
	St. Paul Ramsey Hospital 640 Jackson	612-222-4694
	St. John's Hospital 403 Maria Avenue	612-228-3132
	St. Joseph's Hospital 69 West Exchange	612-291-3348 or 291-3139 or 291-3117 or 291-3118
	St. Luke's Hospital 300 Pleasant Avenue	612-298-8210
	Children's Hospital 311 Pleasant Avenue	612-227-6521 (Ext 432, 433)
Virginia	Virginia Municipal Hospital	218-741-3340
Willmar	Rice Memorial Hospital	612-235-4543 (Ext 291)
Worthington	Worthington Regional Hospital	507-372-2941 (Ext 155, 158)

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Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Roland H. Abraham, Director of Agricultural Extension Service, University of Minnesota, St. Paul, Minnesota 55108. We offer our programs and facilities to all persons without regard to race, creed, color, sex, or national origin. 3M-3-75

1975 WEED, INSECT, AND DISEASE **CONTROL** **GUIDE** FOR COMMERCIAL VEGETABLE GROWERS

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 1975 season will be made available to all commercial growers.

Aldrin, DDT, dieldrin, endrin, heptachlor, lindane, TDE (DDD), mercury, and inorganic arsenicals are classed as restricted-use pesticides in Minnesota. Dealers must be licensed by the Minnesota Department of Agriculture before they may sell these products and then only for certain designated uses. Restrictions for aldrin and dieldrin have been suspended by the Environmental Protection Agency (EPA).

Illegal residues of some of the restricted-use pesticides may occur in vegetable crops grown in soil previously treated with these chemicals. Avoid planting crops such as potatoes, carrots, and radishes in fields where aldrin, heptachlor, or dieldrin were used as soil treatment. Since legal action on the current registrations of chlordane and heptachlor may be taken by EPA before the 1975 crop year, be sure to check their status before using them.

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 methoxychlor wettable powder contains 1 pound of actual methoxychlor, 4 pounds of a 25-percent wettable powder contains 1 pound of actual insecticide, and 20 pounds of a 5-percent dust contains 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 methoxychlor emulsifiable concentrate contains 2 pounds of actual methoxychlor per gallon. If you wish to apply 1 pound of actual methoxychlor 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 methoxychlor concentrate to the amount of water needed for 1 acre.

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

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), 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.
7. Airplane pilots and handlers should know the dangers of handling and applying parathion and other phosphates; especially the danger of skin and respiratory absorption.

Some pesticides, such as carbaryl (Sevin), parathion, and ULV malathion are highly toxic to bees. They should not be applied to crops in bloom nor on or near bee yard locations. The dust formulations should not be applied to sweet corn which is pollinating. Spray pollinating corn in late evening when bees are not in the field. Advise beekeepers in your area about your spray schedule.

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 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 granu-

lar 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

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

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

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 manufacturer's spray nozzle manual. Keep in mind orifice and 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 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 1 for specific chemicals and approved uses for soil fumigation.

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.

During the growing season, green plants exposed to these fumes may be subject to injury.

SEED TREATMENT

A seed-soak treatment with Thiram is suggested for vegetable and flower seeds where the standard seed treatments have not proven effective. It is especially effective for tomatoes and most of the vine crops. Soak the seed in a .2 percent solution of Thiram (4 ounces of Thiram 75% in 10 gallons of water) for 24 hours at 86° F. Drain and air dry the seed at 77° F.

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

Some herbicide mixtures are in use and several new herbicide mixtures show promise for overcoming limitations of single chemicals. Certain mixtures may (1) control more kinds of weeds, (2) give more consistent performance with different soils and weather conditions, (3) lessen soil residue problems, (4) increase persistence enough to give full-season weed control, or (5) reduce crop injury.

Only those mixtures that have been field tested under local conditions and registered for use by the U.S. Department of Agriculture should be used. Use of unregistered mixtures may result in poor weed control, crop injury, or accumulation of illegal chemical residues in the crop. Growers are responsible for residues resulting from use of unregistered mixtures.

Table 1. Characteristics of Nematicides

Trade name	Active ingredients	Hazards to mammals†		Effective against			
		Oral	Dermal	Nematodes	Soil insects	Soil fungi	Weed seeds
Brozone Brom-O-Sol	methyl bromide (68.6%) chloropicrin (1.4%)	serious inhalation hazard		★	★	★	★
Chloropicrin Picfume Larvicide Chlor-O-Pic	trichloronitromethane (99%)	serious inhalation hazard		★	★	★	★
DBCP Nemagon Fumazone	1,2-dibromo-3-chloropropane and other halogenated C ₃ compounds	low	low	★			
D-D Mixtures D-D Vidden D	1,3-dichloropropene-1,2-dichloropropane and related chlorinated hydrocarbons	moderate	low	★	★		
Dasanit	0,0-diethyl-0-p[methyl sulfinyl] phenyl phosphorothioate	high	high	★	★		
Diazinon Sarolex	0,0-diethyl-0-p[2-isopropyl-4-methyl-6-pyrimidyl] thiophosphate	moderate	moderate	★	★		
Dorlone	ethylene dibromide (18.9%) 1,3-dichloropropenes and related C ₃ hydrocarbons (79.9%)	moderate	moderate	★			
DowFume MC-2 Brom-O-Gas	methyl bromide (98%) and chloropicrin (2%)	serious inhalation hazard		★	★	★	★
DowFume MC-33 Terr-O-Gas	methyl bromide (67%) and chloropicrin (33%)	serious inhalation hazard		★	★	★	★
Ethylene Dibromide DowFume W-85 Soilbrom-85	1,2-dibromoethane	moderate	moderate	★	★		
Mocap	0-ethyl, S,S-dipropyl phosphorodithioate	high	high	★	★		
Telone	1,3-dichloropropene and related chlorinated hydrocarbons (100%)	moderate	moderate	★	★		
Vapam VPM	sodium methyl dithiocarbamate (32.7%)	low	moderate	★	★	★	★
Terr-O-Cide 15	1,2-dibromoethane (40%) and chloropicrin (15%) —or—	moderate	moderate	★	★	★	
Terr-O-Cide 30	1,2-dibromoethane (36%) and chloropicrin (30%)						
Terr-O-Cide 15-D	1,3-dichloropropene-1,2 dichloropropane and other halogenated C ₃ compounds (85%) and chloropicrin (15%) —or—	moderate	low	★	★		
Terr-O-Cide 30-D	1,3-dichloropropene-1,2 dichloropropane and other halogenated C ₃ compounds (70%) and chloropicrin (30%)						

† Most fumigants are vesicants which cause severe burns when in contact with skin or mucous membranes. Avoid direct contact and INHALATION of these materials.

Table 2. 1975 herbicide, insecticide, and fungicide recommendations for vegetable crops

ASPARAGUS

Weeds	Chemical†	Remarks and limitations
SEEDBEDS		
Annual weeds	chloramben 3 lb. (6 qt. Amiben or 30 lb. 10% granular Amiben) Stoddard Solvent 40 gal. paraquat 1 lb. (½ gal. Paraquat)	Immediately after seeding. Delayed preemergence when weeds are 1 to 2 inches tall. Delayed preemergence
ESTABLISHED BEDS		
Annual weeds	diuron 0.8 to 3.2 lb. (Karmex 1 to 4 lb.)	Two applications can be made. Apply first, pre-emergence before weeds become established but not later than the early cutting period. Apply second spray after harvest. Use lower rate on sandy soils and higher rate on clay and organic soils.
	simazine 2 to 4 lb. (2½ to 5 lb. Princep)	After disking and before spears appear in spring, and/or after postharvest disking before weeds appear. Do not treat during last year in asparagus because of residue.
	2,4-D 1.6 to 2.0 lb. (2 to 2½ lb. 2,4-D Sodium Salt)	Apply to actively growing weeds in April or May. Spray immediately after cutting if spears are present. Make no more than 2 applications spaced at least 1 month apart during harvest. Cut and destroy all spears contacted by the spray immediately. Use drop nozzels with ground equipment for post harvest applications to avoid damage to ferns.
Quackgrass	dalapon 7½ lb. (10 lb. Dowpon)	Before cutting and again 3 to 4 weeks later if needed. Treat when grass weeds are 3 to 4 inches tall. Direct spray under fern growth.
Insects		
Asparagus beetles	carbaryl (Sevin) 1 lb. (1¼ lb. 80% WP) malathion 1¼ lb. (2 pt. 5 lb. EC) methoxychlor 1 lb. (2 lb. 50% WP)	1 day. Do not repeat within 3 days. 1 day 3 days (unless washed and/or blanched)
Diseases		
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 1 to 1½ lb. W.P. zineb 1 to 1½ lb. W.P. Polyram 1 to 1½ lb. W.P.	Only on fern growth after spears are harvested. Apply every 7 to 10 days to fern growth only.

