Mix pesticides downwind and below eye level. Avoid excessive splashing and sloshing. If pesticides are spilled on you, wash them off immediately with lots of water and change clothing. Resume spraying only after cleaning up any spills. Try to use closed handling/mixing systems when appropriate.

Mix only what is required for the area to be sprayed according to label directions. Avoid mixing excessive amounts. To do otherwise will create a hazardous waste which is difficult and expensive to dispose of. Keep unauthorized persons out of the area in which you handle pesticides.

**Application Equipment**

Efficient use of application machinery is very important to any pesticide application program. In many cases, improper use of machinery will result in poor pest control. With such occurrences, the grower may blame the efficacy of the pesticide for the failure of the control program when poor coverage is at fault.

Proper equipment and its maintenance is very important for any pesticide control program. Spray equipment should have the following features:

- The equipment should be made of non-corrodible materials.
- A tank with sufficient capacity so that the number of mixing and filling operations are minimized.
- A pump with a capacity of at least 5 gal/minute and pressure up to 100 psi.
- An agitation system from the pressure control to the bottom of the tank.
- A plumbing system with 50-mesh screens in the intake line and at each nozzle.
- A pressure gauge that accurately measures pressures up to 100 psi.
- A spray boom that can be adjusted for distance above application site and nozzle placement along the structure.
- Nozzles of the proper size, arrangement, airstream placement and dispersal pattern.

Pest control on vegetable crops has been applied successfully with standard low-pressure sprayers, air-blast sprayers, aircraft, irrigation systems and soil application equipment. Use the proper implements for the crop and soil situation. In the case of insect and disease control, the location of the pests on the plants determines how the machinery should be adjusted and used. For example, if pests are on the underside of the leaves, adjust the implement so that the chemical is applied on those areas. A general rule to follow with application implements is that the best control results when the chemical treatments are aimed directly at the pests.

**Accurate Equipment Calibration**

Accurate applicator calibration is essential for effective chemical pest control without crop injury and environmental injury. Always calibrate a new sprayer before use and routinely recalibrate the applicator implement during the growing season. If you have difficulty calibrating your applicator, contact your nearest county Extension Service agent and/or your chemical dealer for assistance.

**Unused and Unwanted Pesticides**

Pesticides that for some reason cannot be used on a crop must be disposed of as hazardous waste. To avoid the difficulty and expense of hazardous waste disposal, use your pesticides on labeled crops. If you have to dispose of some pesticides, contact the Michigan Department of Natural Resources Hazardous Waste Management Division for instructions on the legal disposal of pesticide waste.

**Cleaning and Care of Pesticide Application Equipment**

It is important to clean pesticide application equipment, especially if it is used for more than one crop and for applying insecticides, fungicides and herbicides. The need for extensive cleaning can be minimized if one sprayer is only used to apply herbicides and another is used for insecticide and fungicide applications.

When cleaning a sprayer that is used for applying only one type of pesticide, a thorough water rinse is necessary. Rinse the entire spray system with one of the following cleaning agents in 100 gal of water:

- 1 gal household ammonia. Allow to stand in the spray tank and system overnight.

or
nematode-crop action thresholds. These thresholds are published in the MSU Vegetable Pest Scouting Manual, and will be included in a new muck vegetable nematology Extension bulletin being developed. The rate of nematicide selected for use should be based, in part, on the nematode type and population density present in a specific production site. The procedures for nematode analysis are presented in Appendix B.

For More Information

For more information on the use of pesticides, see the following publications. All are available from your MSU Extension Service or the Michigan State University Bulletin Office.

