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Insect, Disease and Nematode Control on Commercial Vegetables

Michigan State University Extension Service

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Entomology, Plant Pathology and Nematology; Lynnae J. Jess, Pesticide Education

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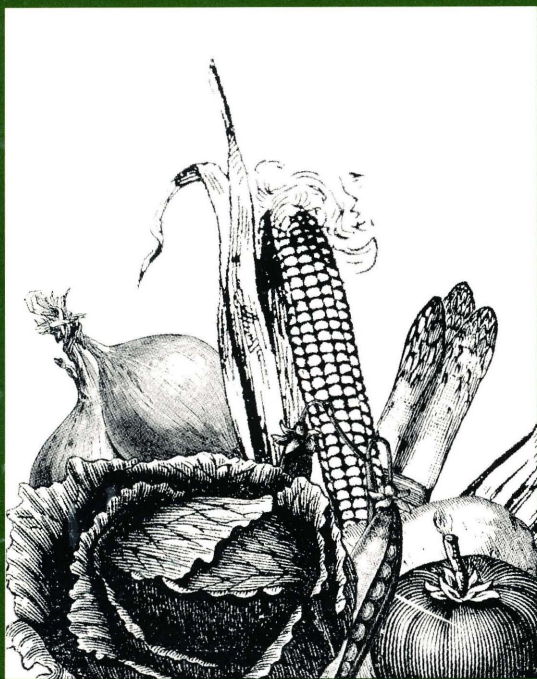
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# **Insect, Disease and Nematode Control for Commercial Vegetables**

MICHIGAN STATE  
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Remember that the pesticide label is the legal document on pesticide use. Read the label and follow all instructions closely. The use of a pesticide in a manner not consistent with the label can lead to the injury of crops, humans, animals and the environment. The use of a pesticide inconsistent with the label directions can also lead to civil or criminal fines and/or condemnation of the crop. Pesticides are good management tools for the control of pests on crops, but only when they are used in a safe, effective and prudent manner according to the label.

**These recommendations are not intended to replace the specific product labels.  
Always read and follow label instructions carefully.**

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# Insect, Disease and Nematode Control for Commercial Vegetables

By George Bird, Beth Bishop, Mary Hausbeck,  
Lynnae J. Jess, William Kirk, Walter Pett and Fred Warner \*

This MSU Extension bulletin was prepared to help commercial vegetable producers make informed decisions on pest management.

## How to Use This Bulletin

Recommendations are organized into sections by crop. Within a crop, specific pests are listed along with their control recommendations. Frequent users may want to insert tabs for easy location of each crop section.

This publication focuses on chemical tactics and should be used in conjunction with an overall sound program of integrated pest management. Chemical recommendations are included for insect, disease and nematode control, as well as handling pesticides safely to prevent human and environmental harm. The management suggestions in this bulletin are designed to help protect the grower's crop from the pre-plant stage to market and, in certain cases, through storage.

The suggestions include the basic information necessary for the chemical components of pest control. The majority of the suggested materials have been tested at Michigan State University to determine the most effective materials, rates of application, timing of applications, method of application and site of application on the plant or in the soil. When this information is coupled with week-to-week information on pest populations, as disseminated in Crop Advisory Teams (CAT) Alerts, the minimum number of chemicals and treatments need be applied to attain the desired level of control.

It is extremely important that growers monitor (scout) each individual field for potential pest problems. Pest populations (insects, nematodes, and diseases) vary not only from year to year, but also from field to field and even within a given field. Pest populations vary in first appearance, number of individuals and severity of damage. These observations are the prime responsibility of the grower.

Growers should make them known to county and university Extension personnel. Through this type of two-way communication, Michigan agriculture will remain in the forefront in quality and quantity.

A grower's choice of a particular pesticide should be based on pests present, beneficial insects present (including honeybees and predators and parasites of pests), available materials, days to harvest, environmental and personal safety and cost.

Materials and rates of application listed on pages 22-123 are based on the latest information available at the time this publication went to press. Materials marked with an asterisk (\*) are particularly recommended for problem infestations.

Recommendations are changed as products are removed from the market, new products are introduced, new uses are found for old products, or new restrictions are placed on their use.

Your county MSU Extension agent is informed of the changes as they occur through Crop Advisory Team (CAT) Alerts or the MSU Extension computer network. Recommendations may be updated in the on-line version of this bulletin (see Useful Websites). Check with your Extension agent for updates that have occurred since the publication of this bulletin. **Always read and follow the directions and limitations on the pesticide label.**

The information given here is for educational purposes only. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by MSU Extension is implied.

Some of the more hazardous pesticides are on the Restricted Use Pesticide (RUP) list. You will need to be certified by the Michigan Department of Agriculture in order to buy and use these RUP's. Your county Extension agent has a current listing of the RUP's and will advise you on the procedures for certification.

## Safety Tips and Special Warnings

Your county agricultural agent can supply information on the dangers of environmental and personal safety with insecticides, fungicides and nematicides. You can get help for insecticide, fungicide and nematicide poison cases by telephoning the nearest Poison Control Center (see back cover). A list of insecticides and nematicides and their relative toxicities (LD50) is given on the following pages. The potential to leach into the groundwater or runoff into surface waters is given for both insecticides and fungicides.

**Phosphate Insecticides.** The phosphate group includes Imidan, Guthion and other similar materials. Many of these are extremely dangerous to users at the time of application. Read the label on the container for instructions for safe use. If any insecticide cannot be used according to those directions, do not use it at all.

**Note to Aerial Applicators.** Pilots and loading crews should know the dangers of applying methyl parathion and other hazardous insecticides. Take special care to avoid skin, respiratory and oral absorption.

- Always read the label before buying or using pesticides. Use pesticides only for the purpose(s) listed and in the manner directed.
- Pesticides that require special protective clothing or equipment should be used only by trained, experienced applicators.

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\* The authors are Extension specialists in Entomology, Plant Pathology, and Nematology, and Lynnae is in the Pesticide Education Program.



- Do not apply more than the specified amount of pesticides; overdoses can harm you, the consumers and the environment.
- Keep pesticides away from food and dishes.
- Keep children and pets away from pesticides and sprayed areas.
- Do not smoke or eat while applying pesticides.
- Avoid inhaling pesticides.
- Never spray on a windy day.
- When mixing pesticides, use care to avoid splashing.
- Avoid breaking or spilling pesticide containers.
- Avoid contact with skin and clothing.
- If you spill a pesticide on your skin, wash with detergent and water. If spilled on clothing, change clothing immediately.
- Store pesticides in their original containers with proper labels in a locked storage area. Never transfer a pesticide to a container that would attract children, such as a soft drink bottle.
- Dispose of empty containers safely. Triple rinse (or equivalent) containers and offer for recycling or dispose of in a licensed sanitary landfill. Refer to your dealer for directions for disposal of specific containers.
- Wash with soap and water after using pesticides and launder clothes separately before wearing again.
- Getting any pesticide into the eyes or mouth can be especially serious. Read and understand first aid instructions listed on the label **BEFORE** you use the pesticide. Follow instructions explicitly. Flush eyes or mouth with water as soon as possible after exposure. Do not induce vomiting unless it is specified on the label. See a doctor immediately if there is any chance of poisoning. Take the pesticide container or label with you so that the doctor can read the "Instructions to the Physician" that are included on the label. Many labels carry the telephone number of a 24-hour emergency service offered by the pesticide company. Call this number for authoritative advice on diagnosis and treatment. Your physician can use this service if needed. The physician can also receive advice, when needed, by calling the nearest Poison Treatment Center listed on the back cover.

### **Pesticide Emergency Preparedness**

At the time that the pesticide is purchased, ask the chemical dealer for a complete specimen label and Material Safety Data Sheet (MSDS are required for farms with employees) of the product you bought. This label and labeling information packet is an exact duplicate of the label information that is affixed to and/or must accompany the pesticide container. Use the specimen label material as a reference during any pesticide emergency. Bring the label along with any person who has become poisoned and needs medical attention.

Closely follow all the warning statements outlined in the Precautionary Statements section of the pesticide label. Be certain that you use all protective clothing and equipment as specified by the label. Make certain all persons involved in the operation of the farm know and can carry out the information in the Statement of Practical Treatment. (See also the section on SARA Title III.)

You can develop an emergency farm plan that will prepare you and your employees for pesticide and other farm emergencies, by completing the form in Extension Bulletin E-2575.

### **Pesticide Registration**

Recommendations in this bulletin are based on field trials conducted in Michigan and other North Central Region states over a period of several years. All pesticides must be currently registered with the U.S. Environmental Protection Agency (E.P.A.) and the Michigan Department of Agriculture before they can be used legally in Michigan.

The pesticide label is a legal document on pesticide use. Read the label carefully and follow all instructions closely. Use of any pesticide in a manner not consistent with the label can lead to civil or criminal punishment and/or condemnation of the illegally sprayed crop. Do not mix and apply together any pesticides and fertilizers if it is forbidden on either product label.

### **Pesticide Tolerances (Residues) on Vegetable Crops**

Tolerances are established by the E.P.A. for every pesticide registered in the United States. These tolerances are the maximum allowable residues in parts per million (ppm) of a pesticide that may be on or in a specified crop at the time of harvest. If residues of a pesticide on a crop exceed the tolerance established for that pesticide, that crop may be seized and destroyed.

To keep below the tolerance levels established for a pesticide, apply only the formulated amount of pesticide per acre as instructed by the product label. Do not exceed this restriction. Also, to meet the label-required pre-harvest interval, discontinue the use of pesticides the number of days before harvest that the label specifies. Always remember the following restrictions on the use of all pesticides: 1) The legal amount of active material per acre that can be applied during a given growing season; and 2) The number of days before harvest that chemical application on a crop must be discontinued.

### **Use of Pesticides for Insects Not on Label**

The law regulating pesticides in the United States is the Federal Insecticide, Fungicide and Rodenticide Act, or FIFRA. FIFRA is administered by the Environmental Protection Agency (EPA) and in Michigan by the Michigan Department of Agriculture (MDA). FIFRA governs the registration, distribution, sale and use of all pesticides. Within FIFRA there exists a provision that allows the use of a pesticide for a pest not noted on the label as long as the application is made to a crop specified on the label. This provision is referred to as 2(ee). All rates and restrictions, including preharvest intervals, for the labeled crop must be followed. Please note, however, that the manufacturer will not assume responsibility for product performance so 2(ee) applications are made at the grower's risk. For more information about 2(ee) applications, contact your local MSU Extension or Michigan Department of Agriculture office.

### **Record Keeping**

The 1990 Farm Bill requires that all applicators who apply restricted use pesticides (RUP) keep records and maintain them for two years. Records to be kept include:

- brand name or product name and the EPA registration number,
- total amount of the product used,
- size of the area treated,



- crop, commodity, stored product or site to which the pesticide was applied,
- location of the application,
- month, day and year of the application,
- name and certification number of the applicator or applicator's supervisor.

Any record form is acceptable as long as the required data is included. Penalties are up to \$500 for the first violation and up to \$1,000 for subsequent violations. Provisions for protecting the identity of the individual producers are included in the law. Commercial applicators must furnish a copy of the required records to the customer of the RUP application.

### **Agricultural Chemical Use Precautions**

The use of any pesticide, especially a restricted-use-pesticide (RUP), entails a significant amount of responsibility and liability on the part of the grower. Therefore, handle all pesticides with extreme caution and respect for the following reasons:

- to protect yourself and others.
- to protect your crop and soil from chemical damage.
- to protect the environment from chemical damage.

These points cannot be emphasized enough. Pesticide accidents occur most often during mixing and tank filling operations. Although accidental ingestion of chemicals is considered to be the greatest health hazard, there is also great danger of poisoning when pesticides contact skin or eyes or when dust or vapors are inhaled. To prevent such accidents, wear protective clothing at all times when handling and applying pesticides and cleaning spray equipment. Such mandatory garments include chemical resistant gloves and boots, splash-guard goggles and a respirator manufactured specifically for the type of chemical compound that is being used. Care for these items as you would your farm implements. They may save your life in case of an accident. Always heed all the precautionary statements on the product label and cover-up to protect yourself. (See MSU Extension Bulletins E-1546, Take Cover! Protect Yourself from Exposure, E-2215, Using Pesticides Safely: A Guide for the Applicator; NC-204, Protective Clothing for Handling Pesticides, and AM-106, EPA Chemical Resistance Category Chart, for more information.)

Protecting yourself during any application of an agricultural chemical is required. Give the same consideration to any field worker(s) you may employ. Farm workers assisting in the application of any pesticide should also wear protective clothing, as specified by the product label.

Protect your crops and land by applying any pesticide at the label directed rate and under favorable environmental conditions. To do otherwise may be a violation of the label and could cause damage to the crop and carry over in the soil. Excessive pesticide residues in the soil may also leach into surface and groundwater. Overdosing will also increase residues on the crop and the number of days before the crop can be harvested legally. To avoid any pesticide damage and/or illegal residues on crops and in the soil, follow the recommended rates of application and use properly calibrated implements.

Pesticide drift from aerial and ground application is a serious problem. Drift can be a particular problem if houses, schools or urban areas are nearby. Drift can also contaminate sensitive crops and the environment (crop land and surface water). Avoid pesticide drift from all pesticides. Because few chemicals are allowed

on forage for all types of livestock, exercise extreme caution when using any pesticides to avoid contaminating hay, pasture and stover. Where problems with pesticide drift exist, use the least hazardous materials with additives labeled to reduce spray drift. These additives add elasticity to spray suspensions to reduce the shearing effect (break up of spray stream) caused by spray dispensing equipment and air movement.

### **SARA Title III Emergency Planning and Community Right to Know Act**

The Emergency Planning and Community Right to Know Law, under SARA Title III, requires farmers to notify their State Emergency Response Commission (SERC), Local Emergency Planning Committee (LEPC), and local fire department that they store extremely hazardous materials, along with the name and telephone number of the facility representative. Check with your state Department of Natural Resources or MSU Extension to receive a list of EPA established "Extremely Hazardous Substances" and their threshold planning quantities.

The LEPC and fire chief may request maps of your storage facility and detailed lists of materials you store.

This law also requires that, in the event of a spill, the SERC, LEPC and National Response Commission be notified. The reportable quantities for spills is much less than for storage and can be obtained from the above sources. See Extension Bulletin E-2575 for more details on SARA Title III and a list of commonly used extremely hazardous substances.

### **Worker Protection Standard**

New federal rules for farm worker protection, issued during 1992, require farmers to provide additional training and notification to farm workers to prevent accidental or occupational exposure to pesticides. Farmers should contact Extension agents to learn the details of this standard and availability of training materials for education of workers and handlers.

Read and follow the label instructions on Restricted Entry Intervals (REI) for every pesticide used. Some pesticide labels require both oral warning and posted signs to notify workers of pesticide applications. If the label doesn't require both forms of notification, notify workers either orally or by posting warning signs at entrances to treated areas. (Greenhouses must post warning signs for every application.) When using posted signs, post 24 hours or less before the pesticide application and remove signs within three days after the end of the restricted entry interval. Keep workers out during the entire time the signs are posted (except for early-entry workers wearing the proper personal protective equipment).

### **Michigan Groundwater Stewardship Program (MGSP)**

The Michigan Groundwater Stewardship Program is a cooperative effort between the Michigan Department of Agriculture (MDA), Michigan State University Extension, Conservation Districts, and the USDA Natural Resources Conservation Service. The program is funded through fees assessed on sales of pesticides and nitrogen fertilizers. MGSP-sponsored education, technical assistance and cost share help individuals reduce the risk of groundwater contamination associated with pesticide and nitrogen fertilizer use.



Producers who complete the environmental risk assessments for their farmstead and cropping systems (Farm\*A\*Syst and Crop\*A\*Syst) will be able to determine what structural, management and record-keeping changes (if any) will be needed for their farming systems to be in conformance with Michigan Right to Farm guidelines and state and federal environmental laws.

Once a producer develops and implements a plan to address the risks indicated by the environmental assessments, he or she can contact the MDA to request farming system verification under the Michigan Agriculture Environmental Assurance Program (MAEAP). MAEAP-verified farms are eligible for various incentives.

### Protect Nontarget Organisms

Bees and other pollinating insects are essential for successful production of tree fruits, small fruits, most seed crops and certain vegetables. Many insecticides are highly toxic to pollinating honeybees and wild bees. Be aware of how bee poisonings can occur from applying pesticides and how to prevent them. Take the following precautions to reduce the chance of bee poisoning:

- Do not apply pesticides that are toxic to bees if the site contains a crop or weeds which are in bloom. This applies not only to the fruit bloom but also to dandelions and clovers that may be reached by the spray. Mow cover crops and weeds to remove the blooms prior to spraying.
- Select pesticides that are least harmful to bees and select the safest formulation. Dusts are more hazardous to bees than sprays. Wettable powders and microencapsulated products are more hazardous than emulsifiable concentrates or water soluble formulations because particulate pesticide material may be carried back to the hive. Granular insecticide formulations are generally the least hazardous to bees.
- Reduce drift during application. Use drift control materials whenever possible.
- Time pesticide applications carefully. Evening applications are less hazardous than early morning; both are safer than midday applications.
- Do not let puddles of spray accumulate on the ground where bees might drink it. Supplying fresh water near bee's hives can reduce this hazard.
- Do not treat near hives. Bees may need to be moved or covered before using insecticides near colonies.

The best way to avoid injury of beneficial insects and microorganisms is to minimize pesticide usage. Use selective pesticides when ever possible and apply only when necessary as part of a total pest management program.

Pesticides can be harmful to all kinds of vertebrates such as fish and wildlife. Most recognizable are the direct effects from acute poisoning. Fish kills can result from water polluted by a pesticide (usually insecticides). Pesticides can enter water via drift, surface runoff, soil erosion, and leaching.

Bird kills from pesticides can occur when birds ingest the toxicant in granules, baits, or treated seed; are exposed directly to the spray; consume a treated crop; drink and use contaminated water; or feed on pesticide-contaminated prey.

### Endangered Species Act

To minimize the adverse impact of pesticides on endangered species, the EPA has initiated The Endangered Species Act. Every implicated pesticide will have an endangered species warning statement regarding use of the product within the geographic area where endangered species restrictions apply. Users must obtain a county-specific endangered species bulletin from the local Extension office, which will identify the specific area where use restrictions apply. Application of listed pesticides in the identified geographic areas in that county will be restricted or prohibited.

### Right to Farm

Farmers in Michigan are protected from nuisance lawsuits under the Right to Farm Act if they follow acceptable management practices. The Generally Accepted Agricultural and Management Practices for pesticide utilization and pest control, nutrient utilization, and manure management have been completed and are revised annually. Contact your Extension agent or regional office of the Michigan Department of Agriculture to obtain copies.

### Pesticide Name

The insecticide trade name (first letter capitalized; Lorsban, for example) is used when an insecticide is sold under only one well known brand name. The accepted common name of an insecticide is used when it is sold under several brand names, with some trade names are shown on the following line(s). The fungicide and nematicide trade names are listed underneath the chemical formulation name.

### Pesticide Formulations

Fungicides, insecticides and nematicides can be purchased in a variety of formulations. Not only is it important that a grower purchase the correct pesticide for the intended pest control (i.e., pesticide product labeled for both the crop and the pest), but also that the grower chooses the formulation best suited for the particular job. Such a decision should be based on the pesticide product's effectiveness, cost, practicality and relative safety to the applicator, the crop and the environment. The following are some additional considerations worth remembering when choosing a specific formulation:

- Some formulations require constant spray tank agitation; others do not.
- Dusts and granules do not require water for application, but accurate calibration of equipment and uniform distribution are often difficult to achieve and maintain.
- The potential hazard to the applicator and the potential of drift and environmental contamination vary substantially among formulations.
- Dry formulations are generally less affected by subfreezing temperatures during storage than liquid formulations.
- Some crops may be treated with any formulation of a particular pesticide; others require using a specific formulation.
- The price per pound of active ingredient varies for different formulations.

Also remember that for two products with the same active ingredient but different formulation, the application rate to be used



on a specific site and pest may be different. **Always read and follow the label instructions carefully.**

### Restrictions

The pre-harvest interval, the minimum number of days required between last application and harvest or other use of the crop, is listed. Special limits on the use of the pesticide are also given when they apply. Follow these restrictions exactly to avoid possible deleterious residues on the crop at harvest. Pesticides that are relatively safe around honeybees are also noted when pertinent.

### Compatibility

When two or more chemicals are mixed together in a spray tank, they may or may not mix well, or the mixture may cause injury to germinating seeds or plants. This relationship is called compatibility. The lack of compatibility could affect the application and effectiveness of the chemical spray.

It is usually not advisable to mix different formulations such as wettable powders and emulsifiable concentrates together in a spray tank. This is especially important if other materials, such as foliar nutrients, are included in the spray and applied in low gallonage per acre. Always be sure to read and follow the directions and limitations on the pesticide label before mixing.

### Pesticide Additives

During the development of a pesticide, chemical companies attempt to formulate the active ingredient to optimize performance, mixing and handling under diverse conditions. Every commercially available pesticide formulation contains its own particular set of additives to accomplish this action. However, sometimes additional additives are required for specific applications or when compatibility or mixing problems occur. The pesticide label will describe the need and use of these additives. Avoid indiscriminate use of additives because they may not improve pesticide performance and may actually reduce pest control or cause crop injury.

The following are some definitions of pesticide spray additives. For more information on types of spray additives and when to use them with herbicides, see MSU Extension Bulletin E-1858, *Using Spray Additives with Herbicides*.

- **Adjuvant**—any substance that enhances pesticide effectiveness, an added ingredient.
- **Surfactant**—a surface active material that can facilitate emulsifying, dispersing, spreading, wetting, sticking or other surface-modifying characteristics of a pesticide solution.
- **Emulsifier** — an agent that promotes the dispersion of one liquid in another.
- **Wetting Agent Spreader**— an ingredient that reduces water surface tension causing better contact between the spray solution and treated surfaces.
- **Soap**—sodium or potassium salts of fatty acids. These additives can form insoluble materials in hard water. Detergents are synthetic materials used for cleaning.
- **Sticker**—a deposit builder that increases pesticide adhesion to plant surfaces.
- **Defoaming Agent**—reduces or eliminates foaming in the spray tank.

- **Drift Control Agent**—an agent that prevents the formation of very fine spray droplets that are especially subject to drift; improves coverage.
- **Compatibility Agent or Co-solvent** — an inert ingredient that may aid in the dispersion of otherwise incompatible mixtures.

Pesticides are applied in a number of ways, so adding and using an additive is up to the applicator. Sometimes, additives are only required for pest control treatments made during adverse climatic conditions. In other cases, the nature of the pesticide may require adding an additive to the spray mixture rather than the formulation. The pesticide label always gives directions for the use of additives, if they are required.

### Soil Type Considerations

Soil texture (sand, silt, clay) and organic matter content influence the effectiveness of soil-applied pesticides. In general, lower rates of pesticides are required on sandy (coarse-textured) soils than on clays or soils with high organic matter content (fine-textured) to obtain the same level of control. Pesticide rate recommendations in this bulletin are given for medium-textured soils with greater than 3 per cent organic matter content, unless otherwise noted. Clay and organic matter absorb pesticides, making them less available to kill soil-borne pests. Soils with high clay and organic matter content require greater pesticide rates for adequate pest control. Sandy soils with low organic matter content require careful pesticide rate selection to avoid crop injury.

Poor application of soil insecticides, such as plowing or drilling the insecticides deeper than about 4 inches, or using sidedressings when broadcast treatments are best, reduces the value of pesticide treatments. Do not expect the impossible in your efforts to control soil-borne pests. As with foliar sprays, materials need to be carefully applied to achieve maximum effectiveness.

### Pesticides and the Environment

Many people obtain their drinking water from wells. Well water is groundwater. Groundwater is stored in water-bearing geological formations called aquifers. It moves through aquifers and is obtained at springs, streams, or wells.

The upper level of the saturated zone in the soil is called the water table. The water table depth fluctuates, depending on the amount of water removed from the ground and the amount of water added by recharge.

Both surface water and groundwater are subject to contamination by point and non point source pollution. Point source contamination refers to movement of a pesticide into water from a specific site. Nonpoint source contamination generally results from land runoff, precipitation, acid rain, or percolation rather than from discharge at a single location.

Several factors influence the fate of pesticides in groundwater.

**Adsorption** is the binding of chemicals to soil particles. The amount and persistence of pesticide adsorption varies with pesticide properties, soil moisture, soil pH, and soil texture. Soils high in organic matter or clay are the most adsorptive; coarse, sandy soils are much less adsorptive.

A soil-adsorbed pesticide is less likely to volatilize, leach or be degraded by microorganisms. It is also less available for absorption by plants. Therefore, pesticides used on highly adsorptive



soils may require higher rates or more frequent applications to compensate for soil adsorption.

**Volatilization** occurs when a solid or liquid turns into a gas. A pesticide in a gaseous state can be carried away from the treated area by air currents. This is called vapor drift. Unlike the drift of sprays and dusts that can sometimes be seen during application, vapor drift is invisible.

Avoid applying volatile pesticides when conditions favor volatilization, such as temperature inversions. Pesticide labels usually mention the potential for volatility of pesticides. Volatilization can sometimes be reduced through the use of low volatile formulations or soil incorporation of the pesticide.

**Photodegradation** is the breakdown of pesticides by the sunlight. Pesticides applied to foliage or the soil surface may be broken down by exposure to light. Soil incorporation can reduce pesticide exposure to sunlight.

**Microbial degradation** occurs when microorganisms such as fungi and bacteria use a pesticide as a food source. It can be rapid and thorough under favorable soil conditions, including warm temperatures, favorable pH levels, adequate soil moisture, oxygen and fertility. The amount of adsorption also influences microbial degradation. Adsorbed pesticides are more slowly degraded because they are less available to some microorganisms.

**Chemical degradation** is the breakdown of a pesticide by soil processes not involving a living organism. Adsorption of the pesticides, soil pH, soil temperature and moisture influence the rate of degradation. Some pesticides are more rapidly degraded on low pH soils.

**Absorption** is the process by which plants and microorganisms take up chemicals. It is another process that can transfer pesticides in the environment. Once absorbed, most pesticides are degraded within plants. Residues may persist inside the plant or be released back into the environment as the plant decays.

**Runoff** moves pesticides in surface water, either mixed in the water or bound to soil particles. The amount of pesticide runoff depends on the grade or slope of the field, the type of soil, the amount of rainfall, (especially close to the time of application), and properties of the pesticide. For example, a pesticide applied to a saturated clay soil is highly susceptible to runoff. Established vegetation or plant residues reduce runoff.

Pesticide runoff is greatest when heavy rainfall occurs shortly after application. No-tillage, minimum-tillage, and soil incorporation reduce runoff. Surface grading, drainage ditches and dikes, and the use of border vegetation can help reduce pesticide movement into surface water.

**Leaching** is the movement of pesticides through the soil into groundwater. Several factors influence leaching including water solubility of the pesticide, soil structure and texture, and persistence of pesticide adsorption to soil particles. If a pesticide is strongly adsorbed to soil particles, it is less likely to leach, regardless of its solubility, unless the soil particles themselves move with the water flow.

### Keeping Pesticides Out of Groundwater and Surface Water

It is very difficult to purify or clean contaminated groundwater or surface water. Management practices can be implemented to effectively reduce pesticide runoff and leaching and protect groundwater and surface water.

Use integrated crop management programs —Minimize pesticide use by combining chemical control with other pest management practices such as tillage, cultivation, crop rotation, and pest scouting.

- Reduce compaction—Surface water runoff increases when soils are compacted.
- Rotate crops —Crop rotations may provide more surface crop residue and may reduce the application of the same pesticides to a field.
- Use conservation tillage practices —Include no-till, minimum till, cover crops, grass waterways and buffer strips.
- Consider the geology of your area—When planning pesticide applications, be aware of the water table depth and the permeability of the geological layers between the surface soil and groundwater.
- Select pesticides carefully—Choose pesticides with the least potential for leaching into groundwater or for runoff into surface water.
- Transport pesticides safely—Have pesticides delivered directly to your pesticide storage facility to avoid liability and potential accidents and spills in transit whenever possible. DOT shipping rules must be followed for transporting large quantities of pesticides, including proper placarding of the vehicle, liability insurance, special handling requirements, etc.
- Follow label directions—The label carries crucial information about the proper rate, timing, and placement of the pesticide.
- Calibrate accurately—Equipment should be calibrated carefully and often.
- Measure accurately—Concentrates need to be carefully measured before they are placed into the spray tank. Do not “add a little extra” to ensure the pesticide will do a better job.
- Avoid back-siphoning —The end of the fill hose should remain above the water level in the spray tank at all times to prevent back-siphoning of chemicals into the water supply. Use an anti-backflow device when siphoning water directly from a well, pond, or stream. These practices also reduce the likelihood of the hose becoming contaminated with pesticides.
- Consider weather and irrigation—If you suspect heavy or sustained rain, delay applying pesticides. Control the quantity of irrigation to minimize the potential for pesticide leaching and runoff.
- Avoid spray drift and volatilization—Do not spray when the wind is greater than 10 miles per hour and/or weather conditions (e.g. inversions) are conducive to pesticide drift from the target area. Make every effort to **AVOID PESTICIDE DRIFT!**
- Clean up spills—Avoid spills. When they do occur, contain and clean them up quickly with an absorbent material like cat litter. Chemicals spilled near wells and sinkholes can move directly and rapidly into groundwater. Chemicals spilled near ditches, streams or lakes can move rapidly into surface water.
- Change the location of mixing areas —Mix and load pesticides on an impervious pad, if possible. If mixing is done in



the field, change the location of the mixing area regularly. Do not mix pesticides adjacent to the water source, and do not let the water run inadvertently on the soil near the mixing area. This will increase pesticide leaching and/or runoff.

- Dispose of wastes and containers properly—All pesticide wastes must be disposed of in accordance with local, state, and federal laws. Pesticide containers are considered hazardous waste until they are cleaned or disposed of properly. When possible, reduce the number of pesticide containers by using bulk or returnable containers.

All pesticide containers can be rendered non-hazardous waste by triple rinsing (or equivalent). The rinsate should be added to the spray tank. After triple rinsing, perforate both ends so the container cannot be reused.

All metal and plastic triple-rinsed containers should be recycled, if possible. If this option is not available, dispose of them in a state licensed sanitary landfill. Dispose of all paper containers in a sanitary landfill or a municipal waste incinerator. Do not bury or burn any pesticide containers. Do not reuse any empty pesticide containers for any purpose.

Store pesticides away from water sources —Pesticide storage facilities should be situated away from wells, cisterns, springs, and other water sources. Pesticides must be stored in a facility that will protect them from temperature extremes, high humidity, and direct sunlight. The storage facility should be heated, dry and well ventilated. It should be designed for easy containment and cleanup of pesticide spills and made of materials that will not absorb any pesticide material that leaks out of a container. Store only pesticides in such a facility and always store them in their original containers.

Do not store any protective clothing or equipment in the pesticide storage facility. Store pesticides separately from insecticides and fungicides to avoid contamination of one material by another and accidental misuse.

Keep the facility locked at all times when not in use to prevent animals, children, and irresponsible adults from entering and becoming poisoned. Post the facility as a Pesticide Storage Facility to warn others that the area is off limits. Maintain an accurate inventory of the pesticides stored in the facility at all times in case of emergency.

Always read and follow the Storage and Disposal section of pesticide labels for specific storage and handling instructions.

For additional information on pesticide storage, refer to Midwest Plan Service Bulletin 37, Designing Facilities for Pesticide and Fertilizer Containment, available from Agricultural and Biosystems Engineering Dept., 122 Davidson Hall, Iowa State University, Ames, IA 50011; and MSU Bulletin E-2335 On-Farm Agrichemical Storage and Handling. Your state's water resources currently provide a vast supply of clean water for agriculture, homes, and industry. They can ensure high water quality for future needs only if they are protected now. Be sure to understand how your activities, including pesticide usage, can affect them.

### Handling and Mixing Pesticides

Always wear protective clothing and equipment when handling, mixing, and applying pesticides and during the cleanup of application equipment. Protective clothing should include full coverage clothing, chemical resistant gloves and boots, eye protec-

tion, hard hat, and a MSHA/NIOSH approved respirator with a chemical absorbent material as specified on the pesticide label.

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 are 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 the 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.

### 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 sprayer, inside and out, including the boom, hoses and



nozzles. Partially fill the spray tank with water and keep the pump running so that the rinse water circulates throughout the entire system. Spray the water rinsate out through the nozzles, making sure to properly collect the rinsate. To save money and protect the environment, rinse the equipment in the field using a water-filled nurse tank and apply the collected water rinsate to the crop.

To clean application equipment used to apply a variety of pesticides, thoroughly wash 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**
- 5 lb of sal soda. **OR**
- 8 lb trisodium phosphate.

Run the pump so that the cleaning solution circulates throughout the entire system. Leave the cleaning solution in the spray system for at least 2 hours, and do not apply it to any crop or crop land. Discard the cleaning solution in an appropriate pesticide rinsate degradation pit. Rinse the entire system with water at least three times after all the cleaning solution has drained from the sprayer. Do not leave pesticide solutions or cleaning solutions in the tank overnight unless otherwise instructed.

Corrosion and mechanical damage to pumps, tanks, nozzles, etc., may result from leaving water in the spray system over the winter. To prepare the spray equipment for storage, disconnect all hoses and allow all water to drain out. Coat all bare metal parts with oil or a rust inhibitor.

Disassemble metal nozzles and store them in oil. Prepare the spray pump for storage based on the manufacturer's recommendations.

### Notes on Nematode Management

Nematodes are microscopic worms that live in the soil and roots of plants. A few species feed on foliage or modified tissue, like onion bulbs. Nematode-infected vegetables do not grow well, yields are low and quality is often poor. Some nematodes cause root swellings called knots or galls (root-knot nematode), while others cause necrosis (root-lesion nematode, onion bloat nematode), and still others cause root stunting (stubby-root nematode). All of these nematodes can cause reduced yields or quality of various vegetable crops.

Plant parasitic nematodes can be present in most soil types, but usually cause the greatest damage in sandy soils. Some species, however, cause serious problems in muck soils. Nematode damage is frequently blamed on other causes, such as nutrient deficiencies or disease-causing organisms, like fungi and bacteria. Nematodes can also reduce plant resistance to certain fungi and bacteria.

Most soil-borne nematodes are beneficial and help control insects, decompose organic matter and regulate soil nutrition. While plant-parasitic nematodes cannot be eliminated completely from a field, control measures such as crop rotation, fallowing and applying chemical nematicides help prevent nematode damage in vegetable production.

1. Rotate vegetable crops so that plants injured by nematodes are not grown on the same soil more often than once every 3 years. For example, Irish potatoes, tomatoes, peppers, carrots, celery and other crops are injured by root-knot nematodes. Sweet corn and onions are less susceptible to damage caused by this nematode, and are poor reproductive hosts for the nematode.

2. In some cases, fallowing can be used to reduce nematode populations. Fallowed ground must be worked several times to keep it dry and free of weeds.

3. Sudax is a good cover crop for lowering population densities of root-knot and to a lesser extent root-lesion nematodes.

4. Whenever necessary, use an appropriate nematicide. Specific nematicide recommendations for each crop are presented in this bulletin. Information about how to submit soil and root samples for nematode analysis is given in MSU Extension Bulletin E-2199, *Detecting and Avoiding Nematode Problems*. Use root and soil samples to identify nematode problem sites.

Use chemical nematicides only when nematode population densities exceed specific nematode-crop action thresholds. 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 procedure for nematode analysis is presented in Appendix C.

### For More Information

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

#### Insects:

- 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-2278 Managing Sweet Corn Pests in Massachusetts (with Michigan insert)
- E-2453 Biological Control of Insects
- NC-155 Mint Production in the Midwestern United States
- NC-327 European Corn Borer, Ecology and Management.