BEANS

Weeds	Chemical†	Remarks and limitations
SNAP BEANS		
Annual weeds	EPTC 3 lb. (3½ lb. Eptam 7E or 30 lb. 10% granular Eptam) trifluralin ½ to ¾ lb. (1 to 1½ pt. Treflan or 10 to 15 lb. 5% granular Treflan) dinoseb amine 6 to 9 lb. (8 to 12 qt. Premerge or Sinox PE) dinoseb amine 3 to 4 lb. (4 to 6 qt. Premerge or Sinox PE)	Preplanting or at planting time. Incorporate thoroughly into top 2 inches of soil. Preplanting soil application. Incorporate with soil immediately. Use lower rate on light soils. Immediately after seeding. Do not apply to light sandy soil. Use higher rate on heavy soils. Heavy rain or high temperatures before emergence may cause injury. If delayed, apply just before emergence at the crook stage.

† 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 exceptions.

BEANS (continued)

Weeds	Chemical†	Remarks and limitations
	chloramben methyl ester 2 to 3 lb. (Vegiben 2E 1-1½ gal.)	Preemergence. Do not use on sandy soils.
LIMA BEANS		
Annual weeds	trifluralin ¾ lb. (1½ pt. Treflan or 15 lb. 5% granular Treflan) chloramben 4 lb. (8 qt. Amiben or 40 lb. 10% granular Amiben)	Preplanting soil application. Incorporate with soil immediately. Immediately after seeding. May be applied following Treflan incorporation. Do not feed plant parts to livestock.
Insects	Chemical†	Remarks and limitations
Aphids	diazinon ½ lb. (1 lb. 50% WP) disulfoton (Di-Syston) 2 lb. (13.3 lb. 15% G) dimethoate (Cygon, De-Fend, Dimex, Rebelate) ½ lb. (1½ pt. 2.67 lb. EC; 2 lb. 25% WP) endosulfan (Thiodan) ¾ lb. (1½ qts. 2 lb. EC)	7 days for beans; 4 days for hay; 1 day for forage. Band soil treatment at planting time. Do not place with seed. 60 days. NTL; Do not feed treated forage to livestock. Do not exceed 3 applications. Do not treat lima beans. Do not feed forage. May be combined with pyrenone 3 days.
Bean leaf beetle	malathion 1 lb. (1½ pt. 5 lb. EC) phorate (Thimet) 2 lb. (20 lb. 10% G, 14 lb. 15% G) carbaryl (Sevin) 1 lb. (1¼ lb. 80% WP) ethion ¼-½ lb. (1-2 lbs. 25% WP or ½ to 1 pt. 4 lb. EC) methoxychlor 1 lb. (2 lb. 50% WP, 2 qt. 2 lb. EC)	1 day. Apply in furrow but not in contact with seed. 60 days for forage. NLT. 2 days. Do not feed treated vines to livestock.
Green cloverworm	carbaryl (Sevin) 1 lb. (1¼ lb. 80% WP) malathion 1 lb. (1½ pt. 5 lb. EC)	3 days. NTL
Leafhoppers	carbaryl (Sevin) 1 lb. (1¼ lb. 80% WP) dimethoate (Cygon, DeFend, Dimex, Rebelate) ¼ lb. (¾ pt. 2.67 lb. EC, 1 lb. 25% WP) disulfoton (Di-Syston) 2 lb. (13.3 lb. 15% G) endosulfan (Thiodan) ¾ lb. (1½ qts. 2 lb. EC) ethion ½ lb. (2 lbs. 25% WP or 1 pt. 4 lb. EC) malathion 1 lb. (1½ pt. 5 lb. EC) methomyl (Lannate) ¼ to 1 lb./A (¼-½ soluble powder, ½ pts. "L") methoxychlor 1 lb. (2 lb. 50% WP) phorate (Thimet) 2 lb. (20 lb. 10% G, 14 lb. 15% G)	NTL 1 day NTL Do not feed treated vines. Band soil treatment at planting time. Do not place with seed. 60 days. See remarks and limitations under aphids. 2 days. Do not feed forage. 1 day. 1 day (succulent beans only). 3 days. Apply in furrow but not in contact with seed. 60 days for forage.
Spider mites	dicofol (Kelthane) ½ lb. (1½ lb. 35% WP) disulfoton (Di-Syston) 2 lb. (13.3 lb. 15% G) ethion ¾ lb. (20 lbs. 4% D) phorate (Thimet) 2 lb. (20 lb. 10% G, 14 lb. 15% G)	7 days; do not feed treated vines. Band soil treatment at planting time. Do not place with seed. 60 days. 2 days. Do not feed treated foliage to livestock. Apply in furrow but not in contact with seed. 60 days for forage.
Seed corn maggot	diazinon, heptachlor, or lindane, 1 oz. per bu.	Seed treatment only. See page 3.
Wireworms, white grubs	chlordane 4 lb. (16 lb. 25% G or 12 lb. 33% G) diazinon 3½ lb. (25 lb. 14% G)	Broadcast soil treatment before planting. Disc in thoroughly. Broadcast soil treatment before planting. Disc in thoroughly.
Diseases	Chemical†	Remarks and limitations
Seed rot, damping off	Captan 2.5 oz. 75 WP/100 lb. seed Chloranil 4 oz./100 lb. seed Dexon 0.7 oz./100 lb. seed Thiram 1.5 oz. 75 WP/100 lb. seed	Do not use treated seed for food or feed. Dexon or captan overdose may cause injury to seedlings.

† 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 exceptions.

BEANS (continued)

Diseases	Chemical†	Remarks and Limitations
Common and Halo blight	Kocide 2 lb	Use western grown seed, practice a 3 to 5 year crop rotation, plow down crop refuse in the fall. If symptoms appear, begin a spray program early. Applications should be made at 7 to 10 day intervals.
White mold	Sprays for bacterial blight control Streptomycin formulations Benomyl 1 lb 50 WP Botran 3 lb 75 WP	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. Do not plant on bean, potato, tomato, lettuce, sunflower, or crucifer ground. Where you have had the problem before, spray with Benomyl at green bud stage and again in 5-7 days. Harvest limitations: Benomyl, 14 days for snap and dry beans; 28 days for lima. Botran, 2 days for snap.
Anthracnose	Zineb Ziram 2 lb/100 gal. water and spread sticker Ferbam 3 lb/100 gal. water Tri Basic Copper Sulfate 1½ to 2 lb. WP Kocide-101 ¾ to 1 lb. WP	Protective sprays should be started early before symptoms appear and applied at 10 day intervals. Do not apply Ferbam within 4 days of harvest. Not over 4 lb. metallic copper equivalent per acre per application. NTL.
Rust	Maneb (1½ to 2 lb) Zineb (1½ to 2 lb)	Use a crop rotation system so that beans do not occur more than once every 3 years. Bury all bean crop debris before planting new crop. NTL on maneb usage when sprayed on dry beans. 4 days on snap beans.
Mosaics	See aphid control	Use certified or disease free seed.

BEETS

Weeds	Chemical†	Remarks and limitations
Annual weeds	pyrazon 4 lb. (5 lb. Pyramin) cycloate 3 to 4 lb. (½ to 2/3 gal. Ro-Neet or 30 to 40 lb. 10% granular Ro-Neet)	Preemergence or immediately after beets emerge and before weeds have 2 leaves. Preplant soil incorporation, use on mineral soils only. Use lower rate on sandy soils.
Insects	Chemical†	Remarks and limitations
Leaf miner	diazinon ½ lb. (1 lb. 50% WP) malathion 20 oz. (2 pt. 5 lb. EC)	14 days. 7 days.
Cutworms	carbaryl (Sevin) 1 to 2 lb. (20 to 40 lb. 5% bait)	3 days (14 days for tops).
Diseases	Chemical†	Remarks and limitations
Seed rot, damping off	Captan 9 oz. 75 WP/100 lb. seed Dexon 4 oz. 75% WP/100 lb. (dust) seed	Do not use treated seed for food or feed.
Cercospora leaf spot	Thiram 96 gms/10 gal. water See carrots, page 12.	NTL unless tops are to be eaten; then stop spray 7 days before harvest.

CABBAGE, BROCCOLI, CAULIFLOWER, BRUSSELS SPROUTS

Weeds	Chemical†	Remarks and limitations
Annual weeds	trifluralin ¾ lb. (1½ pt. Treflan or 15 lb. 5% granular Treflan) trifluralin 1 lb. (2 pt. Treflan or 20 lb. 5% granular Treflan) DCPA 8 lb. (10 lb. 75% Dacthal) nitrofen 3 to 6 lb. (1½ to 3 gal. TOK E-25 or 6 to 12 lb. TOK 50% WP) nitrofen 3 to 6 lb. (6 to 12 lb. TOK 50% WP)	Preplanting soil incorporation. Pretransplant soil incorporation. Transplant crop immediately to 3 weeks after treatment. At time of seeding or immediately after transplanting. Preemergence. Make a single application immediately after seeding the crop. 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. Do not use TOK E-25 at postemergence or post transplant.
Insects	Chemical†	Remarks and limitations
Aphids	demeton (Systox) ½ lb. (2 pt. 2 lb. EC) diazinon ½ lb. (1 lb. 50% WP)	21 days. 7 days for cabbage and Brussels sprouts; 5 days for broccoli and cauliflower.

† 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 exceptions.