AM-95 Rinsing & Recycling Pesticide Containers
E-584 European Corn Borer: Corn, Peppers, Potatoes, Snap Beans
E-890 Detection and Control of Carrot Weevil
E-959 Know Your Asparagus Pests
E-965 Potato Insect Pests
E-966 Snap Bean Insect Pests
E-967 Sweet Corn Insect Pests
E-968 Cole Crop Insect Pests
E-969 Cucumber, Melon, Squash and Pumpkin Insect Pests
E-970 Celery and Carrot Insect Pests
E-971 Tomato, Eggplant and Pepper Insect Pests
E-972 Lettuce and Onion Insect Pests
E-1427 Disease and Insect Pests of Celery
E-1546 Take Cover: Protect Yourself from Exposure
E-1668 Disorders of Cole Crops
E-1679 Disorders of Tomatoes
E-1720 Diseases of Carrots
E-1721 Diseases of Onions
E-1823 Fusarium Yellows of Celery in Michigan
E-1858 Using Spray Additives with Herbicides
E-1943 Bacterial Canker of Tomatoes
E-2067 Vegetable Pest Scouting
E-2099 Using Chemigation Safely and Effectively
E-2149 Ten Tips for Laundering Pesticide Soiled Clothing
E-2150 Choosing Clothing for Pesticide Safety
E-2160 Commercial Pesticide Applicator: Vegetable Crop Pest Management - Category 1B
E-2173 SARA Title III: The Farmers Responsibility under the Emergency Planning and Community Right-to-Know Law.

E-2174 SARA Title III: The Agricultural Businesses' Responsibilities under the Emergency Planning and Community Right-to-Know Law.
E-2195 Commercial and Private Applicator Core Manual: Initial Certification
E-2195-SP Manual Basico Para Aplicadores de pesticidas Comerciales y Privados
E-2199 Detection and Control of Nematodes
E-2200 Soybean Cyst Nematode
E-2215 Using Pesticides Safely: A Guide for the Applicator
E-2278 Managing Sweet Corn Pests in Massachusetts (with Michigan insert)

E-2334 Sara Title III Farm Response Planning: Information Needed to Prepare Offsite Response Plans for Farms in Michigan
E-2335 On-Farm Agrichemical Storage & Handling
E-2340 Recordkeeping System for Crop Production
E-2341 Recordkeeping System for Crop Production, Annual Record Book (pocket size)
E-2342 Recordkeeping System for Crop Production, Annual Record Book (full size)
E-2343 Field File
E-2413 Read Before Washing Pesticide-Soiled Clothing - Magnet in English
E-2413-SP Lea Esto Antes de Lavar la Ropa Manchada o Sucia con Pesticides - Magnet in Spanish

E-2434 Silver Scurf of Potato
E-2448 Diseases of Potato: Fusarium Dry Rot
E-2453 Biological Control of Insects

MWPS-37 Designing Facilities for Pesticide and Fertilizer Containment
NB-07 Michigan Onion Growers' Manual
NCR-126 Diseases of Radishes in the U.S.
NCR-261 Will Disorders of Cucurbits
VT-023 Vegetable Pest Scouting (video)
VT-036 Integrated Pest Management for Michigan Celery (video)

xxx-xxx Vegetable Crop Advisory Team(CAT) Alerts Newsletter (see p. 103 of this bulletin)
**Lettuce**

Methyl parathion 7.5 EC, 1 to 2 pt (21 days).

or  
**Malathion** 5 EC, 2 pt (7 days for head; 14 days for leaf).

**Aphids.**

**Orthene** 75 S 2/3 to 1 1/3 lb (21 days). Head lettuce only.

or  
**Diazinon** 4 EC, 1 pt or 50 WP, 1 lb (10 days) (RUP).

or  
Dimethoate (**Cygon**) 4 EC, 1/2 pt (7 days for head; 14 days for leaf).

or  
**MetaSystox-R** 2 S, 1 1/2 to 2 pt (14 days for 1 application, 21 days for 2 or 3 applications). Head lettuce only. Maximum 3 applications.

or  
**Malathion** 5 EC, 2 pt (7 days for head; 14 days for leaf and bibb).

or  
**Endosulfan** (**Phaser, Thiodan**) 3 EC, 2 pt or 50 WP, 1 1/2 lb (14 days). Consult label for number of applications and other restrictions.

or  
**Orthene** 75 S, 2/3 to 1 1/3 lb (21 days). Head lettuce only.

or  
**Bacillus thuringiensis**  
*Agree, Biobit, Cutlass, Dipel, Javelin, MVP or Thuricide* (0 days).