#### Books:

*Vegetable Insect Management with Emphasis on the Midwest.* Foster and Flood. Meister Publ., Willoughby, OH, (800) 572-7740

*Diseases and Pests of Vegetable Crops in Canada.* Howard, Garland and Seaman. Entomological Soc. of Canada, Ottawa, ON-TARIO (613)725-2619

#### Diseases:

- E-1427 Disease and Insect Pests of Celery
- E-1668 Disorders of Cole Crops
- E-1679 Disorders of Tomatoes
- E-1721 Diseases of Onions
- E-1823 Fusarium Yellows of Celery in Michigan
- E-1943 Bacterial Canker of Tomatoes
- E-2434 Silver Scurf of Potato
- E-2448 Diseases of Potato: Fusarium Dry Rot
- NC-126 Diseases of Radishes in the U.S.
- NC-155 Mint Production in the Midwestern United States
- NC-261 Wilt Disorders of Cucurbits

**Nematodes:**

- E-2199 Detecting and Avoiding Nematode Problems
- E-2200 Soybean Cyst Nematode

**Crop Production & IPM:**

- E-2067 Vegetable Pest Scouting
- 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-2278 Managing Sweet Corn Pests in Massachusetts (with Michigan insert)
- E-2453 Biological Control of Insects
- NB-07 Michigan Onion Growers' Manual
- VT-023 Vegetable Pest Scouting (video)
- VT-036 Integrated Pest Management for Michigan Celery (video)
- Vegetable Crop Advisory Team (CAT) Alerts Newsletter (see form in back of this bulletin)

**Pesticide Handling:**

- AM-95 Rinsing & Recycling Pesticide Containers
- AM-106 EPA Chemical Resistance Category Chart
- E-1546 Take Cover: Protect Yourself From Exposure
- E-1858 Using Spray Additives with Herbicides
- 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-2215 Using Pesticides Safely: A Guide for the Applicator
- 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-2413 Read Before Washing Pesticide-Soiled Clothing - Magnet in English
- E-2413-SP Lea Esto Antes de Lavar la Ropa Manchada o Sucia con Pesticidas - Magnet in Spanish
- MWPS-37 Designing Facilities for Pesticide and Fertilizer Containment

**Useful Web Sites**

E-312 On-line  
<http://web4.msue.msu.edu/veginfo/E312/>  
Michigan State University IPM Program:  
<http://www.ipm.msu.edu>

Michigan State University Vegetable Crop Advisory Team Newsletter:  
<http://www.ipm.msu.edu/vegCAT.htm>

Michigan State University Vegetable Area of Expertise Team:  
<http://www.msue.msu.edu/vegetable>

Michigan Department of Agriculture:  
<http://www.michigan.gov/mda>

Insecticide Registration, Product Labels and MSDS Sheets:  
<http://www.cdms.net/pfa/LUpdateMsg.asp>

MSU Extension Educational Materials Distribution Center  
<http://web2.msue.msu.edu/bulletins/inventorysearch.cfm>



## LIST OF INSECTICIDES AND NEMATOCIDES USED ON COMMERCIAL VEGETABLES

Trade Name	Common Name	Class <sup>1</sup>	LD <sub>50</sub> 's <sup>2</sup>		Leaching Potential <sup>3</sup>	Runoff Potential <sup>3</sup>	Restricted Entry Interval <sup>4</sup>
			Oral	Dermal			
Actara	thiamthoxam	4	>5000	>2000	1	2	12 hrs
Admire	imidacloprid	4	4143-4870	>2000	1	2	12 hrs
Agree	<i>Bacillus thuringiensis aizawai</i>	11	>5050	>2020	3	1	4 hrs
• Agri-Mek	abamectin	6	300	>1800	3	2	12 hrs
• Ambush	permethrin	3	>5000	>2000	3	2	12 hrs
• Ammo	cypermethrin	3	137	>2000	3	1	12 hrs
• Asana XL	esfenvalerate	3	458	>2000	3	2	12 hrs
Assail	acetamiprid	4	1064	>2000	2	3	12 hrs
Avaunt	indoxacarb	22	687-1867	>5000	3	1	12 hrs
• Aztec	cyfluthrin + tebupirimphos	3, 1	132-190	>2000	2	1	48 hrs
• Baythroid	cyfluthrin	3	826-1015	>2000	3	2	12 hrs
Beleaf	Flonicamid	9	>2000	>2000	-	-	12 hrs
• Bifenture	bifenthrin	3	262	>2000	3	2	12 hrs
Biobit	<i>Bacillus thuringiensis kurstaki</i>	11	>5000	>2500	3	1	4 hrs
• Brigade	bifenthrin	3	262	>2000	3	2	12 hrs
• Brom-o-gas	methyl bromide	8	214	-	1	2	48 hrs
• Capture	bifenthrin	3	262	>2000	3	2	2-18 days
Clutch 50 WDG	clothianidin	4	3900-4700	>5000	1	2	12 hrs
• Counter	terbufos	1	<50	182	3	3	48 hrs
Cruiser	thiamethoxam	4	>5000	>2000	1	2	12 hrs
• Danitol	fenpropathrin	3	66	>2000	3	2	24 hrs
Deadline M-Ps	metaldehyde	-	227	2275	3	3	12 hrs
Decis	deltamethrin	3	42.9	>2000	3	1	12 hrs
• Diazinon	diazinon	1	500-2000	>1000	3	1	1-4 days
Dibrom	naled	1	92-250	360-800	3	3	48-72 hrs
Dimethoate	dimethoate	1	571	>2000	2	3	48 hrs
Dipel	<i>Bacillus thuringiensis kurstaki</i>	11	4000	>5050	3	1	4 hrs
• DiSyston	disulfoton	1	3-52	9-1000	2	3	48 hrs

<sup>1</sup> Insecticide Resistance Action Committee Mode of Action Classification (<http://www.irac-online.org/resources/moa.asp>)

- |   |   |
|---|---|
| 1. Acetylcholine esterase inhibitors  | 11. Microbial disruptors of insect midgut membranes         |
| 2. GABA-gated chloride channel antagonists  | 15. Inhibitors of chitin biosynthesis, type O, Lepidopteran |
| 3. Sodium channel modulators  | 17. Inhibitors of chitin biosynthesis, type 2, Dipteran     |
| 4. Nicotinic acetylcholine receptor agonists/antagonists                            | 18. Ecdysone agonist/disruptor                              |
| 5. Nicotinic acetylcholine receptor agonists (not group 4)                          | 20. Site II electron transport inhibitors                   |
| 6. Chloride channel activators  | 21. Site I electron transport inhibitors                    |
| 7. Juvenile hormone mimics  | 22. Voltage-dependent sodium channel blocker                |
| 9. Compounds of unknown or non-specific mode of action (selective feeding blockers) |   |

<sup>2</sup> The LD<sub>50</sub> is a standard toxicological term which indicates the number of milligrams (mg) of pesticide per kilogram (kg) of test animal body weight required to kill 50 percent of a test animal population. Values less than 10 indicate extremely high toxicity to mammals. The LD<sub>50</sub> data have been obtained from Material Safety Data Sheets.

<sup>3</sup> 1=high, 2=intermediate, 3=low. These leaching/runoff potential ratings are from the NRCS WIN-PST Pesticide Properties Database at [http://www.wcc.nrcs.usda.gov/pestmgmt/sp2\\_main.html](http://www.wcc.nrcs.usda.gov/pestmgmt/sp2_main.html)

<sup>4</sup> SL=See Label. Read and follow the label directions. Post areas or give oral warnings that areas have been treated to warn workers not to enter until the REI has elapsed as required by the label.

• = Restricted Use Pesticide. All or certain formulations of these toxicants have been classified Restricted Use Pesticides.

## LIST OF INSECTICIDES AND NEMATICIDES USED ON COMMERCIAL VEGETABLES

Trade Name	Common Name	Class <sup>1</sup>	LD <sub>50</sub> 's <sup>2</sup>		Leaching Potential <sup>3</sup>	Runoff Potential <sup>3</sup>	Restricted Entry Interval <sup>4</sup>
			Oral	Dermal			
Endosulfan	endosulfan	2A	50-481	1467-2000	3	1	24 hrs
Entrust	spinosad	5	>5000	>5000	-	-	4 hrs
Esteem	pyriproxyfen	7	3773-4733	>2000	3	2	12 hrs
• Force	tefluthrin	3	969	>2000	3	2	-
Fulfill	pymetriszone	9	>5000	>2000	2	1	12 hrs
• Furadan	carbofuran	1	7	6783	1	2	2-14 days
• Gaucho	imidacloprid	4	4143-4870	>5000	1	2	n/a (seed treatment)
• Genesis	imidacloprid	4	4143-4870	>5000	1	2	n/a (seed treatment)
Hero	bifenthrin + zeta cypermethrin	3	550	>5000	3	2	12 hrs
Imidan	phosmet	1	126-681	>4.6	3	3	24 hrs
Javelin	<i>Bacillus thuringiensis kurstaki</i>	11	>5100	5000	3	1	4 hrs
Kelthane	dicofol	20	1835-5022	>5000	3	1	12-48 hrs
Kryocide	cryolite	9	>5000	>2100	3	1	12 hrs
• Lannate	methomyl	1	30-59	>2000	1	3	48 hrs
• Larvin	thiodicarb	1	166	>2000	3	3	48 hrs
Lepinox	<i>Bacillus thuringiensis kurstaki</i>	11	-	-	3	1	12 hrs
• Leverage	imidacloprid + cyfluthrin	4, 3	200	>5000	1	2	12 hrs
Lorsban	chlorpyrifos	1	300-2250	>2000	3	2	2-3 days
Malathion	malathion	1	>5000	>2000	3	3	12 hrs
Metaldehyde	metaldehyde	8	227	2275	3	3	12 hrs
Metasystox-R	oxydemetonmethyl	1	125-138	253-359	1	3	48 hrs
• Mocap	ethoprop	1	15-425	166-369	1	3	48 hrs
• Monitor	methamidophos	1	17-21	516-987	2	3	48 hrs
• Mustang	cypermethrin	3	234	>2000	3	1	12 hrs
• Nemacur	fenamiphos	2	10-24	72-75	1	2	48 hrs
Novodor	<i>Bacillus thuringiensis tenebrionensis</i>	11	>5000	>2500	3	1	4 hrs

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- |   |   |
|---|---|
| 1. Acetylcholine esterase inhibitors  | 11. Microbial disruptors of insect midgut membranes           |
| 2. GABA-gated chloride channel antagonists  | 15. Inhibitors of chitin biodegradation, type O, Lepidopteran |
| 3. Sodium channel modulators  | 17. Inhibitors of chitin biosynthesis, type 2, Dipteran       |
| 4. Nicotinic acetylcholine receptor agonists/antagonists                            | 18. Ecdysone agonist/disruptor                                |
| 5. Nicotinic acetylcholine receptor agonists (not group 4)                          | 20. Site II electron transport inhibitors                     |
| 6. Chloride channel activators  | 21. Site I electron transport inhibitors                      |
| 7. Juvenile hormone mimics  | 22. Voltage-dependent sodium channel blocker                  |
| 9. Compounds of unknown or non-specific mode of action (selective feeding blockers) |   |

<sup>2</sup> The LD<sub>50</sub> is a standard toxicological term which indicates the number of milligrams (mg) of pesticide per kilogram (kg) of test animal body weight required to kill 50 percent of a test animal population. Values less than 10 indicate extremely high toxicity to mammals. The LD<sub>50</sub> data have been obtained from Material Safety Data Sheets.

<sup>3</sup> 1=high, 2=intermediate, 3=low. These leaching/runoff potential ratings are from the NRCS WIN-PST Pesticide Properties Database at [http://www.wcc.nrcs.usda.gov/pestmgmt/sp2\\_main.html](http://www.wcc.nrcs.usda.gov/pestmgmt/sp2_main.html)

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## LIST OF INSECTICIDES AND NEMATICIDES USED ON COMMERCIAL VEGETABLES

Trade Name	Common Name	Class <sup>1</sup>	LD <sub>50</sub> 's <sup>2</sup>		Leaching Potential <sup>3</sup>	Runoff Potential <sup>3</sup>	Restricted Entry Interval <sup>4</sup>
			Oral	Dermal			
Oberon	spiromesifen	23	>2000	>4000	-	-	12 hrs
Orthene	acephate	1	846-1447	>2000	3	3	24 hrs
• Pennncap-M	methyl parathion (encapsulated)	1	1237	>1250	3	2	4-5 days
Perm-Up	permethrin	3	1030-1100	>2000	3	2	12 hrs
Phaser	Endosulfan	2A	50-481	1467-2000	3	1	24 hrs
Platinum	thiamethoxam	4	>5000	>2000	1	2	12 hrs
Poncho	chlothianidin	4	>5000	>5000	1	2	n/a (seed treatment)
• Pounce	permethrin	3	1030-1100	>2000	3	2	12 hrs
• Proclaim	emamectin benzoate	6	1516	>2000	2	1	48 hrs
Provado	imidacloprid	4	4143-4870	>2000	1	2	12 hrs
Pyrellin	pyrethrin + rotenone + piperonyl butoxide	3, 21	1620	-	3	2	12 hrs
Pyrenone	pyrethrin plus piperonyl butoxide	3	4500-4900	>2000	3	2	12 hrs
Radiant SC	spinetoram	5	>5000	>5000	-	-	4 hrs
Rimon	novaluron	15	>5000	>2000	-	-	12 hrs
Scout X-tra	tralomethrin	3	284	>2000	3	2	24 hrs
Sevin	carbaryl	1	250-649	>2000	3	3	12 hrs
SpinTor	spinosad	5	>5000	>5000	3	2	4 hrs
• Telone II	1,3-Dichloropropene	1	224-300	333	3	3	5 days
• Thimet	phorate	1	5-13	86-113	3	1	48 hrs
Trigard	cyromazine	17	4460	>2010	1	2	12 hrs
Vapam	metam sodium	3	812	>2020	2	3	48 hrs
Vault	<i>Bacillus subtilis</i>	-	-	-	3	1	See label
Venom	dinotefuran	-	>5000	>5000	-	-	12 hrs
• Vydate	oxamyl	1	9	>5000	3	3	48 hrs
• Warrior	Lambda-cyhalothrin	3	351	>2000	3	2	24 hrs
Xentari	<i>Bacillus thuringiensis aizawai</i>	11	>5000	>2000	3	1	4 hrs

<sup>1</sup> Insecticide Resistance Action Committee Mode of Action Classification (<http://www.irac-online.org/resources/moa.asp>)

- |   |   |
|---|---|
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| 3. Sodium channel modulators  | 17. Inhibitors of chitin biosynthesis, type 2, Dipteran     |
| 4. Nicotinic acetylcholine receptor agonists/antagonists                            | 18. Ecdysone agonist/disruptor                              |
| 5. Nicotinic acetylcholine receptor agonists (not group 4)                          | 20. Site II electron transport inhibitors                   |
| 6. Chloride channel activators  | 21. Site I electron transport inhibitors                    |
| 7. Juvenile hormone mimics  | 22. Voltage-dependent sodium channel blocker                |
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## LIST OF FUNGICIDES USED ON COMMERCIAL VEGETABLES

Fungicide	Common Name	LD <sub>50</sub> 's <sup>1</sup>		Leaching Potential <sup>2</sup>	Runoff Potential <sup>2</sup>	Restricted Entry Interval <sup>3</sup>
		Oral	Dermal			
Acrobat 50WP	dimethomorph	2498-3453	>2000	2	2	12 hrs
Acrobat MZ	dimethomorph + mancozeb	1971	>2000	2	1	24 hrs
Aliette WDG	fosetyl-aluminum	2860	>2000	3	3	12 hrs
Allegiance-FL	metalaxyl	2900	>2000	1	2	24 hrs
Amistar 80 WG	azoxystrobin	>2000	>5000	3	1	4 hrs
Apron XL LS	mefenoxam	862	>2020	1	2	48 hrs
Armcarb 100	potassium bicarbonate	2700	>5000	-	-	4 hrs
Basic Copper 53	copper sulfate	1000	>2000	3	1	24 hrs
Basicop	copper sulfate	1000	>8000	3	1	24 hrs
Blocker 4F	PCNB	>5050	>2020	3	2	12 hrs
Botran	DCNA	>4640	>6320	3	2	12 hrs
Bravo	chlorothalonil	3784-9000	>2000	3	2	12-48 hrs
Cabrio	Pyraclostrobin	>500	>4000	3	1	12 hrs
C-O-C-S WDG	copper oxychloride sulfate	1131	>2000	3	1	24 hrs
Captan	captan	2000-5000	>2000	3	3	96 hrs
Champ	copper hydroxide	1346-1630	>5000	3	1	24 hrs
Champion	copper hydroxide	833	>5000	3	1	24 hrs
Copper Count N	copper ammonium carbonate	-	-	-	-	12 hrs
Cuprofix Disperss	copper sulfate	>2000	>4000	3	1	24 hrs
Cuprofix MZ Disperss	mancozeb + copper sulfate	>4470	>2000	3	1	24 hrs
Cuprofix Ultra 40 Disperss	copper sulfate	300-960	>4000	3	1	12 hrs
Curzate	cymoxanil	433	>5000	3	3	12 hrs
Dithane	mancozeb	>5000	>5000	3	1	24 hrs
Echo	chlorothalonil	3260	>2020	3	2	12 hrs
Equus DF	chlorothalonil	3750	>5000	3	2	12 hrs
Endura	boscalid	>2000	>2000	2	1	12 hrs
Flint 50WG	trifloxystrobin	>5050	>2000	3	2	12 hrs
Folicur	tebuconazole	-	-	-	-	Varies with crop, see label
Forum	dimethomorph	>500-2000	>4000	2	2	12 hrs
Fosphite	mono-, dibasic sodium salts of phosphorous acid	-	-	-	-	4 hrs
Gavel	zoxamide/mancozeb	>5000	>5000	3	1	48 hrs
Headline	pyraclostrobin	200-500	>4000	3	1	12 hrs
Iprodione 4L	iprodione	>2000	>1000	3	3	24 hrs
Kocide	copper hydroxide	646-1630	>5000	3	1	24 hrs
Kodiak	Bacillus subtilis	>5000	>2000	-	-	4 hrs
Kumulus DF	sulfur	>2200	>2000	1	1	24 hrs
Manex	maneb	>5000	>2000	3	1	24 hrs
Maneb	maneb	>5000	>2000	3	1	24 hrs
ManKocide	copper hydroxide/mancozeb	2535	>5000	3	1	24 hrs

<sup>1</sup> The LD<sub>50</sub> is a standard toxicological term which indicates the number of milligrams (mg) of pesticide per kilogram (kg) of test animal body weight required to kill 50 percent of a test animal population. Values less than 10 indicate extremely high toxicity to mammals. The LD<sub>50</sub> data have been obtained from Material Safety Data Sheets.

<sup>2</sup> 1=high, 2=intermediate, 3=low. These leaching/runoff potential ratings are from the NRCS WIN-PST Pesticide Properties Database at <http://www.wcc.nrcs.usda.gov/pestmgmt/winpst.html>

<sup>3</sup> SL=See Label. Read and follow the label directions. Post areas or give oral warnings that areas have been treated to warn workers not to enter until the REI has elapsed as required by the label.

• = Restricted Use Pesticide. All or certain formulations of these toxicants have been classified Restricted Use Pesticides.



## LIST OF FUNGICIDES USED ON COMMERCIAL VEGETABLES (continued)

Fungicide	Common Name	LD <sub>50</sub> 's <sup>1</sup>		Leaching Potential <sup>2</sup>	Persistence <sup>3</sup>	Pre-harvest Interval
		Oral	Dermal			
Manzate 75DF	mancozeb	>5000	>2000	3	1	12 hrs
Maxim 4FS	fludioxonil	>5050	>2020	3	1	12 hrs
Mertect 340-F	thiabendazole	>5000	>2000	3	1	12 hrs
Microthiol Disperss	sulfur	>2000	2000	1	1	24 hrs
Micro Sulf	sulfur	>5000	>2000	1	1	24 hrs
Rally 40WSP	myclobutanil	1870-2090	>5000	2	2	24 hrs
Nu-Cop	copper hydroxide	1300	>2000	3	1	24 hrs
Penncozeb 75 DF	mancozeb	>4470	>2000	3	1	24 hrs
Penncozeb 4 FL	mancozeb	>5000	>2000	3	1	24 hrs
Phostrol	mono-, dibasic sodium, potassium, and ammonium phosphites	>5000	>5000	-	-	4 hrs
Presidio	fluopicolide	>2000	>4000	-	-	12 hrs
Previcur Flex	propamocarb	2000-8550	>3920	3	2	12 hrs
Pristine	boscalid + pyraclostrobin	>2000	>2000	2	1	12 hrs
Procure 50 WS	triflumizole	2230	>2000	2	3	12 hrs
Prophyt	mono-, dibasic sodium, potassium and ammonium phosphites	5000	4000	-	-	4 hrs
Propimax	propiconazole	-	-	2	1	24 hrs
Quadris	azoxystrobin	>5000	>4000	3	1	4 hrs
Quadris Opti	azoxystrobin/ chlorothalonil	1750	>5000	3	1	12 hrs
Quintec	quinoxifen	>2000	>2000	-	-	12 hrs
Quilt	azoxystrobin/ propiconazole	1750	>5000	2	1	24 hrs
Reason 500 SC	fenamidone	>5000	>5000	-	-	12 hrs
Revus	mandipropamid	>5000	>5000	-	-	12 hrs
Revus Top	Mandipropamid/difenoconazole	2958	>5000	-	-	12 hrs
Ridomil Gold/Bravo	mefenoxam/chlorothalonil	2438	>2020	1	2	48 hrs
Ridomil Gold MZ	mefenoxam/mancozeb	>5000	>2000	1	1	48 hrs
Ridomil Gold/Copper	mefenoxam/copper hydroxide	550	>2020	1	1	48 hrs
Ridomil Gold PC	mefenoxam/PCNB	3990-5050	>2020	1	2	48 hrs
Ridomil Gold GR	mefenoxam	>5000	>2000	1	2	48 hrs
Ridomil Gold SL	Mefenoxam	550	>2000	-	-	48 hrs
Ronilan	vinclozolin	>5000	>2000	2	3	12 hrs
Rovral	iprodione	1170	>2000	3	3	24 hrs
Scala SC	pyrimethanil	>4505	>5000	-	-	12 hrs
Serenade	<i>Bacillus subtilis</i>	>5000	>2000	3	1	4 hrs
SoilGard	<i>Gliricidium virens</i>	-	-	-	-	-
Sulfur DF	sulfur	-	-	1	1	24 hrs
Switch 62.5 WG	cypodiniil / fludioxonil	>5000	>2000	3	1	12 hrs
System 3-Seed Treatment	metalaxyl + PCNB + <i>Bacillus subtilis</i>	>5000	>2000	1	1	24 hrs
Tanos	famoxadone + cymoxanil	960-5000	>2000	-	-	12 hrs
• Telone C-17	dichloropropene / chloropicrin	304-519	200-500	2	3	5 hrs
Tenn-Cop 5E	copper salts of fatty & rosin acid	4000	>2000	-	-	12 hrs

<sup>1</sup> The LD<sub>50</sub> is a standard toxicological term which indicates the number of milligrams (mg) of pesticide per kilogram (kg) of test animal body weight required to kill 50 percent of a test animal population. Values less than 10 indicate extremely high toxicity to mammals. The LD<sub>50</sub> data have been obtained from Material Safety Data Sheets.

<sup>2</sup> 1=high, 2=intermediate, 3=low. These leaching/runoff potential ratings are from the NRCS WIN-PST Pesticide Properties Database at <http://www.wcc.nrcs.usda.gov/pestmgmt/winpst.html>

<sup>3</sup> SL=See Label. Read and follow the label directions. Post areas or give oral warnings that areas have been treated to warn workers not to enter until the REI has elapsed as required by the label.

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## LIST OF FUNGICIDES USED ON COMMERCIAL VEGETABLES (cont.)

Terraclor	PCNB	3700-6400	>2000	3	2	12 hrs
Thiolux Jet DF	Sulfur	>5000	>2000	1	1	24 hrs
Thiram	Thiram	>2000	>5000	3	3	24 hrs
Tilt	Propiconazole	1310	>5000	2	1	24 hrs
Topsin M	thiophanate-methyl	>5000	>2000	3	2	12 hrs
Trilogy	neem oil	>5000	-	3	2	4 hrs
Ultra Flourish	Mefenoxam	1172	>2020	1	2	48 hrs
Vapam	metam-sodium	812	>2020	2	3	48 hrs
Ziram 76DF	ziram	1889	>5000	2	3	48 hrs

<sup>1</sup> The LD<sub>50</sub> is a standard toxicological term which indicates the number of milligrams (mg) of pesticide per kilogram (kg) of test animal body weight required to kill 50 percent of a test animal population. Values less than 10 indicate extremely high toxicity to mammals. The LD<sub>50</sub> data have been obtained from Material Safety Data Sheets.

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## INSECTICIDE EFFECTIVENESS

Most insecticides are not equally effective against all groups of insects. The following table categorizes the insecticides that are registered for use on vegetable crops on the basis of general effectiveness against broad groups of insects (for example, effectiveness against beetles or aphids, F = fair, G = good), relative length of residual activity, estimated mammalian toxicity, etc. These generalities will not hold true under all conditions (such as particular host crops or pests, weather conditions, soil conditions, etc.) but they should help the grower choose materials. Materials listed with a "dash" under effectiveness are ineffective or there was no data available (presumed to be ineffective).

### General Insecticide Effectiveness

Common Name	Treatment Type	Aphids	Leaf-hoppers	Plant Bugs	Thrips	Caterpillars	Beetles	Root Maggots	Residual Activity	Mammalian Toxicity	Bee Toxicity <sup>1</sup>	Runoff/Leaching Potential <sup>2</sup>	Restricted Use Pesticide	Comments
abamectin (Agri-Mek)	foliar spray	—	—	—	—	—	G	—	moderate	low	HT	L/S	yes	effective on mites and leafminers
acephate (Orthene Acephate UP)	foliar spray	G	G	G	G	G	F	—	long	low	HT	S/S	no	—
acetamiprid (Assail)	foliar spray	G	F	G	G	-	G	-	moderate	low	MT	-	no	
<i>Bacillus thuringiensis</i> <i>kurstaki</i> (Agree, Biobit, Dipel, Javelin, Lepinox Xentari)	foliar spray	—	—	—	—	G	—	—	short	none	NT	—	no	biological insecticide, good selective treatment
<i>Bacillus thuringiensis</i> <i>tenebrionis</i> (Novodor)	foliar spray	—	—	—	—	—	—	—	short	none	NT	—	no	small Colorado potato beetle larvae only
Bifenthrin (Capture, Brigade, Bifenture)	foliar spray	F	G	G	G	G	G	---	Moderate	Moderate	HT		yes	
carbaryl (Sevin)	foliar spray	—	G	G	G	G	G	—	short	low	HT	M/S	no	may cause aphid build-up
carbofuran (Furadan)	foliar spray	F	G	G	G	—	G	—	very long	very high oral, low dermal	HT	S/L	yes	
chlorpyrifos (Lorsban)	soil treatment, foliar spray	—	—	—	—	G	—	G	moderate	moderate oral, low dermal	HT	L/S	no	—
clothianidin (Poncho, Clutch)	seed treatment foliar spray	-	-	-	-	-	G	G	moderate	low	LT	-	No	commercial seed treatment
cyfluthrin (Baythroid)	foliar spray	F	G	G	G	G	G	—	moderate	low	HT	L/S	yes	—
Cyhalothrin (Warrior, Proaxis, Lambda-Cy)	foliar spray	F	G	G	G	G	G	—	moderate	low	HT	S/L	yes	—
cypermethrin (Ammo, Mustang, UP-Cyde)	foliar spray	—	G	G	G	G	G	—	moderate	moderate	HT	L/XS	yes	—

1. HT=HIGHLY TOXIC. This group includes materials that kill bees on contact during application and for one or more days after treatment. Bees should be moved from the area if highly toxic materials are used on plants the bees are visiting.

MT= MODERATELY TOXIC. These materials can be used with limited danger to bees if not applied over bees in the field or the hives. Correct dosage, timing and method of application are essential.

NT=RELATIVELY NONTOKIC. Materials in this group can be used with few precautions and a minimum of injury to bees.

2. Xs = extra small, S= small, M= medium, L = Large. These leaching/runoff potential ratings are from the NRCS WIN-PST Pesticide Properties Database at <http://www.wcc.nrcs.usda.gov/pestmgt>

## General Insecticide Effectiveness (continued)

Common Name	Treatment Type	Aphids	Leaf-hoppers	Plant Bugs	Thrips	Caterpillars	Beetles	Root Maggots	Residual Activity	Mammalian Toxicity	Bee Toxicity <sup>1</sup>	Runoff/Leaching Potential <sup>2</sup>	Restricted Use Pesticide	Comments
cyromazine ( <i>Trigard</i> )	foliar spray for leaf miners	—	—	—	—	—	—	—	moderate	low	—	M/L	yes	insect growth regulator
diazinon ( <i>Diazinon</i> )	foliar spray, soil treatment	G	G	—	G	G	G	F	moderate	moderate	HT	L/S	no	—
dicofol ( <i>Kelthane</i> )	foliar spray	—	—	—	—	—	—	—	short	low	LT	L/XS	no	specific miticide
deltamethrin ( <i>Decis</i> )	foliar spray	G	F	G	F	--	G	--	moderate	low	HT	--	no	--
dinotefuran ( <i>Venom</i> )	foliar spray or soil treatment	G	F	G	F	--	G	--	moderate	low	MT	--	no	--
dimethoate ( <i>Cygon</i> )	foliar spray	G	G	G	G	—	—	—	moderate	moderate	HT	S/M	no	good selective insecticide, miticide
disulfoton ( <i>Di-Syston</i> )	soil systemic or foliar spray	G	G	—	G	—	G	—	very long	very high	MT	M/S	yes	—
endosulfan	foliar spray	G	G	G	—	G	G	—	moderate	high	MT	L/XS	no	—
esfenvalerate ( <i>Asana</i> )	foliar spary	F	G	G	G	G	G	—	moderate	low	HT	M/S	yes	—
ethoprop ( <i>Mocap</i> )	soil treatment	—	—	—	—	G	G	G	long	high	MT	M/L	yes	good nematocide
flonicamid ( <i>Beleaf</i> )	Foliar spray	G	—	G	—	—	—	—	moderate	low	LT	—	No	—
imidacloprid ( <i>Admire, Provado, Nuprid, Gaucho, Genesis</i> )	foliar spray or in-furrow	G	F	G	F	—	G	—	long	low	MT	unknown	no	—
indoxacarb ( <i>Avaunt</i> )	foliar spray	—	—	—	—	G	—	—	moderate	low	—	—	—	Helps conserve beneficials
malathion	foliar spray	G	G	G	G	G	G	—	short	low	MT	S/S	no	—
metaldehyde	bait	—	—	—	—	—	—	—	moderate	moderate	LT	M/S	no	effective for controlling slugs and snails
methamidophos ( <i>Monitor</i> )	foliar spray	G	G	G	G	G	G	—	long	high	—	S/M	yes	—
methomyl ( <i>Lannate</i> )	foliar spray	G	G	G	G	G	F	—	moderate	high oral, low dermal	HT	M/L	yes (except soluble package)	—
methoxyfenozide ( <i>Intrepid</i> )	foliar spray	—	—	—	—	G	—	—	Moderate	Low	LT	—	no	—
naled ( <i>Dibrom</i> )	foliar spray	G	G	G	—	G	F	—	short	moderate	—	S/S	no	good miticide
novaluron ( <i>Rimon</i> )	foliar spray	-	-	-	-	G	G	-	Short	low	NT	unknown	no	small larvae only – a molting disruptor

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# General Insecticide Effectiveness (continued)

Common Name	Treatment Type	Aphids	Leaf-hoppers	Plant Bugs	Thrips	Caterpillars	Beetles	Root Maggots	Residual Activity	Mammalian Toxicity	Bee Toxicity <sup>1</sup>	Runoff/Leaching Potential <sup>2</sup>	Restricted Use Pesticide	Comments
Oxamyl (Vydate)	foliar spray	G	G	—	—	—	G	—	moderate	high oral, low dermal	MT	S/S	yes	good miticide & nematocide; good for leafminers
oxydemetonmethyl (Meta-Systox R)	foliar spray	G	G	G	F	—	—	—	moderate	high oral, moderate dermal	MT	S/L	yes	good miticide, good selective insecticide
permethrin (Ambush, Pounce, Perm-Up)	foliar spray	F	G	G	G	G	G	G	long	low	HT	L/XS	yes	—
phorate (Thimet)	soil systemic	G	G	—	G	G	G	—	very long	very high	MT	L/S	yes	—
phosmet (Imidan)	foliar spray	G	G	G	—	—	—	G	moderate	moderate oral, low dermal	HT	M/S	no	—
piperonyl butoxide (Butacide, PBO-8)	foliar spray	—	—	—	—	—	—	—	short	none	NT	—	no	not directly toxic, blocks some resistance mechanisms
rotenone (Rotenox, Rotacide)	foliar spray	G	—	—	—	G	G	—	short	moderate oral, low dermal	NT	—	no	excellent for resistant Colorado potato beetles
spinetoram (Radiant)	foliar spray	-	-	-	G	G	G	-	long	low	MT	---	no	—
spinosad (SpinTor, Entrust)	foliar spray	-	-	-	G	G	G	-	moderate	low	MT	low	no	—
spiromesifen (Oberon)	foliar spray	--	--	--	--	--	--	--	moderate	low	LT	--	no	miticide
pyriproxifen	foliar spray	--	--	--	--	--	--	--	moderate	low	LT	--	no	action on whiteflies
tefluthrin (Force)	soil treatment	—	—	—	—	G	G	—	long	low	—	low	no	—
terbufos (Counter)	soil treatment	—	—	—	—	—	G	G	long	very high	MT	M/S	yes	good nematocide
thiodicarb (Larvin)	foliar spray	—	F	F	—	G	G	—	short	moderate oral, low dermal	HT	M/S	no	—
thiamethoxam (Actara, Cruiser, Platinum)	foliar spray soil treatment or seed treatment	G	G	G	—	—	G	—	long	low	MT	unknown	no	—

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## Conversion Equivalents and Abbreviations

### Measurements

1 fluid ounce (fl oz)=2 tablespoons (Tbsp) =

6 teaspoons

1 cup (c)=8 fluid ounces (fl oz)

1 pint (pt)= 16 fluid ounces (fl oz) =

32 tablespoons (Tbsp)

1 quart (qt)=2 pints (pts) = 32 fluid

ounces (fl oz)

1 gallon (gal)=4 quarts (qt) = 12 fluid

ounces (fl oz)

1 pound (lb)=16 ounces (oz)

1 Acre (A)=43,560 square feet (sq ft)

=17,424 row feet (ft) for 30 in. rows

ppm=parts per million

### Label Key

B means Bait

D means Dust

DF means Dry Flowable

DG means Dispersable Granule

EC means Emulsifiable Concentrate, or Emulsion

F means Flowable

G means Granule

L or LC means Liquid Concentrate

LS means Liquid Solution

S means Sprayable

SC means Suspension Concentrate

SP means Soluble Powder

μ means micro

μm means micrometer

W or WP means Wettable Powder

RUP means Restricted Use Pesticide

### Calculation of Banded Rates

To calculate a banded rate from a given broadcast rate, use the following formula:

$$\text{Rate/A needed for banded application} = \frac{\text{Band width in inches} \times \text{Broadcast Rate/A}}{\text{Row spacing in inches}}$$



# Asparagus

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) to subscribe.)

## INSECTS

### FOLIAR TREATMENT:

**CUTWORM:** Apply if >5% of crowns are infested.

*Lannate* LV (3 pt) or *Lannate* SP (1 lb) (7 days) (RUP)

or

Permethrin

*Perm-UP* 3.2 EC (4 oz) or *Pounce* 25 WP (6.4 oz) or *Pounce* 3.2 EC (4 oz) (1 day) (RUP)

**ASPARAGUS BEETLE:** Apply during harvest season if >2% of spears have eggs or >5% of plants are infested with common asparagus beetle. Treat after harvest if defoliation exceeds 10%.

Carbaryl

*Sevin* 4 F (1 to 2 qt) or *Sevin* 80 WSP (1 1/4 to 2 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt) (1 day) Apply treatments no closer than 3 days apart. Maximum of 3 applications to spears and 5 applications total per year. Apply 2 1/2 to 5 lb of 80 WSP or 2 to 4 qt of 4 F or XLR Plus on ferns post-harvest.

or

*Lannate* LV (1 1/2 to 3 pt) or *Lannate* SP (1/2 to 1 lb) (1 day) (RUP)

or

*Lorsban* 4 E / *Lorsban* Advanced, 2 pt. (1 day) Limited to 1 pre-harvest application and 2 applications to fern per season. (RUP)

or

*Malathion* 57 EC, 1 1/2 to 2 pt. (3 days)

or

Permethrin

*Perm-UP* 3.2 EC (2 to 8 oz) or *Pounce* 25 WP (3.2 to 6.4 oz) or *Pounce* 3.2 EC (2 to 4 oz) (1 day) (RUP)

or

*SpinTor* 2 SC, 4 to 6 fl oz. (60 days) Fern treatment only.

or

*Entrust*, 1.3 to 2 oz. (60 days) Fern treatment only.

or

*Radiant* SC, 4 to 8 fl oz. (60 days) Fern Treatment Only. Do not make more than 3 applications or exceed 24 fl oz/acre per season.

**ASPARAGUS APHIDS:** Apply if >5% of ferns show injury.

*Dimethoate* 2.67 EC, 3/4 to 1.5 pints. Post harvest only.

or

*Lorsban* 4 E / *Lorsban* Advanced, 2 pt. (1 day) Limited to 1 pre-harvest application and 2 applications to fern per year. (RUP)

or

*Malathion* 57 EC, 1 1/2 to 2 pt. (3 days)

or

*Di-Syston* 8 E, 1 pt. (45 days) Fern application only. Maximum 2 applications per year. (Special Michigan SLN label). (RUP)

or

*Fulfill*, 2.75 oz. (170 days) Fern application only. May require 5 to 7 days for aphid mortality.

**PLANT BUGS:** Apply if >5% of new growth shows tip die-back injury.

Permethrin

*Perm-UP* 3.2 EC (4 oz) or *Pounce* 25 WP (6.4 oz) or *Pounce* 3.2 EC (4 oz) (7 days) (RUP)

## DISEASES

### PRE-PLANT FUMIGATION:

Soil sterilization by fumigation is best achieved by proper application of material. Correct soil moisture, temperature, and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or immediate tarping.

### CROWN NURSERY:

#### FUSARIUM CROWN ROT, ROOT ROT:

1,3 Dichloropropene/chloropicrin

*Telone* C35, 13-35 gal. (RUP)

or

Metam Sodium

*Sectagon* 42, *Vapam* HL, 37.5-75 gal.

or

Potassium N-methylidithiocarbamate

*Sectagon-K54*, 30-60 gal.

### FOLIAR TREATMENT:

**RUST** (*Puccinia asparagi*): Apply after harvest (fern growth only).

\* Tebuconazole

*Folicur* 3.6F, 4-6 fl oz. (180 days) Maximum 3 applications per season. Maximum 18 fl oz/acre/season. 12 hr REI.

or

Chlorothalonil

*Bravo* Ultrex, *Equus* DF, 1.8 to 3.6 lb. (190 days) Every 14 to 28 days.

or

*Bravo* Weather Stik, *Echo* 720, *Equus* 720 SST, 2 to 4 pt. (190 days)

or

Mancozeb

*Dithane* DF Rainshield, *Dithane* M-45, 2 lb. (180 days)

*Dithane* F-45 Rainshield, 1.6 qt. (180 days)

*Manzate* 75 DF, 2 lb. (180 days) Maximum 8 lb/season.

*Penncozeb* 4 F, 1.6 qt. (180 days)

or

*Penncozeb* 75 DF, *Penncozeb* 80 WP, 2 lb. (180 days) Maximum 8 lb/season.

or

Myclobutanil

*Rally* 40 WSP, 5 oz. (180 days) At least every 14 days, 6 applications maximum.

or

Sulfur

*Kumulus* DF, *Thiolux* Jet, 10 to 30 lb. (0 days)

*Sulfur* DF, 10 to 30 lb. (0 days)

**Note:** Control will be limited under heavy disease pressure.

## Beans, Snap

**PHYTOPHTHORA SPEAR ROT, CROWN ROT:** Apply 30 to 60 days before first cutting, and another application just before harvest in a minimum of 10 gal of water.