**CABBAGE, BROCCOLI, CAULIFLOWER, BRUSSELS
SPROUTS (continued)**

Insects	Chemical†	Remarks and limitations
	dimethoate (Cygon, DeFend, Dimex, Rebelate) ¼ to ½ lbs. (¾ to 1½ pt. 2.67 EC)	3 days for cabbage, 7 days for broccoli and cauliflower.
	disulfoton (Di-Syston) 1 lb. (6.7 lbs. 15 G)	One application per season as furrow treatment or side dressing. 42 days cabbage; 40 days cauliflower; 14 days broccoli; 30 days Brussels sprouts.
	endosulfan (Thiodan) ¾ lb. (1½ qt. 2 lb. EC)	7 days cabbage, 4 days broccoli; 14 days cauliflower and Brussels sprouts. May be combined with pyrene.
	malathion ½ to ¾ lb. (3/5 to 1 pt. 5 lb. EC)	7 days.
	oxydemetonmethyl (Meta Systox-R) ½ lb. (2 pt. 2 lb. EC)	3 days Brussels sprouts, 7 days broccoli, cabbage, and cauliflower. Not more than 3 times per season.
	mevinphos (Phosdrin) ¼ lb. (1 pt. 2 lb. EC)	1 day broccoli, cabbage; 3 days cauliflower, Brussels sprouts.
	Monitor ½ to 1 lb. (1-2 pt. 4 lb. EC)	28 days for cauliflower, 21 days for broccoli, 14 days for Brussels sprouts, and 35 days for cabbage.
	naled (Dibrom) 1 lb. (1 pt. 8 lb. EC)	1 day.
Flea beetles	carbaryl (Sevin) 1½ lb. diazinon ½ lb. (1 lb. 50% WP)	3 days. 7 days cabbage and Brussels sprouts; 5 days broccoli, cauliflower.
	disulfoton (Di-Syston) 1 lb. (6.7 lb. 15 G)	One application per season as furrow treatment or side dressing. 42 days cabbage; 40 days cauliflower; 14 days broccoli; 30 days Brussels sprouts.
	endosulfan (Thiodan) ¾ lb. (1½ qt. 2 lb. EC)	7 days cabbage, broccoli; 14 days cauliflower and Brussels sprouts.
	methoxychlor 1½ lb. (3 lb. 50% WP)	3 days for cabbage; 7 days for cauliflower; 14 days for broccoli, Brussels sprouts.
	toxaphene 1 lb. (1¼ pt. 6 lb. EC)	Before heading only.
Cabbageworm, loopers NOTE: Loopers should be controlled when they are small. Fully grown loopers are very difficult to control.	<i>Bacillus thuringiensis</i> (Biotrol, Dipel, Thuricide) as labeled	N.T.L.
	aziphosmethyl (Guthion) ½ to ¾ lb. (1 to 1½ lb. 50% WP), 2 to 3 pt. 2 lb. EC)	15 days broccoli and cauliflower; 7 days Brussels sprouts, 21 days cabbage.
	carbaryl (Sevin, Sevimol) 1½ to 2 lb. (2 to 2½ lb. 80% WP)	3 days.
	chlordimeform (Galecron, Fundal) ½ lb. (1 pt. 4 lb. EC)	14 days. Not more than 9 applications.
	endosulfan (Thiodan) ¾ lb. (1½ qt. 2 lb. EC)	See remarks and limitations under aphids. May be combined with parathion.
	methomyl (Lannate, Nudrin) ½ to 0.9 lb. (½ to 1 lb. soluble powder)	1 day for cabbage; 14 days for broccoli, cauliflower, and Brussels sprouts.
	methyl parathion or parathion ¼ lb. (1 lb. 25% WP)	7 days for Brussels sprouts, broccoli, cauliflower; 10 days for cabbage. May be combined with endosulfan or toxaphene.
	mevinphos (Phosdrin) ½ lb. (1 qt. 2 lb. EC)	1 day for broccoli, cabbage; 3 days for cauliflower and Brussels sprouts.
	Monitor ½ to 1 lb. (1 to 2 pt. 4 lb. EC)	28 days cauliflower, 21 days broccoli, 14 days Brussels sprouts, and 35 days cabbage.
	naled (Dibrom) lb. (1 pt. 8 lb. EC)	1 day.
	toxaphene 3 lb. (½ gal. 6 lb. EC)	Before heading only. May be combined with parathion.
	trichlorfon (Dylox) 1 lb. (20 oz. 80% soluble powder, 20 lb. 5% bait)	21 days.
Cabbage maggot	diazinon 2 to 3 lb. (4 to 6 lb. 50% WP) diazinon 4 lb. (8 lb. 50% WP or 28 lb. 14% G)	As furrow drench or in transplant water. Broadcast soil treatment before planting.
Cutworms	chlordane 4 lb. (40 lb. 10% or 15 lb. 33% G) carbaryl (Sevin, Sevimol) 2 lb. (2½ lb. 80% WP) trichlorfon (Dylox) 1 lb. (20 oz. 80% soluble powder, 20 lb. 5% bait)	Broadcast soil treatment before planting. 3 days. 21 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 exception.

**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 Seed rot, damping off	See section on seedbed fumigation, page 5. Seed treatment; captan, thiram, or chloranil ½ tsp. 75% WP per lb. of seed. 4 to 8 oz. per 100 lb. seed	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.
	Lime	Use hydrated lime to reach pH 7 or above. Use a long crop rotation.
Downy mildew Alternaria leaf spot	Bravo W75 1½ lb. Maneb 2 lb. Fixed coppers 2 lb.	Days to harvest: Maneb, 7 days; NTL for Bravo, Kocide. Use at first signs of mildew. Repeat every 7 days.
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 ¼ inch in diameter. Most effective if weeds are small, air still, and humidity high. Crop injury may occur when temperature exceeds 75° F.
	linuron ¾ to 1½ lb. (1½ to 3 lb. Lorox)	Postemergence. Apply when carrots are at least 3 inches tall. Use the lower rate on smaller weeds and the higher rate on larger established weeds. Apply before annual grasses exceed 2 inches in height and before broad-leaved weeds exceed 6 inches in height. Do not exceed 40 psi spray nozzle pressure as crop injury may result. Lorox may follow Stoddard Solvent if treatments are at least one day apart. Stoddard Solvent may follow Lorox if treatments are at least 2 weeks apart. Shorter time intervals may result in crop injury. Do not apply Lorox as a tank mixture with Stoddard Solvent, surfacants, nitrogen solution, other pesticides, or when temperatures exceed 85° F. as crop injury may result. Multiple applications may be made if total does not exceed 4 lb. Lorox per acre. Do not replant to other crops within 4 months after treatment.
	nitrofen 2 to 6 lb. (1 to 3 gal. TOK E-25)	Preemergence. Make a single application immediately after seeding the crop. Postemergence. Apply within two weeks after crop emergence while weeds are in the seedling stage.

Insects	Remarks or limitations	Chemical†
Aster (six-spotted) leafhoppers NOTE: Insecticide reduces aster yellows virus transmission through reduction of leafhopper numbers.	carbaryl (Sevin) 1 lb. 1¼ lb. 80% WP) methoxychlor 2 lb. (1 gal. 2 lb. EC) malathion 1 lb. (1½ pt. 5 lb. EC)	NTL. 14 days if tops are used; 7 days roots. 7 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 exceptions.

CARROTS

Diseases	Chemical†	Remarks and limitations
Seed rot, damping off	Seed treatment: captan or thiram 50% WP. 2 tsp. per lb. seed. 8 oz. per 100 lb. seed	Follow hot-water treatment for bacterial blight after seed is dry.
Bacterial blight and Cercospora leaf spot and Alternaria leaf spot	Spray in field: fixed copper—use label directions Tri Basic Copper Kocide 101 Bravo W-75 1-1½ lb. maneb—use label directions zinc ion plus maneb—use label directions zineb—use label directions	7- to 10-day intervals. Not later than 7 days before harvest. Do not use tops for food or feed. 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 leafhoppers that spread the virus (see above)	
Root knot nematode	DD, Vidden-D, Telone, Vorlex, or EDB	See Table 1 for trade names. Use at rates suggested on label. Treatment must be made at least 14-21 days before planting, preferably during the fall previous to planting. A 2- to 3-year rotation with grass sod will eliminate the nematode.
Storage	0.05-0.1% Dowcide A Botran 1 lb. 75 WP/100 gal.	Carrots may be dipped or sprayed. Postharvest use only.