**Vegetable leafminer,** apply as soon as visible mines appear and repeat every 7 days as needed.

**Trigard** 75 WP, 1/6 lb (7 days). Aerial application only.

**Slugs.**

**Metaldehyde** 2.75% bait, 70 to 72.5 lb, apply between the rows. Avoid contact to edible product.

**DISEASES**

**Drop** (**Sclerotinia sclerotiorum**) and **bottom rot** (**Rhizoctonia solani**).

**Rovral** 50 W, 1 1/2 to 2 lb (14 days). Head lettuce only. Apply at 3-leaf stage and again in 10 days. Apply a third treatment 10 days later, if conditions for disease remain favorable.

or  
**Ronilan** 50 W, 1 to 2 lb (28 days). Make first application immediately after thinning (direct-seeded lettuce) or 7 to 10 days after transplanting. Repeat in 14 days. Apply a third treatment 14 days later, if cool conditions continue (direct seeded lettuce only).

**Note:** For best results, cultivated just prior to treatment; do not disturb until just prior to next treatment.

**Downy mildew** (**Bremia lactucae**), apply when disease first appears and repeat every 7 to 10 days as needed.

**Manex** 4 F, 1 1/5 to 1 3/5 qt (10 days). Do not apply more than 9.6 qt per season.
Onions to Parsnips

or
Kocide DF, 2 lb (0 days).
or
Aliette 80 W, 2 to 3 lb (7 days). Do not make more than 7 applications per season.

**Purple blotch** (*Alternaria porri*), apply every 7 to 10 days after the 4-leaf stage.

- *Rovral* 50 W, 1 1/2 lb (7 days).
or
- *Rovral* 4 F, 1.5 pt (7 days).
or
- *Bravo* 720, 1 1/2 to 2 pt (7 days for dry bulbs; 14 days for green onions). Do not use on Spanish onions.
or
- *Terranil* 6 L, 1 1/2 to 2 pt (7 days for dry bulbs; 14 days for green onions).
or
- *Champ Formula 2 Copper 37.5% F*, 1 1/3 pt after plants are 4-6 inches high (0 days).
or
- *Manzate* 200 80 W, 2 to 3 lb (7 days).
or
- *Dithane M-45* 80 W, 2 to 3 lb (7 days).
or
- *Manex* 4 F, 2 2/5 qt (7 days).
or
- *Penncozeb* 80 W, 2 to 3 lb (7 days).

**Neck rot** (*Botrytis* spp.).

Effective chemical control is not available at this time. However, treatments for onion leaf blight may retard or prevent symptomless spread in the field prior to harvest.

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**S**

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### PARSNIPS

*Amount of chemical formulation to apply per acre (unless otherwise directed). Apply no closer to harvest than number of days given in parentheses. (RUP) = Restricted Use Pesticide.*

**SOIL TREATMENT**

**NEMATODES**

Northern root-knot nematodes can reduce parsnip yields. Fields with soil or root problems of undetermined cause should be tested for nematodes (see Appendix B). If the above plant-parasitic nematodes are present in population densities above the economic threshold for parsnips, crop rotation or application of a nematicide is recommended. The following nematicide is suitable for control of root-knot nematodes in parsnip production.

**FALL SOIL TREATMENT (Broadcast)**

**NEMATODES**

1,3-D

---Telone II, 36 gal (muck soil), 15 gal (mineral soil).

Fumigate in the fall when soil temperatures at a 6 inch depth are above 50°F. Inject the fumigant to a soil depth of 8 inches and lightly seal the soil immediately after application. Use soil fumigants only as directed on the label. See Extension Bulletin E-1025b for details about soil fumigation. In some limited situations soil fumigants can be applied in the spring in Michigan.