\* Mefenoxam

*Ridomil Gold SL*, 1 pt. (1 day)

*Ultra Flourish*, 2 pt. (1 day)

or

Mono-, dibasic sodium, potassium and ammonium phosphites

*Phostrol*, 2.5 to 5 pt. (0 days) Apply to full fern.

*Prophyt*, 2 to 4 pt. (0 days)

or

Mono-, dibasic sodium salts of phosphorous acid

*Fosphite*, 1 to 3 qt per 20 gal (ground) or 10 gal (aerial) of water. (0 days)

**PURPLE SPOT** (*Stemphylium vesicarium*):

\* Chlorothalonil

*Bravo Ultrex*, *Equus DF*, 1.8 to 3.6 lb. (190 days) Every 14 to 28 days.

or

*Bravo Weather Stik*, *Echo 720*, *Equus 720 SST*, 2 to 4 pt. (190 days)

or

Azoxystrobin

*Amistar*, 2 to 5 oz. (100 days) every 7-14 days.

*Quadris*, 6.0-15.0 fl oz. (100 days)

Do not apply more than one foliar application of Amistar or Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

**Note:** Products labeled for rust control may be helpful for purple spot control

## Beans, Snap

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

### SOIL TREATMENT:

(See E-2200, Soybean Cyst Nematode).

*Mocap 15 G*, 40 to 54 lb/A. Broadcast from 3 days prior to planting to at-planting time and incorporate to a depth of 4 inches. (RUP)

### PLANTING TREATMENT:

*Mocap 15 G*, 13 to 20 lb. (36 inch row spacing) In a 12- to 15-inch band over the row. Do not allow spray or granules to contact the seed. (RUP)

## INSECTS

### SEED TREATMENT:

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

**SEED CORN MAGGOT, BEAN MAGGOT:** Adults are attracted to rotting organic matter and freshly plowed soil for egg laying. Plow sod and green manure crops under thoroughly and use the seed treatment suggestions below.

*Diazinon 50 WP*, 1/2 oz per bushel of seed. Planter box treatment. (RUP)

or

*Lorsban 50 SL*, 2 oz/100 lb seed as slurry treatment only. (RUP)

**SEED CORN MAGGOT, BEAN LEAF BEETLE,**

**LEAFHOPPERS:** Early season control.

*Cruiser 5 FS*, 1.3 fl oz per 100 lb seed.

or

*Gaucho 480*, 2 to 4 fl oz per 100 lb seed.

### PLANTING TREATMENT:

**MEXICAN BEAN BEETLE, LEAFHOPPERS, APHIDS, MITES:**

Imidacloprid

*Admire Pro*, 4.6 F, 7.0 to 10.5 fl oz. (21 days) See label for application method.

or

*Nuprid 2 F*, 16 to 24 fl oz. (21 days) Apply preplant, in furrow, or as a post-planting drench.

or

*Di-Syston 15 G* (6 to 12 oz/1,000 ft) or *Di-Syston 8 E* (0.9 to 1.9 oz/1,000 ft) (60 days) Do not apply directly on the seed. (RUP)

or

Phorate

*Thimet 20 G*, 4.9 to 9.4 oz / 1,000 ft. (60 days) Do not feed foliage of treated beans to livestock. Do not apply directly in contact with the seed. (RUP)

### FOLIAR TREATMENT:

**LEAFHOPPERS:** Apply when 5 or more are seen per ft of row (2/ft for seedlings).

\* *Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (7 days) (RUP)

or

Acephate

*Acephate 97 UP*, *Orthene 97*, 1/2 to 1 lb. (14 days) Do not apply more than 2-1/8 lb per season.

or

*Asana XL*, 2.9 to 5.8 oz. (3 days) **Note:** Do not allow livestock to graze treated fields. Do not harvest treated bean vines for livestock forage, fodder or hay. (RUP)

or

Bifenthrin

*Bifenture EC*, *Brigade 2EC*, *Capture 2 EC*, 1.6 to 6.4 oz. (3 days) (RUP)

or

Carbaryl

*Sevin 80 S* (1 1/4 lb) or *Sevin XLR Plus* (1 qt) (3 days)

See label for pre-harvest intervals for forage and fodder.

or



*Dibrom* 8 EC, 1 pt. (1 day)

**Note:** Do not feed treated vines to livestock.

or

*Dimethoate* 2.67 EC, 3/4 to 1 1/2 pt. (0 days)

**Note:** Do not feed treated forage to livestock.

or

*Lannate* LV (3/4 to 3 pt (1 1/2 pt or less, 1 day; over 1 1/2 pt, 3 days)) or *Lannate* SP (1/4 to 1 lb (1/2 lb or less, 1 day; over 1/2 lb, 3 days)) (RUP)

or

*Imidacloprid*

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.5 fl oz. (7 days) Do not exceed 10.5 oz/Acre per season.

or

*Mustang* Max, 2.8 to 4.0 oz. (1 day) (RUP)

or

*Lambda-cyhalothrin*

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (7 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (3 days) (RUP)

or

*Assail* 30 SG, 2.5 to 5.3 oz. (7 days)

or

*Brigadier*, 3.8 to 5.5 oz. (7 days)

**EUROPEAN CORN BORER:** Treat at bud-bloom stage. Use higher rates and/or more frequent application during periods of high adult activity and egg laying.

\* *Acephate*

*Acephate* 97 UP, *Orthene* 97, 3/4 to 1 lb. (14 days) Do not apply more than 2-1/8 lb per season.

or

\* *Asana* XL, 5.8 to 9.6 oz. (3 days) **Note:** Do not allow livestock to graze treated fields. Do not harvest treated bean vines for livestock forage, fodder, or hay. (RUP)

or

\* *Bifenthrin*

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (3 days) (RUP)

or

\* *Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (7 days) (RUP)

or

*Carbaryl*

*Sevin* 80 S (1 1/2 lb) or *Sevin* XLR Plus (1 to 1 1/2 qt) (3 days)

or

*Lannate* LV (1 1/2 to 3 pt (1 1/2 pt, 1 day; over 1 1/2, pt 3 days)) or *Lannate* SP (1/2 to 1 lb (1/2 lb, 1 day; over 1/2 lb, 3 days))

**Note:** Do not graze or feed treated bean vines to livestock within 3 days nor bean hay within 7 days of last application. (RUP)

or

*SpinTor* 2 SC, 3 to 6 oz. (3 days)

or

*Mustang* Max, 2.8 to 4.0 oz. (1 day) (RUP)

or

*Lambda-cyhalothrin*

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (7 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (3 days) (RUP)

or

*Radiant* SC, 3 to 8 fl oz. (3 days) Do not make more than 6 applications or exceed 28 fl oz/acre per season.

or

*Brigadier*, 5.1 to 5.5 oz. (7 days)

**BEAN LEAF BEETLE:** Feeding on seedlings can cause severe defoliation. Treat if numbers exceed 1 per plant or defoliation exceeds 50%. A preharvest application may also be necessary to prevent pod damage.

*Bifenthrin*

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (3 days) (RUP)

or

*Carbaryl*

*Sevin* 80 S (5/8 to 1-1/4 lb) or *Sevin* XLR Plus (1 to 1 1/2 qt) (3 days)

or

*Acephate*

*Orthene* 75 S, 2/3 to 1-1/3 lb. (14 days)

or

*Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (7 days) (RUP)

or

*Mustang* Max, 2.8 to 4.0 oz. (1 day) (RUP)

or

*Lambda-cyhalothrin*

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (7 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (3 days) (RUP)

or

*Assail* 30 SG, 2.5 to 5.3 oz. (7 days)

or

*Brigadier*, 5.1 to 5.5 oz. (7 days)

**CORN EARWORM:** Treat from bud stage to 7 days before harvest if significant numbers of adults are being trapped in pheromone traps.

*Acephate*

*Acephate* 97 UP, *Orthene* 97, 3/4 to 1 lb. (14 days) Do not apply more than 2-1/8 lb per season.

or

*Asana* XL, 5.8 to 9.6 oz. (3 days) **Note:** Do not allow livestock to graze treated fields. Do not harvest treated bean vines for livestock forage, fodder, or hay. (RUP)

or

*Bifenthrin*

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (3 days) (RUP)

or

*Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (7 days) (RUP)

or

*Mustang* Max, 2.8 to 4.0 oz. (1 day) (RUP)

or

*Lambda-cyhalothrin*

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (7 days) (RUP)

or

*Brigadier*, 5.1 to 5.5 oz. (7 days)

## Beans, Snap

**CUTWORM:** Cutworm feed on plants close to soil surface. Control may be applied when the crop first comes up and as needed.

\* *Asana* XL, 9.6 oz. (3 days) Do not allow livestock to graze treated fields. Do not harvest treated bean vines for livestock forage, fodder, or hay. (RUP)

or

\* Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (3 days) (RUP)

or

\* *Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (7 days) (RUP)

or

Carbaryl

*Sevin* 20 B (10 lb) or *Sevin* 5 B (40 lb) or *Sevin* 80 S (1 7/8 lb) or *Sevin* XLR Plus (1 to 1 1/2 qt) (3 days) See label for pre-harvest intervals for forage and fodder.

or

*Lannate* LV (1 1/2 to 3 pt (1 1/2 pt, 1 day; over 1 1/2, pt 3 days))

or *Lannate* SP (1/2 to 1 lb (1/2 lb, 1 day; over 1/2 lb, 3 days))

**Note:** Do not graze or feed treated bean vines to livestock within 3 days nor bean hay within 7 days of last application. (RUP)

or

*Mustang* Max, 2.8 to 4.0 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (7 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (3 days) (RUP)

or

*Brigadier*, 5.1 to 5.5 oz. (7 days)

**MEXICAN BEAN BEETLE:** Apply if there is more than 1 adult/2 plants or 1 egg mass/ft. of row.

\* *Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (7 days) (RUP)

or

Acephate. Also registered for bean leaf beetle.

*Acephate* 97 UP, *Orthene* 97, 1/2 to 1 lb. (14 days) Do not apply more than 2-1/8 lb per season.

or

Carbaryl. Also registered for bean leaf beetle.

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 qt) (3 days) See label for pre-harvest intervals for forage and fodder.

or

*Endosulfan* 3 EC, 2 pt. (3 days) Apply only 3 times per season.

**Note:** Do not feed threshings to livestock or allow them to graze. See label for further restrictions.

or

*Lannate* LV (3/4 to 3 pt (1 1/2 pt or less, 1 day; over 1 1/2 pt, 3 days)) or *Lannate* SP (1/4 to 1 lb (1/2 lb or less, 1 day; over 1/2 lb, 3 days)) (1 day) **Note:** Do not graze or feed treated bean vines to livestock within 3 days, nor bean hay within 7 days of last application. (RUP)

or

*Malathion* 57 EC, 1 1/2 pt. (1 day) Also registered for bean leaf beetle.

or

*Mustang* Max, 2.8 to 4.0 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (7 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (3 days) (RUP)

or

*Assail* 30 SG, 2.5 to 5.3 oz. (7 days)

**TARNISHED PLANT BUG:** Treat if numbers exceed 1 per 5ft of row.

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (3 days) (RUP)

or

*Lannate* LV (3/4 to 3 pt (1 1/2 pt or less, 1 day; over 1 1/2 pt, 3 days)) or *Lannate* SP (1/4 to 1 lb (1/2 lb or less, 1 day; over 1/2 lb, 3 days)) (1 day) **Note:** Do not graze or feed treated bean vines to livestock within 3 days, nor bean hay within 7 days of last application. (RUP)

or

*Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (7 days) (RUP)

or

*Hero*, 10.3 oz. (3 days) (RUP)

or

*Brigadier*, 3.8 to 5.5 oz. (7 days)

**GREEN CLOVERWORM:** Apply when damage to leaves is seen.

*Asana* XL, 5.8 to 9.6 oz. (3 days) **Note:** Do not allow livestock to graze treated fields. Do not allow harvest treated bean vines for livestock forage, fodder, or hay. (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (3 days) (RUP)

or

*Mustang* Max, 2.8 to 4.0 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (7 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (3 days) (RUP)

or

*Brigadier*, 5.1 to 5.5 oz. (7 days)

**APHIDS:** Apply if numbers exceed 1 per leaf.

\* Acephate

*Acephate* 97 UP, *Orthene* 97, 1/2 to 1 lb. (14 days) Do not apply more than 2-1/8 lb per season.

or

\* *Dimethoate* 2.67 EC, 3/4 to 1 1/2 pt. (1 day)

**Note:** Do not feed treated forage to livestock.

or

\* Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.5 fl oz. (7 days) Do not exceed 10.5 oz/Acre per season.

or

*Dibrom* 8 EC, 1 pt. (1 day)

**Note:** Do not feed treated vines to livestock.

or

*Malathion* 57 EC, 2 pt. (1 day)

or

*Brigadier*, 3.8 to 5.5 oz. (7 days)



## MITES

Apply to underside of leaves as needed. Most serious in dry years.

\* *Kelthane* MF, 3/4 to 1 pt. (7 days)

or

*Bifenthrin*

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 5.1 to 6.4 oz. (3 days) (RUP)

or

*Dibrom* 8 EC, 1 pt. (1 day)

**Note:** Do not feed treated vines to livestock.

or

*Dimethoate* 4 EC, 1 pt. (7 days)

**Note:** Do not feed treated forage to livestock.

## DISEASES

### SEED TREATMENT:

**DAMPING OFF** (*Pythium* spp., *Rhizoctonia solani*, early season *Phytophthora*, *Fusarium* spp.):

*Bacillus subtilis* GB03

*Kodiak*, 0.125 oz/100 lb seed. *Fusarium*, *Rhizoctonia*.

or

*Captan*

*Captan* 30-DD (2 1/4 oz/100 lb seed) or *Captan* 400 (2 to 3 oz/100 lb seed)

or

*Fludioxinil*

*Maxim* 4 FS, 0.08 to 0.16 fl oz/100 lb seed. Commercial seed treatment plants only. (*Fusarium*, *Rhizoctonia*).

or

*Mefenoxam*

*Apron* XL LS, 0.32 to 0.64 fl oz/100 lb seed. *Pythium* and *Phytophthora* only.

or

*Metalaxyl*

*Alliance-FL*, 0.75 to 1.5 oz/100 lb seed. *Pythium* and *Phytophthora*.

or

*Apron* 50 W, 1/2 to 1 oz/100 lb seed. *Phytophthora*.

*System* 3-Seed Treatment, 2 to 3 oz.

or

*Thiram*

42-S *Thiram*, *Thiram* 50 WP Dyed, 2 oz/100 lb seed.

### PREPLANT INCORPORATED:

**DAMPING OFF** (*Pythium* and *Phytophthora* spp. and *Rhizoctonia solani*):

\* *Mefenoxam/PCNB*

*Ridomil* Gold PC, 3/4 lb/1,000 linear feet of row. Apply at the time of planting (*Pythium* and *Rhizoctonia* only).

**Note:** Do not feed treated vines to livestock.

### SOIL TREATMENT AT PLANTING:

**ROOT and STEM ROT** (*Rhizoctonia solani*):

*PCNB*

*Blocker* 4 F, 2.2 to 3.3 oz/100 row feet.

or

*Terraclor* 2 E (1/2 to 3/4 gal) or *Terraclor* 75 WP (1 1/3 to 2 lb) or *Terraclor* F (2 to 3 pt) Use in 8 to 10 gallons of water. Avoid spraying directly to seed; otherwise delayed emergence may occur. **Note:** Do not feed treated vines to livestock.

### FOLIAR TREATMENT:

**ANTHRACNOSE** (*Colletotrichum lindemuthianum*):

\* *Thiophanate-Methyl*

*Topsin* 4.5 FL, 20-40 fl oz. (14 days) Apply at 10 to 30% bloom, repeat once 4 to 7 days or at peak bloom.

or

*Topsin* M WSB, 1 to 1 1/2 lb. (14 days) Apply at 10 to 30% bloom, repeat once 4 to 7 days or at peak bloom.

or

*Azoxystrobin*

*Amistar*, 2 - 5 oz every 7-14 days. (0 days)

*Quadris*, 6.2 - 15.4 fl oz. (0 days)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

*Copper Sulfate*

*Basic Copper* 53 (2 to 4 lb) or *Basicop* (2 lb) (0 days) Apply at 7 to 10 day intervals when plants are 5 inches.

or

*Neem Oil*

*Trilogy*, 2 pt. (0 days)

or

*Copper Oxychloride / Copper Sulfate*

C-O-C-S WDG, 2 to 4 lb. (0 days)

**BACTERIAL BLIGHT** (*Pseudomonas phaseolicola*): Apply as a protective spray and continue at 7- to 14-day intervals through harvest. The treatment is particularly important during wet weather.

*Copper Sulfate*

*Basic Copper* 53 (2 to 4 lb) or *Basicop* (4 lb) (0 days)

*Cuprofix* Ultra, 3/4 to 2 lb. (0 days)

or

*Copper Ammonium Carbonate*

*Copper Count* N, 1 to 3 qt. (0 days)

or

*Copper Hydroxide*

*Champ* DP, 0.67 to 2 lb. (0 days)

*Champ* Formula 2 F, *Kocide* 4.5 LF, 2/3 to 2 pt. (0 days)

or

*Champion* WP, *Kocide* 101, *Kocide* DF, *Nu-Cop* 50 DF, 1 to 3 lb. (0 days)

or

*Kocide* 2000, 3/4 to 2 1/4 lb. (0 days)

*Nu-Cop* 3 L, 2/3 to 4 pt. (0 days)

or

*Copper Oxychloride / Copper Sulfate*

C-O-C-S WDG, 2 to 4 lb. (0 days)

or

*Copper Resinate*

*Tenn-Cop* 5 E, 3 pt. (0 days)

## Beets

**RUST** (*Uromyces phaseoli typica*): Apply when there are fewer than 10 pustules per plant and repeat every 7 days.

\* **Tebuconazole**

*Folicur* 3.6F, 4-6 fl oz. (7 days) Maximum 24 fl oz/acre/season.  
12 hr REI.

or

**Boscalid**

*Endura*, 8 to 11 oz. (7 days)

or

**Chlorothalonil**

*Bravo Ultrex*, *Equus* DF, 1.25 to 2.7 lb. (7 days)

or

*Bravo Weather Stik*, 1 3/8 to 3 pt. (7 days)

**Note:** Do not feed treated tops to livestock.

or

*Echo* 720, *Equus* 720 SST, 1.375 to 3 pt/A. (7 days)

*Echo* 90 DF, 1.2 to 2.4 lb. (7 days)

or

**Myclobutanil**

*Rally* 40 WSP, 4 to 5 oz. (0 days)

**Note:** Do not apply more than 1.25 lb/acre/crop.

or

**Neem Oil**

*Trilogy*, 2 pt. (0 days)

or

**Sulfur**

*Thiolux* Jet, 3 to 10 lb. (0 days)

**GRAY MOLD** (*Botrytis cinerea*):

\* **Iprodione**. Apply at early bloom and again at peak bloom if conditions are favorable for disease development. **Note:** Observe restrictions on feeding of forage. See label for permissible crop rotations.

*Iprodione* 4L AG, 1.5 to 2 pt.

*Rovral*, 1 1/2 to 2 lb. (14 days)

*Rovral* 4 F, 1/2 to 2 pt. (14 days)

or

\* **Thiophanate-Methyl**

*Topsin* 4.5 FL, 20-30 fl oz (2 applications), 30-40 fl oz (1 application). (14 days)

or

*Topsin* 70 W, *Topsin* M WSB, 1 1/2 to 2 lb. (14 days) Apply once using the higher rate at 50-70% of full bloom or apply twice using the lower rate with first application at 10 to 30% of full bloom and a second application 4 to 7 days later or at peak bloom. **Note:** Observe restrictions on feeding of forage.

or

\* **Chlorothalonil**. Begin applications during early bloom stage and repeat every 7 days. **Note:** Observe restrictions on feeding of forage.

*Bravo Ultrex*, *Equus* DF, 2.7 lb.

*Bravo Weather Stik*, 3 pt.

*Echo* 720, *Equus* 720 SST, 3 pt. (7 days)

*Echo* 90 DF, 2.4 lb. (7 days) Every 7-10 days.

or

**Boscalid**

*Endura*, 8 to 11 oz. (7 days)

or

**Neem Oil**

*Trilogy*, 2 pt. (0 days)

**WHITE MOLD** (*Sclerotinia sclerotiorum*):

**Boscalid**

*Endura*, 8 to 11 oz. (7 days)

or

**DCNA**

*Botran* 75 W, 2 1/4 lb (bush beans) or 4 lb (pole beans),. (2 days) Begin applications when disease is anticipated and continue at 7-day intervals during periods favorable to development of disease. **Note:** Observe restrictions on feeding of forage.

or

**Iprodione**. See label for permissible crop rotations. **Note:** Observe restrictions on feeding of forage.

*Iprodione* 4L AG, 1.5 to 2 pt. (0 days)

*Rovral*, 1 1/2 to 2 lb. (14 days)

or

*Rovral* 4 F, 1 1/2 to 2 pt. (14 days) Apply at early bloom and again at peak bloom if conditions are favorable for disease development.

or

**Neem Oil**

*Trilogy*, 2 pt. (0 days)

or

**Thiophanate-Methyl**

*Topsin* 4.5 FL, 20-40 fl oz. (14 days) Apply at 10 to 30% bloom, repeat once 4 to 7 days or at peak bloom.

or

*Topsin* 70 W, *Topsin* M WSB, 1 to 2 lb. (14 days) Apply once using the higher rate at 50 to 70% of full bloom or apply twice using the lower rate with first application at 10 to 30% of full bloom and a second application 4 to 7 days later or at peak bloom.

**Note:** Observe restrictions on feeding of forage.

## Beets

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

Sugar beet cyst and northern root-knot nematodes can reduce red beet yields. Fields with soil or root problems of undetermined cause should be tested for nematodes (see Appendix C). If the plant-parasitic nematodes are present in population densities above the economic threshold for red beets, crop rotation or application of a nematicide is recommended. The following nematicides are suitable for control of sugar beet cyst and northern root-knot nematodes in red beet production.



**FALL SOIL FUMIGATION (BROADCAST):**

1,3-D

*Telone* II, 25 gal/A (muck soil), 9-18 gal/A (mineral soil).

or

1,3-D and chloropicrin

*Telone* C-17, 27-30 gal/A (muck soil), 10-21 gal/A (mineral soil).

Fumigate in the fall when soil temperatures at a 6-inch depth are above 50F. 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. In some limited situations, soil fumigants can be applied in the spring in Michigan.

Correct soil moisture, temperature and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or by immediate tarping. (RUP)

**SOIL TREATMENT AT PLANTING:**

Fenamiphos (RUP)

*Nemacur* 3 S, 4-6 fluid oz/1,000 row feet. Apply in an 8- to 12-inch band over the row before or at seeding. Incorporate immediately by shallow cultivation or by sprinkler irrigation. Do not apply within 90 days of harvest. Apply only once per season.

**Note:** For hydrologic soil group A, soils that are excessively drained or predominantly sand or loamy sand with shallow water tables (less than 50 feet deep), *Nemacur* can no longer be used. For all other soil types, *Nemacur* will be sold until May 31, 2008 and stores of the product can be used until depleted.

**INSECTS****SOIL TREATMENT:****APHIDS, FLEA BEETLE:**

Imidacloprid

*Admire* Pro, 4.4 - 10.5 fl oz. (21 days) See label for application method.

or

*Nuprid* 2 F, 10 to 24 fl oz. (21 days) Apply preplant or in furrow.

or

*Platinum*, 5 to 6.5 fl oz.

**FOLIAR TREATMENT:****CUTWORM:** Usually damage plants soon after they emerge.

Apply if damage is observed.

\* *Baythroid* XL, 1.6 to 2.4 fl oz. (0 days) (RUP)

**FLEA BEETLE:** Apply if damage is noted on leaves.

*Actara*, 1.5 to 3 oz. (7 days)

or

*Baythroid* XL, 1.6 to 2.4 fl oz. (0 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 qt) (7 days; 14 days if tops are eaten or fed to livestock) See label for pre-harvest intervals for forage and fodder.

or

Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.5 fl oz. (7 days) Do not exceed 10.5 oz/Acre per season.

**APHIDS:** Apply as soon as they appear.

*Actara*, 1.5 to 3 oz. (7 days)

or

*Diazinon* AG 500, 1 pt. (14 days) (RUP)

or

*Malathion* 57 EC, 2 pt. (7 days)

or

Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.5 fl oz. (7 days) Do not exceed 10.5 oz/Acre per season.

**DISEASES****SEED TREATMENT:**

**DAMPING OFF** (*Pythium* spp., *Rhizoctonia solani*): Treatments are applied to seed prior to planting. Use Thiram and Captan as seed treatments only. Use only as directed; over-treatment may cause injury.

*Bacillus subtilis* GB03

*Kodiak*, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

Captan

*Captan* 30-DD, 9 1/2 oz.

*Captan* 400, 8 to 12 oz.

or

Fludioxinil

*Maxim* 4 FS, 0.08 to 0.16 fl oz/100 lb seed (*Rhizoctonia*).

Commercial seed treatment plants only.

or

Mefenoxam

*Apron* XL LS, 0.32 to 0.64 fl oz/100 lb seed (*Pythium*).

or

Metalaxyl

*Allegiance*-FL, 0.75 fl oz/100 lb seed (*Pythium*).

or

Thiram

42-S Thiram, *Thiram* 50 WP Dyed, 8 oz.

**PREPLANT INCORPORATED:****DAMPING OFF** (*Pythium* and *Phytophthora* spp.):

\* Mefenoxam. Apply as a broadcast preplant incorporation or a surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 2 in. of sprinkler irrigation.

*Ridomil* Gold SL, 1-2 pt.

*Ridomil* Gold WSP, 1 to 2 lb.

**FOLIAR TREATMENT:**

**CERCOSPORA LEAF SPOT** (*Cercospora beticola*): Apply every 7 to 10 days.

\* Azoxystrobin

*Amistar*, 3 to 5 oz every 7 - 14 days. (0 days)

*Quadris*, 9.2 to 15.4 fl oz. (0 days)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

## Broccoli

### \* Trifloxystrobin

*Flint*, 2 to 3 oz. (7 days) Do not apply more than three sequential foliar applications of strobilurin fungicides before alternating with a fungicide that has a different mode of action.

or

### Copper Sulfate

*Basicop* 53 WP, 3 lb. (0 days)

or

### Copper Hydroxide

*Champ* 2FL, 1 1/3 to 2 2/3 pt. (0 days)

*Champ* DP, 1 1/3 to 2 2/3 lb. (0 days)

*Champ* WP, 2 to 5 lb. (0 days)

*Kocide* 101, *Kocide* DF, 2 to 5 lb. (0 days)

*Kocide* 2000, 1 1/2 to 3 3/4 lb. (0 days)

*Kocide* 4.5 LF, 1 1/3 to 3 1/3 pt. (0 days)

*Nu-Cop* 3 L, 1 1/3 to 6 2/3 pt. (0 days)

or

### Tebuconazole

*Folicur* 3.6F, 3-7.2 fl oz. (7 days) Maximum 28.8 fl oz/acre/season. 12 hr REI.

## Broccoli

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

Sugar beet cyst, root-knot and lesion nematodes can reduce broccoli yields. Fields with soil or root problems of undetermined cause should be tested for nematodes (see Appendix C). If the plant-parasitic nematodes are present in population densities above the economic threshold for broccoli, crop rotation or application of a nematicide is recommended. The following nematicides are suitable for control of sugar beet cyst, root-knot and lesion nematodes in broccoli production.

### FALL SOIL FUMIGATION (BROADCAST): 1,3-D

*Telone* II, 25 gal/A (muck soil), 9-18 gal/A (mineral soil). Fumigate in the fall when soil temperatures at a 6-inch depth are above 50F. 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. In some limited situations soil fumigants can be applied in the spring in Michigan.

Correct soil moisture, temperature and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or by immediate tarping.

## INSECTS

### SEEDBED TREATMENT:

Apply treatments to soil according to directions to protect young seedlings in the seedbed before transplanting in field.

**CABBAGE MAGGOT:** Apply to seedbed surface and incorporate to 3 to 4 inches.

*Diazinon* AG 500, 2 to 3 qt. Apply only as directed. (RUP)

### SOIL TREATMENT:

#### APHIDS:

*Venom*, 5 to 6 oz. (21 days) See label for application method.

#### APHIDS, FLEA BEETLE:

*Platinum*, 5 to 11 fl oz. (30 days) See label for application methods.

### TRANSPLANT WATER TREATMENT:

#### CABBAGE MAGGOT:

*Diazinon* 50 WP (1 lb/100 gal) or *Diazinon* AG 500 (1/2 to 1 pt/100 gal) Use only as directed. (RUP)

### PLANTING TREATMENT:

Treatments applied at seeding.

#### CABBAGE MAGGOT:

*Lorsban* 15 G (4.6 to 9.2 oz /1,000 ft of row) or *Lorsban* 4 E / *Lorsban* Advanced (1.6 to 2.75 fl oz / 1,000 ft of row) Apply in a 4-inch band over row at time of seeding. Use only as directed. (RUP)

or

*Capture* LFR, 3.4 to 6.8 oz. See label for application methods.

**APHIDS, FLEA BEETLE:** Apply as band on each side of seed row or transplant row at time of planting or sidedressed after plants become established. Treatments applied at seeding or transplanting are translocated into foliage systemically.

*Di-Syston* 15 G, 7.4 oz / 1,000 ft. (40 days) Use only as directed. (RUP)

or

*Platinum*, 5 to 11 oz. (30 days) See label for application methods.

### SOIL TREATMENT AFTER TRANSPLANTING:

Apply to the soil at the base of plants after transplanting.

Adequate water is needed to wet the soil surface.

**APHIDS:** Apply as a post-seeding drench, transplant drench, or hill drench, or as a sidedress after plants are established.

Imidacloprid

*Admire* Pro, 4.4 - 10.5 fl oz. (21 days)

*Nuprid* 2 F, 10 to 24 oz. (21 days)

or

*Platinum*, 5 to 11 fl oz. (30 days)

#### CABBAGE MAGGOT:

*Lorsban* 4 E / *Lorsban* Advanced, 1.6 to 2.75 fl oz / 1,000 ft of row. (RUP)



**FOLIAR TREATMENT:****FLEA BEETLE:** Apply as needed soon after plants emerge.

Cypermethrin

*Ammo* 2.5 EC (2.5 to 5 oz) or *Ammo* WSB (1 to 2 bags) or *UP-Cyde* 2.5 EC (2.5 to 5 oz) (1 day) (RUP)

or

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

or

*Baythroid* XL, 2.4 to 3.2 fl oz. (0 days) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (7 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 qt) (3 days)

or

*Endosulfan* 3 EC, 2 pt. (7 days) Consult label for rotation restrictions.

or

Thiodicarb

*Larvin* 3.2 EC, 24 to 40 oz. (7 days)

or

*Lorsban* 50 W, 2 lb. (21 days) (RUP)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

*Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (1 day) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Venom*, 3 to 4 oz. (1 day)

or

Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.8 fl oz. (7 days) Do not exceed 19.2 oz/Acre per season.

or

*Actara*, 1.5 to 3 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

Permethrin

*Perm-UP* 3.2 EC, 2 to 4 oz. (1 day) (RUP)**CUTWORM, ARMYWORM:** Apply when damage is first seen.

Repeat as needed.

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

or

\* Cypermethrin

*Ammo* 2.5 EC (2.5 to 5 oz) or *Ammo* WSB (1 to 2 bags) or *UP-Cyde* 2.5 EC (2.5 to 5 oz) (1 day) (RUP)

or

\* *Baythroid* XL, 2.4 to 3.0 fl oz. (0 days) (RUP)

or

\* Bifenthrin (RUP)

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 6.4 oz. (7 days)

or

*Endosulfan* 3 EC, 2 2/3 pt. (7 days) Consult label for rotation restrictions.

or

*Lorsban* 50 W, 2 lb. (21 days) (RUP)

or

*Mustang* Max, 3.2 to 4.0 oz. (1 day) (RUP)

or

*SpinTor* 2 SC, 4 to 8 oz. (1 day) Do not apply more than 3 times in 30 days.

or

*Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (5 days) (RUP)

or

*Entrust*, 1 to 2 oz. (1 day)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (1 day) (RUP)

or

*Rimon*, 6 to 12 fl oz. (7 days)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 3.8 to 6.1 oz. (7 days)**IMPORTED CABBAGE WORM:** Apply if: 1) >10% of transplants are infested with any type of cabbage "worm" or 2) >50% of plants are infested before flowering, or 3) >10% of plants are infested at or after first flowering.

Cypermethrin

*Ammo* 2.5 EC (2.5 to 5 oz) or *Ammo* WSB (1 to 2 bags) or *UP-Cyde* 2.5 EC (2.5 to 5 oz) (1 day) (RUP)

or

*Asana* XL, 2.9 to 5.8 oz. (3 days) (RUP)

or

*Avaunt*, 2.5 to 3.5 oz. (3 days) Do not exceed 14 oz/acre per crop.

or

*Bacillus thuringiensis**Agree*, *Biobit*, *Dipel*, *Javelin*, *Lepinox*, *Xentari*. (0 days)

or

*Baythroid* XL, 1.6 to 2.4 fl oz. (0 days) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (7 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt) (3 days)

or

*Danitol* 2.4 EC, 10 2/3 to 16 fl oz. (7 days) (RUP)

or

*Diazinon* 50 WP (1 lb) or *Diazinon* AG 500 (1 pt) (7 days) (RUP)

or

*Dibrom* 8 EC, 1 pt. (1 day)

or

*Endosulfan* 3 EC, 2 pt. (7 days) Consult label for rotation restrictions.

or

## Broccoli

*Lannate* LV (3/4 to 3 pt) or *Lannate* SP (1/4 to 1/2 lb) (3 days) (RUP)

or

Thiodicarb

*Larvin* 3.2 EC, 24 to 40 oz. (7 days)

or

*Lorsban* 50 W, 2 lb. (21 days) (RUP)

or

*Malathion* 57 EC, 2 pt. (3 days)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

Permethrin

*Ambush* 25 W, 3.2 to 6.4 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (2 to 8 oz) or *Pounce* 25 WP (3.2 to 6.4 oz)

or *Pounce* 3.2 EC (2 to 4 oz) (1 day) (RUP)

or

*Proclaim*, 2.4 to 4.8 oz. (7 days) (RUP)

or

*SpinTor* 2 SC, 3 to 6 oz. (1 day) Do not apply more than 3 times in 30 days.

or

*Warrior* with Zeon Technology, 1.9 to 3.2 fl oz. (1 day) (RUP)

or

*Entrust*, 1 to 2 oz. (1 day) Do not apply more than 3 times in 30 days.

or

*Intrepid* 2 F, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 1.9 to 3.2 fl oz. (1 day) (RUP)

or

*Rimon*, 6 to 12 fl oz. (7 days)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 3.8 to 6.1 oz. (7 days)

**DIAMONDBACK MOTH:** Apply treatments if: 1) >10% of transplants are infested with any type of cabbage "worm", 2) >50% of plants are infested before flowering, or 3) >10% of plants are infested at or after 1st flowering. Use *Bacillus thuringiensis* to avoid killing important natural enemies of diamondback moth.

\* *Avaunt*, 3.5 oz. (3 days) Do not apply more than twice to one generation. Do not exceed 14 oz/acre per crop.

or

\* *Bacillus thuringiensis*

*Agree*, *Biobit*, *Dipel*, *Javelin*, *Lepinox*, *Xentari*. (0 days)

or

\* *SpinTor* 2 SC, 1.5 to 3 oz. (1 day) Do not apply more than 3 times in 30 days.

or

\* *Entrust*, 0.5 to 1.3 oz. (1 day) Do not apply more than 3 times in 30 days.

or

*Baythroid* XL, 2.4 to 3.2 fl oz. (0 days) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (7 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt) (3 days)

or

*Diazinon* 50 WP (1 lb) or *Diazinon* AG 500 (1 pt) (7 days) (RUP)

or

*Dibrom* 8 EC, 1 pt. (1 day)

or

*Endosulfan* 3 EC, 2 pt. (1 day) Consult label for rotation restrictions.

or

*Lannate* LV (1/2 to 3 pt) or *Lannate* SP (1/2 to 1 lb) (3 days) (RUP)

or

Thiodicarb

*Larvin* 3.2 EC, 24 to 40 oz. (7 days)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

Permethrin

*Ambush* 25 W, 3.2 to 6.4 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (2 to 8 oz) or *Pounce* 25 WP (3.2 to 6.4 oz)

or *Pounce* 3.2 EC (2 to 4 oz) (1 day) (RUP)

or

*Proclaim*, 2.4 to 4.8 oz. (7 days) (RUP)

or

*Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (1 day) (RUP)

or

*Rimon*, 6 to 12 fl oz. (7 days)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 3.8 to 6.1 oz. (7 days)

**CABBAGE LOOPERS:** Apply treatments if: 1) >10% of transplants are infested with any type of cabbage "worm", 2) if >5% of plants are infested before flowering, or 3) if 10% of plants are infested at or after 1st flowering. Most controls are less effective on larger worms.