CORN, SWEET

Weeds	Chemical†	Remarks and limitations
Annual	propachlor 4 to 5 lb. (6 to 7.5 lb Ramrod 65W or 20 to 25 lb. 20% granular Ramrod) atrazine 1 to 4 lb. (1¼ to 5 lb. Aatrex 80W or 1 to 4 qts. Aatrex 4L) alachlor 2 to 3 lb. (2 to 3 qt. Lasso or 13 to 20 lb. Lasso II 15 G) cyanazine 1½ to 3 lb. (2 to 4 lb. Bladex 80W or 1½ to 3 qt. Bladex 4L) Mixture of atrazine 1 to 2 lb. (1¼ to 2½ lb. Aatrex 80W) and alachlor 1½ to 2½ lb. (1½ to 2½ qt. Lasso) cyanazine 2 lb. (2½ lb. Bladex 80 W or 13 lb. Bladex 15G or 2 qt. Bladex 4L) Mixture of atrazine ½ to 1½ lb. (2/3 to 1¾ lb. Aatrex 80W) and butylate 3-4 lb. (3¾ to 4¾ pt. Sutan + 6.7E). Mixture of cyanazine 1 to 2 lb. (1¼ to 2½ lb. Bladex 80W) and butylate 3 to 4 lb. (3¾ to 4¾ pt. Sutan + 6.7E) Mixture of atrazine 1 to 1½ lb. (1¼ to 1¾ lb. Aatrex 80W) and propachlor 2 to 3¾ lb. (3 to 4¾ lb. Ramrod 65W) Mixture of atrazine 1 to 3 lb. (1¼ to 3¾ Aatrex 80W) and 1 to 2 gals. of special oil with an emulsifier or ¼ to ½ gal. of emulsified vegetable oil.	Preemergence. Preplant soil incorporation. Pre or postemergence. 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 applications or injury may occur. Toxic residues are more likely to persist if soil mixture or temperature is low. Do not graze or feed forage from treated areas to livestock for 21 days after treatment. Preemergence. Do not forage or harvest immature corn for feed within 12 weeks after treatment. Preemergence. Do not use on sandy soils, peat, or muck. Preemergence. Do not forage or harvest immature corn for feed within 12 weeks after treatment. Early postemergence. Can be applied up through the 4th leaf stage. Do not use on sand, peat, or muck. Do not use with any additive such as oils surfactants, or wetting agents. Preplanting soil incorporation. Preplanting soil incorporation. Preemergence. Early postemergence. Apply within 3 weeks of planting while weeds are less than 1½ inches tall. Use oils labeled for this purpose only.
Broad-leaved weeds	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 nozzles.
Annual grasses	butylate 4 lb. (4¾ pt. Sutan + 6.7E)	Preplanting soil incorporation.

† 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 exceptions.

CORN, SWEET (continued)

Insects	Chemical†	Remarks and limitations
Aphids	diazinon 1/2 lb. (1 lb. 50% WP)	NTL.
	malathion 1 lb. (1 1/2 pt. 5 lb. EC)	5 days.
	parathion 1/2 lb. (2 lb. 25% WP)	12 days.
Armyworm, cutworms	NOTE: Worms more than half grown are difficult to control	
	carbaryl (Sevin) 2 lb. (2 1/2 lb. 80% WP, 40 lb. 5% bait)	NTL.
	trichlorfon (Dylox) 1 lb. (20 oz. 80% soluble powder)	NTL.
	toxaphene 2 lb. (1/3 gal. 6 lb. EC)	Do not feed forage.
Corn earworm	carbaryl (Sevin) 1 1/2 to 2 lb. (2 to 2 1/2 lb. 80% WP)	NTL. Carbaryl is extremely toxic to bees. Avoid drift into bee yards; do not use dusts on corn; avoid treatment while bees are in field.
	diazinon 1 1/2 lb. (1 1/2 qt. AG500 or 3 lbs. 50% WP)	NTL.
	endosulfan (Thiodan) 1 1/2 lb. (3 qts. 2 lb. EC)	Do not use on corn for processing. Do not feed forage. Not more than 5 applications.
	methomyl (Lannate, Nudrin) 1/4 to 1/2 lb. (1/4 to 1/2 lb. soluble powder)	NTL; 3 days for forage. May injure some varieties.
	Methylparathion (Penncap M) 1/2 lb., 4 pts.	12 days.
Corn rootworm	Dasanit 1 lb. (7 lb. 15% G) Dyfonate 1 lb. (10 lb. 10% G) Mocap, 1 lb. (10 lb. 10% G) phorate 1 lb. (7 lb. 15% G)	Apply one of these insecticides in 7 inch band just ahead of press wheels at planting time. Rates are for 40 inch rows.
Corn rootworm adults ("Silk beetles")	carbaryl (Sevin) 1 lb. (1 1/2 lb. 80% WP)	NTL.
	EPN 1/4 lb. (1/2 pt. 2 lb. EC)	14 days.
	malathion 1 lb. (3 pts. 5 lb. EC) or 4 oz. ULV by air	5 days.
	diazinon 1/2 to 1 lb. (1 to 2 pts. AG500)	NTL.
European corn borer	<i>Bacillus thuringiensis</i> (Biotrol, Dipel, Thuricide) as labeled	NTL.
	carbaryl (Sevin) 1 to 2 lb. (1 1/4 to 2 1/2 lb. 80% WP, or 5 to 10 lb. 20% G)	NTL. Highly toxic to bees. (see corn earworm)
	diazinon 1 to 2 lb. (7 to 14 lb. 14% G)	NTL.
	EPN 1/4 lb. (granules) to 1/2 lb. (spray) (1 pt. 4 lb. EC)	14 days.
	methomyl (Lannate, Nudrin) 1/2 lb. (1/2 lb. 90% soluble powder)	NTL for grain; 3 days for forage.
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.	

NOTE: For second brood treat at the time of egg hatch or after moths are detected in traps (mid to late August). Direct spray at ear zone. Additional treatments should be made at 3 to 7 day intervals as determined by egg counts or moth flights. Treatment for first brood usually not warranted in Minnesota unless infestation is extremely heavy in late June and early July.

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

CORN, SWEET (continued)

Insects	Chemical†	Remarks and limitations
Seed corn maggot, corn seed beetle, wireworms	diazinon, heptachlor, lindane	1 oz. per bushel as seed treatment only.
White grubs, wireworms	chlordane 2 to 4 lb. (1 to 2 qt. 8 lb. EC or 6 to 12 lb. 33% G)	Soil treatment before or at planting. 2 lb. for row treatment, 4 lb. broadcast.
Seed corn beetles, maggots	Dasanit 1 lb. (6.7 lb. 15G) Dyfonate 1 lb. (10 lb. 10G)	Apply in 7-inch band just ahead of press wheels at planting time. Rates are for 40-inch rows.
Diseases	Chemical†	Remarks and limitations
Seed rot, damping off	Seed treatment: captan, chloranil, dichlone, or thiram 2 to 4 oz. 75% WP Bravo W-75 1½-2 lb.	Do not use treated seed for food or feed. Follow label directions. Do not apply within 14 days of harvest. For fresh market only.
Southern leaf blight	zinc ion maneb 1.2 lb./acre with sufficient water Maneb 1.2 lb./100 gal. water Zineb see label directions	7 days. Start early in season. Follow through with application in 7 to 10 day interval.

CUCUMBERS, MELONS, PUMPKINS, SQUASH

Weeds	Chemical†	Remarks and limitations
Annual weeds ALL CUCURBITS	dinoseb amine 3 lb. (1 gal. Premerge or Sinox PE) bensulide 5 to 6 lb. (5 to 6 qt. Prefar)	Preemergence. Very effective if weeds are emerged at time of application. Do not use on light sandy soils. For pumpkin and squash use dinoseb 3 to 6 lb. (1 to 3 gal. Premerge) per acre. Preplant soil incorporation once per year. Do not plant to any crop for 18 months after treatment except those specified on the label.
CUCUMBERS AND MELONS	naptalam 4 lbs. (2 gal. Alanap 2E or 40 lbs. 10% granular Alanap) Mixture of bensulide 6 lb. (6 qt. Prefar) plus naptalam 4 lb. (2 gal. Alanap 2E) chloramben methyl ester 1½ to 3 lb. (3 to 6 qt. Vegiben 2E)	Preemergence or postemergence. Apply to weed-free soil before weeds emerge. Light irrigation after application will improve results. Varieties of pumpkins and squash differ in their tolerance to Alanap. Preplant or Preemergence and soil incorporate. Irrigation immediately after planting may be helpful. Preemergence. Apply immediately after planting on same day. Do not use on muck soils. Use lower rate on lighter soils. Do not use on watermelon.
PUMPKINS AND SQUASH	chloramben 3 to 4 lb. (6 to 8 Amiben or 30 to 40 lb. 10% granular Amiben)	Preemergence. Use lower rate on lighter soils.

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.		
Aphids	diazinon ½ lb. (1 lb. 50% WP) dimethoate (Cygon, Defend, Dimex, Rebelate) ¼ to ½ lb. (1 to 1½ pt. 2.67 lb. EC, 1 to 2 lb. 50% WP) endosulfan (Thiodan) ½ lb. (1 qt. 2 lb. EC) malathion ½ lb. (12 lb. 4% D) parathion ¼ lb. (1 pt. 2 lb. EC)	7 days. Melons only. 3 days. NTL. 1 day. 15 days.
Cucumber beetles (striped and spotted)	aziphosmethyl (Guthion) ½ lb. (2 pts. 2 lb. EC) carbaryl (Sevin) 1 lb. (1¼ lb. 80% WP) endosulfan (Thiodan) ½ to 1 lb. (¾ lb.-1½ lb. 80% WP) malathion 1¼ lb. (1 qt. 5 lb. EC) methoxychlor 1 lb. (10 lb. 10% D or 2 lb. 50% WP)	1 day NTL. Carbaryl is very toxic to honey bees. Avoid treating when bees are in field. NTL. 1 day 1 day.