**SEED TREATMENT**

**DISEASES**

**Damping off** (*Pythium* spp.).

Anchor, 1.5 oz/100 lb seed.

**FOLIAR TREATMENT**

**INSECTS**

**Flea beetle.** apply as needed, usually soon after plants come up.

- Carbaryl (Sevin) 80 S, 1 1/4 lb or XLR Plus, 1 qt (3 days).

**Leafhoppers,** apply when first seen. Repeat as needed.

- Carbaryl (Sevin) 80 S, 1 1/4 lb or XLR Plus, 1 qt (3 days).

**Armyworm, cutworms,** apply if needed. Repeat as needed.

- Carbaryl (Sevin) 80 S, 2 1/2 lb or 5 B, 40 lb or XLR Plus, 2 qt (3 days).

**Aphids,** apply if necessary.

- Malathion 5 EC, 2 pt (7 days).

**DISEASES**

*Alternaria leafspot, downy mildew, anthracnose, Botrytis blight, bottom rot.* Apply at first sign of disease and repeat every 7 to 10
Amount of chemical formulation to apply per acre (unless otherwise directed). Apply no closer to harvest than number of days given in parentheses. (RUP) = Restricted Use Pesticide.

*Materials marked with an asterisk are particularly recommended for problem infestations.

**SEED TREATMENT**

Treatments applied to seed prior to planting. Insecticide and fungicide treatments can be combined according to directions. Handle seed carefully to prevent cracking.

**INSECTS**

**Seed corn maggot.**

Diazinon (RUP). USE COMMERCIAL FORMULATION.

or Lindane (Isotox Seed Treater F), 4 oz/100 lb seed. Use as planter box treatment only.

or Lorsban 50 SL, 2 oz/100 lb seed. Use as a slurry.

or Lindane/Diazinon/Captan (Triple Seed Protectant) 3 oz/bushel as a planter box treatment.

**DISEASES**

Damping off (Pythium spp., Rhizoctonia solani), early season Phytophthora.

Use slurry or dust method:

Thiram 50 WP Dyed, 3 oz/100 lb seed.

or Apron-Terraclor, 4 oz/bu seed.

or Apron 25 W, 2 oz/100 lb seed (Pythium and early season Phytophthora control only).

or Apron 25 W, 5 oz/100 lb seed (Pythium damping off and systemic downy mildew).

or Captan 300, 2 oz/100 lb seed.

or Captan 30-DD, 2 oz/100 lb seed.

or Captan 400, 2 1/2 oz/100 lb seed.

or Captan 400-D, 2 1/2 oz/100 lb seed.

or Captan 75%, 1 oz/bu. seed.

or Anchor, 1.5 to 2.25 oz/100 lb seed (Pythium spp. only).

or Apron FL, 0.75 to 1.5 oz/100 lb seed (Pythium spp. only).

or Apron FL, 3.4 oz/100 lb seed (Pythium damping off and systemic downy mildew).

Note: If possible, buy fungicide treated seed instead of treating seed on the farm.

**PLANTING TREATMENT**

**DISEASES**

Damping off (Pythium, Phytophthora and Rhizoctonia spp.).

Apron, 4 oz/100 lb seed.

or Apron + Captan, 4 oz/100 lb seed.

**SOIL TREATMENT**

Apply in a band (not in contact with seed) at planting time, or as a sidedress after emergence.

**INSECTS**

Leafhoppers and aphids.

Di-Syston 15 G, 6.7 to 16.7 lb or 8 E, 1 to 2 1/2 pt (RUP) (50 days).

**FOLIAR TREATMENT**

**INSECTS**

Armyworm, loopers and climbing cutworms, apply as needed. Pay special attention to grassy areas in the field.

* Asana XL, 5.8 to 9.6 oz (3 days) (RUP).

or Carbaryl (Sevin) 80 S, 1 7/8 lb or XLR Plus 1 1/2 to 2 1/2 qt (0 days).