Cypermethrin

*Ammo* 2.5 EC (3.75 to 5 oz) or *Ammo* WSB (1 to 2 bags)

or *UP-Cyde* 2.5 EC (3.75 to 5 oz) (1 day) (RUP)

or

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

or

*Avaunt*, 2.5 to 3.5 oz. (3 days) Do not exceed 14 oz/acre per crop.

or



*Bacillus thuringiensis*

Agree, Biobit, Dipel, Javelin, Lepinox, Xentari. (0 days)

or

Baythroid XL, 1.6 to 2.4 fl oz. (0 days) (RUP)

or

Bifenthrin

Bifenture EC, Brigade 2EC, Capture 2 EC, 2.1 to 6.4 oz. (3 days) (RUP)

or

Danitol 2.4 EC, 10 2/3 to 16 fl oz. (7 days) (RUP)

or

Dibrom 8 EC, 2 pt. (1 day)

or

Endosulfan 3 EC, 1 1/3 qt. (7 days) Consult label for rotation restrictions.

or

Lannate LV (1/2 to 3 pt) or Lannate SP (1 lb) (3 days) (RUP)

or

Thiodicarb

Larvin 3.2 EC, 24 to 40 oz. (7 days)

or

Mustang Max, 3.2 to 4.0 oz. (1 day) (RUP)

or

Permethrin

Perm-UP 3.2 EC (4 oz) or Pounce 25 WP (3.2 to 6.4 oz) or Pounce 3.2 EC (4 oz) (1 day) (RUP)

or

Proclaim, 3.2 to 4.8 oz. (7 days) (RUP)

or

SpinTor 2 SC, 3 to 6 oz. (1 day) Do not apply more than 3 times in 20 days.

or

Warrior with Zeon Technology, 1.9 to 3.2 fl oz. (1 day) (RUP)

or

Intrepid 2 F, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

Entrust, 1 to 2 oz. (1 day) Do not apply more than 3 times in 30 days.

or

Lambda-cyhalothrin

Lambda-Cy, Proaxis, 1.9 to 3.2 fl oz. (1 day) (RUP)

or

Rimon, 6 to 12 fl oz. (7 days)

or

Hero, 4 to 10.3 oz. (7 days) (RUP)

or

Radiant SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

Brigadier, 3.8 to 6.1 oz. (7 days)

**APHIDS:** Apply if there are >100 aphids per plant before flowering or >5/plant at flowering or beyond.

Assail 30 SG, 1.9 to 2.8 oz. (7 days)

or

Diazinon 50 WP (1 lb) or Diazinon AG 500 (1 pt) (7 days) (RUP)

or

Dibrom 8 EC, 1 pt. (1 day)

or

Dimethoate 2.67 EC, 3/4 to 1 1/2 pt. (7 days)

or

Endosulfan 3 EC, 2 pt. (7 days) Consult label for rotation restrictions.

or

Fulfill, 2.75 oz. (7 days) May require 5 to 7 days for aphid mortality.

or

Lorsban 50 W, 2 lb. (21 days) (RUP)

or

Malathion 57 EC, 2 pt. (3 days)

or

Imidacloprid

Nuprid 1.6 F, Provado 1.6 F, 3.75 fl oz. (7 days) Do not use if Imidacloprid was used at planting. Do not exceed 19.2 oz/Acre per season.

or

Beleaf 50 SG, 2 to 2.8 oz. (0 days)

or

Venom, 1 to 4 oz. (1 day)

or

Actara, 1.5 to 3 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

Brigadier, 3.8 to 6.1 oz. (7 days)

## DISEASES

### SEED TREATMENT:

**BLACK LEG** (*Phoma lingam*), **DAMPING OFF**, **WIRE STEM** (*Pythium* spp., *Rhizoctonia* spp.):

Captan

Captan 30-DD, 1 1/4 fl oz/100 lb seed.

Captan 400, 1 to 2 fl oz/100 lb seed.

or

Fludioxinil

Maxim 4 FS, 0.08 to 0.16 fl oz/100 lb seed. Commercial seed treatment plants only (*Rhizoctonia*).

or

Thiram

42-S Thiram, Thiram 50 WP Dyed, 8 oz/100 lb seed.

### SEEDBED TREATMENT:

**CLUBROOT** (*Plasmodiophora brassicae*):

PCNB

Terraclor F (7.5 gal in 30 gal of water (broadcast)) or Terraclor F (5.6 gal in 30 gal of water (band)) Band application: Spray as a 12- to 15-inch band centered on the row and incorporate to a depth of 4 to 6 inches prior to planting. May be used on direct seeded crops. Broadcast application: Apply as a preplant broadcast prior to planting. Incorporate to a depth of 4 to 6 inches. May be used on direct seeded crops.

or

PCNB

Terraclor 75 WP (40 lb in 35 gal of water (broadcast)) or Terraclor 75 WP (30 lb in 25 gal of water (band)) Band application: 40 inch row spacing. Spray as a 12- to 15-inch band centered on the row and incorporate to a depth of 4 to 6 inches immediately prior to planting. Broadcast application: Apply as a

## Broccoli

preplant broadcast prior to planting. Thoroughly incorporate to a depth of 4 to 6 inches using a disc harrow or other suitable equipment. May be used on direct seeded crops.

### **WIRE STEM** (*Corticium solani*):

**PCNB.** Row drench treatment: Spray as an 8-inch band centered on the row at the time of or immediately after seeding (40-inch row spacings).

*Blocker* 4 F, 2.8 to 3.75 gal.

*Terraclor* 75 WP, 10 to 15 lb in 35 gal of water.

*Terraclor* F, 1.9 to 2.8 gal in 35 gal water.

or

**PCNB.** Broadcast drench application: Apply in 50 gal of water as a soil drench at the time of or immediately after seeding. For smaller areas use 1 level tablespoon per gallon of water as a soil drench per 50 sq ft of seed bed. Apply with watering can or similar equipment.

*Terraclor* 75 WP, 15 to 20 lb.

*Terraclor* F, 2.8 to 3.8 gal.

### **DAMPING OFF** (*Pythium* spp.), **BASAL ROT** (*Phytophthora* spp.):

**Mefenoxam.** Apply as a broadcast preplant incorporation or surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 1 in. of sprinkler irrigation.

*Ridomil* Gold SL, \* 0.25-0.5 pt (*Pythium*) 1-2 pt (*Phytophthora*).

*Ultra* Flourish, 1 to 1.5 pt (*Pythium*), 2 to 4 pt (*Phytophthora*).

## **GREENHOUSE SOIL DRENCH:**

### **ROOT/STEM ROT** (*Rhizoctonia solani*):

#### **PCNB**

*Terraclor* 400, see label for rates specific to soil depth.

## **GREENHOUSE PREPLANT INCORPORATION:**

### **DAMPING OFF** (*Pythium* spp.), **ROOT ROT** (*Rhizoctonia* spp.):

#### ***Gliocladium virens* GL-21**

*SoilGard* 12 G, 1 to 1.5 lb per cubic yard. Biological control product that needs to be applied before disease development. Control may be limited under heavy disease pressure.

## **TRANSPLANT WATER TREATMENT:**

### **CLUBROOT** (*Plasmodiophora brassicae*):

**PCNB.** Treatments applied in 100 gal water using 1/2 pt per plant around roots at time plants are being set in the field.

**Note:** Frequent agitation is needed with wettable powders.

*Terraclor* 75 WP (2 lb) or *Terraclor* F (3 pt)

## **FOLIAR TREATMENT:**

**BLACK ROT** (*Xanthomonas campestris*): Apply treatment (lowest rates) in fields as soon as transplants are established.

#### **Copper Ammonium Carbonate**

*Copper* Count N, 1 to 3 qt. (0 days) **Note:** Reddening of older leaves may occur.

or

#### **Copper Hydroxide**

*Champ* DP, 1/3 to 2/3 lb. (0 days)

*Champ* Formula 2 F, 1/3 to 2/3 pt. (0 days)

*Champion* WP, *Kocide* 101, *Kocide* DF, 1 to 2 lb. (0 days)

*Kocide* 2000, 3/4 to 1 1/2 lb. (0 days)

*Kocide* 4.5 LF, 2/3 to 1 1/3 pt. (0 days)

or

#### **Copper Oxychloride / Copper Sulfate**

*C-O-C-S* WDG, 3 to 4 lb. (0 days)

or

#### **Copper Sulfate**

*Cuprofix* Ultra, 3/4 to 1 1/4 lb. (0 days)

or

#### **Acibenzolar-S-methyl**

*Actigard*, 1 oz per 20 gal (ground) or 10 gal (aerial) of water. (7 days) Do not apply more than 4 applications per crop per year.

**ALTERNARIA LEAF SPOT** (*Alternaria brassicae*): Apply when conditions favor disease and repeat every 7 to 10 days.

#### **\* Azoxystrobin**

*Amistar*, 2 to 5 oz. (0 days) Every 7-14 days

*Quadris*, 6.2 to 15.4 fl oz. (0 days)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

#### **\* Chlorothalonil**

*Bravo* Ultrex, 1.4 lb. (7 days)

*Bravo* Weather Stik, *Equus* 720 SST, 1 to 1.5 pt. (7 days)

*Echo* 720, 2 to 4 pt. (7 days)

*Echo* 90 DF, 1.3 lb. (7 days)

*Equus* DF, 1.4 to 1.8 lb. (7 days)

or

#### **\* Maneb**

*Maneb* 75 DF, *Maneb* 80 WP, 1 1/2 to 2 lb. (7 days)

*Manex*, 1 1/5 to 1 3/5 qt. (7 days)

or

#### **Copper Ammonium Carbonate**

*Copper* Count N, 1 to 3 qt. (0 days)

**Note:** Reddening of older leaves may occur.

or

#### **Copper Hydroxide**

*Champ* DP, 1/3 to 2/3 lb. (0 days)

*Champ* Formula 2 F, 1/3 to 2/3 pt. (0 days)

*Champion* WP, *Kocide* 101, *Kocide* DF, 1 to 2 lb. (0 days)

*Kocide* 2000, 3/4 to 1 1/2 lb. (0 days)

*Kocide* 4.5 LF, 2/3 to 1 1/3 pt. (0 days)

or

#### **Copper Sulfate**

*Basicop*, 1 to 3 lb. (0 days)

*Cuprofix* Ultra, 3/4 to 1 1/4 lb. (0 days)

or

#### **Cyprodinil/Fludioxonil**

*Switch* 62.5 WG, 11 to 14 oz. (7 days)

or

#### **Neem Oil**

*Trilogy*, 2 pt. (0 days)

or

#### **Boscalid**

*Endura*, 6 to 9 oz. (0 days)

or



Copper Resinate*Tenn-Cop 5 E*, 3 pt. (0 days)**BLACK LEG** (*Phoma lingam*):

Iprodione. Apply immediately after thinning (2 to 4 leaf stage) as a directed spray to the base of the plant and adjacent soil surface. If disease persists or recurs a second application may be made up to day of harvest. **Note:** See label for permissible crop rotations.

*Iprodione* 4L AG, 2 pt. (0 days)*Rovral*, 2 lb. (0 days)*Rovral* 4 F, 2 pt. (0 days)

**DOWNY MILDEW** (*Peronospora parasitica*): Begin applications when conditions are favorable for disease but before infection.

\* Fosetyl-Aluminum*Aliette* WDG, 2 to 5 lb. (3 days) Apply at 7 to 10 day intervals.

Do not tank mix with copper fungicides.

or

\* Mefenoxam/Chlorothalonil*Ridomil* Gold Bravo, 1 1/2 lb. (7 days) Apply at 14 day intervals (maximum 4 applications/crop).

or

\* Mefenoxam*Ridomil* Gold SL, 0.125-0.25 pt. (7 days)

or

Mono-, dibasic sodium, potassium and ammonium phosphites*Phostrol*, 2.5 to 5 pt. (0 days) Every 7-21 days*Prophyt*, 2 to 4 pt. (0 days)

or

Neem Oil*Trilogy*, 2 pt. (0 days)

or

Acibenzolar-S-methyl*Actigard*, 1 oz per 20 gal (ground) or 10 gal (aerial) of water. (7 days) Do not apply more than 4 applications per crop per year.

or

Mono-, dibasic sodium salts of phosphorous acid*Fosphite*, 1 to 3 qt per 20 gal (ground) or 10 gal (aerial) of water. (0 days)

or

Mandipropamid*Revus*, 8 fl oz. (1 day)

**Note:** Most fungicides that protect against *Alternaria* may also provide limited downy mildew protection.

## Brussels Sprouts

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

Sugar beet cyst, root-knot and lesion nematodes can reduce Brussels sprouts yield. Fields with soil or root problems of undetermined cause should be tested for nematodes (see Appendix C). If the plant-parasitic nematodes are present in population densities above the economic threshold for Brussels sprouts, crop rotation or application of a nematicide is recommended. The following nematicides are suitable for control of sugar beet cyst, root-knot and lesion nematodes in Brussels sprouts production.

### FALL SOIL FUMIGATION (BROADCAST): 1,3-D

*Telone* II, 25 gal/A (muck soil), 9-18 gal/A (mineral soil).

Fumigate in the fall when soil temperatures at a 6-inch depth are above 50F. Inject fumigant to a soil depth of 6 to 8 inches and lightly seal the soil immediately after application. Use soil fumigants only as directed on the label. In some limited situations soil fumigants may be applied in the spring in Michigan.

Correct soil moisture, temperature and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or by immediate tarping.

### SOIL TREATMENT AT PLANTING:

Fenamiphos

*Nemacur* 15 G, 7.3 to 18.4 oz per 1,000 row feet. Apply in 6-15 inch band width. Application may be made prior to planting, at planting or immediately following transplanting. NOT FOR BRUSSELLS SPROUTS GROWN FROM SEED. Incorporate mechanically or with overhead irrigation. Do not treat more than 50% of total field area. DO NOT ALLOW BANDS TO OVERLAP. (RUP)

**Note:** For hydrologic soil group A, soils that are excessively drained or predominantly sand or loamy sand with shallow water tables (less than 50 feet deep), *Nemacur* can no longer be used. For all other soil types, *Nemacur* can no longer be purchased, but stores of the product can be used until depleted.

## INSECTS

### SEEDBED TREATMENT:

Apply treatments to soil according to directions to protect young seedlings in the seedbed before transplanting in field.

**CABBAGE MAGGOT:** Apply to seedbed surface and incorporate to 3 to 4 inches.

*Diazinon* 4 EC, 3 qt. Apply only as directed. (RUP)

### SOIL TREATMENT:

APHIDS:*Venom*, 5 to 6 oz. (21 days) See label for application methods.

or

*Platinum*, 5 to 11 fl oz. (30 days) See label for application methods.FLEA BEETLE:*Platinum*, 5 to 11 fl oz. (30 days) See label for application methods.

### TRANSPLANT WATER TREATMENT:

Treatments applied in water around roots at time plants are set in the field. **Note:** Treatment rates are given in amount of formulation per 100 gal of water. Apply at rate of 1 cup of solution per plant. Frequent agitation is needed with wettable powders.

#### CABBAGE MAGGOT:

*Diazinon* 50 WP (1 lb/100 gal) or *Diazinon* AG 500 (1/2 to 1 pt/100 gal) Use only as directed. (RUP)

### PLANTING TREATMENT:

Treatments are applied at seeding.

#### CABBAGE MAGGOT:

*Lorsban* 15 G (4.6 to 9.2 oz/1,000 ft of row) or *Lorsban* 4 E / *Lorsban* Advanced (1.6 to 2.75 fl oz / 1,000 ft of row) Use only as directed. Apply in a 4-inch band over row at time of seeding. (RUP)

or

*Capture* LFR, 3.4 to 6.8 oz. See label for application methods.

**APHIDS, FLEA BEETLE, THRIPS:** Apply as band on each side of seed row or transplant row at time of seeding or sidedressed after plants become established. Treatments applied at seeding or transplanting are translocated into foliage systemically.

*Di-Syston* 15 G (7.4 oz / 1,000 ft) or *Di-Syston* 8 E (1.1 fl oz/1,000 ft) (40 days) Use only as directed. (RUP)

#### APHIDS, FLEA BEETLE:

*Platinum*, 5 to 11 fl oz. (30 days) See label for application methods.

### SOIL TREATMENT AFTER TRANSPLANTING:

Apply to the soil at base of plants after transplanting. Apply water to wet soil surface.

**APHIDS:** Apply as a post-seeding drench, transplant drench, or hill drench, or as a sidedress after plants are established.

Imidacloprid

*Admire* Pro, 4.4 - 10.5 fl oz. (21 days)

or

Imidacloprid

*Nuprid* 2 F, 10 to 24 oz. (21 days)

#### CABBAGE MAGGOT:

*Lorsban* 15 G (4.6 to 9.2 oz per 1,000 ft of row) or *Lorsban* 4 E / *Lorsban* Advanced (1.6 to 2.75 fl oz / 1,000 ft of row) Apply in a 4-inch band over row at time of seeding. Use only as directed. (RUP)

### FOLIAR TREATMENT:

**FLEA BEETLE:** Apply as needed soon after plants emerge when field seeded.

Cypermethrin

*Ammo* 2.5 EC (2.5 to 5 oz) or *Ammo* WSB (1 to 2 bags) or *UP-Cyde* 2.5 EC (2.5 to 5 oz) (1 day) (RUP)

or

*Baythroid* XL, 2.4 to 3.2 fl oz. (0 days) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (3 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1/2 to 1 qt) (3 days)

or

*Endosulfan* 3 EC, 2 pt. (14 days) Consult label for rotation restrictions.

or

*Lorsban* 4 E / *Lorsban* Advanced (1 to 2 pt) or *Lorsban* 50 W (2 lb) (21 days) (RUP)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Venom*, 3 to 4 oz. (1 day)

or

Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.8 fl oz. (7 days) Do not exceed 19.2 oz/Acre per season.

or

*Actara*, 1.5 to 3 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

Permethrin

*Perm-UP* 3.2 EC, 2 to 4 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (RUP)

**CUTWORM, ARMYWORM:** Apply when damage is first seen. Repeat as needed.

\* Cypermethrin

*Ammo* 2.5 EC (2.5 to 5 oz) or *Ammo* WSB (1 to 2 bags) or *UP-Cyde* 2.5 EC (2.5 to 5 oz) (7 days) (RUP)

or

\* *Baythroid* XL, 2.4 to 3.2 fl oz. (0 days) (RUP)

or

\* Bifenthrin (RUP)

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 6.4 oz. (7 days)

or

\* Permethrin

*Ambush* 25 W, 6.4 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC, *Pounce* 25 WP, *Pounce* 3.2 EC, 4 oz. (1 day) (RUP)

or

*Endosulfan* 3 EC, 2 2/3 pt. (14 days) Consult label for rotation restrictions.

or

*Lannate* LV (1 1/2 pt) or *Lannate* SP (1/2 lb) (3 days) (RUP)

or

*Lorsban* 4 E / *Lorsban* Advanced (1 to 2 pt) or *Lorsban* 50 W (2 lb) (21 days) (RUP)

or

*Mustang* Max, 3.2 to 4.0 oz. (1 day) (RUP)

or



*SpinTor* 2 SC, 4 to 8 oz. (1 day) Do not apply more than 3 times in 30 days.

or

*Entrust*, 1.3 to 3 oz. (1 day) Do not apply more than 3 times in 30 days.

or

*Rimon*, 6 to 12 fl oz. (7 days)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 3.8 to 6.1 oz. (7 days)

or

Lambda-cyhalothrin

*Lambda-Cy, Proaxis*, 2.6 to 3.8 fl oz. (RUP)

**IMPORTED CABBAGE WORM:** Apply treatments if >10% of plants are infested with any cabbage "worm".

Acephate

*Acephate* 97 UP, *Orthene* 97, 1 lb. (14 days) Do not apply more than 2-1/8 lb per season.

or

Cypermethrin

*Ammo* 2.5 EC (2.5 to 5 oz) or *Ammo* WSB (1 to 2 bags) or *UP-Cyde* 2.5 EC (2.5 to 5 oz) (7 days) (RUP)

or

*Avaunt*, 2.5 to 3.5 oz. (3 days) Do not exceed 14 oz/acre per crop.

or

*Bacillus thuringiensis*

*Agree, Biobit, Dipel, Javelin, Lepinox, Xentari*. (0 days)

or

*Baythroid* XL, 1.6 to 2.4 fl oz. (0 days) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (7 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt) (3 days)

or

*Danitol* 2.4 EC, 10 2/3 to 16 fl oz. (7 days) (RUP)

or

*Diazinon* 50 WP (1 lb) or *Diazinon* AG 500 (1 pt) (7 days) (RUP)

or

*Dibrom* 8 EC, 1 pt. (1 day)

or

*Endosulfan* 3 EC, 2 pt. (14 days) Consult label for rotation restrictions.

or

*Lannate* LV (1 1/2 pt) or *Lannate* SP (1/2 lb) (3 days) (RUP)

or

*Lorsban* 4 E / *Lorsban* Advanced (1 to 2 pt) or *Lorsban* 50 W (2 lb) (21 days) (RUP)

or

*Malathion* 57 EC, 2 pt. (7 days)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

Permethrin

*Ambush* 25 W, 3.2 to 6.4 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (2 to 8 oz) or *Pounce* 25 WP (3.2 to 6.4 oz) or *Pounce* 3.2 EC (2 to 4 oz) (1 day) (RUP)

or

*Proclaim*, 2.4 to 4.8 oz. (7 days) (RUP)

or

*SpinTor* 2 SC, 3 to 6 oz. (1 day) Do not apply more than 3 times in 20 days.

or

*Entrust*, 1 to 2 oz. (1 day) Do not apply more than 3 times in 30 days

or

*Intrepid* 2 F, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

*Rimon*, 6 to 12 fl oz. (7 days)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 3.8 to 6.1 oz. (7 days)

or

Lambda-cyhalothrin

*Lambda-Cy, Proaxis*, 1.9 to 3.2 fl oz. (RUP)

**DIAMONDBACK MOTH:** Apply if >10% of plants are infested with any cabbage "worm". Use *Bacillus thuringiensis* to avoid killing important natural enemies of diamondback "moth".

\* *Avaunt*, 3.5 oz. (3 days) Do not apply more than twice to one generation. Do not exceed 14 oz/acre per crop.

or

\* *Bacillus thuringiensis*

*Agree, Biobit, Dipel, Javelin, Lepinox, Xentari*. (0 days)

or

\* *SpinTor* 2 SC, 1.5 to 3 oz. (1 day) Do not apply more than 3 times in 30 days.

or

\* *Entrust*, 0.5 to 1.3 oz. (1 day) Do not apply more than 3 times in 30 days.

or

Acephate

*Acephate* 97 UP, *Orthene* 97, 1 lb. (14 days) Do not apply more than 2-1/8 lb per season.

or

*Baythroid* XL, 2.4 to 3.2 fl oz. (0 days) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (7 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt) (3 days)

or

*Diazinon* 50 WP (1 lb) or *Diazinon* AG 500 (1 pt) (7 days) (RUP)

or

## Brussels Sprouts

*Dibrom* 8 EC, 1 pt. (1 day)

or

*Endosulfan* 3 EC, 2 pt. (1 day) Consult label for rotation restrictions.

or

*Lannate* LV (1 1/2 to 3 pt) or *Lannate* SP (1/2 to 1 lb) (3 days) (RUP)

or

*Malathion* 57 EC, 2 pt. (7 days)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

Permethrin

*Ambush* 25 W, 3.2 to 6.4 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (2 to 8 oz) or *Pounce* 25 WP (3.2 to 6.4 oz) or *Pounce* 3.2 EC (2 to 4 oz) (1 day) (RUP)

or

*Proclaim*, 2.4 to 4.8 oz. (7 days) (RUP)

or

*Rimon*, 6 to 12 fl oz. (7 days)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 3.8 to 6.1 oz. (7 days)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (RUP)

**CABBAGE LOOPERS:** Apply if >10% of plants are infested with any cabbage "worm". Most controls are less effective on larger worms.

Acephate

*Acephate* 97 UP, *Orthene* 97, 1 lb. (14 days) Do not apply more than 2-1/8 lb per season.

or

Cypermethrin

*Ammo* 2.5 EC (5 oz) or *Ammo* WSB (2 bags) or *UP-Cyde* 2.5 EC (5 oz) (1 day) (RUP)

or

*Avaunt*, 2.5 to 3.5 oz. (3 days) Do not exceed 14 oz/acre per crop.

or

*Bacillus thuringiensis*

*Agree*, *Biobit*, *Dipel*, *Javelin*, *Lepinox*, *Xentari*. (0 days)

or

*Baythroid* XL, 1.6 to 2.4 fl oz. (0 days) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (7 days) (RUP)

or

*Danitol* 2.4 EC, 10 2/3 to 16 fl oz. (7 days) (RUP)

or

*Dibrom* 8 EC, 2 pt. (1 day)

or

*Endosulfan* 3 EC, 1 1/3 qt. (1 day) Consult label for rotation restrictions.

or

*Lannate* LV (3 pt) or *Lannate* SP (1 lb) (3 days) (RUP)

or

*Mustang* Max, 3.2 to 4.0 oz. (1 day) (RUP)

or

Permethrin

*Perm-UP* 3.2 EC (4 oz) or *Pounce* 25 WP (6.4 oz) or *Pounce* 3.2 EC (4 oz) (1 day) (RUP)

or

*Proclaim*, 3.2 to 4.8 oz. (7 days) (RUP)

or

*SpinTor* 2 SC, 3 to 6 oz. (1 day) Do not apply more than 3 times in 20 days.

or

*Entrust*, 1 to 2 oz. (1 day) Do not apply more than 3 times in 30 days.

or

*Intrepid* 2 F, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

*Rimon*, 6 to 12 fl oz. (7 days)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 3.8 to 6.1 oz. (7 days)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 1.9 to 3.2 fl oz. (RUP)

**APHIDS:** Apply if needed to prevent infestations on edible parts.

Acephate

*Acephate* 97 UP, *Orthene* 97, 1/2 to 1 lb. (14 days) Do not apply more than 2-1/8 lb per season.

or

*Assail* 30 SG, 1.9 to 2.8 oz. (7 days)

or

*Diazinon* 50 WP (1 lb) or *Diazinon* AG 500 (1 pt) (7 days) (RUP)

or

*Dibrom* 8 EC, 1 pt. (1 day)

or

*Endosulfan* 3 EC, 2 pt. (14 days) Consult label for rotation restrictions.

or

*Fulfill*, 2.75 oz. (7 days) May require 5 to 7 days for aphid mortality.

or

*Malathion* 57 EC, 2 pt. (7 days)

or

Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.75 fl oz. (7 days) Do not use if Imidacloprid was used at planting. Do not exceed 19.2 oz/Acre per season.

or

*Venom*, 1 to 4 oz. (1 day)

or



*Beleaf* 50 SG, 2 to 2.8 oz. (0 days)

or

*Actara*, 1.5 to 3 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

*Brigadier*, 3.8 to 6.1 oz. (7 days)

## DISEASES

### SEED TREATMENT:

**DAMPING OFF, WIRE STEM** (*Pythium* spp., *Rhizoctonia* spp.):

*Bacillus subtilis* GB03

*Kodiak*, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

*Fludioxinil*

*Maxim* 4 FS, 0.08 to 0.16 fl oz/100 lb seed. Commercial seed treatment plants only (*Rhizoctonia*).

or

*Captan*

*Captan* 30-DD, 1 1/4 oz/100 lb seed.

*Captan* 400, 1 to 2 oz/100 lb seed.

or

*Thiram*

42-S *Thiram*, *Thiram* 50 WP Dyed, 8 oz/100 lb seed.

### SEEDBED TREATMENT:

**CLUBROOT** (*Plasmodiophora brassicae*):

**PCNB**. Before planting, sterilize seedbeds (Appendix A) or apply to soil surface as a drench.

*Terraclor* 10 G, 200 lb (row) or 300 lb (broadcast). Row application: Apply as a 12- to 15-inch band and rototill to a depth of 4 to 6 inches immediately prior to planting. Broadcast application: Apply to the soil surface prior to planting. Disc and cross disc to a depth of 4 to 6 inches.

or

*Terraclor* 75 WP, 30 lb in 25 gal of water (band) or 40 lb in 35 gal of water (broadcast). Band application (40 inch row spacing): Spray as a 12- to 15 inch band centered on the row and incorporate to a depth of 4 to 6 inches immediately prior to planting. Broadcast application: Apply as a preplant broadcast prior to planting. Thoroughly incorporate to a depth of 4 to 6 inches using a disc or other suitable equipment.

or

*Terraclor* F, 5.6 gal in 25 gal of water (band) or 7.5 gal in 30 gal of water (broadcast). Band application: Spray as a 12- to 15-inch band centered on the row and incorporate to a depth of 4 to 6 inches prior to planting. May be used on cole crops that are direct seeded. Broadcast application: Apply as preplant broadcast. Incorporate to a depth of 4 to 6 inches. May be used on direct seeded crops.

**WIRE STEM or BLACK ROOT** (*Corticium solani*):

**PCNB**. Broadcast drench application: Apply in 50 gal or water as a soil drench at the time of or immediately after seeding. For smaller areas use 1 level tablespoon/gal water as a soil drench per 50 sq ft of seedbed. Apply with watering can or similar equipment.

*Terraclor* 75 WP, 15 to 20 lb.

*Terraclor* F, 2.8 to 3.8 gal.

or

**PCNB**. Row treatment: Apply as an 8-inch band centered on the row (40-inch row spacing) at the time of or immediately after seeding.

*Terraclor* 10 G, 110 to 150 lb before seeding.

*Terraclor* 75 WP, 10 to 15 lb in 35 gal of water.

### TRANSPLANT WATER TREATMENT:

**CLUBROOT** (*Plasmodiophora brassicae*):

**PCNB**. Applied in 100 gal of water using 1/2 pt per acre around roots at time plants are set in the field. **Note:** Apply at rate of 1 cup of solution per plant. Frequent agitation is needed.

*Terraclor* 75 WP, 2 lb.

*Terraclor* F, 3 pt.

### FOLIAR TREATMENT:

**BLACK ROT** (*Xanthomonas campestris*): Apply treatment (lowest rate) in fields as soon as transplants are established.

*Copper Ammonium Carbonate*

*Copper Count* N, 2 qt. (0 days)

or

*Copper Hydroxide*

*Champ* 2FL, 1/3 to 2/3 pt. (0 days)

*Champ* DP, 1/3 to 2/3 lb. (0 days)

*Champ* WP, 1 to 2 lb. (0 days)

*Kocide* 101, *Kocide* DF, 1 to 2 lb. (0 days)

*Kocide* 2000, 3/4 to 1 1/2 lb. (0 days)

*Kocide* 4.5 LF, 2/3 to 1 1/3 pt. (0 days)

or

*Copper Sulfate*

*Cuprofix* Ultra, 3/4 to 1 1/4 lb. (0 days)

or

*Acibenzolar-S-methyl*

*Actigard*, 1 oz per 20 gal (ground) or 10 gal (aerial) of water. (7 days) Do not apply more than 4 applications per crop per year.

**BLACK LEG** (*Phoma lingam*): There are presently no chemicals registered for use on this disease.

**ALTERNARIA LEAF SPOT** (*Alternaria brassicae*): Apply when conditions favor disease development and repeat every 7 to 10 days.

\* *Azoxystrobin*

*Amistar*, 2 to 5 oz every 7 - 14 days. (0 days)

*Quadris*, 6.2 to 15.4 fl oz. (0 days)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* *Chlorothalonil*

*Bravo* Ultrex, 1.4 lb. (7 days)

*Bravo* Weather Stik, *Equus* 720 SST, 1.5 pt. (7 days)

or

\* *Maneb*

*Maneb* 75 DF, *Maneb* 80 WP, 1 1/2 to 2 lb. (7 days)

*Manex*, 1 1/5 to 1 3/5 qt. (7 days)

or

*Copper Ammonium Carbonate*

*Copper Count* N, 2 qt. (0 days)

or

## Cabbage

### Copper Sulfate

*Basicop* 53 WP, 1 to 3 lb. (0 days)

*Cuprofix* Ultra, 3/4 to 1 1/4 lb. (0 days)

or

### Cyprodinil/Fludioxonil

*Switch* 62.5 WG, 11 to 14 oz. (7 days)

or

### Mefenoxam/Chlorothalonil

*Ridomil* Gold Bravo, 1 1/2 lb, 14-day intervals. (7 days) Maximum 4 applications.

or

### Boscalid

*Endura*, 6 to 9 oz. (0 days)

**DOWNY MILDEW** (*Peronospora parasitica*): Apply when conditions favor disease development and repeat every 7 to 10 days.

### \* Mefenoxam/Chlorothalonil

*Ridomil* Gold Bravo, 1 1/2 lb, 14-day intervals. (7 days) Maximum 4 applications.

or

### \* Mefenoxam

*Ridomil* Gold SL, 0.125-0.25 pt. (7 days)

or

### \* Fosetyl-Aluminum

*Aliette* WDG, 2 to 5 lb, 7- to 21-day intervals. (3 days)

**Note:** Do not tank mix with copper fungicides.

or

### Mono-, dibasic sodium, potassium and ammonium phosphites

*Phostrol*, 2.5 to 5 pt every 7 - 21 days. (0 days)

*Prophyt*, 2 to 4 pt. (0 days)

or

### Acibenzolar-S-methyl

*Actigard*, 1 oz per 20 gal (ground) or 10 gal (aerial) of water. (7 days) Do not apply more than 4 applications per crop per year.

or

### Mono-, dibasic sodium salts of phosphorous acid

*Fosphite*, 1 to 3 qt per 20 gal (ground) or 10 gal (aerial) of water. (0 days)

or

### Mandipropamid

*Revus*, 8 fl oz. (1 day)

**Note:** Fungicides that protect against *Alternaria* also provide limited downy mildew protection.

undetermined cause should be tested for nematodes (see Appendix C). If the plant-parasitic nematodes are present in population densities above the economic threshold for cabbage, crop rotation or application of a nematicide is recommended. The following nematicides are suitable for control of sugar beet cyst, root-knot and lesion nematodes in cabbage production. It is best not to plant cabbage on land infested with sugar beet cyst nematodes.

## FALL SOIL FUMIGATION (BROADCAST):

1,3-D

*Telone* II, 25 gal/A (muck soil), 9-18 gal/A (mineral soil).

Fumigate in the fall when soil temperatures at a 6-inch depth are above 50F. 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. In some limited situations soil fumigants can be applied in the spring in Michigan. Correct soil moisture, temperature and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or by immediate tarping.

## PREPLANT SOIL TREATMENT:

*Mocap* 15 G. Apply 34 lb/A up to one week before planting and incorporate to a depth of 3 inches. (RUP)

## SOIL TREATMENT AT PLANTING:

Fenamiphos

*Nemacur* 15 G, 7.3 to 18.4 oz per 1,000 row feet. Apply in 6-15 inch band width. Application may be made prior to planting, at planting or immediately following transplanting. Incorporate mechanically or with overhead irrigation. Do not treat more than 50% of total field area. DO NOT ALLOW BANDS TO OVERLAP. May be used on seeded or transplanted cabbage. (RUP)

**Note:** For hydrologic soil group A, soils that are excessively drained or predominantly sand or loamy sand with shallow water tables (less than 50 feet deep), *Nemacur* can no longer be used. For all other soil types, *Nemacur* can no longer be purchased, but stores of the product can be used until depleted.

or

*Mocap* 15 G (13 lb) or *Mocap* 6 EC (1.3 to 2 qt) (36 inch row spacing) Apply in a 12- to 15-inch band over the row. Do not allow material to contact the seed. (RUP)

## INSECTS

### SEEDBED TREATMENT:

Apply treatments to soil according to directions to protect young seedlings in the seedbed before transplanting in field.

**CABBAGE MAGGOT:** Apply to seedbed surface and incorporate to 3 to 4 inches.

*Diazinon* AG 500, 3 qt. Apply only as directed. (RUP)

### SOIL TREATMENT:

APHIDS:

*Venom*, 5 to 6 oz. (21 days) See label for application methods. or

## Cabbage

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

Sugar beet cyst, northern root-knot and root-lesion nematodes can reduce cabbage yields. Fields with soil or root problems of

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



*Platinum*, 5 to 11 fl oz. (30 days) See label for application methods.

#### FLEA BEETLE, THRIPS:

*Platinum*, 5 to 11 fl oz. (30 days) See label for application methods.

#### TRANSPLANT WATER TREATMENT:

Treatments are applied in water around roots at time plants are set in field. **Note:** Treatment rates are given in amount of formulation per 100 gallons of water. Apply at rate of 1 cup solution per plant. Frequent agitation is needed with wet-table powders.

#### CABBAGE MAGGOT:

*Diazinon* 50 WP (1 lb/100 gal) or *Diazinon* AG 500 (1/2 to 1 pt/100 gal) Use only as directed. (RUP)

#### PLANTING TREATMENT:

Treatments applied at seeding.

**CABBAGE MAGGOT:** Apply in a 4-inch band over row at time of seeding.

*Lorsban* 15 G (4.6 to 9.2 oz/1,000 ft of row) or *Lorsban* 4 E / *Lorsban* Advanced (1.6 to 2.75 fl oz / 1,000 ft of row) Use only as directed. (RUP)

or

*Capture* LFR, 3.4 to 6.8 oz. See label for application methods.

**APHIDS, FLEA BEETLE:** Apply as band on each side of seed row or transplant row at time of seeding or sidedressed after plants become established. Treatments applied at seeding or transplanting are translocated into foliage systemically.

*Di-Syston* 15 G (7.4 oz / 1,000 ft) or *Di-Syston* 8 E (1.1 fl oz/1,000 ft) (42 days) Use only as directed. (RUP)

or

*Platinum*, 5 to 11 fl oz. (30 days) See label for application methods.

#### SOIL TREATMENT AFTER TRANSPLANTING:

**APHIDS:** Apply as a post-seeding drench, transplant drench, or hill drench, or as a sidedress after plants are established.