† 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 exceptions.

CUCUMBERS, MELONS, PUMPKINS, SQUASH
(continued)

Insects	Chemical†	Remarks and limitations
Cutworms	carbaryl (Sevin) 1 to 2 lb. (20 to 40 lb. 5% bait)	NTL
Squash bugs	endosulfan (Thiodan) ½-1 lb. (1-2 qts. 2E) carbaryl (Sevin) 1 lb. (1¼ lb. 80% WP) parathion ¼ lb. (1 pt. 2 lb. EC)	NTL. Lower dosage for nymphs. NTL. 15 days.
White grubs, wireworms	chlordane 2 to 5 lbs. per acre (20 to 50 lb. 10% G)	Soil treatment before planting only.
Diseases	Chemical†	Remarks and limitations
Seed rot, damping off	Captan 3 oz./100 lb. Chloranil 3.8 oz./100 lb. Thiram 3 oz. 75 WP/100 lb.	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 zinc ion maneb, maneb, or polyram 1¼ to 2½ lb. WP Plus Tri basic Copper Sulfate 1½ to 2½ lb. WP Kocide 101 1 to 2 lb. WP Bravo W-75—use label directions 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	Crop rotation: At least 2 intervening years of other unrelated crops. Copper is needed to control bacterial diseases. 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 and Kocide 101 are good for angular leaf spot (a bacterial disease). Bravo, 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. NTL. NTL. NTL. NTL. NTL. NTL. NTL on cucumbers and melons. Do not use on other vine crops. Control cucumber beetles.
Cucumber mosaic virus (CMV)	See weed, aphid and cucumber beetle control.	Plant resistant varieties.
Powdery mildew	Karathane ½ lb. WP Benomyl ¼ lb. WP	At first sign of mildew, apply Karathane and again in 7 days. Apply Benomyl at first signs of mildew and again in 10 days. Days to harvest: Karathane, 7 days; Benomyl, NTL. Use disease resistant varieties.
Alternaria leaf spot on cucumbers and melons	Bravo 1.5 pt. Dithane M-45 216 WP Difolatan 1.5 pt. maneb 2 lb. WP	Days to harvest: Dithane M-45, 5 days, maneb, 5 days; Bravo and Difolatan, NTL.
Bacterial wilt Black rot, storage rot of pumpkin and squash	Spray in field as for anthracnose control or use Benomyl at 7-14 day intervals (see label directions). See cucumber beetle 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. Spray three-four times.
Fruit rot, muskmelon and cucumber	Captan 1.2 lb./100 gal. Folpet 1.2 lb./100 gal. Maneb 1.2-1.6 lb./ 100 gal. Captan 1.2 lb./100 gal.	Postharvest dip or spray. See page 5.

EGGPLANT

Weeds	Chemical†	Remarks and limitations
Annual weeds	D CPA 8 lb. (10 lb. 75% Dacthal)	Application should be confined to a period of 4 to 6 weeks after transplanting. Plants should be well established and growing conditions favorable. Spray can be directed right over transplants without injury. If weeds have emerged, cultivate or weed the crop prior to application.

† 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 exceptions.

EGGPLANT (continued)

Insects	Chemical†	Remarks and limitations
Aphids	malathion 1 lb. (1½ pt., 5 lb. EC) oxydemetonmethyl ½ lb. (MetaSystox-R) (2 pt., 2 lb. EC)	3 days. 7 days.
Flea Beetles	carbaryl 1 lb. (1¼ lb. 80 WP)	NTL.
Cutworms	carbaryl 2 lb. spray or bait (2½ lb. 80 WP) (40 lb. 5% bait) toxaphene 2 lb.	NTL. 5 days.
Diseases	Chemical†	Remarks and limitations
Damping off	Captan 2 lb. 50 WP Weekly spray 2 lb. WP/100 gal.	Hot water soak 122° F. for 25 minutes. Dry, then dust seed with thiram (4 oz. 75 WP/100 lb.).
Verticillium wilt	Fumigate with Vorlex or Vapam. Soil must be free of clods and old plant debris.	See fumigation chart, page 6.

LETTUCE

Weeds	Chemical†	Remarks and limitations
Annual weeds	bensulide 5 to 6 lb. (5 to 6 qt. Prefar) CDEC 4 lb. (4 qt. Vegadex) benefin 1½ to 1¾ lb. (3 to 4 qt. Balan) paraquat 1 lb. (½ gal. Paraquat)	Preplant soil incorporation once per year. Do not plant to any crop for 18 months after treating except those specified on the label. Preemergence. Apply and incorporate anytime within 10 weeks before planting up to the day of planting. Do not apply after planting or transplanting. Use lower rate on light sandy soils. Do not plant to other vegetable crops for 12 months after treatment. Preemergence. Apply to emerged weeds. Do not apply to peat or muck soils.
Insects	Chemical†	Remarks and limitations
Leafhoppers	carbaryl (Sevin) 1 to 1½ lb. (1¼ to 2 lb. 80% WP) dimethoate (Cygon, DeFend, Dimex, Rebelate) ¼ lb. (¾ pt. 2.67 EC, ½ lb. 50% WP) disulfoton (Di-Syston) 2 lb. (4 to 8 oz. 15%G per 1000 ft. of row) 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)	3 days for head lettuce; 14 days for leaf lettuce. 7 days for head lettuce; 14 days for leaf lettuce. 60 days. Do not use on transplanted lettuce. 7 days for head lettuce; 14 days for leaf lettuce. 14 days. 2 days.
Greenhouse pests	malathion 15% aerosol 1 lb. per 50,000 cu. ft. parathion 10% aerosol 1 lb. per 50,000 cu. ft.	10 days. 21 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 Botrytis gray mold	Control six-spotted leafhoppers (see above) Botran 2.7 lb. 75% WP per acre	Several days after thinning and again in 7 and 14 days or work Botran 4% dust into top 3 inches of soil 2-3 days before planting. Use 1 oz./sq. yd. Do not spray later than 14 days before harvest.

ONIONS

Weeds	Chemical†	Remarks and limitations
Annual weeds	CIPC 6 lb. (6 qt. Chloro IPC or 60 lbs. 10% granular Chloro IPC) Mixture of CIPC 6 lb. (6 qt. Chloro IPC) and CDAA 6 lb. (6 qt. Randox)	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 within 30 days of harvest. 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. Randox) per acre.

† 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 exceptions.

ONIONS (continued)

Weeds	Chemical†	Remarks and limitations
Annual weeds	DCPA 8 lb. (10 lb. 75% Dacthal)	Apply at seeding or transplanting and/or layby. Can be applied uniformly to the soil as a spray or directly over transplants without injury. Layby applications can be made up to 14 weeks after planting or transplanting. Weeds must emerge prior to application. Do not soil incorporate at preplanting treatment.
Annual grasses	CDAA 6 lb. (6 qt. Randox)	Preemergence. Apply to direct seeded crop just before onions emerge. Posttransplant. Apply directed or overall spray soon after setting. Post-emergence. Repeat as a directed spray or as granular after 3 true leaves have developed. Do not use on green onions. Repeat applications at 4 week intervals for granular use only. Do not apply within 45 days before harvest for spray or 30 days for granular formulations. On mineral soils do not use more than 4 lb. CDAA (4 qt. Randox) per acre.
Broad-leaved weeds	nitrofen 3 to 4 lb. (1½ to 2 gal. TOK E-25 or 6 to 8 lb. TOK 50 WP)	Postemergence. For dry bulbs only. Apply 50 WP when onions are fully emerged and in the flag leaf stage to the 6 inch stage. Weeds should be young and less than 2 inches tall. Apply E-25 for dry bulbs and green onions as a single postemergence treatment by ground equipment, and then only when onions are in the two- to three-leaf stage, or injury may result.
Prevention of sprouting in storage	Chemical†	Remarks and limitations
	3 lbs. maleic hydrazide (1 gal. MH 30)	Apply 2 weeks before harvest but when bulbs are mature and tops still show green. Use in 100 to 140 gals. water. Do not add wetting agent. If applied too early, may cause some breakdown in storage.
Insects	Chemical†	Remarks and limitations
Onion maggot	carbophenothion (Trithion) 2 lb. (8 lb. 25% WP) Dasanit 1 lb. For 18-inch row spacing. (6½ lb. 15% G) diazinon 1 lb. (2 lb. 50% WP)	Furrow treatment. Not for green onions. Furrow treatment. As furrow drench.
	diazinon 2 to 4 lb. (4 to 8 lb. 50% WP or 14 to 28 lb. 14% G)	Broadcast and incorporate into soil before planting.
	Dyfonate 1 lb. (10 lb. 10% G)	Furrow treatment for dry bulb onions only.
	ethion 1 lb. (12½ lb. 8% G, 20 lb. 5% G)	Furrow treatment at planting time.
Onion thrips, aster (six-spotted) leafhopper	diazinon 1 lb. (2 lb. 50% WP) malathion 1 lb. (4 lb. 25% WP, 2 pt. 5 lb. EC)	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. (2 EC) per acre OR maneb (Manzate 200, Dithane M-45 3 lbs. 80% WP/A in water 50 to 100 gal./A.)	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.

† 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 exceptions.

ONIONS (continued)

Diseases	Chemical†	Remarks and limitations
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 with Maneb 3 lb./acre zinc ion maneb 3 lb./acre	Spray weekly starting June 1. Use a spreader-sticker. Not later than 7 days before harvest on green onions. 7 days. Do not apply to exposed bulbs. Control six-spotted leafhoppers.
Aster yellows virus Bulb rot	Captan 1.25 lb./100 gal.	Postharvest dip or spray. See page 5.

PARSLEY

Weeds	Chemical†	Remarks and limitations
Annual weeds	nitrofen 3 to 4 lb. (1½ to 2 gal. TOK E-25 or 6 to 8 lb. 50% WP)	Preemergence. Apply a single application just after seeding. Postemergence. Apply within 2 weeks after crop emergence.

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 a single application to crop planted ½ inch deep. Do not plant to other crops within 4 months after treatment.
Insects	Chemical†	Remarks and limitations
Aster (six-spotted) leafhopper Root knot nematode	(see carrots) page 11 DD, Vidden-D, Telone, Vorlex or EDB	See Table 1 for trade names. Use at rates suggested on label. Treatment must be made at least 14-21 days before planting, preferably during the fall previous to planting. A 2- to 3-year rotation with grass sod will eliminate the nematode.
Diseases	Chemical†	Remarks and limitations
Leaf spot and canker Root knot nematode	Kocide 101 (3.4 lbs.) Fixed copper (2 lbs. metallic)	Apply every 10 days beginning August 1 until tops die. Especially needed during wet weather. See carrot root knot control.

PEAS

Weeds	Chemical†	Remarks and limitations
Annual grasses	CDAA 4 lb. (4 qt. Randex) dalapon ¾ lb. (0.94 lb. Dowpon) propachlor 4 lb. (6 lb. Ramrod)	Preemergence. Apply after peas are 2 to 6 inches tall and have 4 to 6 nodes. Do not apply within 25 days of harvest. Do not feed treated pea vine hay to livestock. Preemergence, of either crop or weeds. Apply in 20-40 gal. of water per acre. Use 5 gal. of Ramrod 65 WP in 3 to 10 gal. of water for airplane application.
Annual weeds	dinoseb amine 1 to 3 lb. (1¼ qt. to 4 qt. Premerge or Sinox PE) (Use 1 to 3 qt. in 5-10 gal. water per acre for airplane application) trifluralin ½ to ¾ lb. (1 pt. to 1½ pt. Treflan or 10 to 15 lb. granular Treflan)	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. See temperature table on label. Preplanting soil incorporation. Use lower rate on lighter soil.

† 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 exceptions.

PEAS (continued)

Weeds	Chemical†	Remarks and limitations
Broad-leaved weeds and thistle buds	MCPB sodium salt ¾-1 lb.	Postemergence. Apply in at least 15 gallons of water. Apply before flowering stage when crop has 6 to 12 nodes and before thistles are 9 inches tall. Do not feed treated vines to livestock.
	MCPA amine 2.0 to 2.6 oz. (¼ to 1/3 pt. MCPA Amine)	Apply in at least 15 gal. water per acre when peas are 3 to 7 inches tall, before first flowering and weeds are small. Higher rates of 4 to 6 oz. (½ to ¾ pt.) may improve control of difficult weeds but crop injury may occur. Do not apply if peas are taller than 7 inches or when stressed for lack of soil moisture. Do not apply when temperatures are over 90° F. Do not feed treated vines to livestock. MCPA can cause injury and delayed maturity to peas.

Insects	Chemical†	Remarks and limitations
Pea aphid	demeton (Systox) ¼ lb. (1 pt. 2 lb. EC) diazinon ½ lb. (1 lb. 50% WP)	21 days. Do not feed as hay for 4 days after treatment. No waiting period for harvesting peas.
Loopers	dimethoate (Cygon, De-Fend, Dimex, Rebelate) 3 oz. (½ pt. 2.67 lb. EC)	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.
	disulfoton (DiSyston) 1 lb. (10 lbs. 10% G)	In furrow at planting or Side dress—50 days. 3 days, 7 days for forage.
	malathion 1 lb. (1½ pt. 5 lb. EC, 4 lb. 25% WP)	1 day.
	mevinphos (Phosdrin) 0.2 lb. (1 pt. 2 lb. EC)	4 days.
	naled (Dibrom) 1 to 2 lb. (1 to 2 pt. 8 lb. EC)	10 days.
	parathion ¼ to ½ lb. (1 to 2 pt. 2 lb. EC)	NTL.
	carbaryl (Sevin, Sevimol) 1½ lb. (2 lb. 80% WP)	15 days for forage, 10 days for peas.
Seed corn maggot	parathion ½ lb. (2 pt. 2 lb. EC)	1 day. Do not feed or graze within 5 days. Do not feed pea vine hay within 14 days.
	methomyl (Lannate, Nudrin) ½ to 1 lb. (½ to 1 lb. 90% SP)	1 day.
	mevinphos (Phosdrin) 4 oz. (1 pt. 2 lb. EC)	Seed treatment

Diseases	Chemical†	Remarks and limitations
Seed rot	Seed treatments: Captan (follow label directions) Chloranil 3 oz. actual/100 lb. (dry) Dexon 0.75 oz. 70 WP/100 lb. Dichlone 1 oz./100 lb. Thiram 2 oz. 75 WP/700 lb.	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.

PEPPERS

Weeds	Chemical†	Remarks and limitations
Annual weeds	trifluralin 1 lb. (1 qt. Treflan or 20 lb. 5% granular Treflan)	Preplanting. Must be incorporated into soil.
	diphenamid 5 lb. (6 lb. Dymid, 10 lb. Enide)	Post transplanting. Apply within one month after transplanting. Pretransplant soil incorporation 0 to 6 weeks before setting. Use only on sandy soils. Do not replant to cucumbers, watermelon crops for one year.
	chloramben 3 to 4 lb. (30 to 40 lb. 10% granular 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 soil. Treat only once during the season.

† 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 exceptions.

PEPPERS (continued)

Insects	Chemical†	Remarks and limitations
European corn borer	carbaryl (Sevin) 1½ lb. (2 lb. 80% WP)	NTL.
Aphids	malathion 1 lb. methomyl 0.45 lb./A	3 days 10 days
Diseases	Chemical†	Remarks and limitations
Seedbed or flat treatment for damping off	Captan—2 lb./100 gal.	Apply 1 gallon over each 100 square feet of surface. Do not use if house temperatures go above 90° F.
Leaf and fruit spots	Bacterial Zineb (use label directions) Fixed copper 1.5 lb./100 gal.	NTL.
	Fungal Captan 1.5 lb./100 gal. Maneb 1.2-1.6 lb./100 gal. Zineb (use label directions)	NTL. NTL.
Mosaic		See aphid and weed control.
Root rot	Zineb 1½ lb. WP/100 gal. Copper oxychloride 2 lb. dust or 1¼-2 lb. WP/25 to 100 gal.	NTL.

† 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 exceptions.

POTATOES

SPROUT INHIBITION OF POTATOES

Maleic hydrazide is effective as a potato sprout inhibitor when applied at 2 to 3 pounds per acre (⅔ 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). Apply 4 to 6 weeks before harvest. 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. Do not use on seed potatoes.

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. Application can be made any time before sprouting begins. Do not feed treated potatoes to livestock.

Chemical sprouting inhibitors should not be applied to seed potatoes.

POTATO VINE KILLERS

The most generally used chemical for killing potato vines is dinoseb which is sold as Dow General or Sinox General.

For ground application apply dinoseb at 1¼ to 2½ pounds (1 to 2 quarts Dow General or Sinox General) with either:

5 gallons of diesel fuel plus water

or

1 quart of any EPA registered surfactant plus water

or

1 to 2 gallons of emulsifiable crop oil plus water to make up 25 to 40 gallons of mixed spray per acre.

For aerial application apply dinoseb at 1¼ to 1¾ pounds (1 to 1½ quarts Dow General or Sinox General) with either:

3 to 5 gallons of diesel fuel oil

or

1 quart of any EPA registered surfactant plus water

or

1 to 2 gallons of emulsifiable crop oil plus water to make up 3 to 5 gallons of mixed spray per acre.

Use the higher rates during cool, cloudy weather or where foliage growth is especially heavy. 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.

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

Dinoseb 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.

Endothall, which is sold under the trade name Desiccate, is another newly registered potato vine killer. Apply to potato vines 10 to 14 days prior to harvest using 1½ to 2 gallons per acre in 20 to 100 gallons of total spray where vines are light to medium and 2 gallons per acre in 20 to

100 gallons of total spray where vines are heavy. Fill tank first with water and then add Des-i-cate. Additives are necessary only when a quick kill is required. The addition of 3 to 5 gallons per acre of diesel fuel or 1 pint of paraffin base herbicidal oil for each 20 gallons of total spray will speed up the kill. Do not use high rate diesel fuel or other oils when conditions are favorable for rapid vine kill (low soil moisture or high temperatures), since stem end discoloration may occur. Use a cone nozzle (hollow or solid) for best coverage.