Imidacloprid

*Admire* Pro, 4.4 - 10.5 fl oz. (21 days)

*Nuprid* 2 F, 10 to 24 oz. (21 days)

**CABBAGE MAGGOT:** Apply to the soil at base of plants after transplanting. Apply water to wet soil surface.

*Lorsban* 15 G (4.6 to 9.2 oz per 1,000 of row) or *Lorsban* 4 E / *Lorsban* Advanced (1.6 to 2.75 fl oz / 1,000 ft of row) Apply in a 4-inch band over row at time of seeding. Use only as directed. (RUP)

#### FOLIAR TREATMENT:

**FLEA BEETLE:** Apply as needed soon after plants emerge.

Cypermethrin

*Ammo* 2.5 EC (2 1/2 to 5 oz) or *Ammo* WSB (1 to 2 bags)

or *UP-Cyde* 2.5 EC (2 1/2 to 5 oz) (1 day) (RUP)

or

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

or

*Baythroid* XL, 2.4 to 3.2 fl oz. (0 days) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (7 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1/2 to 1 qt) (3 days)

or

*Endosulfan* 3 EC, 2 pt. (7 days) Consult label for rotation restrictions.

or

Thiodicarb

*Larvin* 3.2 EC, 16 to 32 oz. (7 days)

or

*Lorsban* 50 W, 2 lb. (21 days) (RUP)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

*Warrior* with Zeon Technology, 2.6 to 3.8 fl oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (1 day) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Venom*, 3 to 4 oz. (1 day)

or

Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.8 fl oz. (7 days) Do not exceed 19.2 oz/Acre per season.

or

*Actara*, 1.5 to 3 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

Permethrin

*Perm-UP* 3.2 EC, 2 to 8 oz. (1 day) (RUP)

**CUTWORM, ARMYWORM:** Apply when damage is first seen.

Repeat as needed

\* Cypermethrin

*Ammo* 2.5 EC (2 1/2 to 5 oz) or *Ammo* WSB (1 to 2 bags)

or *UP-Cyde* 2.5 EC (2 1/2 to 5 oz) (1 day) (RUP)

or

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

or

\* *Baythroid* XL, 2.4 to 3.2 fl oz. (0 days) (RUP)

or

\* Bifenthrin (RUP)

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 6.4 oz. (7 days)

or

\* *Mustang* Max, 3.2 to 4.0 oz. (1 day) (RUP)

or

\* *Warrior* with Zeon Technology, 2.6 to 3.8 fl oz. (1 day) (RUP)

or

*Endosulfan* 3 EC, 2 2/3 pt. (7 days) Consult label for rotation restrictions.

or

*Lannate* LV (1 1/2 pt) or *Lannate* SP (1/2 lb) (1 day) (RUP)

or

## Cabbage

*SpinTor* 2 SC, 4 to 8 oz. (1 day) Do not apply more than 3 times in 30 days.

or

*Entrust*, 1.3 to 3 oz. (1 day) Do not apply more than 3 times in 30 days.

or

Lambda-cyhalothrin

*Lambda-Cy, Proaxis*, 2.6 to 3.8 fl oz. (1 day) (RUP)

or

*Rimon*, 6 to 12 fl oz. (7 days)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 3.8 to 6.1 oz. (7 days)

**IMPORTED CABBAGE WORM:** Apply if 20% or more are infested with any cabbage "worm" before heading or if >10% are infested at or after heading.

Permethrin

*Ambush* 25 W, 3.2 to 6.4 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (2 to 8 oz) or *Pounce* 25 WP (3.2 to 6.4 oz) or *Pounce* 3.2 EC (2 to 4 oz) (1 day) (RUP)

or

Cypermethrin

*Ammo* 2.5 EC (2 1/2 to 5 oz) or *Ammo* WSB (1 to 2 bags) or *UP-Cyde* 2.5 EC (2 1/2 to 5 oz) (1 day) (RUP)

or

*Asana* XL, 2.9 to 5.8 oz. (3 days) (RUP)

or

*Avaunt*, 2.5 to 3.5 oz. (3 days) Do not exceed 14 oz/acre per crop.

or

*Bacillus thuringiensis*

*Agree, Biobit, Dipel, Javelin, Lepinox, Xentari*. (0 days)

or

*Baythroid* XL, 1.6 to 2.4 fl oz. (0 days) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (7 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt) (3 days)

or

*Danitol* 2.4 EC, 10 2/3 to 16 fl oz. (7 days) (RUP)

or

*Diazinon* 50 WP (1 lb) or *Diazinon* AG 500 (1 pt) (7 days) (RUP)

or

*Dibrom* 8 EC, 1 pt. (1 day)

or

*Endosulfan* 3 EC, 2 pt. (7 days) Consult label for rotation restrictions.

or

Thiodicarb

*Larvin* 3.2 EC, 16 to 32 oz. (7 days)

or

*Lannate* LV (3/4 to 3 pt) or *Lannate* SP (1/4 lb) (1 day) (RUP)

or

*Lorsban* 50 W, 2 lb. (21 days) (RUP)

or

*Malathion* 57 EC, 2 pt. (7 days)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

*Proclaim*, 2.4 to 4.8 oz. (7 days) (RUP)

or

*SpinTor* 2 SC, 3 to 6 oz. (1 day) Do not apply more than 3 times in 20 days.

or

*Warrior* with Zeon Technology, 1.9 to 3.2 fl oz. (1 day) (RUP)

or

*Entrust*, 1 to 2 oz. (1 day) Do not apply more than 3 times in 30 days.

or

*Intrepid* 2 F, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

Lambda-cyhalothrin

*Lambda-Cy, Proaxis*, 1.9 to 3.2 fl oz. (1 day) (RUP)

or

*Rimon*, 6 to 12 fl oz. (7 days)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 3.8 to 6.1 oz. (7 days)

**DIAMONDBACK MOTH:** Apply if 20% or more are infested with any cabbage "worm" before heading or if >10% are infested at or after heading. Use *Bacillus thuringiensis* to avoid killing important natural enemies of diamondback moth.

\* *Avaunt*, 3.5 oz. (3 days) Do not apply more than twice to one generation. Do not exceed 14 oz/acre per crop.

or

\* *Bacillus thuringiensis*

*Agree, Biobit, Dipel, Javelin, Lepinox, Xentari*. (0 days)

or

\* *SpinTor* 2 SC, 1.5 to 3 oz. (1 day) Do not apply more than 3 times in 30 days.

or

\* *Entrust*, 0.5 to 1.3 oz. (1 day) Do not apply more than 3 times in 30 days.

or

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

or

*Baythroid* XL, 2.4 to 3.2 fl oz. (0 days) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (7 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt) (3 days)

or



*Diazinon* 50 WP (1 lb) or *Diazinon* AG 500 (1 pt) (7 days) (RUP)  
 or  
*Dibrom* 8 EC, 1 pt. (1 day)  
 or  
*Endosulfan* 3 EC, 2 pt. (7 days) Consult label for rotation restrictions.  
 or  
*Lannate* SP, 1 1/2 lb. (1 day) (RUP)  
 or  
 Thiodicarb  
*Larvin* 3.2 EC, 24 to 40 oz. (7 days)  
 or  
*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)  
 or  
 Permethrin  
*Ambush* 25 W, 3.2 to 12.8 oz. (1 day) (RUP)  
 or  
*Perm-UP* 3.2 EC (2 to 8 oz) or *Pounce* 25 WP (3.2 to 12.8 oz) or *Pounce* 3.2 EC (2 to 8 oz) (1 day) (RUP)  
 or  
*Proclaim*, 2.4 to 4.8 oz. (7 days) (RUP)  
 or  
*Warrior* with Zeon Technology, 2.6 to 3.8 fl oz. (1 day) (RUP)  
 or  
 Lambda-cyhalothrin  
*Lambda-Cy, Proaxis*, 2.6 to 3.8 fl oz. (1 day) (RUP)  
 or  
*Rimon*, 6 to 12 fl oz. (7 days)  
 or  
*Hero*, 4 to 10.3 oz. (7 days) (RUP)  
 or  
*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.  
 or  
*Brigadier*, 3.8 to 6.1 oz. (7 days)  
**CABBAGE LOOPERS:** Apply if 20% or more are infested with any cabbage "worm" before heading or if >10% are infested at or after heading. Most controls are less effective on larger worms.  
 Cypermethrin  
*Ammo* 2.5 EC (3 3/4 to 5 oz) or *Ammo* WSB (1 to 2 bags) or *UP-Cyde* 2.5 EC (3 3/4 to 5 oz) (7 days) (RUP)  
 or  
*Asana* XL, 5.8 to 9.6 oz. (1 day) (RUP)  
 or  
*Avaunt*, 2.5 to 3.5 oz. (3 days) Do not exceed 14 oz/acre per crop.  
 or  
*Bacillus thuringiensis*  
*Agree, Biobit, Dipel, Javelin, Lepinox, Xentari*. (0 days)  
 or  
*Baythroid* XL, 1.6 to 2.4 fl oz. (0 days) (RUP)  
 or  
 Bifenthrin  
*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (7 days) (RUP)  
 or  
*Danitol* 2.4 EC, 10 2/3 to 16 fl oz. (7 days) (RUP)  
 or  
*Dibrom* 8 EC, 2 pt. (1 day)

or  
*Endosulfan* 3 EC, 1 1/3 qt. (7 days) Consult label for rotation restrictions.  
 or  
*Lannate* LV (3 pt) or *Lannate* SP (1 lb) (1 day) (RUP)  
 or  
 Thiodicarb  
*Larvin* 3.2 EC, 24 to 40 oz. (7 days)  
 or  
*Mustang* Max, 3.2 to 4.0 oz. (1 day) (RUP)  
 or  
 Permethrin  
*Perm-UP* 3.2 EC (2 to 8 oz) or *Pounce* 25 WP (3.2 to 12.8 oz) or *Pounce* 3.2 EC (2 to 8 oz) (1 day) (RUP)  
 or  
*Proclaim*, 3.2 to 4.8 oz. (7 days) (RUP)  
 or  
*Warrior* with Zeon Technology, 1.9 to 3.2 fl oz. (1 day) (RUP)  
 or  
*SpinTor* 2 SC, 3 to 6 oz. (1 day) Do not apply more than 3 times in 30 days.  
 or  
*Entrust*, 1 to 2 oz. (1 day) Do not apply more than 3 times in 30 days.  
 or  
*Intrepid* 2 F, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)  
 or  
 Lambda-cyhalothrin  
*Lambda-Cy, Proaxis*, 1.9 to 3.2 fl oz. (1 day) (RUP)  
 or  
*Rimon*, 6 to 12 fl oz. (7 days)  
 or  
*Hero*, 4 to 10.3 oz. (7 days) (RUP)  
 or  
*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.  
 or  
*Brigadier*, 3.8 to 6.1 oz. (7 days)  
**APHIDS:** Apply if there are >5 per plant.  
*Assail* 30 SG, 1.9 to 2.8 oz. (7 days)  
 or  
*Diazinon* 50 WP (1 lb) or *Diazinon* AG 500 (1 pt) (7 days) (RUP)  
 or  
*Dibrom* 8 EC, 1 pt. (1 day)  
 or  
*Endosulfan* 3 EC, 2 pt. (1 day) Consult label for rotation restrictions.  
 or  
*Fulfill*, 2.75 oz. (7 days) May require 5 to 7 days for aphid mortality.  
 or  
*Malathion* 57 EC, 2 pt. (7 days)  
 or  
 Imidacloprid  
*Nuprid* 1.6 F, *Provado* 1.6 F, 3.75 fl oz. (7 days) Do not use if Imidacloprid was used at planting. Do not exceed 19.2 oz/Acre per season.  
 or

## Cabbage

*Venom*, 1 to 4 oz. (1 day)

or

*Beleaf* 50 SG, 2 to 2.8 oz. (0 days)

or

*Actara*, 1.5 to 3 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

*Brigadier*, 3.8 to 6.1 oz. (7 days)

**THRIPS:** Apply insecticide if thrips are present at cupping. Use resistant cabbage varieties.

\* *Cypermethrin*

*Ammo* 2.5 EC (3 3/4 to 5 oz) or *Ammo* WSB (1 to 2 bags)

or *UP-Cyde* 2.5 EC (3 3/4 to 5 oz) (1 day) (RUP)

or

\* *Bifenthrin*

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz.

(7 days) (RUP)

or

*Assail* 30 SG, 4 oz. (7 days)

or

*Entrust*, 1.3 to 3 oz. (1 day) Do not apply more than 3 times in 30 days.

or

*Hero*, 10.3 oz. (7 days) (RUP)

or

*Actara*, 3 to 5.5 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

*Radiant* SC, 6 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 3.8 to 6.1 oz. (7 days)

## SLUGS

*Deadline* M-Ps 4% (20 to 40 lb) or *Metaldehyde* 3.5 G (30 to 40 lb) Apply between rows. Avoid contact to edible product.

## DISEASES

### SEED TREATMENT:

**DAMPING OFF, WIRE STEM** (*Pythium* spp., *Rhizoctonia solani*):

*Bacillus subtilis* GB03

*Kodiak*, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

*Captan*

*Captan* 30-DD, 1 1/4 oz/100 lb seed.

*Captan* 400, 1 to 2 oz/100 lb seed.

or

*Fludioxinil*

*Maxim* 4 FS, 0.08 to 0.16 fl oz/100 lb seed. Commercial seed treatment plants only (*Rhizoctonia*).

or

*Thiram*

42-S *Thiram*, *Thiram* 50 WP Dyed, 8 oz/100 lb seed.

**BLACK LEG** (*Phoma lingam*):

There are presently no chemicals registered for use on this disease.

### SEEDBED TREATMENT:

Apply treatments to soil according to directions to protect young seedlings in the seedbed before transplanting in field.

**CLUBROOT** (*Plasmodiophora brassicae*):

**PCNB.** Sterilize seedbed before planting (Appendix A) or apply to soil surface as a drench.

*Terraclor* 10 G, 200 lb (row) or 300 lb (broadcast). Row application: Apply in a 12 to 15 inch band by means of a suitable applicator and rototill to a depth of 4 to 6 inches. Broadcast application: Apply and disc and cross disc to depth of 4 to 6 inches. May be used on direct seeded crops.

or

*Terraclor* 75 WP, 30 lb in 25 gal of water (band) or 40 lb in 35 gal of water (broadcast). Band application: Spray as a 12 to 15 inch band centered on the row and incorporate to a depth of 4 to 6 inches. Broadcast application: Apply and thoroughly incorporate to a depth of 4 to 6 inches. May be used on directly seeded crops.

or

*Terraclor* F, 5.6 gal in 25 gal of water (band) or 7.5 gal in 30 gal of water (broadcast). Band application: Spray as a 12- to 15-inch band centered on the row and incorporate to a depth of 4 to 6 inches prior to planting. Broadcast application: Apply as a preplant broadcast prior to planting. Incorporate to a depth of 4 to 6 inches. May be used on direct seeded crops.

**DAMPING OFF** (*Pythium* spp.), **BASAL STEM ROT**

(*Phytophthora* spp.):

*Mefenoxam*. Apply as a broadcast preplant incorporation or surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 1 in. of sprinkler irrigation.

*Ridomil* Gold SL, \* 0.25-0.5 pt (*Pythium*) 1-2 pt (*Phytophthora*).

or

*Ridomil* Gold WSP, 1 to 2 lb (1/4 to 1/2 lb, surface application, *Pythium* only).

**WIRE STEM** or **BLACK ROOT** (*Corticium solani*):

**PCNB**

*Terraclor* 10 G, 110 to 150 lb. Row application (40 in. row spacing): Apply in an 8 in. band immediately prior to seeding.

or

*Terraclor* 75 WP, 10 to 15 lb in 35 gal of water (row) or 15 to 20 lb in 50 gal of water (broadcast). Row drench treatment: Apply 10 to 15 lb in 35 gal of water. Spray as an 8 inch band centered on the row.

or

*Terraclor* F, 1.9 to 2.8 gal in 35 gal of water (row) or 2.8 to 3.8 gal in 50 gal of water (broadcast). Row drench treatment: Spray as an 8 inch band centered on the row.

### TRANSPLANT WATER TREATMENT:

**CLUBROOT** (*Plasmodiophora brassicae*):

**PCNB.** Apply in 100 gal of water using 1/2 pt per plant around roots at time plants are set in field. **Note:** Frequent agitation is needed.

*Terraclor* 75 WP, 2 lb.

*Terraclor* F, 3 pt.



**FOLIAR TREATMENT:**

**BLACK ROT** (*Xanthomonas campestris*): Apply treatment (lowest rate) in the field as soon as transplants are established.

Copper Ammonium Carbonate

*Copper Count N*, 2 qt. (0 days) Flecking of wrapper leaves may occur.

or

Copper Hydroxide

*Champ Formula 2 F*, 1 1/3 pt. Flecking of wrapper leaves may occur.

or

*Champion WP*, *Kocide 101*, *Kocide DF*, *Nu-Cop 50 DF*, 2 lb. (0 days) Flecking of wrapper leaves may occur.

or

*Kocide 2000*, 3/4 to 1 1/2 lb. (0 days)

*Kocide 4.5 LF*, 2/3 to 1 1/3 pt. (0 days)

*Nu-Cop 3 L*, 1 1/3 to 2 2/3 pt. (0 days)

or

Acibenzolar-S-methyl

*Actigard*, 1 oz per 20 gal (ground) or 10 gal (aerial) of water. (7 days) Do not apply more than 4 applications / crop per year.

**ALTERNARIA LEAF SPOT** (*Alternaria brassicae*): Apply when conditions favor disease development and repeat every 7 to 10 days.

\* Azoxystrobin

*Amistar*, 2 to 5 oz 7 - 14 days. (0 days) Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

*Quadris*, 6.2 to 15.4 fl oz. (0 days)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* Chlorothalonil

*Bravo Ultrex*, 1.4 lb. (7 days)

*Bravo Weather Stik*, *Equus 720 SST*, 1.5 pt. (7 days)

or

\* Maneb

*Maneb 75 DF*, *Maneb 80 WP*, 1 1/2 to 2 lb. (7 days) Cabbage and tight-headed Chinese cabbage.

or

*Maneb 75 DF*, 1 to 1 1/2 lb. (10 days) Loose-headed Chinese cabbage only.

or

*Manex*, 1 1/5 to 1 3/5 qt (cabbage and tight-headed Chinese cabbage) or 4/5 to 1 1/5 qt.. (7 days) Cabbage and tight-headed Chinese cabbage.

or

Copper Ammonium Carbonate

*Copper Count N*, 2 qt. (0 days) Flecking of wrapper leaves may occur.

or

Copper Hydroxide

*Champ Formula 2 F*, 1 1/3 pt. (0 days) Flecking of wrapper leaves may occur.

or

*Champ WP*, *Kocide 101*, *Kocide DF*, *Nu-Cop 50 DF*, 2 lb. (0 days) Flecking of wrapper leaves may occur.

or

*Kocide 2000*, 3/4 to 1 1/2 lb. (0 days)

*Kocide 4.5 LF*, 2/3 to 1 1/3 pt. (0 days)

*Nu-Cop 3 L*, 1 1/3 to 2 2/3 pt. (0 days) Minimum of 25 GPA.

or

Copper Sulfate

*Basicop 53 WP*, 1 to 3 lb. (0 days)

*Cuprofix Ultra*, 3/4 to 1 1/4 lb. (0 days)

or

Cyprodinil/Fludioxonil

*Switch 62.5 WG*, 11 to 14 oz. (7 days)

or

Mefenoxam/Chlorothalonil

*Ridomil Gold Bravo*, 1 1/2 lb, 14-day intervals. (7 days) Cabbage and tight-headed Chinese cabbage. Maximum 4 applications. Do not tank mix with copper fungicides.

or

Boscalid

*Endura*, 6 to 9 oz. (0 days)

**DOWNY MILDEW** (*Peronospora parasitica*): Apply when conditions favor disease development and repeat every 7 to 10 days.

\* Fosetyl-Aluminum

*Aliette WDG*, 2 to 5 lb, 7- to 21-day intervals. (3 days) Do not tank mix with copper fungicides.

or

\* Mefenoxam/Chlorothalonil

*Ridomil Gold Bravo*, 1 1/2 lb, 14-day intervals. (7 days) Cabbage and tight-headed Chinese cabbage. Maximum 4 applications.

\* Mefenoxam

*Ridomil Gold SL*, 0.125-0.25 pt. (7 days)

or

or

Mono-, dibasic sodium, potassium and ammonium phosphites

*Phostrol*, 2.5 to 5 pt every 7 - 21 days.

*Prophyt*, 2 to 4 pt. (0 days)

or

Acibenzolar-S-methyl

*Actigard*, 1 oz per 20 gal (ground) or 10 gal (aerial) of water.

(7 days) Do not apply more than 4 applications / crop per year.

or

Mono-, dibasic sodium salts of phosphorous acid

*Fosphite*, 1 to 3 qt per 20 gal (ground) or 10 gal (aerial) of water. (0 days)

or

Mandipropamid

*Revus*, 8 fl oz. (1 day)

**Note:** Fungicides that protect against Alternaria also provide limited downy mildew protection.

## Carrots

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

### NEMATODES

Northern root-knot, pin and carrot cyst nematodes severely reduce carrot quality and yields. Crop rotation is an essential part of nematode management in carrot production in Michigan. Fields with soil or root problems of undetermined cause should be tested for nematodes (see Appendix C). If the plant-parasitic nematodes are present, crop rotation or application of a nematicide will be recommended. The following nematicides are suitable for control of root-knot nematodes in carrot production. Nematicide failures have been observed with increasing frequency in sites with very high population densities, or where the carrot cyst nematode is the major problem.

### FALL SOIL FUMIGATION (BROADCAST):

1,3-D

*Telone II*, 25 gal/A (muck soil), 9-18 gal/A (mineral soil).

Fumigate in the fall when soil temperatures at a 6-inch depth are above 50F. 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. In some limited situations, soil fumigants can be applied in the spring in Michigan.

Correct soil moisture, temperature and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or by immediate tarping.

or

Metam Sodium

*Vapam HL*, 37.5 to 75 gal/A (use higher rate for muck soil).

Inject with shanks spaced 5 inches apart or to a depth of 4 to 10 inches in well prepared soil. If shanked, roll and irrigate treated surface to prevent escape of gas.

### PREPLANT TREATMENT:

*Vydate L*, Broadcast. Apply 2 to 4 gal in a minimum of 20 gallons of water as a broadcast treatment. Apply within one week of planting and thoroughly incorporate to a depth of 4 to 6 inches. (RUP)

### PLANTING TREATMENT:

*Vydate L*, in-row. Apply 1 to 2 gal in a minimum of 20 gallons of water in the seed furrow at planting. (RUP)

### POST-PLANT TREATMENT:

*Vydate L*, Broadcast. Apply 2 gal/A in at least 20 gal water/A before emergence. Incorporate into the soil. (RUP)

## INSECTS

### PRE-PLANT TREATMENT:

**WIREWORM:** May be found in grassy or weedy fields. If wireworm are present, apply evenly to the soil surface and incorporate 4 to 6 inches deep prior to planting.

*Diazinon AG 500*, 4 qt. Preplant soil application only. (RUP)

**APHIDS, EARLY SEASON LEAFHOPPERS:** Apply preplant or in furrow.

Imidacloprid

*Admire Pro*, 4.4 - 10.5 fl oz. (21 days)

*Nuprid 2 F*, 10 to 24 fl oz. (21 days)

or

*Platinum*, 5 to 12 fl oz. (30 days) See label for application methods.

### FOLIAR TREATMENT:

**CUTWORM:** Apply when cutworm are first seen.

\* *Asana XL*, 5.8 to 9.6 oz. (1 day) Ground application only. (RUP)

or

\* *Baythroid XL*, 1.6 fl oz. (0 days) (RUP)

or

*Lannate LV* (1 1/2 pt) or *Lannate SP* (1/2 lb) (1 day) (RUP)

**CARROT WEEVIL ADULTS:** Apply early in the spring when adults are first detected. Repeat weekly as needed.

\* *Asana XL*, 9.6 oz. (7 days) Ground application only. (RUP)

or

\* *Baythroid XL*, 2.8 fl oz. (0 days) (RUP)

**CARROT WEEVIL LARVAE:** Apply when larvae are first seen or 3 to 5 days after appearance of first eggs. Repeat in 2 to 3 weeks, up to 3 applications.

*Vydate L*, 4 pt. (14 days) Special Michigan SLN label. (RUP)

**LEAFHOPPERS (*Aster yellows*):** Treat fields if numbers exceed 20/100 sweeps. Repeat as needed (every 3 to 6 days) depending on the number of leafhoppers.

\* *Asana XL*, 5.8 to 9.6 oz. (1 day) Ground application only. (RUP)

or

\* *Baythroid XL*, 1.6 to 2.8 fl oz. (0 days) (RUP)

or

*Actara*, 1.5 to 3 oz. (7 days)

or

Carbaryl

*Sevin 80 S*, 1 1/4 lb. (0 days)

or

*Endosulfan 3 EC*, 2/3 to 1 1/3 qt. (7 days) Only 1 application per year.

or

*Lannate LV* (1 1/2 to 3 pt) or *Lannate SP* (1/2 to 1 lb) (1 day) (RUP)

or

*Malathion 7 EC*, 2 1/2 pt. (7 days)

**APHIDS:** Apply if needed.

*Actara*, 1.5 to 3 oz. (7 days)

or

*Diazinon AG 500*, 1 pt. (10 days) (RUP)

or



*Endosulfan* 3 EC, 2/3 to 1 1/3 qt. (7 days) Only 1 application per year.

or

*Malathion* 57 EC, 1 1/4 pt. (7 days)

or

*Imidacloprid*

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.5 fl oz. (7 days) Do not exceed 10.5 oz/Acre per season.

#### ASTER LEAFHOPPERS:

*Carbaryl*

*Sevin* XLR Plus, 1 qt. (7 days)

## DISEASES

### SEED TREATMENT:

**DAMPING OFF** (*Pythium* spp., *Rhizoctonia solani*): Use only as directed; overtreatment may cause injury.

*Fludioxinil*

*Maxim* 4 FS, 0.08 to 0.16 fl oz/100 lb seed. Commercial seed treatment plants only (*Rhizoctonia*).

or

*Mefenoxam*

*Apron* XL LS, 0.32 to 0.64 fl oz/100 lb seed (*Pythium*).

or

*Metalaxyl*

*Allegiance-FL*, 0.75 fl oz/100 lb seed.

or

*Thiram*

42-S *Thiram*, *Thiram* 50 WP Dyed, 8 oz/100 lb seed.

### PREPLANT INCORPORATED:

**CAVITY SPOT** (*Pythium violae*):

\* *Mefenoxam*

*Ridomil* Gold SL, 0.5-2 pt.

### PREPLANT OR PLANTING TREATMENT:

**CAVITY SPOT** (*Pythium* spp. and *Phytophthora* spp.):

*Mefenoxam*

*Ultra* Flourish, 2 to 4 pt.

### FOLIAR TREATMENT:

**POWDERY MILDEW** (*Sphaerotheca fuliginea* or *Erysiphe cichoracearum*): Apply at early leaf stage and repeat every 14 days.

\* *Pyraclostrobin/Boscalid*

*Pristine*, 8 to 10.5 oz. (0 days)

or

\* *Trifloxystrobin*

*Flint*, 2 to 3 oz. (7 days) Do not apply more than three sequential foliar applications of strobilurin fungicides before alternating with a fungicide that has a different mode of action.

or

*Neem Oil*

*Trilogy*, 2 pt. (0 days)

or

*Sulfur*

*Kumulus* DF, *Microthiol* Disperss, *Thiolux* Jet, 3 to 10 lb. (0 days)

or

*Micro Sulf*, 3 to 10 lb. (0 days)

or

*Propiconazole*

*Propimax* EC, 4 fl oz. (14 days)

*Tilt*, 4 fl oz. (14 days)

**ALTERNARIA LEAF BLIGHT** (*Alternaria dauci*): Apply every 7 to 14 days after emergence.

\* *Azoxystrobin*

*Amistar*, 3 to 5 oz every 7-14 days. (0 days)

*Quadris*, 6.2 - 15.4 fl oz every 7 - 14 days. (0 days)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* *Azoxystrobin/Chlorothalonil*

*Quadris* Opti, 2.4 pt every 7-14 days. (0 days)

or

\* *Boscalid*

*Endura*, 4.5 oz. (0 days)

or

\* *Chlorothalonil*

*Bravo* Ultrex, *Equus* DF, 1.4 to 1.8 lb every 7 to 10 days. (0 days)

or

*Bravo* Weather Stik, *Echo* 720, *Equus* 720 SST, 1.5 to 2 pt. (0 days)

or

*Echo* 90 DF, 1.3 to 1.5 lb. (0 days)

or

\* *Iprodione*

*Iprodione* 4L AG, *Rovral* 4 F, 1 to 2 pt. (0 days) Maximum 4 applications. See label for permissible rotation crops. Or 1 pt as a tank mix with another fungicide, maximum 10 applications.

or

*Rovral*, 1 to 2 lb. (0 days) Maximum 4 applications. See label for permissible rotation crops. Or 1 lb as a tank mix with another fungicide, maximum 10 applications.

or

\* *Pyraclostrobin*

*Cabrio*, 8-12 oz. (0 days) No more than three sequential applications.

or

\* *Pyraclostrobin/Boscalid*

*Pristine*, 8 to 10.5 oz. (0 days)

or

\* *Trifloxystrobin*

*Flint*, 2 to 3 oz. (7 days) Do not apply more than three sequential foliar applications of strobilurin fungicides before alternating with a fungicide that has a different mode of action.

or

*Copper Ammonium Carbonate*

*Copper* Count N, 2 to 3 qt. (0 days)

or

*Copper Hydroxide*

*Champ* DP, 1 1/3 lb. (0 days)

*Champ* Formula 2 F, *Kocide* 4.5 LF, 1 1/3 pt. (0 days)

*Kocide* 2000, 1 1/2 lb. (0 days)

or

## Cauliflower

### Copper Sulfate

*Basic Copper 53* (2 to 4 lb) or *Basicop* (3 to 4 lb) (0 days)  
*Cuprofix Ultra*, 1.25 lb. (0 days)

or

### Copper Resinate

*Tenn-Cop 5 E*, 3 to 4.5 pt. (0 days)

or

### Cyprodinil/Fludioxonil

*Switch 62.5 WG*, 11 to 14 oz. (7 days)

or

### Neem Oil

*Trilogy*, 2 pt. (0 days)

or

### Propiconazole

*Propimax EC*, 4 fl oz. (14 days)

or

*Tilt*, 4 fl oz. (14 days)

**WHITE MOLD** (*Sclerotinia sclerotiorum*): Apply when disease first appears and repeat every 7 to 10 days.

### Neem Oil

*Trilogy*, 2 pt. (0 days)

**CERCOSPORA LEAF SPOT** (*Cercospora carotae*): Apply every 7 to 14 days after emergence.

### \* Azoxystrobin

*Amistar*, 3 to 5 oz. (0 days)

or

*Quadris*, 9.2 to 15.4 fl oz. (0 days)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

### \* Azoxystrobin/Chlorothalonil

*Quadris Opti*, 2.4 pt every 7-14 days. (0 days)

or

### \* Chlorothalonil

*Bravo Ultrex*, *Equus DF*, 1.4 to 1.8 lb. (0 days) May be applied through sprinkler irrigation equipment.

or

*Bravo Weather Stik*, *Echo 720*, *Equus 720 SST*, 1.5 to 2 pt. (0 days)

or

*Echo 90 DF*, 1.3 to 1.5 lb. (0 days)

or

### \* Pyraclostrobin

*Cabrio*, 8-12 oz. (0 days) No more than three sequential applications.

or

### \* Pyraclostrobin/Boscalid

*Pristine*, 8 to 10.5 oz. (0 days)

or

### \* Trifloxystrobin

*Flint*, 2 to 3 oz. (7 days) Do not apply more than three sequential foliar applications of strobilurin fungicides before alternating with a fungicide that has a different mode of action.

or

### Copper Hydroxide

*Champ DP*, 1 1/3 lb. (0 days)

*Champ Formula 2 F*, *Kocide 4.5 LF*, 1 1/3 pt. (0 days)

*Kocide 2000*, 1 1/2 lb. (0 days)

*Nu-Cop 3 L*, 1 1/3 to 2 2/3 pt. (0 days)

or

*Champion WP*, *Kocide 101*, *Kocide DF*, *Nu-Cop 50 DF*, 2 lb. (0 days)

or

### Copper Ammonium Carbonate

*Copper Count N*, 2 to 3 qt. (0 days)

or

### Copper Sulfate

*Basic Copper 53*, 2 to 4 lb. (0 days)

*Basicop*, 3 to 4 lb. (1 day)

*Cuprofix Ultra*, 1.25 lb. (0 days)

or

### Copper Resinate

*Tenn-Cop 5 E*, 3 to 4.5 pt. (0 days)

or

### Neem Oil

*Trilogy*, 2 pt. (0 days)

or

### Propiconazole

*Propimax EC*, 4 fl oz. (14 days)

*Tilt*, 4 fl oz. (14 days)

**BACTERIAL LEAF BLIGHT** (*Xanthomonas campestris* pv. *carotae*): Apply every 7 to 10 days after first appearance.

### Copper Hydroxide

*Champ Formula 2 F*, 2/3 to 2 pt. (0 days)

*Champion WP*, 1 to 3 lb. (0 days)

*Kocide 101*, 2 lb. (0 days)

**CAVITY SPOT** (*Pythium violae*): Apply 2 to 4 times at 14-day intervals beginning 40-50 days after Ridomil at-planting treatment. Maximum 4 applications.

### \* Mefenoxam

*Ridomil Gold SL*, 0.2 pt. (7 days)

or

### Mefenoxam/Chlorothalonil

*Ridomil Gold Bravo*, 1 1/2 to 2 lb. (7 days)

or

### Mefenoxam/Copper Hydroxide

*Ridomil Gold Copper*, 2 lb. (7 days)

## Cauliflower

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)



## NEMATODES

### FALL SOIL FUMIGATION (BROADCAST): SUGAR BEET CYST, ROOT-KNOT and LESION NEMATODES:

Sugar beet cyst, root-knot and lesion nematodes can reduce cauliflower yields. Fields with soil or root problems of undetermined cause should be tested for nematodes (see Appendix C). If the plant-parasitic nematodes are present in population densities above the economic threshold for cauliflower, crop rotation or application of a nematicide is recommended. The following nematicides are suitable for control of sugar beet cyst, root-knot and lesion nematodes in cauliflower production.

1,3-D

*Telone II*, 25 gal/A (muck soil), 9-18 gal/A (mineral soil).  
Fumigate in the fall when soil temperatures at a 6-inch depth are above 50F. 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. In some situations soil fumigation can be applied in the spring in Michigan.

Correct soil moisture, temperature and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or by immediate tarping.

## INSECTS

### SEEDBED TREATMENT:

Apply treatments to the soil according to directions to protect young seedlings in the seedbed before transplanting in field.

**CABBAGE MAGGOT:** Apply equivalent amount to seedbed surface and incorporate to 3 to 4 inches.

*Diazinon AG 500*, 3 qt. Apply only as directed. (RUP)

### SOIL TREATMENT:

#### APHIDS:

*Venom*, 5 to 6 oz. (21 days) See label for application methods.

or  
*Platinum*, 5 to 11 fl oz. (30 days) See label for application methods.

#### FLEA BEETLE:

*Platinum*, 5 to 11 fl oz. (30 days) See label for application methods.

### TRANSPLANT WATER TREATMENT:

Treatments are applied in water around roots at time plants are being set in the field. **Note:** Treatment rates are given in the amount of formulation per 100 gals of water. Apply at rate of 1 cup solution/plant. Frequent agitation is needed with wettable powders.

#### CABBAGE MAGGOT:

*Diazinon 50 WP* (1 lb/100 gal) or *Diazinon AG 500* (1/2 to 1 pt/100 gal) Use only as directed. (RUP)

### PLANTING TREATMENT:

Treatments applied at seeding.

**CABBAGE MAGGOT:** Apply in a 4 inch band over row at time of seeding.

*Lorsban 15 G* (4.6 to 9.2 oz/1,000 ft of row) or *Lorsban 4 E* / *Lorsban Advanced* (1.6 to 2.4 fl oz/1,000 ft of row) (RUP)

or

*Capture LFR*, 3.4 to 6.8 oz. See label for application methods.

**APHIDS and FLEA BEETLE:** Apply as a band on each side of seed row or transplant row at the time of planting or sidedressed after plants are established. Treatments applied at seeding or transplanting are translocated into foliage systemically.

*Di-Syston 15 G* (7.4 oz / 1,000 ft) or *Di-Syston 8 E* (1.1 fl oz/1,000 ft) (40 days) Use only as directed. (RUP)

or

*Platinum*, 5 to 11 fl oz. (30 days) See label for application methods.

### SOIL TREATMENT AFTER TRANSPLANTING:

**APHIDS:** Apply as a post-seeding drench, transplant drench, or hill drench, or as a sidedress after plants are established.

*Imidacloprid*

*Admire Pro*, 4.4 - 10.5 fl oz. (21 days)

*Nuprid 2 F*, 10 to 24 fl oz. (21 days)

**CABBAGE MAGGOT:** Apply to the soil at base of plants after transplanting. Apply water to wet soil surface.

*Lorsban 4 E* / *Lorsban Advanced*, 1.6 to 2.4 fl oz/1,000 ft of row. (RUP)

### FOLIAR TREATMENT:

**FLEA BEETLE:** Apply as needed soon after plants emerge.

*Cypermethrin*

*Ammo 2.5 EC* (2.5 to 5 oz) or *Ammo WSB* (1 to 2 bags) or

*UP-Cyde 2.5 EC* (2.5 to 5 oz) (1 day) (RUP)

or

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

or

*Baythroid XL*, 2.4 to 3.2 fl oz. (0 days) (RUP)

or

*Bifenthrin*

*Bifenture EC*, *Brigade 2EC*, *Capture 2 EC*, 2.1 to 6.4 oz. (7 days) (RUP)

or

*Endosulfan 3 EC*, 2 pt. (14 days) Consult label for rotation restrictions.

or

*Thiodicarb*

*Larvin 3.2 EC*, 24 to 40 oz. (7 days)

or

*Lorsban 50 W*, 2 lb. (21 days) (RUP)

or

*Mustang Max*, 2.2 to 4.0 oz. (1 day) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Venom*, 3 to 4 oz. (1 day)

or

## Cauliflower

Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.8 fl oz. (7 days) Do not exceed 19.2 oz/Acre per season.

or

*Actara*, 1.5 to 3 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

Permethrin

*Perm-UP* 3.2 EC, 2 to 4 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (RUP)

**CUTWORM, ARMYWORM:** Apply when damage is first seen.

Repeat as needed.

\* Cypermethrin

*Ammo* 2.5 EC (2.5 to 5 oz) or *Ammo* WSB (1 to 2 bags) or *UP-Cyde* 2.5 EC (2.5 to 5 oz) (1 day) (RUP)

or

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

or

\* *Baythroid* XL, 2.4 to 3.2 fl oz. (0 days) (RUP)

or

\* Bifenthrin (RUP)

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 6.4 oz. (7 days)

or

\* *Mustang* Max, 3.2 to 4.0 oz. (1 day) (RUP)

or

\* Permethrin

*Ambush* 25 W, 6.4 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (4 oz) or *Pounce* 25 WP (6.4 oz) or *Pounce* 3.2 EC (4 oz) (1 day) (RUP)

or

*Endosulfan* 3 EC, 2 2/3 pt. (14 days) Consult label for rotation restrictions.

or

*Lannate* LV (1 1/2 pt) or *Lannate* SP (1/2 lb) (3 days) (RUP)

or

*Lorsban* 50 W, 2 lb. (21 days) (RUP)

or

*SpinTor* 2 SC, 4 to 8 oz. (1 day) Do not apply more than 3 times in 30 days.

or

*Entrust*, 1.3 to 3 oz. (1 day) Do not apply more than 3 times in 30 days.

or

*Rimon*, 6 to 12 fl oz. (7 days)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 3.8 to 6.1 oz. (7 days)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (RUP)

**IMPORTED CABBAGE WORM:** Apply if: 1) >10% of transplants are infested with any type of cabbage "worm", 2) >50% of plants are infested before flowering, or 3) >10% of plants are infested at or after 1st flowering.