Ametryne, which is sold under the name Evik 80W, is a new desiccant recently approved for potato vine killing when used east of the Mississippi River only. Apply ametryne 1.6 to 2 pounds (2 to 2½ pounds of Evik 80W) in 100 gallons of water per acre to mature green potato vines. With heavy vine growth, it may be desirable to use an E.P.A. registered surfactant. In limited trials, Evik has given a slower kill with vines turning brown in 7-10 days. Skin set and quality appears to be improved with the slower kill. Vine killing is slower, however, when temperatures are cooler. At the present time, it is not recommended for use on potatoes grown for seed. Do not graze livestock on treated areas.

Paraquat also may be used as a preharvest vine killer for potatoes not intended to be used for seed or storage. Apply paraquat at ½ pound (1 quart Paraquat) per acre. 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 peat or muck. Do not allow livestock to graze on treated fields.

Vine killers may often cause browning of the stem and/or vascular ring of tubers, especially with too fast a kill and 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

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 a total of 1.12 ounces per acre.

POTATO INSECT CONTROL

Soil applied systemic insecticides. The use of 2 to 3 pounds active ingredient per acre of aldicarb (Temik), disulfoton (DiSyston), or phorate (Thimet) applied in the seed furrow or fertilizer bands at planting time will give almost full season control of aphids, flea beetles, and leafhoppers. Some control of Colorado potato beetles will also result. Late season infestations may require foliar sprays of one of the other suggested insecticides. Aldicarb or phorate should be applied only at planting time at least 90 days before harvest. Disulfoton may also be applied as a side dressing postemergence, but not within 75 days of harvest. It is also available as a liquid formulation. The control of flea beetles and potato beetles may be erratic with aldicarb.

Use 20 to 30 pounds of 10 percent granules or 13 to 20 pounds of 15 percent granules per acre on a 34-inch

row spacing. For other row spacing, follow the label instructions for rate per 1,000 feet of row. Lower rates are for sandy soils; higher rates are for clay or organic soils.

Aphid control. Many of the generally used potato insecticides may result in heavier aphid infestations than if no sprays were applied. This is due to a rapid development of resistant populations of aphids and to the reduction of numbers of aphid parasites and predators.

It is suggested that a planting time systemic be used and that foliar sprays be used only when economic thresholds of pests develop. This is especially important for seed producers in reducing virus transmission by aphids.

Soil Insects (wireworms, white grubs, cutworms). Broadcast 4 to 5 pounds of actual chlordane per acre and incorporate into the soil thoroughly before planting. A row treatment with phorate as described above or a broadcast incorporated application of 4 pounds actual Dyfonate per acre will help control wireworms.

Cutworm infestations early in the season may result in damage to young plants. These can be controlled by the use of carbaryl bait.

Foliar Sprays. (See Insects, page 23.)

NEMATODES AND VERTICILLIUM WILT

Systemic Insecticides. The application of the systemic insecticide aldicarb (Temik) in the seed furrow at planting time for insect control has been shown to suppress populations of certain nematodes. Where nematode populations have been found to be high, such as in sandy soils, aldicarb (Temik) is recommended for nematode control. It is advisable to attach a row bander to the end of the granular applicator discharge tube so as to spread the granules in a band approximately 4 inches wide in the seed furrow.

Fumigation. Broadcast soil fumigation in the fall (or summer if land is fallowed) may be economically feasible for the control of Verticillium wilt and nematodes where these cause consistently serious yield losses. Chemicals that have produced significant yield responses are Vapam, Vorlex, Telone, and Telone C.

Soil fumigant	Rate/acre	Limitations
Vapam	30-50 gal.	The lighter of these dosages is suggested for lighter soils.
Vorlex	20-30 gal.	The lighter of these dosages is suggested for lighter soils.
DD of Vidden-D	20 gal.	Does not control Verticillium wilt.
Telone	16 gal.	Does not control Verticillium wilt.
Telone C	20-30 gal.	

A number of factors have a pronounced effect on the success or failure of soil fumigation. These are:

Soil preparation prior to fumigation. Soil should be plowed deep (10 inches or more) in order to incorporate previous crop debris as thoroughly as possible and to prevent the "turning up" of nonfumigated soil during fitting in the spring. This should be followed by discing or any other means of fitting that will leave the soil in

seedbed condition. Clods and poorly incorporated debris will provide "chimneys" through which fumigant can escape prematurely from the soil.

Soil moisture. The soil should be neither too wet nor too dry. A good rule of thumb is that moisture content is most favorable when soil will just "ball" in one's hand when pressure is applied. If soil is excessively dry and irrigation is available, moisture supplementation before fumigation is recommended.

Soil temperature. 50°-75° F. is optimal for most fumigants. At warmer temperatures, thorough and rapid dissipation of fumigant is favored, the soil is usually not excessively wet, nematode larvae (which are easier to kill than eggs) have emerged, and a more effective kill of all nematode stages can be expected.

Crop debris. Undecomposed residues from previous crops prevent even distribution of fumigant through the

soil, irreversibly absorb fumigant, interfere with application equipment, prevent proper sealing of the soil surface, and protect nematodes and nematode eggs from fumigant action. Raking, burning, or deep incorporation of such debris should precede fumigation.

Sealing of soil surface. It is essential that fumigated soil be thoroughly sealed as soon after application as possible. This can be achieved by means of equipment such as a cultipacker, chain harrow, or float, or by means of spray irrigation.

Interval between fumigation and planting. Under "average" conditions, with a soil temperature of ±50° F., a minimum of 3 weeks is regarded as necessary between fumigation and planting to prevent phytotoxicity to potatoes. Fall fumigation allows a more than adequate interval between application and planting.

Weeds	Chemical†	Remarks and limitations
Annual weeds	EPTC 3 to 6 lb. (3½ to 7 pt. Eptam 7E or 30 to 60 lb. 10% granular Eptam)	Preplanting. Must be disked or cultivated into surface soil just before planting. Use lower rate on sandy soils. Ineffective on peat or muck soils.
	EPTC 4 lb. (4½ pt. Eptam 6E)	Preemergence. Immediately after drag-off. Incorporate. Do not use over 3 lb. on sand. Ineffective on peat or muck soils.
		Layby. Apply as a directed spray just before the last cultivation but not within 45 days of harvest.
		Incorporate. Ineffective on peat or muck soils.
	linuron ¾ to 2 lb. (1½ to 4 lb. Lorox 50 WP)	Preemergence. Make a single application by air or ground equipment just before the crop emerges, after drag-off or hilling, and before grasses are 2 inches tall and before broadleaf weeds are 6 inches tall, preferably just before or when weed seedlings emerge. If emerged weeds are present, add 1 pint surfactant WK for each 25 gals. spray mixture. In irrigated areas, best results are obtained when application is made to moist soil, followed within 2 weeks by 1" to 2" of sprinkler irrigation or rainfall. On powder-dry soils, irrigate prior to application and follow with sprinkler irrigation to activate the herbicide. Plant crop at least 2 inches deep. Do not spray over top of emerged potatoes. Do not replant to other crops within 4 months after treatment.
	chlorbromuron 2 to 4 lb. 50WP or Maloran 50 WP	Notes on rates: Use 1½ to 2½ lb. per acre on light soils (sandy loams, silt loams; 1 to 2% organic matter). Use 2½ to 4 lb. per acre on heavier soils (silts, clay loams; 2 to 5% organic matter). Use 4 lb. per acre on soils over 5% organic matter. Preemergence. At time of planting or drag-off. When crop emergence is delayed by cold weather, apply just prior to emergence. Use lower rate on light sandy soils. Do not use on soils with less than 1% organic matter. Do not harvest immature potatoes. Do not plant crops other than field corn, potatoes or soybeans within 6 months after application.

† 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 exceptions.