Acephate

*Acephate* 97 UP, *Orthene* 97, 1 lb. (14 days) Do not apply more than 2-1/8 lb per season.

or

Cypermethrin

*Ammo* 2.5 EC (2.5 to 5 oz) or *Ammo* WSB (1 to 2 bags) or *UP-Cyde* 2.5 EC (2.5 to 5 oz) (1 day) (RUP)

or

*Asana* XL, 2.9 to 5.8 oz. (3 days) (RUP)

or

*Avaunt*, 2.5 to 3.5 oz. (3 days) Do not exceed 14 oz/acre per crop.

or

*Bacillus thuringiensis*

*Agree*, *Biobit*, *Dipel*, *Javelin*, *Lepinox*, *Xentari*. (0 days)

or

*Baythroid* XL, 1.6 to 2.4 fl oz. (0 days) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (7 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt) (3 days)

or

*Danitol* 2.4 EC, 2.4 EC, 10 2/3 to 16 fl oz. (7 days) (RUP)

or

*Dibrom* 8 EC, 1 pt. (1 day)

or

*Endosulfan* 3 EC, 2 pt. (14 days) Consult label for rotation restrictions.

or

*Lannate* LV (3/4 to 3 pt) or *Lannate* SP (1/4 to 1 lb) (3 days) (RUP)

or

Thiodicarb

*Larvin* 3.2 EC, 24 to 40 oz. (7 days)

or

*Lorsban* 50 W, 2 lb. (21 days) (RUP)

or

*Malathion* 57 EC, 1 to 2 pt. (7 days)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

Permethrin

*Ambush* 25 W, 3.2 to 6.4 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (2 to 8 oz) or *Pounce* 25 WP (3.2 to 6.4 oz) or *Pounce* 3.2 EC (2 to 4 oz) (1 day) (RUP)

or

*Proclaim*, 2.4 to 4.8 oz. (7 days) (RUP)

or

*SpinTor* 2 SC, 3 to 6 oz. (1 day) Do not apply more than 3 times in 30 days.

or



*Entrust*, 1 to 2 oz. (1 day) Do not apply more than 3 times in 30 days.

or

*Intrepid* 2 F, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

*Rimon*, 6 to 12 fl oz. (7 days)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 3.8 to 6.1 oz. (7 days)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 1.9 to 3.2 fl oz. (RUP)

**DIAMONDBACK MOTH:** Apply if: 1) >10% of transplants are infested with any type of cabbage "worm", 2) >50% of plants are infested before flowering, or 3) >10% of plants are infested at or after 1st flowering. Use *Bacillus thuringiensis* to avoid killing important natural enemies of diamondback moth.

\* *Avaunt*, 3.5 oz. (3 days) Do not apply more than twice to one generation. Do not exceed 14 oz/acre per crop.

or

\* *Bacillus thuringiensis*

*Agree*, *Biobit*, *Dipel*, *Javelin*, *Lepinox*, *Xentari*. (0 days)

or

\* *SpinTor* 2 SC, 1.5 to 3 oz. (1 day) Do not apply more than 3 times in 30 days.

or

\* *Entrust*, 0.5 to 1.3 oz. (1 day)

or

Acephate

*Acephate* 97 UP, *Orthene* 97, 1 lb. (14 days) Do not apply more than 2-1/8 lb per season.

or

*Baythroid* XL, 2.4 to 3.2 fl oz. (0 days) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (7 days) (RUP)

or

*Dibrom* 8 EC, 1 pt. (1 day)

or

*Endosulfan* 3 EC, 2 pt. (14 days) Consult label for rotation restrictions.

or

*Fulfill*, 2.75 oz. (7 days) May require 5 to 7 days for aphid mortality.

or

*Lannate* LV (1 1/2 to 3 pt) or *Lannate* SP (1/2 to 1 lb) (3 days) (RUP)

or

Thiodicarb

*Larvin* 3.2 EC, 24 to 40 oz. (7 days)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

Permethrin

*Ambush* 25 W, 3.2 to 6.4 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (2 to 8 oz) or *Pounce* 25 WP (3.2 to 6.4 oz) or *Pounce* 3.2 EC (2 to 4 oz) (1 day) (RUP)

or

*Proclaim*, 2.4 to 4.8 oz. (7 days) (RUP)

or

Cryolite

*Kryocide*, 8 to 16 lb. (14 days) Apply with maximum tank agitation. Allow at least 14 days between applications. Do not irrigate within 48 to 72 hrs after treatment (14 days).

or

*Rimon*, 6 to 12 fl oz. (7 days)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 3.8 to 6.1 oz. (7 days)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (RUP)

**CABBAGE LOOPERS:** Apply if: 1) >10% of transplants are infested with any type of cabbage "worm", 2) >50% of plants are infested before flowering, or 3) >10% of plants are infested at or after 1st flowering. Most controls are less effective on larger worms.

Acephate

*Acephate* 97 UP, *Orthene* 97, 1 lb. (14 days) Do not apply more than 2-1/8 lb per season.

or

Cypermethrin

*Ammo* 2.5 EC (3.75 to 5 oz) or *Ammo* WSB (1 to 2 bags) or *UP-Cyde* 2.5 EC (3.75 to 5 oz) (1 day) (RUP)

or

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

or

*Avaunt*, 2.5 to 3.5 oz. (3 days) Do not exceed 14 oz/acre per crop.

or

*Bacillus thuringiensis*

*Agree*, *Biobit*, *Dipel*, *Javelin*, *Lepinox*, *Xentari*.

or

*Baythroid* XL, 1.6 to 2.4 fl oz. (0 days) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (7 days) (RUP)

or

*Danitol* 2.4 EC, 2.4 EC, 10 2/3 to 16 fl oz. (7 days) (RUP)

or

*Dibrom* 8 EC, 2 pt. (1 day)

or

*Endosulfan* 3 EC, 1 1/3 qt. (14 days) Consult label for rotation restrictions.

or

*Lannate* LV (3 pt) or *Lannate* SP (1 lb) (3 days) (RUP)

## Cauliflower

or

Thiodicarb

*Larvin* 3.2 EC, 24 to 40 oz. (7 days)

or

*Mustang Max*, 2.2 to 4.0 oz. (1 day) (RUP)

or

Permethrin

*Perm-UP* 3.2 EC (4 oz) or *Pounce* 25 WP (6.4 oz) or *Pounce* 3.2 EC (4 oz) (1 day) (RUP)

or

*Proclaim*, 3.2 to 4.8 oz. (7 days) (RUP)

or

*SpinTor* 2 SC, 3 to 6 oz. (1 day) Do not apply more than 3 times in 30 days.

or

*Entrust*, 1 to 2 oz. (1 day) Do not apply more than 3 times in 30 days.

or

*Intrepid* 2 F, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

*Rimon*, 6 to 12 fl oz. (7 days)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 3.8 to 6.1 oz. (7 days)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 1.9 to 3.2 fl oz. (RUP)

**APHIDS:** Apply if there are >100 aphids per plant before flowering or >5/plant at flowering or beyond.

Acephate

*Acephate* 97 UP, *Orthene* 97, 1/2 to 1 lb. (14 days) Do not apply more than 2-1/8 lb per season.

or

*Assail* 30 SG, 1.9 to 2.8 oz. (7 days)

or

*Dibrom* 8 EC, 1 pt. (1 day)

or

*Dimethoate* 2.67 EC, 3/4 to 1 1/2 pt. (7 days)

or

*Endosulfan* 3 EC, 2 pt (14 days) See label for rotation restrictions.

or

Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.75 fl oz. (7 days) Do not use if Imidacloprid was used at planting. Do not exceed 19.2 oz/Acre per season.

or

*Beleaf* 50 SG, 2 to 2.8 oz. (0 days)

or

*Venom*, 1 to 4 oz. (1 day)

or

*Actara*, 1.5 to 3 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

*Brigadier*, 3.8 to 6.1 oz. (7 days)

## DISEASES

### SEED TREATMENT:

**DAMPING OFF, WIRE STEM** (*Pythium* spp., *Rhizoctonia solani*):  
*Bacillus subtilis* GB03

*Kodiak*, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

*Captan*

*Captan* 30-DD, 1 1/4 oz/100 lb seed.

*Captan* 400, 1 to 2 oz/100 lb seed.

or

*Fludioxinil*

*Maxim* 4 FS, 0.08 to 0.16 fl oz/100 lb seed (*Rhizoctonia*).

Commercial seed treatment plants only.

or

*Thiram*

42-S Thiram, *Thiram* 50 WP Dyed, 8 oz/100 lb seed.

**BLACK LEG** (*Phoma lingam*): There are presently no chemicals registered for use on this disease.

### SEEDBED TREATMENT:

Apply treatments to the soil according to directions to protect young seedlings in the seedbed before transplanting in field.

**CLUBROOT** (*Plasmodiophora brassicae*): Sterilize seedbed before planting (Appendix A) or apply to soil surface as a drench.

**PCNB**

*Terraclor* 10 G, 200 lb (row) or 300 lb (broadcast). Row

application: Apply in a 12- to 15-inch band by means of a suitable applicator and rototill to a depth of 4 to 6 inches.

Broadcast application: Apply and disc and cross disc to depth of 4 to 6 inches. May be used on direct seeded crops.

or

*Terraclor* 75 WP, 30 lb in 25 gal of water (band) or 40 lb in 35 gal of water (broadcast). Band application: Spray as 12- to 15-inch band centered on the row and incorporate to a depth of 4 to 6 inches. Broadcast application: Apply and thoroughly incorporate to a depth of 4 to 6 inches. May be used on direct seeded crops.

or

*Terraclor* F, 5.6 gal in 25 gal of water (band) or 7.5 gal in 30 gal of water (broadcast). Band application: Spray as a 12- to 15-inch band centered on the row and incorporate to a depth of 4 to 6 inches prior to planting. Broadcast application: Apply as preplant broadcast. Incorporate to a depth of 4 to 6 inches. May be used on direct seeded crops.

**WIRE STEM or BLACK ROOT** (*Corticium solani*):

**PCNB**

*Terraclor* 10 G, 110 to 150 lb. Row application in an 8 in. band prior to seeding.

or

*Terraclor* 75 WP, 10 to 15 lb in 35 gal of water (row) or 15 to 20 lb in 50 gal of water (broadcast). Row drench treatment: Spray as an 8 inch band centered on the row.

or

*Terraclor* F, 1.9 to 2.8 gal in 35 gal of water (row) or 2.8 to 3.8 gal in 50 gal of water (broadcast). Row drench treatment: Apply as an 8-inch band centered on the row.



**DAMPING OFF** (*Pythium* spp.):

\* Mefenoxam. Apply as a broadcast preplant incorporation or a surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone with 1/2 to 1 in. of sprinkler irrigation.

*Ridomil* Gold SL, 0.25-0.5 pt.

*Ridomil* Gold WSP, 1 to 2 lb (1/4 to 1/2 lb, surface application).

**TRANSPLANT WATER TREATMENT:**

Apply in 100 gal of water using 1/2 pt per plant around roots at time plants are being set in the field. **Note:** Frequent agitation is needed.

**CLUBROOT** (*Plasmodiophora brassicae*):PCNB

*Terraclor* 75 WP, 2 lb.

*Terraclor* F, 3 pt.

For best results, use with disease free (clubroot) seedlings.

**FOLIAR TREATMENT:**

**BLACK ROT** (*Xanthomonas campestris*): Apply treatment (lowest rates) in the field as soon as transplants are established.

Copper Ammonium Carbonate

*Copper* Count N, 2 qt. (0 days)

or

Copper Hydroxide

*Champ* 2FL, 1/3 to 2/3 pt. (0 days)

*Champ* DP, 1/3 to 2/3 lb. (0 days)

*Champ* WP, 1 to 2 lb. (0 days)

*Kocide* 101, *Kocide* DF, 1 to 2 lb. (0 days)

*Kocide* 2000, 3/4 to 1 1/2 lb. (0 days)

*Kocide* 4.5 LF, 2/3 to 1 1/3 pt. (0 days)

or

Copper Sulfate

*Cuprofix* Ultra, 3/4 to 1 1/4 lb. (0 days)

or

Acibenzolar-S-methyl

*Actigard*, 1 oz per 20 gal (ground) or 10 gal (aerial) of water.

(7 days) Do not apply more than 4 applications / crop per year.

**ALTERNARIA LEAF SPOT** (*Alternaria brassicae*): Apply when conditions favor disease and repeat every 7 to 10 days.

\* Azoxystrobin

*Amistar*, 2 to 5 oz every 7 - 14 days. (0 days)

*Quadris*, 6.2 to 15.4 fl oz.

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* Chlorothalonil

*Bravo* Ultrex, 1.4 lb. (7 days)

*Bravo* Weather Stik, *Equus* 720 SST, 1.5 pt. (7 days)

or

\* Maneb

*Maneb* 75 DF, *Maneb* 80 WP, 1.5 to 2 lb. (7 days)

*Manex*, 1 1/5 to 1 3/5 qt. (7 days)

or

\* Boscalid

*Endura*, 6 to 9 oz. (0 days)

or

Copper Ammonium Carbonate

*Copper* Count N, 2 qt. (0 days)

or

Copper Hydroxide

*Kocide* 101, *Kocide* DF, 1 to 2 lb. (0 days)

*Kocide* 2000, 3/4 to 1 1/2 lb. (0 days)

*Kocide* 4.5 LF, 2/3 to 1 1/3 pt. (0 days)

or

Copper Sulfate

*Basicop* 53 WP, 1 to 3 lb. (0 days)

*Cuprofix* Ultra, 3/4 to 1 1/4 lb. (0 days)

or

Cyprodinil/Fludioxonil

*Switch* 62.5 WG, 11 to 14 oz. (7 days)

or

Mefenoxam/Chlorothalonil

*Ridomil* Gold Bravo, 1 1/2 lb. (7 days) Apply at 14-day intervals.

Maximum 4 applications.

**DOWNY MILDEW** (*Peronospora parasitica*): Apply when conditions favor disease.

\* Fosetyl-Aluminum

*Aliette* WDG, 2 to 5 lb, 7- to 21-day intervals. (3 days)

**Note:** Do not tank mix with copper fungicides.

or

\* Mefenoxam

*Ridomil* Gold SL, 0.125-0.25 pt. (7 days)

or

\* Mefenoxam/Chlorothalonil

*Ridomil* Gold Bravo, 1 1/2 lb. (7 days) Apply at 14-day intervals.

Maximum 4 applications.

or

Mono-, dibasic sodium, potassium and ammonium phosphites

*Phostrol*, 2.5 to 5 pt every 7 - 21 days.

*Prophyt*, 2 to 4 pt. (0 days)

or

Acibenzolar-S-methyl

*Actigard*, 1 oz per 20 gal (ground) or 10 gal (aerial) of water.

(7 days) Do not apply more than 4 applications / crop per year.

or

Mandipropamid

*Revus*, 8 fl oz. (1 day)

**Note:** Fungicides that protect against *Alternaria* also provide limited downy mildew protection.

## Celery

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

Root-knot, pin, needle and root-lesion nematodes can reduce celery yields. Fields with root problems of undetermined cause should be tested for nematodes (see Appendix C). If the plant-parasitic nematodes are present in population densities above the economic threshold for celery, crop rotation or application of a nematicide is recommended. The following nematicides are suitable for control of root-knot, pin, needle and lesion nematodes in celery production. Nematode-free transplants must be used to prevent serious losses.

### FALL SOIL FUMIGATION (BROADCAST):

1,3-D

*Telone II*, 25 gal/A (muck soil), 9-18 gal/A (mineral soil).

Fumigate in the fall when soil temperatures at a 6-inch depth are above 50F. 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. In some limited situations soil fumigants can be applied in the spring in Michigan.

Correct soil moisture, temperature and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or by immediate tarping.

or

Metam Sodium

*Vapam HL*, 37.5 to 75 gal/A. Use higher rate for muck soil.

Inject with shanks spaced 5 inches apart or to a depth of 4-10 inches in well prepared soil. If shanked, roll and irrigate treated surface to prevent escape of gas.

### PREPLANT TREATMENT:

*Vydate L*, Apply 2 gal/acre in 20 gal of water in 8- to 16-inch band. Incorporate to a depth of 4 inches. (RUP)

### PLANTING TREATMENT:

*Vydate L*, apply 0.5 to 1 gal/acre in at least 100 gal of water immediately after transplanting seedlings in the field. (RUP)

### POST-PLANT TREATMENT:

*Vydate L*, apply 1 gal/acre in at least 100 gal of water as a foliar spray 3 weeks after transplanting. Apply again 3 weeks after first treatment. (RUP)

## INSECTS

### SOIL TREATMENT:

**APHIDS:** Apply to soil in narrow band 14 or fewer days before planting, as an in-furrow spray at planting, as a post-seeding drench, transplant drench or hill drench, as a sidedress after plants are established, or in drip or trickle irrigation water.

Imidacloprid

*Admire Pro*, 4.4 - 10.5 fl oz. (45 days)

*Nuprid 2 F*, 10 to 24 fl oz. (45 days)

or

*Venom*, 5 to 6 oz. (21 days) See label for application methods.

### APHIDS, LEAF MINERS, LEAFHOPPER:

*Platinum*, 5 to 11 oz. (30 days) See label for application methods.

### FOLIAR TREATMENT:

**CUTWORM, ARMYWORM:** Apply preventive treatments within 4 weeks of harvest.

\* *Baythroid XL*, 2.4 to 3.2 fl oz. (0 days) (RUP)

or

\* *Mustang Max*, 2.4 to 4.3 oz. (1 day) (RUP)

or

\* Permethrin

*Ambush 25 W*, 6.4 to 12.8 oz. (1 day) (RUP)

or

*Perm-UP 3.2 EC* (4 to 8 oz) or *Pounce 25 WP* (6.4 to 12.8 oz)

or *Pounce 3.2 EC* (4 to 8 oz) (1 day) (RUP)

or

*Lannate LV* (1 1/2 pt) or *Lannate SP* (1/2 lb) (7 days) (RUP)

or

*Radiant SC*, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

**CARROT WEEVIL LARVAE:** Apply as a directed spray. Start when eggs or larvae are first seen and repeat in 2 to 3 weeks. *Vydate L*, 4 pt. (21 days) May also be used for nematode control at same time. (Special Michigan SLN label.) (RUP)

**CARROT WEEVIL ADULTS:** Apply when adults are first caught in traps or eggs are first seen. No materials are labeled specifically for this area, however, permethrin at the rates given below will give some control of carrot weevil adults.

No materials are labeled for this area, however Permethrin at the rates given below will give some control of carrot weevil adults.

**ASTER LEAFHOPPER** (*Aster yellows*): Apply if numbers exceed 14/100 sweeps. Repeat as needed, depending on number of leafhoppers. Over-treatment with permethrin or Guthion may cause increased aphid problems.

\* *Mustang Max*, 2.4 to 4.3 oz. (1 day) (RUP)

or

\* Permethrin

*Ambush 25 W*, 6.4 to 12.8 oz. (1 day) (RUP)

or

*Perm-UP 3.2 EC* (4 to 8 oz) or *Pounce 25 WP* (6.4 to 12.8 oz)

or *Pounce 3.2 EC* (4 to 8 oz) (1 day) (RUP)

or

*Lannate LV* (1 1/2 to 3 pt) or *Lannate SP* (1/2 to 1 lb) (7 days) (RUP)

or

Carbaryl

*Sevin 80 S* (1 1/4 to 1 7/8 lb) or *Sevin XLR Plus* (1 to 2 qt) (14 days)

or

*Venom*, 1 to 3 oz. (7 days)

or

*Actara*, 1.5 to 3 oz. (7 days) Do not exceed 11.0 oz/Acre per season

Do not exceed 11.0 oz/Acre per season.

**TARNISHED PLANT BUG:** Apply if numbers exceed 2 to 4 per 20 plants.

*Baythroid XL*, 2.4 to 3.2 fl oz. (0 days) (RUP)

or

*Mustang Max*, 3.4 to 4.3 oz. (1 day) (RUP)

or



## Carbaryl

*Sevin* 80 S (1 1/4 to 2 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt)  
(14 days)

or

*Beleaf* 50 SG, 2 to 2.8 oz. (0 days)

**APHIDS:** Apply if more than 3% of plants are infested or if there are more than 6/100 sweeps. Over-treatment with pyrethroids or Guthion may cause increased aphid problems.

\* *Assail* 30 SG, 1.9 to 2.8 oz. (7 days)

or

## Acephate

*Acephate* 97 UP, *Orthene* 97, 1/2 to 1 lb. (21 days) Do not apply more than 2-1/8 lb per season.

or

*Lannate* LV (1 1/2 to 3 pt) or *Lannate* SP (1/2 to 1 lb) (7 days) Not labeled for aphids; follow directions for loopers. (RUP)

or

*Endosulfan* 3 EC, 1 1/3 to 2 2/3 pt. (4 days) Limited to 1 application per year.

or

*Malathion* 57 EC, 1 1/2 pt. (7 days)

or

*Pyrellin* EC, 1 to 2 pt. (0 days)

or

*Pyrenone*, 2 to 12 oz. (0 days)

or

*Venom*, 1 to 3 oz. (7 days)

or

*Beleaf* 50 SG, 2 to 2.8 oz. (0 days)

or

*Actara*, 1.5 to 3 oz. (7 days) Do not exceed 11.0 oz/Acre per season.

or

*Fulfill*, 2.75 oz. (7 days) Do not exceed 5.5 oz/acre per season. May require 5 to 7 days for aphid mortality.

**LOOPERS (CELERY and CABBAGE):** Apply if needed to protect plants within 4 weeks of harvest.

\* *Baythroid* XL, 1.6 to 2.4 fl oz. (0 days) (RUP)

or

\* Permethrin

*Ambush* 25 W, 6.4 to 12.8 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz) or *Pounce* 3.2 EC (4 to 8 oz) (1 day) (RUP)

or

## Acephate

*Acephate* 97 UP, *Orthene* 97, 1 lb. (21 days) Do not apply more than 2-1/8 lb per season.

or

*Bacillus thuringiensis*

*Agree*, *Biobit*, *Dipel*, *Javelin*, *Lepinox*, *Xentari*. (0 days)

or

*Endosulfan* 3 EC, 2 2/3 pt. (4 days) Limited to one application per year.

or

*Lannate* LV (3 pt) or *Lannate* SP (1 lb) (7 days) (RUP)

or

*Mustang* Max, 3.4 to 4.3 oz. (1 day) (RUP)

or

*Proclaim*, 3.2 to 4.8 oz. (RUP)

or

*Pyrellin* EC, 1 to 2 pt. (0 days)

or

*Pyrenone*, 2 to 12 oz. (0 days)

or

*SpinTor* 2 SC, 4 to 8 oz. (1 day) Do not apply more than 3 times in 21 days.

or

*Entrust*, 1 to 2 oz. (1 day)

or

*Intrepid* 2 F, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

*Avant*, 3.5 oz. (3 days) Do not exceed 14 oz/acre per crop.

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

**VEGETABLE LEAFMINER:** Apply as soon as visible mines appear and repeat every 7 days as needed.

*Agri-Mek* 0.15 EC, 8 to 16 fl oz. (7 days) (RUP)

or

*SpinTor* 2 SC, 4 to 8 oz. (1 day) Do not apply more than 3 times in 21 days.

or

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

or

*Entrust*, 2 to 3 oz. (1 day) Do not apply more than 3 times in 30 days.

or

*Venom*, 1 to 3 oz. (7 days)

or

*Radiant* SC, 6 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

## MITES

*Agri-Mek* 0.15 EC, 8 to 16 fl oz. (7 days) (RUP)

## SLUGS

*Deadline* M-Ps 4% (20 to 40 lb) or *Metaldehyde* 3.5 G (30 to 40 lb) Apply between rows. Avoid contact to edible product.

## DISEASES

## PREPLANT TREATMENT:

## DAMPING OFF:

\* *Mefenoxam*

*Ridomil* Gold SL, 1-2 pt.

## PLANTING TREATMENT:

DAMPING OFF (*Pythium* spp.):

*Mefenoxam*. Apply as a broadcast preplant incorporation or a surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 1 in. of sprinkler irrigation.

*Ridomil* Gold GR, 20 to 40 lb.

*Ultra* Flourish, 2 to 4 pt.

## Celery

### FOLIAR TREATMENT:

**CRATER ROT** (*Rhizoctonia solani*): Apply as a basal spray after each cultivation.

\* Azoxystrobin

*Amistar*, 0.125 to 0.25 oz per 1000 row feet (see label) (0 days)

*Quadris*, 0.4 to 0.8 fl oz per 1000 row feet (see label) (0 days)

or

\* Azoxystrobin/Chlorothalonil

*Quadris Opti*, 2.4 - 3.7 pts every 7-14 days. (7 days)

or

\* Chlorothalonil

*Bravo Ultrex*, *Equus* DF, 1.8 to 2.7 lb every 7 days.

or

*Bravo Weather Stik*, *Equus* 720 SST, 2 to 3 pt every 7 days. (7 days)

or

*Echo* 720, 1 to 1 1/2 pt every 3-5 days. (7 days)

or

*Echo* 720, 2 to 3 pt every 7 days. (7 days)

or

*Echo* 90 DF, 1 5/8 to 2 1/2 lb every 7 days. (7 days)

or

*Echo* 90 DF, 7/8 to 1 1/4 lb every 3 - 5 days. (7 days)

or

*Echo* Zn, 3 to 4 1/4 pt every 7 days. (7 days)

or

*Echo* Zn, 1 1/2 to 2 1/8 pt every 3 - 5 days. (7 days)

**PINK ROT** (*Sclerotinia sclerotiorum*):

DCNA

*Botran* 75 W (5 1/3 lb (single application)) or *Botran* 75 W (2 lb every 7 - 14 days) (7 days)

or

Chlorothalonil

*Bravo Ultrex*, *Equus* DF, 2.7 lb every 7 days (pink rot suppression). (7 days)

or

*Bravo Weather Stik*, *Equus* 720 SST, 3 pt every 7 days (pink rot suppression). (7 days)

or

*Echo* 90 DF, 1.7 to 2.4 lb. (7 days)

*Equus* DF, 1.8 to 2.7 lb. (7 days)

or

Cyprodinil/Fludioxonil

*Switch* 62.5 WG, 11 to 14 oz. (0 days)

**EARLY BLIGHT** (*Cercospora apii*), **LATE BLIGHT** (*Septoria apiicola*): Treat every 7 to 10 days beginning after transplanting.

\* Azoxystrobin. Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

*Amistar*, 3 to 5 oz every 7 - 14 days. (0 days)

*Quadris*, 9.2 to 15.4 fl oz every 7 - 14 days. (0 days)

or

\* Azoxystrobin/Chlorothalonil

*Quadris Opti*, 2.4 - 3.7 pt every 7-14 days. (7 days)

or

\* Chlorothalonil

*Bravo Ultrex*, *Equus* DF, 1.8 to 2.7 lb every 7 days. (7 days)

or

*Bravo Weather Stik*, *Equus* 720 SST, 2 to 3 pt every 7 days. (7 days)

or

*Echo* 720, 1 to 1 1/2 pt every 3-5 days. (7 days)

*Echo* 720, 2 to 3 pt every 7 days. (7 days)

*Echo* 90 DF, 1 5/8 to 2 1/2 lb every 7 days. (7 days)

*Echo* 90 DF, 7/8 to 1 1/4 lb every 3 - 5 days. (7 days)

*Echo* Zn, 3 to 4 1/4 pt every 7 days. (7 days)

*Echo* Zn, 1 1/2 to 2 1/8 pt every 3 - 5 days. (7 days)

or

\* Propiconazole

*Propimax EC*, *Tilt*, 4 fl oz. (14 days) Maximum of four applications per season.

or

\* Trifloxystrobin

*Flint*, 2 to 3 oz. (7 days) Do not apply more than three sequential foliar application of strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

Copper Hydroxide

*Champ* DP, 1 1/3 lb. (0 days)

*Champ* Formula 2 F, *Kocide* 4.5 LF, 1 1/3 pt. (0 days)

*Champion* WP, *Kocide* 101, *Kocide* DF, 2 lb. (0 days)

*Kocide* 2000, 1 1/2 lb. (0 days)

*Nu-Cop* 3 L, 1 1/3 to 2 2/3 pt. (0 days)

*Nu-Cop* 50 DF, 1 to 2 lb, 5- to 7-day intervals. (0 days)

or

Copper Ammonium Carbonate

*Copper Count* N, 2 to 3 qt. (0 days)

or

Copper Oxychloride / Copper Sulfate

C-O-C-S WDG, 2 to 4 lb, 7 days. (0 days)

or

Copper Resinate

*Tenn-Cop* 5 E, 3 pt (*Cercospora apii*). (0 days) (*Cercospora apii*)

or

Copper Sulfate

*Basic Copper* 53, *Basicop*, 3 to 4 lb. (0 days)

*Cuprofix* Ultra, 1.25 lb. (0 days)

or

Neem Oil

*Trilogy*, 2 pt. (0 days)

**BACTERIAL LEAF SPOT** (*Pseudomonas syringae* pv. *apii*): Treat every 7 to 10 days, beginning after transplanting.

Copper Hydroxide

*Champ* DP, 1 1/3 lb. (0 days)

*Champ* Formula 2 F, *Kocide* 4.5 LF, 1 1/3 pt. (0 days)

*Champion* WP, *Kocide* 101, *Kocide* DF, 2 lb. (0 days)

*Kocide* 2000, 1 1/2 lb. (0 days)

*Nu-Cop* 3 L, 1 1/3 to 2 2/3 pt. (0 days)

*Nu-Cop* 50 DF, 1 to 2 lb, 5- to 7-day intervals. (0 days)

or

Copper Ammonium Carbonate

*Copper Count* N, 2 to 3 qt. (0 days)

or

Copper Oxychloride / Copper Sulfate

C-O-C-S WDG, 2 to 4 lb, 7 days. (0 days)



or  
Copper Sulfate  
*Cuprofix Ultra*, 1.25 lb. (0 days)  
 or  
Copper Resinate  
*Tenn-Cop 5 E*, 3 pt. (0 days)

## Corn (Sweet)

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

### FALL SOIL FUMIGATION:

1,3-D

*Telone II* (3 gal in-row for mineral soil) or *Telone II* (9-12 gal/A broadcast for mineral soil)

Fumigate in the fall when soil temperatures at a 6-inch depth are above 50F. 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. In some limited situations, soil fumigants can be applied in the spring in Michigan.

Correct soil moisture, temperature and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or by immediate tarping.

### SOIL TREATMENT:

Root-lesion, stunt, stubby-root, lance and dagger nematodes can reduce sweet corn yields. Fields with soil or root problems of undetermined cause should be tested for nematodes (see Appendix C). If the above plant-parasitic nematodes are present in population densities above the economic threshold for sweet corn, crop rotation or application of a nematicide is recommended. The following nematicides are suitable for control of root-lesion, lance, stunt, dagger and stubby-root nematodes in sweet corn production.

### PREPLANT TREATMENT:

*Mocap 15 G*, broadcast. Apply 40 lb/A 3 days before planting to at-planting. Mix with the top 2-4 inches of soil. (RUP)

or  
*Mocap 15 G*, band. Add 3/4 to 1 lb per 1,000 row ft in a band 12-15 inches on the row 3 days before planting to at-planting. Mix with the top 2-4 inches of soil. Rate per acre is dependent on row spacing. Rate would be 10-13.3 lb/A at 40-inch row spacings. (RUP)

## INSECTS

### SEED TREATMENT:

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

#### CORN FLEA BEETLE, WIRE WORM, SEED CORN MAGGOT:

*Cruiser 5 FS*, Purchase seed treated at 1.28 to 5.1 fl oz / 100 lb seed.

#### CORN ROOTWORM, FLEA BEETLE, SEED CORN MAGGOT, WIREWORM:

*Poncho 600*, purchase seed treated commercially at 1.13 to 5.64 fl oz/80,000.

#### SEED CORN MAGGOT:

*Lorsban 50 SL*, 2 oz/100 lb seed. Use as a slurry treatment. (RUP)

### PLANTING TREATMENT:

**WIREWORM:** Broadcast evenly on soil surface and incorporate to 4 to 6 inches or band over the row at planting at reduced rate.

**Note:** Consult the labels for other uses of these materials.

*Aztec 2.1 G*, 6.7 oz/1000 row ft. (RUP)

or

*Capture 1.15 G*, 3.2 to 8.0 oz. (RUP)

or

*Counter CR*, 6 oz/1,000 row ft, banded. (RUP)

or

*Mocap 15 G*, 10.5 oz/1,000 row ft, banded. (RUP)

or

*Diazinon 4 EC*, 4 qt. (RUP)

or

*Capture LFR*, 3.4 to 6.8 oz. See label for application methods.

#### SEED CORN MAGGOT:

*Aztec 2.1 G*, 6.7 oz/1,000 ft of row. (RUP)

or

*Capture 1.15 G*, 3.2 to 8.0 oz banded or in furrow. (RUP)

or

*Counter CR*, 6 oz/1,000 row ft, banded. Also controls wireworm and white grubs. May help control flea beetle. (RUP)

or

Phorate

*Thimet 15 G* (8 oz/1000 row ft) or *Thimet 20 G* (6 oz / 1000 row ft) Do not apply in-furrow. (RUP)

or

*Capture LFR*, 3.4 to 6.8 oz. See label for application methods.

**CORN ROOTWORM:** Corn rootworms are a problem only when rotation of crops is not practiced. Apply treatments in a band above seed at time of planting. Use special equipment for correct placement of granules. Consult label for other uses and directions.

*Aztec 2.1 G*, 6.7 oz/1,000 ft of row. (RUP)

or

*Capture 1.15 G*, 3.2 to 8.0 oz banded or in furrow. (RUP)

or

*Counter CR*, 6 oz/1,000 row ft. May help control flea beetle. (RUP)

or

*Force 1.5G*, 8 to 10 oz/1,000 ft of row. (RUP)

or

## Corn (Sweet)

*Furadan* 4 F, 2.5 oz/1,000 row ft. May help control flea beetle. (RUP)

or

*Lorsban* 15 G, 6 to 8 oz/1,000 ft of row. (35 days) (RUP)

or

*Mocap* 15 G, 10.5 oz/1,000 row ft. (RUP)

or

Phorate

*Thimet* 15 G (8 oz/1000 row ft) or *Thimet* 20 G (6 oz / 1000 row ft) Do not apply in-furrow. (RUP)

or

*Capture* LFR, 6.8 to 8.5 oz. See label for application methods.

### EUROPEAN CORN BORER:

*Capture* 1.15 G, 3.2 to 8.0 oz banded or in furrow. (RUP)

### FOLIAR TREATMENT:

**CUTWORM, ARMYWORM:** Apply when they appear. Repeat as needed.

\* *Asana* XL, 5.8 to 9.6 oz. (1 day) (RUP)

or

\* Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (1 day) (RUP)

or

\* *Mustang* Max, 2.8 to 4.0 oz. (3 days) (RUP)

or

\* Permethrin

*Ambush* 25 W, 6.4 to 12.8 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz) or *Pounce* 3.2 EC (4 to 8 oz) (1 day) (RUP)

or

*Avaunt*, 3.5 oz (fall army worm). (3 days)

or

Carbaryl

*Sevin* 80 S (2 lb) or *Sevin* XLR Plus (2 qt) (2 days) See label for pre-harvest intervals for forage and fodder.

or

*Lannate* LV (1 1/2 pt) or *Lannate* SP (1/2 lb) (0 days; 3 days if forage is fed to livestock) (RUP)

or

Thiodicarb

*Larvin* 3.2 EC, 20 to 30 oz. (0 days)

or

*PennCap-M* 2 F, 4 pt. (3 days) Do not apply during pollination. (RUP)

or

*Entrust*, 1 to 2 oz. (1 day) Do not apply more than 3 times in 30 days.

or

*Hero*, 4 to 10.3 oz. (3 days) (RUP)

or

*Radiant* SC, 3 to 6 fl oz. (1 day) Do not make more than 6 applications or exceed 36 fl oz/acre per season.

**CORN FLEA BEETLE:** Apply when damage is first seen, especially if Stewart's disease has been a problem. Plant a variety low in susceptibility to Stewart's wilt for best disease control. Some corn rootworm insecticides may give some early-season flea beetle control (see corn rootworm section).

*Asana* XL, 5.8 to 9.6 oz. (1 day) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (3 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 to 2 qt) (2 days)

See label for pre-harvest intervals for forage and fodder.

or

*Diazinon* AG 500, 1 pt. (0 days) (RUP)

or

*Mustang* Max, 2.4 to 4.3 oz. (3 days) (RUP)

or

Permethrin

*Ambush* 25 W, 6.4 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (4 oz) or *Pounce* 25 WP (6.4 oz) or *Pounce* 3.2 EC (4 oz) (1 day) (RUP)

or

*Hero*, 4 to 10.3 oz. (3 days) (RUP)

**EUROPEAN CORN BORER: For early season control, prior to tasseling.** Treat if >15% of plants are infested. Direct granules into corn whorls.

*Avaunt*, 2.5 to 3.5 oz. (3 days) Whorl application only.

or

*Bacillus thuringiensis*

*Dipel* 10 G, 5 to 10 lb.

or

*Lorsban* 15 G, 6 to 8 oz/1,000 ft of row. (35 days) (RUP)

or

*Pounce* 1.5 G, 6.7 to 13.5 lb. (1 day) (RUP)

**EUROPEAN CORN BORER:** If pheromone trap catch is >5 moths per week. Apply every 5-7 days, beginning at tassel stage.

*Asana* XL, 5.8 to 9.6 oz. (1 day) (RUP)

or

*Avaunt*, 2.5 to 3.5 oz. (3 days)

or

*Baythroid* XL, 1.6 to 2.8 fl oz. (0 days) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (3 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 7/8 to 2 1/2 lb) or *Sevin* XLR Plus (1 1/2 to 2 qt) (2 days) See label for pre-harvest intervals for forage and fodder.

or

*Furadan* 4 F, 1 pt. (14 days) Machine harvest corn only. Do not make more than 4 applications in 1 season. (RUP)

or

*Lannate* LV (3/4 to 1 1/2 pt) or *Lannate* SP (1/4 to 1/2 lb) (0 days; 3 days if forage is fed to livestock) (RUP)

or

Thiodicarb

*Larvin* 3.2 EC, 20 to 30 oz. (0 days)

or



*Mustang* Max, 2.8 to 4.0 oz. (3 days) (RUP)  
 or  
*PennCap-M* 2 F, 2 to 4 pt. (3 days) Do not apply during pollination. (RUP)  
 or  
 Permethrin  
*Ambush* 25 W, 6.4 to 12.8 oz. (1 day) (RUP)  
 or  
*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz) or *Pounce* 3.2 EC (4 to 8 oz) (1 day) (RUP)  
 or  
*SpinTor* 2 SC, 3 to 6 oz. (1 day)  
 or  
*Warrior* with Zeon Technology, 2.6 to 3.8 fl oz. (1 day) (RUP)  
 or  
*Entrust*, 0.5 to 2 oz. (1 day)  
 or  
 Lambda-cyhalothrin  
*Lambda-Cy, Proaxis*, 2.6 to 3.8 fl oz. (1 day) (RUP)  
 or  
*Hero*, 4 to 10.3 oz. (3 days) (RUP)  
 or  
*Radiant* SC, 3 to 6 fl oz. (1 day) Do not make more than 6 applications or exceed 36 fl oz/acre per season.

**CORN EARWORM:** Apply to silks when moths are active to prevent ear damage. Treat every 5 days if 2-6 moths per week are caught in pheromone traps, every 4 to 5 days if catch is 7 to 90 moths per week, and every 3 to 4 days if catch is >90 moths per week. Use the shorter intervals listed above if temperatures are >85.

\* *Asana* XL, 5.8 to 9.6 oz. (1 day) (RUP)  
 or  
 \* *Baythroid* XL, 1.6 to 2.8 fl oz. (0 days) (RUP)  
 or  
 \* Bifenthrin  
*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (3 days) (RUP)  
 or  
 \* Thiodicarb  
*Larvin* 3.2 EC, 20 to 30 oz. (0 days)  
 or  
 \* *Mustang* Max, 2.8 to 4.0 oz. (3 days) (RUP)  
 or  
 \* Permethrin  
*Ambush* 25 W, 6.4 to 12.8 oz. (1 day) (RUP)  
 or  
*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz) or *Pounce* 3.2 EC (4 to 8 oz) (1 day) (RUP)  
 or  
 \* *Warrior* with Zeon Technology, 2.6 to 3.8 fl oz. (1 day) (RUP)  
 or  
 Carbaryl  
*Sevin* 80 S (1 1/4 to 2 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt) (2 days) See label for pre-harvest intervals for forage and fodder.  
 or  
*Diazinon* AG 500, 1 to 1 1/2 qt. (7 days) (RUP)  
 or

*Endosulfan* 3 EC (4 pt) or *Endosulfan* 50 WP (3 lb) (1 day) Maximum of 3 applications. **Note:** Do not use for processing corn. Do not feed forage to livestock.  
 or  
 Lambda-cyhalothrin  
*Lambda-Cy, Proaxis*, 2.6 to 3.8 fl oz. (1 day) (RUP)  
 or  
*Lannate* SP, 1/2 lb. (0 days; 3 days if forage is fed to livestock) (RUP)  
 or  
*SpinTor* 2 SC, 3 to 6 oz. (3 days)  
 or  
*Entrust*, 1 to 2 oz. (1 day) Do not apply more than 3 times in 30 days.  
 or  
*Hero*, 4 to 10.3 oz. (3 days) (RUP)  
 or  
*Radiant* SC, 3 to 6 fl oz. (1 day) Do not make more than 6 applications or exceed 36 fl oz/acre per season.

**CORN ROOTWORM ADULTS:** Apply as needed to protect silks, when beetle are active and feeding on silks.  
*Asana* XL, 5.8 to 9.6 oz. (1 day) (RUP)  
 or  
*Baythroid* XL, 1.6 to 2.8 fl oz. (0 days) (RUP)  
 or  
 Bifenthrin  
*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (1 day) (RUP)  
 or  
 Carbaryl  
*Sevin* 80 S (1 1/4 lb, 1 to 2 qt) or *Sevin* XLR Plus (1 to 2 qt) (2 days) See label for pre-harvest intervals for forage and fodder.  
 or  
*Diazinon* AG 500, 1 pt. (0 days) (RUP)  
 or  
*Mustang* Max, 2.2 to 4.0 oz. (3 days) (RUP)  
 or  
*PennCap-M* 2 F, 1 to 2 pt. (3 days) (RUP)  
 or  
 Permethrin  
*Ambush* 25 W, 6.4 to 12.8 oz. (1 day) (RUP)  
 or  
*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz) or *Pounce* 3.2 EC (4 to 8 oz) (1 day) (RUP)  
 or  
*Hero*, 4 to 10.3 oz. (3 days) (RUP)

**CORN LEAF APHIDS:** Apply when populations start to build, prevents sooty mold on ears at harvest.  
*Diazinon* AG 500, 1 pt. (0 days) (RUP)  
 or  
*Endosulfan* 3 EC, 2 2/3 pt. (1 day) Maximum of 3 applications.  
**Note:** Do not use for processing corn. Do not feed forage to livestock.  
 or  
*Malathion* 57 EC, 1 1/2 pt. (5 days)  
 or  
*PennCap-M* 2 F, 2 pt. (15 days) Do not apply during pollination. (RUP)

## Corn (Sweet)

**SAP BEETLE:** These usually come in following damage by other insects or birds. Controlling damage will be the most effective solution. For short-term control, apply as needed.

*Asana* XL, 5.8 to 9.6 oz. (1 day) (RUP)

or

**Bifenthrin**

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (1 day) (RUP)

Or

**Carbaryl**

*Sevin* 80 S (1 7/8 to 2 1/2 lb) or *Sevin* XLR Plus (1 1/2 to 2 qt) (2 days) See label for pre-harvest intervals for forage and fodder.

or

*Mustang* Max, 2.2 to 4.0 oz. (3 days) (RUP)

or

*Warrior* with Zeon Technology, 2.6 to 3.8 fl oz. (1 day) (RUP)

or

**Lambda-cyhalothrin**

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (1 day) (RUP)

or

*Hero*, 4 to 10.3 oz. (3 days) (RUP)

## MITES

**Bifenthrin**

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 5.1 to 6.4 oz. (1 day) (RUP)

or

*Hero*, 10.3 oz. (3 days) (RUP)

## DISEASES

### SEED TREATMENT:

**DAMPING OFF** (*Pythium* spp., *Rhizoctonia solani*): Treatments applied to seed prior to planting. Insecticide and fungicide treatments can be combined according to directions.

*Bacillus subtilis* GB03

*Kodiak*, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

**Captan**

*Captan* 30-DD, 3 1/4 oz/100 lb seed.

*Captan* 400, 2 to 4 oz/100 lb seed.

or

**Fludioxinil**

*Maxim* 4 FS, 0.08 fl oz/100 lb seed (*Rhizoctonia*). Commercial seed treatment plants only.

or

**Mefenoxam**

*Apron* XL LS, 0.32 to 0.64 oz/100 lb seed (*Pythium*).

or

**Metalaxyl**

*Allegiance-FL* (0.75 fl oz/100 lb seed (*Pythium*)) or *Apron* 50 W (1/2 to 1 oz/100 lb seed (*Pythium*)) or *Apron* FS (3/4 to 1 1/2 oz/100 lb seed (*Pythium*))

or

**Thiram**

*42-S Thiram*, 5 oz/100 lb seed.

or

*Thiram* 50 WP Dyed, 3 oz/100 lb seed. Use as a slurry treatment.

### SYSTEMIC DOWNY MILDEW:

**Mefenoxam**

*Apron* XL LS, 1.28 oz/100 lb seed.

or

**Metalaxyl**

*Apron* 50 W (2 oz/100 lb seed) or *Apron* FS (3 oz/100 lb seed)

### FOLIAR TREATMENT:

**CORN RUST** (*Puccinia sorghi*): Apply when conditions favor disease. **Note:** Do not feed treated forage to livestock.

\* **Tebuconazole**

*Folicur* 3.6F, 4-6 fl oz. (7 days) 19 days REI.

or

**Azoxystrobin**

*Amistar*, 2 to 3 oz. (7 days)

*Quadris*, 6.2 to 9.2 fl oz. (7 days)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

**Azoxystrobin/Propiconazole**

*Quilt*, 10.5 - 14 fl oz every 14 days. (14 days)

or

**Chlorothalonil**

*Bravo* Ultrex, 0.7 to 1.8 lb. (14 days)

**Note:** Do not apply to sweet corn to be processed.

or

*Bravo* Weather Stik, *Equus* 720 SST, 3/4 to 2 pt.

(14 days) Sweet corn and seed corn only, not field corn.

Do not apply to sweet corn to be processed.

or

*Echo* 720, 1.5 to 2 pt. (14 days)

or

**Maneb**

*Maneb* 75 DF, *Maneb* 80 WP, 1 1/2 lb, 3- to 10-day intervals. (7 days)

or

*Manex*, 1 1/5 qt, 3- to 10-day intervals. (7 days)

or

**Mancozeb**

*Dithane* DF Rainshield, *Dithane* M-45, *Dithane* WSP, 1 1/2 lb. (7 days)

or

*Dithane* F-45 Rainshield, 1 1/5 qt. (7 days)

*Manzate* 75 DF, 1 1/2 lb. (7 days)

*Penncozeb* 4 F, 1.6 qt. (7 days)

*Penncozeb* 75 DF, *Penncozeb* 80 WP, 1 1/2 lb. (7 days)

or

**Propiconazole**

*Tilt*, 4 fl oz. (14 days) Apply at 7 to 14 day intervals. Maximum 16 fl oz per season.



# Cucumber

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

Root-knot and root-lesion nematodes can reduce cucumber yields. Fields with soil or root problems of undetermined cause should be tested for nematodes (see Appendix C). If the plant-parasitic nematodes are present in population densities above the economic threshold for cucumber, crop rotation or application of a nematicide is recommended. The following nematicides are suitable for control of root-knot and root-lesion nematodes in cucumber production. Recent observations indicate that cucumber planting the year following a chemigated (metham) potato crop may provide benefits to the cucumber crop.

## FALL SOIL FUMIGATION (BROADCAST): 1,3-D

*Telone II*, 9-18 gal/A (mineral soil).

Fumigate in the fall when soil temperatures at a 6-inch depth are above 50F. 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. In some limited situations soil fumigants can be applied in the spring in Michigan.

Correct soil moisture, temperature and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or by immediate tarping.

## PREPLANT NEMATICIDE TREATMENT (IN-ROW):

*Mocap 15 G*, at 13 lb/A (7-foot row spacing) or 2.1 lb/1000 row feet in a band 12 to 15 inches wide on top of the row at or just before planting. Mix with top 2 to 4 inches of soil immediately after application. Do not use as a seed furrow treatment or allow granules to contact seed. (RUP)

or

*Vydate L*, apply 2 gal (broadcast) or 1 gal (band) per acre. Apply before planting, incorporate 2-4 in into the soil. (RUP)

## INSECTS

### SEED TREATMENT:

#### SEED CORN MAGGOT:

*Lorsban 50 SL*, 2 oz/100 lb seed as slurry treatment only. (RUP)

### SOIL TREATMENT:

#### CUCUMBER BEETLE (STRIPED and SPOTTED), APHIDS,

**THRIPS:** Apply to soil in a narrow band 14 or less days before planting, as an in-furrow spray at planting, as a post-seeding drench, as a sidedress after plants are established or in drip or

trickle irrigation water. Do not make more than 1 application per year.

\* *Imidacloprid*

*Admire Pro*, 7.0 - 10.5 fl oz. (21 days)

*Nuprid 2 F*, 16 to 24 fl oz. (21 days)

**CUCUMBER BEETLE:** Use in areas with high cucumber beetle pressure.

\* *Furadan 4 F*, 2.4 oz/1000 ft of row. Apply at planting or transplanting in a 7-inch band, incorporate into the top 3 inches of soil, or apply in furrow and mix with the covering soil. (Special Michigan SLN label.) (RUP)

#### APHIDS, FLEA BEETLE, CUCUMBER BEETLE, LEAFHOPPER, THRIPS:

*Platinum*, 5 to 11 oz. (30 days) See label for application methods.

#### APHIDS, THRIPS:

*Venom*, 5 to 6 oz. (21 days) See label for application methods.

## FOLIAR TREATMENT:

Cucumber plants may be sensitive to certain insecticide formulations. Make certain a problem exists before treatment. Read and observe restrictions on the label. To avoid killing bees, do not treat cucumbers during bloom. If treatment is necessary, see the Insecticide Effectiveness for bee toxicity.

**CUTWORM:** Apply if needed to prevent >1-5% stand loss.

*Asana XL*, 5.8 to 9.6 oz. (1 day) (RUP)

or

*Baythroid XL*, 0.8 to 1.6 fl oz. (0 days) (RUP)

or

*Bifenthrin* (RUP)

*Bifenture EC*, *Brigade 2EC*, *Capture 2 EC*, 6.4 oz. (3 days)

or

*Lannate LV* (1 1/2 to 3 pt) or *Lannate SP* (1/2 to 1 lb) (3 days) (RUP)

or

*Permethrin*

*Ambush 25 W*, 6.4 to 12.8 oz. (0 days) (RUP)

or

*Perm-UP 3.2 EC* (4 to 8 oz) or *Pounce 25 WP* (6.4 to 12.8 oz)

or *Pounce 3.2 EC* (4 to 8 oz) (0 days) (RUP)

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)

Do not exceed 23 fl oz/acre per season. (RUP)

**STRIPED and SPOTTED CUCUMBER BEETLE:** Apply as soon as possible if numbers exceed 0.1 to 1 per plant. Repeat as needed. Use preplant *Furadan* treatment (above) in fields with severe problems.

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

or

*Baythroid XL*, 2.4 to 2.8 fl oz. (0 days) (RUP)

or

*Bifenthrin*

*Bifenture EC*, *Brigade 2EC*, *Capture 2 EC*, 2.6 to 6.4 oz. (3 days) (RUP)

or

*Carbaryl*

*Sevin 80 S* (1 1/4 lb) or *Sevin XLR Plus* (1 qt) (3 days)

or

## Cucumber

*Endosulfan* 3 EC (1 1/3 pt) or *Endosulfan* 50 WP (1 lb) (2 days)  
or  
*Lannate* LV (1 1/2 (1 day) or 3 pt (3 days)) or *Lannate* SP (1/2 lb (1 day) or 1 lb (3 days)) (RUP)

or

Permethrin

*Ambush* 25 W, 6.4 to 12.8 oz. (0 days) (RUP)

or

*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz)  
or *Pounce* 3.2 EC (4 to 8 oz) (0 days) (RUP)

or

*Danitol* 2.4 EC, 10 2/3 to 16 fl oz. (7 days) (RUP)

or

*Venom*, 3 to 4 oz. (1 day)

or

*Actara*, 3 to 5.5 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)

Do not exceed 23 fl oz/acre per season. (RUP)

or

*Assail* 30 SG, 2.5 to 5.3 oz. (0 days)

**FLEA BEETLE:** Apply when damage is present.

Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 qt) (3 days)

or

*Endosulfan* 3 EC (1 1/3 pt) or *Endosulfan* 50 WP (1 lb) (2 days)

or

*Lannate* LV (1 1/2 pt) or *Lannate* SP (1/2 lb) (1 day) (RUP)

or

*Actara*, 1.5 to 3 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)

Do not exceed 23 fl oz/acre per season. (RUP)

**APHIDS:** Apply if needed.

*Endosulfan* 3 EC, 1 1/3 pt. (2 days)

or

*Fulfill*, 2.75 oz. (0 days) Do not exceed 5.5 oz/acre per season.  
May require 5 to 7 days for aphid mortality.

or

*Lannate* LV (1 1/2 pt) or *Lannate* SP (1/2 lb) (1 day) (RUP)

or

*Malathion* 57 EC, 1 1/2 pt. (1 day)

or

*Venom*, 1 to 4 oz. (1 day)

or

*Beleaf* 50 SG, 2 to 2.8 oz. (0 days)

or

*Actara*, 1.5 to 3 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

*Assail* 30 SG, 2.5 to 4 oz. (0 days)

**THRIPS:** Apply when damage is seen. Repeat as needed.

*SpinTor* 2 SC, 6 to 8 oz. (3 days)

or

*Venom*, 1 to 4 oz. (1 day)

or

*Entrust*, 2 to 2.5 oz. (3 days) Do not apply more than 3 times in 30 days.

or

*Radiant* SC, 6 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)

Do not exceed 23 fl oz/acre per season. (RUP)

### SQUASH BUG:

*Venom*, 3 to 4 oz. (1 day)

## MITES

Apply when needed. Usually a problem only in hot, dry weather.

*Agri-Mek* 0.15 EC, 8 to 16 fl oz. (7 days) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 5.1 to 6.4 oz. (3 days) (RUP)

or

*Danitol* 2.4 EC, 10 2/3 fl oz. (7 days) (RUP)

or

*Kelthane* 35 (1 2/3 lb) or *Kelthane* 50 WSP (1 1/4 lb) (2 days)

or

*Oberon* 2 SC, 7 to 8.5 fl oz. (7 days)

## DISEASES

### SEED TREATMENT:

**DAMPING OFF** (*Pythium* spp., *Rhizoctonia solani*): Use only as directed; over-treatment may cause injury.

*Bacillus subtilis* GB03

*Kodiak*, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

Fludioxinil

*Maxim* 4 FS, 0.08 to 0.16 fl oz/100 lb seed (*Rhizoctonia*).

Commercial seed treatment plants only.

or

Metalaxyl

*Allegiance-FL*, 0.75 fl oz/100 lb seed.

or

Captan

*Captan* 30-DD, 2 1/3 fl oz/100 lb seed.

*Captan* 400, 2 1/2 to 3 fl oz/100 lb seed.

or

Thiram

42-S Thiram, *Thiram* 50 WP Dyed, 4 1/2 oz/100 lb seed.

### SEEDBED PREPARATION:

**ROOT ROTS** (*Fusarium solani*, *Fusarium cucurbitae*, *Pythium* spp., *Rhizoctonia solani*): Grow transplants in disease free soil (sterilized) and fumigate fields before planting. To sterilize soil, use steam or fumigate with Chemicals suggested for seedbed sterilization in Appendix A. Follow manufacturer's recommendations for use with particular crops. Avoid planting until the soil is free of fumigant.



**PREPLANT SOIL FUMIGATION:**

**DAMPING OFF, ROOT ROTS** (*Phytophthora* spp., *Pythium* spp. *Rhizoctonia solani*): This method protects plants grown from seed or transplanted in the field. See Bulletin E-2099.

Soil sterilization by fumigation is best achieved by proper application of material. Correct soil moisture, temperature, and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or immediate tarping.

1,3 Dichloropropene/chloropicrin

*Telone C35*, 13-35 gal. (RUP)

or

Metam Sodium

*Sectagon 42*, *Vapam HL*, 37.5-75 gal.

or

Potassium N-methylidithiocarbamate

*Sectagon-K54*, 30-60 gal.

**PREPLANT TREATMENT:**

**PYTHIUM DAMPING OFF and COTTONY LEAK** (*Pythium* spp.):

\* Mefenoxam. Apply as a broadcast preplant incorporation or a surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 1 in. of sprinkler irrigation.

*Ridomil Gold SL*, 1-2 pt.

*Ultra Flourish*, 2 to 4 qt.

**FOLIAR TREATMENT:**

**POWDERY MILDEW** (*Sphaerotheca fuliginea* or *Erysiphe cichoracearum*):

\* Myclobutanil

*Rally 40 WSP*, 2.5 to 5 oz. (0 days) Do not apply more than 1.5 lb per acre per crop.

or

\* Pyraclostrobin

*Cabrio*, 12-16 oz. (0 days) Alternate one-to-one with fungicides having a different mode of action.

or

\* Pyraclostrobin/Boscalid

*Pristine*, 12.5 to 18.5 oz. (0 days)

or

\* Thiophanate-Methyl

*Topsin 4.5 FL*, 10 fl oz. (1 day)

or

*Topsin M 70 WP*, *Topsin M WSB*, 1/4 to 1/2 lb. (0 days)

Apply at 7 to 14-day intervals.

or

\* Trifloxystrobin

*Flint*, 1 1/2 to 2 oz, 7- to 14-day intervals. (0 days) Maximum 2 consecutive applications, 4 applications/year and 16 oz/season.

or

Azoxystrobin

*Amistar*, 3.5 to 5 oz every 7 - 14 days. (1 day)

*Quadris*, 11.0 to 15.4 fl oz. (1 day)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

Azoxystrobin/Chlorothalonil

*Quadris Opti*, 3.2 pt every 7 - 14 days. (1 day)

or

*Bacillus subtilis*

*Serenade*, 6 to 8 lb every 7 days. (0 days)

*Serenade Max*, 1 - 3 lb every 7 to 10 days. (0 days)

Biological control product that needs to be applied before disease development. Control will be limited under heavy disease pressure.

or

Chlorothalonil

*Bravo Ultrex*, *Equus DF*, 1.8 to 2.7 lb. (0 days) *Sphaerotheca* only.

or

*Bravo Weather Stik*, *Echo 720*, *Equus 720 SST*, 2 to 3 pt. (0 days) *Sphaerotheca* only.

or

*Echo 90 DF*, 1.6 to 2.4 lb every 7 days. (0 days)

or

Copper Ammonium Carbonate

*Copper Count N*, 1 to 2 qt. (0 days)

or

Copper Hydroxide

*Champ DP*, 1 1/3 lb, 5- to 7-day intervals. (0 days)

*Champ Formula 2 F*, *Kocide 4.5 LF*, 1 1/3 pt. (0 days)

*Champion WP*, 1.5 to 3 lb. (0 days)

*Kocide 2000*, 1 1/2 lb. (0 days)

*Nu-Cop 3 L*, 1 to 4 pt, 5- to 10-day intervals. (0 days)

or

Copper Sulfate

*Cuprofix Ultra*, 1.25 lb. (0 days)

or

Neem Oil

*Trilogy*, 2 pt. (0 days)

or

Potassium Bicarbonate

*Armcarb 100*, 2.5 to 5 lb. (0 days)

or

Sulfur

*Kumulus DF*, 2 to 6 lb. (0 days)

*Micro Sulf*, 3 to 10 lb. (0 days)

*Microthiol Disperss*, 2 to 4 lb. (0 days)

*Thiolux Jet*, 4 to 6 lb. (0 days)

or

Triflumizole

*Procure 480 SC*, 4 to 8 fl oz every 7-14 days. (0 days)

or

Copper Resinate

*Tenn-Cop 5 E*, 3 pt. (0 days)

or

Tebuconazole

*Folicur 3.6F*, 4-6 fl oz. (7 days) 12 hr REI.

## Cucumber

**SCAB** (*Cladosporium cucumerinum*): Treat every 7 days after plants are 2 to 3 inches tall.

\* Chlorothalonil

*Bravo Ultrex*, *Equus DF*, 1.8 to 2.7 lb. (0 days)

or

*Bravo Weather Stik*, *Echo 720*, *Equus 720 SST*, 2 to 3 pt. (0 days)

or

*Echo 90 DF*, 1.6 to 2.4 lb every 7 days. (0 days)

or

\* Mancozeb

*Dithane DF Rainshield*, *Dithane M-45*, 2 to 3 lb. (5 days)

*Dithane F-45 Rainshield*, 1 3/5 to 2 2/5 qt. (5 days)

*Penncozeb 4 F*, 1.2 to 2.4 qt. (5 days)

or

*Manzate 75 DF*, 2 to 3 lb, 7- to 10-day intervals. (5 days) Maximum 24 In/year.

or

Copper Ammonium Carbonate

*Copper Count N*, 2 to 3 qt. (0 days)

or

Neem Oil

*Trilogy*, 2 pt. (0 days)

or

Copper Resinate

*Tenn-Cop 5 E*, 3 pt. (0 days)

**ALTERNARIA LEAF BLIGHT** (*Alternaria cucumerin*): Treat plants after vine tip when conditions favor disease and continue at 7 to 10 day intervals.

\* Azoxystrobin

*Amistar*, 3.5 to 5 oz every 7-14 days. (1 day)

*Quadris*, 11.0 to 15.4 fl oz. (1 day)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* Azoxystrobin/Chlorothalonil

*Quadris Opti*, 3.2 pt every 7 - 14 days. (1 day)

or

\* Chlorothalonil

*Bravo Ultrex*, *Equus DF*, 1.8 to 2.7 lb every 7 days. (0 days)

*Echo 90 DF*, 1.6 to 2.4 lb. (0 days)

or

*Bravo Weather Stik*, *Echo 720*, *Equus 720 SST*, 2 to 3 pt. (0 days)

or

\* Maneb

*Maneb 75 DF*, *Maneb 80 WP*, 1 1/2 to 2 lb. (5 days)

*Manex*, 1 1/5 to 1 3/5 qt. (5 days)

or

\* Mancozeb

*Penncozeb 4 F*, 1.2 to 2.4 qt. (5 days)

*Penncozeb 75 DF*, *Penncozeb 80 WP*, 1 1/2 to 3 lb. (5 days)

or

\* Pyraclostrobin

*Cabrio*, 8-12 oz. (0 days) No more than 2 consecutive applications before alternating with a fungicide having a different mode of action.

or

\* Pyraclostrobin/Boscalid

*Pristine*, 12.5 to 18.5 oz. (0 days)

or

Copper Ammonium Carbonate

*Copper Count N*, 1 to 2 qt. (0 days)

or

Copper Hydroxide

*Champ DP*, 1 1/3 lb. (0 days)

*Champ Formula 2 F*, *Kocide 4.5 LF*, 1 1/3 pt. (0 days)

*Champion WP*, 1.5 to 3 lb. (0 days)

*Kocide 2000*, 1 1/2 lb. (0 days)

*Nu-Cop 3 L*, 1 to 4 pt. (0 days)

or

Copper Sulfate

*Cuprox Ultra*, 1.25 lb. (0 days)

or

Famoxadone/Cymoxanil

*Tanos*, 8 oz. (3 days)

or

Mancozeb/Copper Sulfate

*Cuprox MZ Disperss*, 4-7.25 lb. (5 days)

or

Neem Oil

*Trilogy*, 2 pt. (0 days)

or

Potassium Bicarbonate

*Armcarb 100*, 2.5 to 5 lb. (0 days)

or

Copper Resinate

*Tenn-Cop 5 E*, 3 pt. (0 days)

**ANTHRACNOSE** (*Colletotrichum lagenarium*): Treat after flowering when conditions are favorable for disease development.

\* Azoxystrobin

*Amistar*, 3.5 to 5 oz every 7 - 14 days. (1 day)

*Quadris*, 11.0 to 15.4 fl oz. (1 day)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* Azoxystrobin/Chlorothalonil

*Quadris Opti*, 3.2 pt every 7 - 14 days. (1 day)

or

\* Chlorothalonil

*Bravo Ultrex*, *Equus DF*, 1.4 to 1.8 lb. (0 days)

*Echo 90 DF*, 1.3 to 1.6 lb every 7 days. (0 days)

or

*Bravo Weather Stik*, *Echo 720*, *Equus 720 SST*, 1.5 to 2 pt. (0 days)

or

\* Mancozeb

*Dithane DF Rainshield*, *Dithane M-45*, 2 to 3 lb, 7- to 10-day intervals. (5 days)

or

*Dithane F-45 Rainshield*, 1 3/5 to 2 2/5 qt, 7- to 10-day intervals. (5 days)

or

*Manzate 75 DF*, 2 to 3 lb, 7- to 10-day intervals. (5 days)

or



*Penncozeb* 4 F, 1.2 to 2.4 qt. (5 days)  
or  
*Penncozeb* 75 DF, *Penncozeb* 80 WP, 1 1/2 to 3 lb, 7- to 10-day intervals. (5 days)  
or  
\* Maneb  
*Maneb* 75 DF, *Maneb* 80 WP, 1 1/2 to 2 lb, 7- to 10-day intervals. (5 days)  
or  
*Manex*, 1 1/5 to 1 3/5 qt, 7- to 10-day intervals. (5 days)  
or  
\* Pyraclostrobin  
*Cabrio*, 12-16 oz. (0 days) No more than 2 consecutive applications before alternating with a fungicide having a different mode of action.  
or  
\* Pyraclostrobin/Boscalid  
*Pristine*, 18.5 oz. (0 days)  
or  
\* Thiophanate-Methyl  
*Topsin* 4.5 FL, 10 fl oz. (1 day)  
or  
*Topsin* M 70 WP, *Topsin* M WSB, 1/4 to 1/2 lb, 7- to 14-day intervals. (1 day)  
or  
Copper Ammonium Carbonate  
*Copper* Count N, 1 to 2 qt. (0 days)  
or  
Copper Hydroxide  
*Champ* DP, 1 1/3 lb. (0 days)  
*Champ* Formula 2 F, *Kocide* 4.5 LF, 1 1/3 pt. (0 days)  
*Champion* WP, 1.5 to 3 lb. (0 days)  
*Kocide* 2000, 1 1/2 lb. (0 days)  
*Nu-Cop* 3 L, 1 to 4 pt, 5- to 10-day intervals. (0 days)  
or  
Mancozeb/Copper Hydroxide  
*ManKocide*, 2 to 2.5 lb. (5 days)  
or  
Copper Oxychloride / Copper Sulfate  
C-O-C-S WDG, 2 to 4 lb every 7 days. (0 days)  
or  
Copper Sulfate  
*Basic* Copper 53, *Basicop*, 2 lb. (0 days)  
*Cuprofix* Ultra, 1.25 lb. (0 days)  
or  
Famoxadone/Cymoxanil  
*Tanos*, 8 oz. (3 days)  
or  
Mancozeb/Copper Sulfate  
*Cuprofix* MZ Disperss, 4-7.25 lb. (5 days)  
or  
Neem Oil  
*Trilogy*, 2 pt. (0 days)  
**ANGULAR LEAF SPOT** (*Pseudomonas lachrymans*): Spray every 7 days, starting before the first fruit form. The disease is likely to be more serious in high-population plantings (40,000 plants/A or more). Under these conditions spray every 3 or 4 days to protect fruit at all stages of development.

Copper Ammonium Carbonate  
*Copper* Count N, 1 to 2 qt. (0 days)  
or  
Mancozeb/Copper Hydroxide  
*ManKocide*, 2 to 2.5 lb. (5 days)  
or  
Copper Hydroxide  
*Champ* DP, 1 1/3 lb. (0 days)  
*Champ* Formula 2 F, *Kocide* 4.5 LF, 1 1/3 pt. (0 days)  
*Kocide* 2000, 1 1/2 lb. (0 days)  
*Champion* WP (1 1/2 to 3 lb) (0 days)  
*Kocide* 101 or *Kocide* DF (1 1/2 to 2 lb) (0 days)  
*Nu-Cop* 50 DF (1 1/2 to 2 lb) (0 days)  
or  
Copper Sulfate  
*Basic* Copper 53, *Basicop*, 2 lb. (0 days)  
*Cuprofix* Ultra, 1.25 lb. (0 days)  
or  
Neem Oil  
*Trilogy*, 2 pt. (0 days)  
or  
Copper Resinate  
*Tenn-Cop* 5 E, 3 pt. (0 days)  
**BELLY ROT** (*Rhizoctonia solani*):  
\* Thiophanate-Methyl  
*Topsin* 4.5 FL, 10 fl oz. (1 day)  
*Topsin* M 70 WP, *Topsin* M WSB, 1/2 lb. (0 days)  
or  
Azoxystrobin  
*Amistar*, 3.5 to 5 oz. (1 day)  
*Quadris*, 11.0 to 15.4 fl oz. (1 day)  
Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.  
or  
Azoxystrobin/Chlorothalonil  
*Quadris* Opti, 3.2 pt see label for interval. (1 day)  
**DOWNY MILDEW** (*Pseudoperonospora cubensis*): Treat plants at first sign of disease and repeat at 14-day intervals.  
\* Famoxadone/Cymoxanil  
*Tanos*, 8 oz. (3 days)  
or  
\* Propamocarb  
*Previcur* Flex, 1.2 pt every 7 - 14 days. (2 days)  
or  
\* Cyazofamid  
*Ranman*, 2.1 to 2.75 fl oz every 7 to 10 days. (0 days)  
or  
\* Cymoxanil  
*Curzate* 60 DF, 3.2 oz every 5 - 7 days. (3 days)  
or  
\* Chlorothalonil  
*Bravo* Ultrex, *Equus* DF, 1.8 to 2.7 lb. (0 days)  
*Equus* 720 SST (2 to 3 pt every 7 days) (0 days)  
*Echo* 90 DF, 1.6 to 2.4 lb every 7 days. (0 days)  
or  
*Bravo* Weather Stik or *Echo* 720 (2 to 3 pt, 7-day intervals) (0 days)

## Cucumber

or

\* Fluopicolide

*Presidio*, 3-4 fl oz. (2 days)

or

\* Mancozeb

*Dithane DF Rainshield*, *Dithane M-45*, 2 to 3 lb, 7- to 10-day intervals. (5 days)

or

*Dithane F-45 Rainshield*, 1 3/5 to 2 2/5 qt, 7- to 10-day intervals. (5 days)

or

*Manzate 75 DF*, 2 to 3 lb, 7- to 10-day intervals. (5 days) Maximum 24 lb/season.

or

*Penncozeb 4 F*, 1.2 to 2.4 qt. (5 days)

or

*Penncozeb 75 DF*, 1.2 to 2.4 qt. (5 days)

or

\* Mancozeb/Zoxamide

*Gavel 75 DF*, 2.0 lb. (5 days)

or

Azoxystrobin

*Amistar*, 3.5 to 5 oz. (1 day)

*Quadris*, 11.0 to 15.4 fl oz. (1 day)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

Azoxystrobin/Chlorothalonil

*Quadris Opti*, 3.2 pt every 7 - 14 days. (1 day)

or

Dimethomorph

*Acrobat 50 WP*, 6.4 oz. (0 days) Must be tank-mixed with another fungicide.

or

*Forum*, 6 fl oz. (0 days)

or

Fenamidone

*Reason 500 SC*, 5.5 fl oz every 5 to 10 days. (14 days)

or

Fosetyl-Aluminum

*Aliette WDG*, 2 to 5 lb, 7 to 14 day intervals. (0 days) Do not tank mix with copper fungicides.

or

Mancozeb/Copper Sulfate

*Cuprofix MZ Disperss*, 4-7.25 lb. (5 days)

or

Mefenoxam/Chlorothalonil

*Flouronil*, *Ridomil Gold Bravo*, 2 lb. (7 days) Maximum 4 applications. Do not apply to mature or senescent plants.

or

Mefenoxam/Copper Hydroxide

*Ridomil Gold Copper*, 2 lb. (5 days) Maximum 4 applications.

or

Mefenoxam/Mancozeb

*Ridomil Gold MZ*, 2 1/2 lb. (5 days) Maximum 4 applications.

or

Mono-, dibasic sodium, potassium and ammonium phosphites

*Phostrol*, 2.5 to 5 pt every 7 - 14 days. (0 days)

*Prophyt*, 2 to 4 pt. (0 days)

or

Neem Oil

*Trilogy*, 2 pt. (0 days)

or

Potassium Bicarbonate

*Armicarb 100*, 2.5 to 5 lb. (0 days)

or

Pyraclostrobin

*Cabrio*, 8-12 oz. (0 days) Alternate one-to-one with fungicides having a different mode of action.

or

Pyraclostrobin/Boscalid

*Pristine*, 12.5 to 18.5 oz. (0 days)

or

Trifloxystrobin

*Flint*, 4 oz, 7- to 14-day intervals. (0 days) Maximum 2 consecutive applications, 4 applications/year and 16 oz/season. Alternate with *Ridomil Gold Bravo*.

or

Mono-, dibasic sodium salts of phosphorous acid

*Fosphite*, 1 to 3 qt per 20 gal (ground) or 10 gal (aerial) of water. (0 days)

or

Mandipropamid

*Revus*, 8 fl oz. (0 day)

**Note:** Most fungicides that protect against *Alternaria* and gummy stem blight may also provide limited downy mildew protection.

**GUMMY STEM BLIGHT or BLACK ROT** (*Didymella bryoniae* also called *Mycosphaerella melonis*): Begin treatment at the 2-leaf stage.