POTATOES (continued)

Weeds	Chemical†	Remarks and limitations
	dinoseb amine 3 to 6 lb. (4 to 8 qt. Premerge or Sinox PE) Dacthal 8 lb. (10 lb. Dacthal 75W)	Preemergence. Apply just before potatoes emerge but after weeds appear. Preemergence. Apply immediately after planting or drag-off or last cultivation up to 9 weeks after planting. If weeds have emerged at layby, the crop should be weeded or cultivated prior to application.
	trifluralin ½ to 1 lb. (½ to 1 qt. Treflan or 10 to 20 lb. 5% granular Treflan)	Preemergence or post-planting soil incorporation. Apply after planting up to or immediately following drag-off. Use lower rate on sandy soils. Do not graze or feed forage from treated fields. Do not use on muck or peat soils.
	paraquat 1 lb. (½ gal. Paraquat)	Post planting. Apply before 50 percent of crop has emerged. Do not apply to peat or muck soils.
Wild oats	diallate 2 lb. (2 qt. Avadex)	Preplanting. Must be incorporated into soil and planted within 3 weeks.
Quackgrass	EPTC 6 lb. (7 pt. Eptam 7E or 60 lb. 10% granular Eptam) dalapon 6 lb. (8 lb. Dowpon)	Preplanting soil incorporated. Does not interfere with color of red varieties. Ineffective on peat or muck soils. Spring preplanting treatment. Apply when quackgrass is 4 to 6 inches tall and growing well. After spraying, wait at least 4 days before plowing down. Potatoes can be planted immediately. If soil is unusually dry, a longer waiting period will be necessary to avoid crop injury. Do not use on land to be planted to red skinned varieties or White Rose.
	dalapon 3 to 8 lb. (3½ to 10 lb. Dowpon)	Delayed preemergence. Where quackgrass comes up after planting but before potatoes emerge. Do not apply to potatoes that have emerged or to red skinned or White Rose varieties.
	dalapon 3.7 lb. (5 lb. Dowpon)	Postemergence. Apply as a directed spray after last cultivation in 15 to 25 gals. water when grass seeds have germinated but before grass seedlings are 3 inches tall. Use a vine lifter and direct the spray on the grass up to the base of the potato plants. Avoid spraying potato foliage as much as possible. Do not use on red skinned or White Rose varieties.
	dalapon 11 lb. (15 lb. Dowpon)	Fall application. Apply to growing quackgrass. Plow 10 to 20 days later or delay plowing until following spring.
Insects	Chemical and rate (active per acre)†	Remarks and limitations
Aphids	See paragraph on soil preparation, page 21. dimethoate (Cygon, DeFend, Dimex, Rebellate) ½ lb. methomyl (Lannate, Nudrin) ½ to 1 lb. (2 to 4 pt. "L," ½-1 lb. SP) Monitor ¾ to 1 lb.	NTL. May give control for a short time only. 14 days. 14 days.
Colorado potato beetle	azinphosmethyl (Guthion) ½ lb. Azodrin ¼ to ½ lb. carbaryl 1½ lb. diazinon ½ lb. endosulfan 1 lb. Monitor ¾ lb.	7 days. 7 days. NTL. 35 days. NTL. 14 days.
Flea beetle	azinphosmethyl ½ lb. Azodrin ¼ to ½ lb. carbaryl 1 to 1½ lb. diazinon ¼ to ½ lb. endosulfan ½ to 1 lb. Monitor ¾ to 1 lb.	7 days. 7 days. NTL. 35 days. NTL. 14 days.
Leafhoppers	Azodrin ¼ to ½ lb. carbaryl 1 to 1½ lb. diazinon ½ lb.	7 days. NTL. 35 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 exceptions.

POTATOES (continued)

Insects	Chemical†	Remarks and limitations
	dimethoate 1/2 lb. endosulfan 1/2 to 1 lb. malathion 3/4 lb. (1 pt. 5 lb. EC) methomyl 1/2 to 1 lb. Monitor 3/4 to 1 lb. oxydemeton methyl 1/2 lb. (Meta-Systox-R)	NTL. NTL. NTL. 14 days. 14 days. 7 days.
Loopers	methomyl 1 lb. Monitor 1 lb.	14 days. 14 days.
Grasshoppers	carbaryl 1 lb.	NTL.
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 1 1/2-2 weeks before planting. Cut seed may be treated with an organic fungicide (captan, maneb, Polyram, or zineb or a combination of these materials plus an antibiotic.) Plant immediately in moist, warm soil, above 50° F. Seed-piece treatment: captan 8% captan 8% plus streptomycin 100 ppm Dithane M45 or Manzate 200 8% dust maneb 8% maneb 8% plus streptomycin 1ppm Polyram—0.11 lb. actual as dust per 100 lb. seed zineb 8% zineb 8% plus streptomycin 1 ppm	Dip or dust cut potatoes, 0.5 lb. actual per bushel. Dip seed pieces or whole tubers. 1.0 lbs. 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. Not over 0.15 lb. actual as a dust per 100 cut or whole seed pieces or 1 lb. actual per 50 gal. water. Seed piece dip.
Blackleg	Seed-piece treatment	Avoid infected seed potatoes. Warm seed before planting and plant in warm soil.
Scab	Resistant varieties	If possible, grow resistant varieties such as Cherokee, Tawa, Plymouth, Antigo, Norland, La-Rouge, 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 about 15 days.
Late blight and Early blight	Sprays—see label for rates Bravo 75 WP Difolatan 4 Flowable Duter Fixed Coppers Kocide 101 Oxy Cop 8L Tri-Basic-Copper Sulfate maneb 80% WP 1 1/2 to 2 lb. per acre maneb zinc ion complex (Dithane M45 or Manzate 200) Polyram 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.	Do not apply more than label recommendation or plant injury may occur. Do not cut the recommended amount of water for your sprayer. Weed sprayers are not designed for this work.
Tuber rot postharvest	captan	Postharvest dip or spray. See page 5.

† 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 exceptions.

POTATOES (continued)

Diseases	Chemical†	Remarks and limitations
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 Nematodes	Terrachlor EC (see label) See fumigation chart, page 6.	Used as soil treatment. Soil fumigation for nematode and wilt control.

RADISHES

Insects	Chemical†	Remarks and limitations
Cabbage maggot	diazinon 1 to 4 lb. (2 to 8 lb. 50% WP; 7½ to 28 lb. 14% G) Dyfonate 2 lb. (20 lb. 10% G)	Row or broadcast treatment before or at planting time. 1 lb. row; 4 lb. broadcast. Broadcast, disc in before planting.
Flea beetles	carbaryl (Sevin) 1 lb. (1¼ lb. 80% WP) diazinon ½ lb. (1 lb. 50% WP) malathion 1 lb. (1½ pt. 5 lb. EC) methoxychlor 1 lb. (2 lb. 50% WP)	3 days. 10 days. 7 days. 7 days.
Seed rot and damping off	Seed treatment: chloranil	Use label directions. Do not use treated seed for food or feed.
Root rot	Soil fumigation: Vapam, Vorlex, Terr-O-Cide-15	Cultivate prior to planting. Do not plant within 7 days of treatment on light soils or 14 days on heavy soils. Minimum rate 20 gal. per acre.

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) Captan—1 lb./100 gal.	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 planting on ground away from old planting. Apply following budding and weekly until harvest.

RUTABAGAS AND TURNIPS

Insects	Chemical†	Remarks and limitations
Cabbage maggot	Dasanit 1 to 2½ lb. (7 to 16 oz. 15G per 1,000 ft. of row)	Apply in 4 to 6 inch band prior to seeding. Incorporate granules into upper inch and plant in treated bands. Liquid formulation may be applied as a drench over the row about 4 weeks after planting or when flies appear. No more than 4 applications per season. 40 days.
Flea beetles	diazinon 1 to 4 lb. (2 to 8 lb. 50% WP; 7½ to 28 lb. 14% G) carbaryl (Sevin) 1 lb. (1¼ lb. 80% WP) diazinon ½ lb. (1 lb. 50% WP) malathion 1 lb. (1½ pt. 5 lb. EC) methoxychlor 1 lb. (2 lb. 50% WP)	Row or broadcast treatment before or at planting time. 1 lb. row; 4 lb. broadcast, plus a drench treatment over the row when flies appear for second generation. Turnips only. 3 days. 10 days, turnips only. 3 days. 7 days.

† 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 exceptions.

RUTABAGAS AND TURNIPS (continued)

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.

SPINACH

Weeds	Chemical†	Remarks and limitations
Annual weeds	cycloate 3 to 4 lb. (1/2 to 2/3 gal. Ro-neet or 30 to 40 lb. 10% granular Ro-neet)	Preplanting. Must be incorporated into soil. Use on mineral soils only. Use lower rate on sandy soils.
	CIPC 2 lb. (2 qt. Chloro-IPC or 20 lb. 10% granular Chloro-IPC)	Preemergence.
	CDEC 4 lb. (1 gal. Vegidex or 20 lb. 20% granular Vegidex)	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. 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	azinphosmethyl (Guthion) 1/2 lb. (2 pt. 2 lb. EC)	14 days
	diazinon 1/2 lb. (1 lb. 50% WP)	10 days.
	dimethoate (Cygon, De-Fend, Rebelate) 1/4 lb. (3/4 pt. 2.67 lb. EC)	14 days.
	malathion 20 oz. (2 pt. 5 lb. EC) or 2 lb. 25% WP per 100 gal. water	7 days.

Diseases	Chemical†	Remarks and limitations
Damping off	Seed treatment Thiram 6 oz. 75 WP/ 100 lb. Captan 6 oz. 75 WP/100 lb.	Spray 5 to 7 lb. in 25 to 30 gal. of water into the furrow at planting time. Apply 25 to 30 lb. into furrow at planting time.
Root rot	Captan 50 WP Captan 10% dust	2-6 lb./acre in furrow at planting time.

TOMATOES

Weeds	Chemical†	Remarks and limitations
Annual weeds	trifluralin 1 lb. (1 qt. Treflan or 20 lbs. 5% granular Treflan)	Pretransplant. Incorporate into soil.
	diphenamid 6 lb. (7 1/2 lb. Dymid or 12 lb. Enide)	Preplanting. Apply within 14 days before direct seeding. OR Preemergence. Apply to direct seeded crop. OR Postplanting. Apply within 1 month after transplanting or seeding.
	Chloramben 3-4 lb. (30 lb. 10% granular Amiben)	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. Treat only once during the season.

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