\* Azoxystrobin

*Amistar*, 3.5 to 5 oz every 7 - 14 days. (1 day)

*Quadris*, 11.0 to 15.4 fl oz. (1 day)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* Azoxystrobin/Chlorothalonil

*Quadris Opti*, 3.2 pt every 7 - 14 days. (1 day)

or

\* Chlorothalonil

*Bravo Ultrex*, *Equus DF*, 1.8 to 2.7 lb. (0 days)

*Equus 720 SST* (2 to 3 pt every 7 days) (0 days)

*Echo 90 DF*, 1.6 to 2.4 lb every 7 days. (0 days)

or

*Bravo Weather Stik* or *Echo 720* (2 to 3 pt, 7-day intervals) (0 days)

or

\* Mancozeb

*Dithane DF Rainshield*, *Dithane M-45*, 2 to 3 lb, 7- to 10-day intervals. (5 days)

or

*Dithane F-45 Rainshield*, 1 3/5 to 2 2/5 qt, 7- to 10-day intervals. (5 days)

or



*Manzate* 75 DF, 2 to 3 lb, 7- to 10-day intervals.  
(5 days) Maximum 24 lb/season. or  
*Penncozeb* 4 F, 1.2 to 2.4 qt. (5 days)  
*Penncozeb* 75 DF, 1.2 to 2.4 qt. (5 days)

or  
\* Pyraclostrobin  
*Cabrio*, 12-16 oz. (0 days) No more than 2 consecutive applications before alternating with a fungicide having a different mode of action.

or  
\* Pyraclostrobin/Boscalid  
*Pristine*, 12.5 to 18.5 oz. (0 days)

or  
\* Thiophanate-Methyl  
*Topsin* 4.5 FL, 10 fl oz. (1 day)

or  
*Topsin M* 70 WP, *Topsin M* WSB, 1/4 to 1/2 lb, 7- to 14-day intervals. (1 day)

or  
Copper Ammonium Carbonate  
*Copper Count N*, 1 to 2 qt. (0 days)

or  
Copper Hydroxide  
*Champ* DP, 1 1/3 lb. (0 days)  
*Champ* Formula 2 F, *Kocide* 4.5 LF, 1 1/3 pt. (0 days)  
*Champion* WP, 1.5 to 3 lb. (0 days)  
*Kocide* 2000, 1 1/2 lb. (0 days)  
*Nu-Cop* 3 L, 1 to 4 pt, 5- to 10-day intervals. (0 days)

or  
Mancozeb/Copper Hydroxide  
*ManKocide*, 2 to 2.5 lb. (5 days)

or  
Copper Sulfate  
*Cuprofix* Ultra, 1.25 lb. (0 days)

or  
Fenamidone  
*Reason* 500 SC, 5.5 fl oz every 5 to 10 days. (14 days)

or  
Mancozeb/Copper Sulfate  
*Cuprofix* MZ Disperss, 4-7.25 lb. (5 days)

or  
Tebuconazole  
*Folicur* 3.6F, 8 fl oz. (7 days) Approved for gummy stem blight. Suppression only.

**FRUIT ROT** (*Phytophthora* spp., *Pythium* spp.): Initiate treatment at flowering. If possible, tank-mix products with a labeled copper product.

\* Dimethomorph  
*Acrobat* 50 WP, 6.4 oz every 7 days. (0 days)  
*Forum*, 6 fl oz. (0 days)

or  
\* Famoxadone/Cymoxanil  
*Tanos*, 8 - 10 oz every 5 - 7 days. (3 days)

or  
\* Mancozeb/Zoxamide  
*Gavel* 75 DF, 1.5 - 2.0 lb. (5 days)

or  
\* Mandipropamid  
*Revus*, 8 fl oz. (0 day)

or  
Cyazofamid  
*Ranman*, 2.75 fl oz every 7 to 10 days. (0 days)

or  
Fosetyl-Aluminum  
*Aliette* WDG, 2 to 5 lb, 7- to 14-day intervals (*Phytophthora*). (0 days) Do not tank mix with copper fungicides.

or  
Maneb  
*Maneb* 75 DF, *Maneb* 80 WP, 1 1/2 to 2 lb, 7- to 10-day intervals (*Pythium*). (5 days)

or  
*Manex*, 1.2 to 1.6 qt (*Pythium*). (5 days) Maximum 12.8 qt/season.

or  
Mancozeb  
*Penncozeb* 4 F, 1.2 to 2.4 qt. (5 days)

or  
*Penncozeb* 75 DF (1 1/2 to 3 lb, 7- to 10-intervals (*Pythium*)) or *Penncozeb* 80 WP (1 1/2 to 3 lb, 7- to 10-day intervals (*Pythium*)) (5 days)

or  
Mono-, dibasic sodium, potassium and ammonium phosphites  
*Phostrol*, 2.5 to 5 pt every 7 - 14 days. (0 days)  
*Prophyt*, 6 pt. (0 days)

or  
Mono-, dibasic sodium salts of phosphorous acid  
*Fosphite*, 1 to 3 qt per 20 gal (ground) or 10 gal (aerial) of water. (0 days)

**Note:** Fungicides applied to control downy mildew may have limited efficacy against *Phytophthora* crown and fruit rot.

**PHYTOPHTHORA CROWN and FRUIT ROT** (*Phytophthora* spp.):

\* Fluopicolide  
*Presidio*, 3-4 fl oz. (2 days)

## Eggplant

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

### SOIL TREATMENT AT PLANTING:

Fenamiphos  
*Nemacur* 15 G, 13.4 lb/A on 36-in rows. Apply in 12-in band over the row at transplanting and incorporate immediately. (RUP)

or

*Nemacur* 3 S, 5.9 fl oz/1000 row feet (or 2 2/3 qt/A on 36 inch rows) in a 12-inch band over the row at transplanting.

Incorporate immediately into the soil. **Note:** on narrow row crops, do not allow bands to overlap. (RUP)

**Note:** For hydrologic soil group A, soils that are excessively drained or predominantly sand or loamy sand with shallow water tables (less than 50 feet deep), *Nemacur* cannot be used. For all other soil types, *Nemacur* can no longer be purchased but stores of the product can be used until depleted.

or  
*Vydate* L. Apply 1 gal/A in a band 2 to 3 weeks after transplanting and again 4 weeks later. Make 2 foliar treatments of 2 qt 2-4 weeks after the soil treatments at 1 to 2 week intervals. (RUP)

## INSECTS

### SOIL TREATMENT:

**COLORADO POTATO BEETLE, APHIDS, FLEA BEETLE:** Apply where high potato beetle, aphid, or flea beetle numbers are expected. Apply in a band prior to transplanting or in a drench at transplanting.

\* Imidacloprid

*Admire* Pro, 7.0 - 10.5 fl oz. (21 days) Consult label for rotation restrictions and application methods.

or

*Nuprid* 2 F, 16 to 24 fl oz.

or

\* *Platinum*, 5 to 11 fl oz. (30 days) Apply as in-furrow spray or narrow surface band, as a post seeding, transplant or hill drench, in trickle or drip irrigation, or shanked into root zone after establishment or transplanting.

or

*Venom*, 5 to 6 oz. (21 days) See label for application methods.

### FOLIAR TREATMENT:

**CUTWORM:** Apply when damage is first seen, usually soon after transplanting.

\* *Baythroid* XL, 1.6 to 2.8 fl oz. (0 days) (RUP)

or

\* Permethrin

*Perm-UP* 3.2 EC, 4 to 8 oz. (3 days) (RUP)

or

\* *Warrior* with Zeon Technology, 2.6 to 3.8 fl oz. (5 days) (RUP)

or

Carbaryl

*Sevin* 80 S (2 1/2 lb) or *Sevin* XLR Plus (2 qt) (3 days)

or

*Intrepid* 2 F, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 1.9 to 3.2 fl oz. (5 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Brigadier*, 5.1 to 9.85 oz. (7 days)

### COLORADO POTATO BEETLE:

\* *Actara*, 2 to 3 oz. (0 days) Do not apply if a neonicitinoid was used at planting. Do not exceed 11 oz/acre per season.

or

\* *Assail* 30 SG, 1.4 to 2.5 oz. (7 days) Do not use if Imidacloprid or Platinum was used at planting.

or

\* Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.8-6.2 fl oz. (0 days) Do not use if neonicitinoids were used at planting. Do not apply more than 19.2 oz/acre per season.

or

\* *SpinTor* 2 SC, 2.25 to 4.5 oz (for larvae). (1 day) Do not apply more than 3 times in 21 days.

or

\* *Venom*, 1 to 4 oz. (1 day) Do not use if neonicitinoids were used at planting.

or

*Asana* XL, 5.8 to 9.6 oz. (7 days) (RUP)

or

*Bacillus thuringiensis tenebrionis*

*Novodor*. (0 days) Small larvae only.

or

*Baythroid* XL, 1.6 to 2.8 fl oz. (0 days) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (7 days) (RUP)

or

Carbaryl

*Sevin* 80 S (2/3 to 1 1/4 lb) or *Sevin* XLR Plus (1 to 2 qt) (3 days)

or

Permethrin

*Ambush* 25 W, 12.8 oz. (3 days) (RUP)

or

*Perm-UP* 3.2 EC (8 oz) or *Pounce* 25 WP (12.8 oz) or *Pounce* 3.2 EC (8 oz) (3 days) (RUP)

or

*Vydate* L, 1 to 2 qt. (1 day) Repeat in 1 to 3 weeks if needed. (RUP)

or

*Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (5 days) (RUP)

or

*Entrust*, 1 to 2 oz. (1 day)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (5 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 5.1 to 9.85 oz. (7 days)



**FLEA BEETLE:** Apply when damage is first seen.

*Actara*, 2 to 3 oz. (0 days) Do not apply if a neonicitinoid was used at planting. Do not exceed 11 oz/acre per season.

or

*Asana* XL, 5.8 to 9.6 oz. (1 day) (RUP)

or

*Baythroid* XL, 1.6 to 2.8 fl oz. (0 days) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (7 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 qt) (3 days)

or

*Dibrom* 8 EC, 1 pt. (1 day)

or

*Endosulfan* 3 EC, 1 1/3 pt. (1 day) Consult label for rotation limitations.

or

Permethrin

*Ambush* 25 W, 12.8 oz. (3 days) (RUP)

or

*Perm-UP* 3.2 EC (8 oz) or *Pounce* 25 WP (12.8 oz) or *Pounce* 3.2 EC (8 oz) (3 days) (RUP)

or

Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.8-6.2 fl oz. (0 days) Do not use if neonicitinoids were used at planting. Do not apply more than 19.2 oz/acre per season.

or

*Venom*, 1 to 4 oz. (1 day) Do not use if neonicitinoids were used at planting.

or

*Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (5 days) (RUP)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (5 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Brigadier*, 5.1 to 9.85 oz. (7 days)

**APHIDS:** Apply when needed.

\* *Assail* 30 SG, 1.9 to 2.8 oz. (7 days)

or

\* *Actara*, 2 to 3 oz. (0 days) Do not apply if a neonicitinoid was used at planting. Do not exceed 11 oz/acre per season.

or

\* Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.8-6.2 fl oz. (0 days) Do not use if neonicitinoids were used at planting. Do not apply more than 19.2 oz/acre per season.

or

*Dibrom* 8 EC, 1 pt. (1 day)

or

*Endosulfan* 3 EC, 1 1/3 pt. (1 day) Consult label for rotation limitations.

or

*Fulfill*, 2.75 oz. (0 days) May require 5 to 7 days for aphid mortality

or

*Malathion* 57 EC, 1 pt. (3 days)

or

*Venom*, 1 to 4 oz. (1 day) Do not use if neonicitinoids were used at planting.

or

*Beleaf* 50 SG, 2 to 2.8 oz. (0 days)

or

*Brigadier*, 3.8 to 9.85 oz. (7 days)

**MITES**

Apply if needed to avoid foliar injury.

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 5.1 to 6.4 oz. (7 days) (RUP)

or

*Oberon* 2 SC, 7 to 8.5 fl oz. (7 days)

or

*Trithion* 8 EC, 1/2 to 1 pt. (7 days)

or

*Vydate* L, 1 to 2 qt. (1 day) Repeat in 1 to 3 weeks if needed. (RUP)

or

*Hero*, 10.3 oz. (7 days) (RUP)

or

*Agri-Mek* 0.15 EC, 8 to 16 fl oz. (7 days) (RUP)

**DISEASES****SEED TREATMENT:**

**DAMPING OFF** (*Pythium* spp., *Phytophthora* spp., *Rhizoctonia solani*): Apply to seed as slurry or dust. Use only as directed; overtreatment may cause injury.

*Bacillus subtilis* GB03

*Kodiak*, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

Thiram

42-S Thiram, 6 1/2 oz/100 lb seed.

*Thiram* 50 WP Dyed, 6 oz/100 lb seed.

or

Thiram

*Thiram* 50 WP Dyed, 6 oz/100 lb seed.

**SEEDBED TREATMENT:**

**DAMPING OFF** (*Pythium* spp.), **CROWN ROT** (*Phytophthora capsici*): Ridomil must be applied to the soil before the plants are infected with *Phytophthora* to obtain satisfactory disease control.

\* Mefenoxam

*Ridomil* Gold SL, 1 pt. (7 days)

*Ridomil* Gold WSP, 1 lb. (7 days)

*Ultra* Flourish, 2 pt. (7 days)

Incorporate mechanically before planting or move into root zone after planting with 1/2 to 1 inch sprinkler water. For banded applications, use 12 to 16 inch band.

## Garden Greens

After initial application, 2 supplemental post-directed applications at 1 lb (Ridomil Gold WSP) or 1 pt (Ridomil Gold EC) should be made at 30-day intervals. Spray should be directed at the base of the plants and cover 6 to 8 inches of soil on either side of the plants. Ridomil Gold must be moved into the root zone mechanically or by sprinkler irrigation. Spray may be applied with liquid fertilizer shanked in as a band treatment to either side of the plant. The foliar blight phase of *Phytophthora* cannot be controlled with foliar applications of Ridomil Gold.

**Note:** Observe limit of active ingredient/crop on label.

### PREPLANT SOIL FUMIGATION:

#### FUSARIUM, VERTICILLIUM WILT, *PHYTOPHTHORA* spp:

Preplant treatment (production fields). Most fumigants applied to the soil to control disease organisms will also control soil insects, nematodes and weed seeds.

Soil sterilization by fumigation is best achieved by proper application of material. Correct soil moisture, temperature, and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or immediate tarping.

#### 1,3 Dichloropropene/chloropicrin

*Telone C35*, 13-35 gal. (RUP)

or

#### Metam Sodium

*Sectagon 42*, *Vapam HL*, 37.5-75 gal.

or

#### Potassium N-methylidithiocarbamate

*Sectagon-K54*, 30-60 gal.

### FOLIAR TREATMENT:

#### ALTERNARIA BLIGHT (*Alternaria melongenae*),

ANTHRACNOSE (*Colletotrichum melongenae*): Treat every 7 to 10 days after disease first appears.

#### \* Azoxystrobin

*Amistar*, 2 to 5 oz every 7-14 days (*Anthracnose* only) (0 days)

*Quadris*, 6.2 to 15.4 fl oz (*Anthracnose* only). (0 days)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

#### \* Boscalid

*Endura*, 2.5 to 3.5 oz. (0 days)

or

#### \* Maneb

*Maneb 75 DF*, *Maneb 80 WP*, 1 1/2 to 2 lb. (5 days)

*Manex*, 1 1/5 to 1 3/5 qt. (5 days)

or

#### \* Trifloxystrobin

*Flint*, 2 to 3 oz. (3 days) Do not apply more than three sequential foliar applications of strobilurin fungicides before alternating with a fungicide that has a different mode of action.

or

#### Copper Ammonium Carbonate

*Copper Count N*, 2 qt. (0 days)

or

#### Copper Hydroxide

*Champ Formula 2 F*, *Kocide 4.5 LF*, *Nu-Cop 3 L*, 1 1/3 pt (0 days)

or

*Champion WP*, *Kocide 101*, *Kocide DF*, *Nu-Cop 50 DF*, 2 lb. (0 days)

or

*Kocide 2000*, 1 1/2 lb. (0 days)

or

#### Copper Sulfate

*Basicop 53 WP*, 3 to 4 lb. (0 days)

*Cuprofix Ultra*, 1.25 lb. (0 days)

or

#### Pyraclostrobin

*Cabrio*, 8 to 12 oz. (0 days)

**PHOMOPSIS BLIGHT** (*Phomopsis vexans*): Treat every 7 to 10 days after disease first appears.

#### Copper Ammonium Carbonate

*Copper Count N*, 2 qt. (0 days)

or

#### Copper Hydroxide

*Champ Formula 2 F*, *Kocide 4.5 LF*, *Nu-Cop 3 L*, 1 1/3 pt. (0 days)

or

*Champion WP*, *Kocide 101*, *Kocide DF*, *Nu-Cop 50 DF*, 2 lb. (0 days)

or

*Kocide 2000*, 1 1/2 lb. (0 days)

or

#### Copper Sulfate

*Basicop 53 WP*, 3 to 4 lb. (0 days)

*Cuprofix Ultra*, 1.25 lb. (0 days)

## Garden Greens

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## INSECTS

### PLANTING TREATMENT:

#### APHIDS:

Imidacloprid. See label for application methods.

*Admire Pro*, 4.4 - 10.5 fl oz. (21 days; 45 days for Swiss Chard)

*Nuprid 2 F*, 10 to 24 oz. (21 days)

or

*Venom*, 5 to 6 oz. (21 days) Non-Brassica greens.

or

*Platinum*, 5 to 11 fl oz. (30 days) See label for application methods.



**CABBAGE MAGGOT:**

*Lorsban* 15 G (4.6 to 9.2 oz per 1,000 ft of row) or *Lorsban* 4 E / *Lorsban* Advanced (1.6 to 2.75 fl oz / 1,000 ft of row) Apply in a 4-inch band over row at time of seeding. Use only as directed. Brassica greens only. (RUP)

**FLEA BEETLE, THRIPS:**

*Platinum*, 5 to 11 fl oz. (30 days)

**FOLIAR TREATMENT:**

**FLEA BEETLE:** Apply when damage is first seen on young plants. Repeat as needed.

Cypermethrin

*Ammo* 2.5 EC (2.5 to 5 oz) or *Ammo* WSB (1 to 2 bags) or *UP-Cyde* 2.5 EC (2.5 to 5 oz) (1 day) (RUP)

or

*Asana* XL, 5.8 to 9.6 oz. (7 days) Collards only. (RUP)

or

*Baythroid* XL, 1.6 to 2.4 fl oz. (0 days) Mustard greens only. (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 qt) (14 days)

or

*Lorsban* 50 W, 2 lb. (21 days) Collards, kale and kohlrabi only. (RUP)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.75 fl oz. (7 days) Do not use if Imidacloprid was used at planting. Do not exceed 19.2 oz/Acre per season.

or

*Pyrellin* EC, 1 to 2 pt. (0 days)

or

*Pyrenone*, 2 to 12 oz. (0 days)

or

*Actara*, 1.5 to 3 oz. (7 days) Do not exceed 11.0 oz/Acre per season.

or

Bifenthrin (RUP)

*Bifenture* EC, 2.1 to 6.4 oz. (7 days) Brassica greens only.

**CUTWORM, LOOPERS:** Apply as needed.

\* Cypermethrin (RUP)

*Ammo* 2.5 EC (2.5 to 5 oz) or *Ammo* WSB (1 to 2 bags) or *UP-Cyde* 2.5 EC (2.5 to 5 oz) (1 day) Brassica greens only.

or

\* *Asana* XL, 9.6 oz. (7 days) Collards and mustard greens only. (RUP)

or

\* *Baythroid* XL, 1.6 to 2.4 fl oz. (0 days) Mustard greens only. (RUP)

or

\* Permethrin

*Ambush* 25 W, 6.4 to 12.8 oz. (1 day) Non-Brassica greens only. (RUP)

or

*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz) or *Pounce* 3.2 EC (4 to 8 oz) (1 day) Chard and non-Brassica greens only. (RUP)

or

*Endosulfan* 3 EC, 1 qt. (21 days) Collards, kale and mustard greens only.

or

Thiodicarb

*Larvin* 3.2 EC, 16 to 30 oz. (14 days) Cress, dandelion, endive, parsley and Swiss chard (consult label for a complete list).

or

*Lorsban* 50 W, 2 lb. (21 days) Collards, kale and kohlrabi only. (RUP)

or

*Mustang* Max, 3.2 to 4.0 oz. (1 day) (RUP)

or

*SpinTor* 2 SC, 3 to 6 oz. (1 day)

or

*Entrust*, 1 to 2 oz. (1 day)

or

*Intrepid* 2 F, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

*Avaunt*, 2.5 to 3.5 oz. (3 days)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 4.2 to 6.1 oz. (7 days) Brassica greens only.

**CABBAGE "WORM":** Apply when feeding damage is seen. Repeat as needed.

Cypermethrin (RUP)

*Ammo* 2.5 EC (2.5 to 5 oz) or *Ammo* WSB (1 to 2 bags) or *UP-Cyde* 2.5 EC (2.5 to 5 oz) (1 day) Brassica greens only.

or

*Asana* XL, 9.6 oz. (7 days) Collards and mustard greens only. (RUP)

or

*Avaunt*, 2.5 to 3.5 oz. (3 days)

or

*Bacillus thuringiensis*

*Agree*, *Biobit*, *Dipel*, *Javelin*, *Lepinox*, *Xentari*. (0 days)

or

*Baythroid* XL, 1.6 to 2.4 fl oz. (0 days) Mustard greens only. (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 to 2 qt) (14 days)

or

*Dibrom* 8 EC, 1 pt. (1 day) Collards and kale only.

or

*Endosulfan* 3 EC, 1 qt. (21 days) Collards, kale and mustard greens only.

or

*Lannate* LV (1 1/2 to 3 pt) or *Lannate* SP (1/2 to 1 lb) (3 days) (RUP)

or

## Garden Greens

### Thiodicarb

*Larvin* 3.2 EC, 16 to 30 oz. (14 days) Cress, dandelion, endive, parsley and swiss chard (consult label for a complete list).

or

*Lorsban* 50 W, 2 lb. (21 days) Collards, kale and kohlrabi only. (RUP)

or

*Malathion* 57 EC, 1 qt. (7 days)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

### Permethrin

*Ambush* 25 W, 6.4 to 12.8 oz. (1 day) Non-Brassica greens only. (RUP)

or

*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz) or *Pounce* 3.2 EC (4 to 8 oz) (1 day) Chard and non-Brassica greens only. (RUP)

or

*SpinTor* 2 SC, 3 to 6 oz. (1 day)

or

*Entrust*, 1 to 2 oz. (1 day)

or

*Intrepid* 2 F, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 4.2 to 6.1 oz. (7 days) Brassica greens only.

**APHIDS:** Apply as needed to avoid infestations on leaves at harvest.

\* *Assail* 30 SG, 1.9 to 2.8 oz. (7 days) Do not use if Imidacloprid was used at planting.

or

\* *Fulfill*, 2.75 oz (7 days) May require 5-7 days for aphid mortality.

or

\* Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.75 fl oz. (7 days) Do not use if Imidacloprid was used at planting. Do not exceed 19.2 oz/Acre per season.

or

*Dibrom* 8 EC, 1 pt. (1 day) Collards and kale only.

or

*Dimethoate* 2.67 EC, 3/4 pt. (14 days)

or

*Endosulfan* 3 EC, 1 qt. (21 days) Collards, kale and mustard greens only.

or

*Malathion* 57 EC, 1 qt. (7 days) Collards, kale and mustard greens only.

or

*Pyrellin* EC, 1 to 2 pt. (0 days)

or

*Pyrenone*, 2 to 12 oz. (0 days)

or

*Venom*, 1 to 3 oz. Non-Brassica greens.

or

*Beleaf* 50 SG, 2 to 2.8 oz. (0 days)

or

*Actara*, 1.5 to 3 oz. (7 days) Do not exceed 11.0 oz/Acre per season.

or

*Brigadier*, 4.2 to 6.1 oz. (7 days) Brassica greens only.

### CUTWORM, EUROPEAN CORN BORER:

Bifenthrin (RUP)

*Bifenture* EC, 2.1 to 6.4 oz. (7 days) Brassica greens only.

## MITES

May be a problem in hot, dry weather.

*Dibrom* 8 EC, 1 pt. (1 day) Collards and kale.

or

Bifenthrin (RUP)

*Bifenture* EC, 5.1 to 6.4 oz. (7 days) Brassica greens only.

## SLUGS

*Deadline* M-Ps 4% (20 to 40 lb) or *Metaldehyde* 3.5 G (30 to 40 lb) Apply between rows. Avoid contact to edible product.

## DISEASES

### SEED TREATMENT:

**DAMPING OFF** (*Rhizoctonia* spp., *Pythium* spp.):

*Bacillus subtilis* GB03

*Kodiak*, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

*Fludioxinil*

*Maxim* 4 FS, 0.08 to 0.16 fl oz/100 lb seed (*Rhizoctonia*).

Commercial seed treatment plants only. Collards, endive, kale, swiss chard.

or

*Captan*

*Captan* 30-DD, 1 1/4 oz/100 lb seed. Collards, kale, mustard.

*Captan* 30-DD, 9 1/2 oz/100 lb seed. Swiss chard.

*Captan* 400, 1 to 2 oz/100 lb seed. Mustard.

*Captan* 400, 10 to 12 oz/100 lb seed. Swiss chard.

or

*Thiram*

42-S Thiram, *Thiram* 50 WP Dyed, 8 oz/100 lb seed.

### PREPLANT INCORPORATED:

**DAMPING OFF** (*Pythium* spp.):

*Mefenoxam*. Apply as a broadcast preplant incorporation or a surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into seed zone after planting with 1/2 to 1 in. of sprinkler irrigation. Endive and Swiss chard only).

*Ridomil* Gold GR, 20 to 40 lb.

*Ridomil* Gold WSP, 1 to 2 lb.

### FOLIAR TREATMENT:

**BOTRYTIS GRAY MOLD** (*Botrytis* spp.): Apply 7 days following transplanting. Repeat applications when plants are half, mature. Do not apply to wilted plants or seedlings.

\* *DCNA*

*Botran* 75 W, 2 2/3 lb (endive, escarole). (14 days)



**DOWNY MILDEW** (*Peronospora parasitica*): Apply as needed to maintain control.

\* Fosetyl-Aluminum

*Aliette* WDG, 2 to 5 lb at 7- to 21-day intervals.

(3 days) Collards, kale, mustard greens, endive, escarole, Swiss chard. **Note:** Do not tank mix with copper fungicides.

or

Mono-, dibasic sodium, potassium and ammonium phosphites

*Phostrol*, 2.5 to 5 pt every 7 - 21 days. (0 days)

or

Dimethomorph

*Forum*, 6 fl oz. (0 days)

or

Acibenzolar-S-methyl

*Actigard*, 1 oz per 20 gal (ground) or 10 gal (aerial) of water.

(7 days) Do not apply more than 4 applications / crop per year.

or

Mono-, dibasic sodium salts of phosphorous acid

*Fosphite*, 1 to 3 qt per 20 gal (ground) or 10 gal (aerial) of water. (0 days)

or

Mandipropamid

*Revus*, 8 fl oz. (1 day)

**Note:** Fungicides that protect against *Alternaria* also provide limited downy mildew protection.

**CERCOSPORA LEAF SPOT** (*Cercospora beticola*):

\* Azoxystrobin

*Amistar*, 2 to 5 oz. (0 days)

*Quadris*, 6.2 to 15.4 fl oz. (0 days)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* Trifloxystrobin

*Flint*, 2 to 3 oz. (7 days) Swiss chard only.

Do not apply more than three sequential foliar applications of strobilurin fungicides before alternating with a fungicide that has a different mode of action.

or

Tebuconazole

*Folicur* 3.6F, 3-4 fl oz. (7 days) Maximum 16 fl oz/acre/season. 12 hr REI.

**ALTERNARIA LEAF SPOT** (*Alternaria cucumerina*):

\* Azoxystrobin

*Amistar*, 2 to 5 oz. (0 days)

*Quadris*, 6.2 to 15.4 fl oz. (0 days)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* Maneb

*Maneb* 75 DF, *Maneb* 80 WP, 1 1/2 to 2 lb. (10 days) Kale only.

*Manex*, 1.2 to 1.6 qt. (10 days) Kale only.

or

Copper Hydroxide

*Kocide* 101, *Kocide* DF, 1 to 2 lb. (0 days) Collards only.

*Kocide* 4.5 LF, 1 1/3 pt. (0 days)

or

*Kocide* 2000, 3/4 to 1 1/2 lb. (0 days) Mustard greens and Collards only.

or

Cyprodinil/Fludioxonil

*Switch* 62.5 WG, 11 to 14 oz. (7 days)

or

Tebuconazole

*Folicur* 3.6F, 3-4 fl oz. (7 days) Maximum 16 fl oz/acre/season. 12 hr REI.

## Garlic

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

### SOIL TREATMENT:

#### BULB and STEM NEMATODE:

Fenamiphos

*Nemacur* 15 G, 9.2 to 18.4 oz/1,000 ft in furrow with seed. For best results, plant the crop within 7 to 10 days after cracking (seed preparation). (RUP)

**Note:** For hydrologic soil group A, soils that are excessively drained or predominantly sand or loamy sand with shallow water tables (less than 50 feet deep), *Nemacur* cannot be used. For all other soil types, *Nemacur* can no longer be purchased but stores of the product can be used until depleted.

## INSECTS

### FOLIAR TREATMENT:

#### LOOPERS, ARMYWORM: Apply as needed.

\* Cypermethrin

*Ammo* 2.5 EC (2 to 5 oz) or *Ammo* WSB (1 to 2 bags) or

*UP-Cyde* 2.5 EC (2 to 5 oz) (7 days) (RUP)

or

\* *Mustang* Max, 2.2 to 4.0 oz. (7 days) (RUP)

or

\* Permethrin

*Ambush* 25 W, 9.6 to 19.2 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (6 to 12 oz) or *Pounce* 25 WP (9.6 to 19.2 oz)

or *Pounce* 3.2 EC (6 to 12 oz) (1 day) (RUP)

or

*Bacillus thuringiensis*

*Agree*, *Biobit*, *Dipel*, *Javelin*, *Lepinox*, *Xentari*. (0 days)

or

*Lannate* SP, 1/2 lb. (7 days) (RUP)

or

*Entrust*, 1 to 2 oz. (1 day) Do not apply more than 9 oz per acre per crop. Do not make more than 5 applications per year.

or

## Garlic

*SpinTor* 2 SC, 3 to 6 oz. (1 day) Do not apply more than 29 oz per acre per crop. Do not make more than 5 applications per year.

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 5 applications or exceed 30 fl oz/acre per season.

**APHIDS:** Apply as needed.

*Malathion* 57 EC, 1 1/2 to 2 pt. (3 days)

**THRIPS:** Apply as needed.

\* Cypermethrin

*Ammo* 2.5 EC (4 to 5 oz) or *Ammo* WSB (1 to 2 bags) or

*UP-Cyde* 2.5 EC (4 to 5 oz) (7 days) (RUP)

or

\* *Mustang* Max, 2.9 to 4.0 oz. (7 days) (RUP)

or

*Malathion* 57 EC, 1 1/2 to 2 pt. (3 days)

or

Permethrin

*Ambush* 25 W, 9.6 to 19.2 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (6 to 12 oz) or *Pounce* 25 WP (9.6 to 19.2 oz)

or *Pounce* 3.2 EC (6 to 12 oz) (1 day) (RUP)

or

*Pyrellin* EC, 1 to 2 pt. (0 days)

or

*Pyrenone*, 2 to 12 oz. (0 days)

or

*Entrust*, 1.25 to 2.5 oz. (1 day)

or

*SpinTor* 2 SC, 4 to 8 oz. (1 day) Suppression only. Do not apply more than 29 oz per acre per crop. Do not make more than 5 applications per year.

or

*Radiant* SC, 6 to 10 fl oz. (1 day) Do not make more than 5 applications or exceed 30 fl oz/acre per season.

## DISEASES

### SEED TREATMENT:

**WHITE ROT** (*Sclerotium cepivorum*): Apply a uniform mist spray. For best results use a commercial sticker to the spray solution.

PCNB

*Terraclor* 75 WP, 13 1/2 lb/1000 lb of "seed" cloves.

*Terraclor* F, 2.5 gal/1000 lb of "seed" cloves.

### PLANTING TREATMENT:

**DAMPING OFF** (*Pythium* spp.):

\* Mefenoxam. Apply as a broadcast preplant incorporation or a surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 1 in. or sprinkler irrigation.

*Ridomil* Gold SL, 0.5-1 pt.

*Ultra* Flourish, 1 to 2 pt.

**WHITE ROT** (*Sclerotium cepivorum*): Apply as an in-furrow spray at planting.

Iprodione

*Iprodione* 4L AG, *Rovral* 4 F, 4 pt. **Note:** See label for permissible crop rotation.

or

DCNA

*Botran* 75 W, 2 2/3 to 5 1/3 lb. The use of a spreader/sticker is not recommended. Do not make more than one application per season.

or

PCNB

*Blocker* 4 F, 29 oz/1000 row feet.

*Terraclor* 2 E, 10 gal.

*Terraclor* 75 WP, 27.5 lb.

*Terraclor* F, 5 gal.

or

Thiophanate-Methyl

*Topsin* 4.5 FL, 40 fl oz.

## FOLIAR TREATMENT:

**BOTRYTIS LEAF BLIGHT** (*Botrytis* spp.), **PURPLE BLOTCH**

(*Alternaria porri*):

\* Azoxystrobin

*Amistar*, 2 to 5 oz every 7 - 14 days. (0 days)

*Quadris*, 6.2 to 15.4 fl oz. (0 days)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* Chlorothalonil

*Bravo* Ultrex, 0.9 to 2.7 lb. (7 days)

*Echo* 90 DF, 1.2 to 2.4 lb every 7 days. (7 days)

*Equus* DF, 0.9 to 2.7 lb. (7 days)

or

*Bravo* Weather Stik, *Bravo* Weather Stik Zn, *Echo* 720, *Equus* 720 SST, 1 to 3 pt. (7 days)

or

\* Mancozeb

*Dithane* DF Rainshield, *Dithane* M-45, 3 lb. (7 days)

*Dithane* F-45 Rainshield, 2.4 qt. (7 days)

*Manzate* 75 DF, 3 lb. (7 days) Do not apply to exposed bulbs.

*Penncozeb* 4 F, 1.6 to 2.4 qt. (7 days)

*Penncozeb* 75 DF, *Penncozeb* 80 WP, 2 to 3 lb. (7 days)

or

\* Maneb

*Maneb* 75 DF, *Maneb* 80 WP, 2 to 3 lb. (7 days)

*Manex*, 3.2 to 4.8 pt. (7 days)

or

\* Pyraclostrobin

*Cabrio*, 8-12 oz. (7 days) Do not apply more than three sequential applications

or

\* Pyraclostrobin/Boscalid

*Pristine*, 14.5 to 18.5 oz for *Botrytis*, 10.5 to 18.5 oz for *Alternaria*. (7 days)

or

\* Boscalid

*Endura*, 6.8 oz. (7 days)

or



DCNA

*Botran* 75 W, 2 2/3 to 5 1/3 lb. (14 days) The use of a spreader/sticker is not recommended. Do not make more than one application per season.

or

Fenamidone

*Reason* 500 SC, 5.5 fl oz every 5 to 10 days. (7 days) Purple blotch only.

or

Neem Oil

*Trilogy*, 2 pt. (0 days)

or

Pyrimethanil

*Scala*, 9 to 18 fl oz. (7 days)

or

Propiconazole

*Propimax* EC, 4 fl oz. (14 days)

*Tilt*, 4-8 fl oz. (14 days)

**BACTERIAL BLIGHT** (*Erwinia carotovora* subsp. *carotovora*, *Pseudomonas* spp.): Apply at 7 to 10 day intervals when plants are 4-6 in. tall. Can cause foliar phytotoxicity.

Copper Hydroxide

*Champ* DP, 2/3 to 1 lb. (0 days)

*Champ* Formula 2 F, 2/3 to 1 pt. (0 days)

*Kocide* 4.5 LF, 1 1/3 pt. (0 days)

or

Copper Sulfate

*Cuprofix* Ultra, 1.25 to 3 lb. (0 days)

**DOWNY MILDEW** (*Peronospora destructor*): Apply after the 4-leaf stage.

\* Dimethomorph

*Acrobat* 50 WP, 6.4 oz. (0 days) Must be tank-mixed with another fungicide.

or

*Forum*, 6 fl oz. (0 days)

or

\* Mancozeb

*Dithane* DF Rainshield, *Dithane* M-45, 3 lb. (7 days)

*Dithane* F-45 Rainshield, 2.4 qt. (7 days)

*Manzate* 75 DF, 3 lb. (7 days) Do not apply to exposed bulbs.

*Penncozeb* 4 F, 1.6 to 2.4 qt. (7 days)

*Penncozeb* 75 DF, *Penncozeb* 80 WP, 2 to 3 lb. (7 days)

or

\* Maneb

*Manex*, 3.2 to 4.8 pt. (7 days)

or

\* Mefenoxam/Chlorothalonil

*Ridomil* Gold Bravo, 2 lb. (7 days) Maximum 4 applications.

or

\* Mefenoxam/Mancozeb

*Ridomil* Gold MZ, 2 1/2 lb. (7 days) Maximum 4 applications.

or

\* Mefenoxam/Copper Hydroxide

*Ridomil* Gold Copper, 2 lb. (10 days) Maximum 4 applications.

or

Azoxystrobin

*Amistar*, 3 to 5 oz every 5 - 7 days. (0 days)

or

*Quadris*, 6.2 to 15.4 fl oz. (0 days)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

Chlorothalonil. Downy mildew suppression.

*Bravo* Ultrex, 0.9 - 2.7 lb every 7 to 10 days. (7 days)

*Bravo* Weather Stik Zn, 1.5 to 3 pt every 7 to 10 days. (7 days)

*Echo* 90 DF, 1.2 to 2.4 lb every 7 days. (7 days)

*Echo* 720, *Equus* 720 SST, 1 to 3 pt. (7 days)

or

Fenamidone

*Reason* 500 SC, 5.5 fl oz every 5 to 10 days. (14 days)

or

Neem Oil

*Trilogy*, 2 pt. (0 days)

or

Pyraclostrobin

*Cabrio*, 12 oz. (7 days) Do not apply more than one application before alternating with another chemical.

or

Pyraclostrobin/Boscalid

*Pristine*, 18.5 oz. (7 days)

or

Mono-, dibasic sodium, potassium and ammonium phosphites

*Prophyt*, 4 pt. (0 days)

or

Mandipropamid

*Revus*, 8 fl oz. (7 day)

**Note:** Most fungicides that protect against purple blotch or Botrytis leaf blight may also provide limited downy mildew protection.

**WHITE ROT** (*Sclerotium cepivorum*):Tebuconazole

*Folicur* 3.6F, 20.5 fl oz in 4-6 inch band. 12 hr REI.

**PURPLE BLOTCH** (*Alternaria porri*):Tebuconazole

*Folicur* 3.6F, 4-6 fl oz. (7 days) Maximum 12 fl oz/acre/season. 12 hr REI.

## Leeks

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

Leeks are hosts for root-knot nematodes. Fields with soil or root problems of undetermined cause should be tested for nematodes (see Appendix C). Management of root-knot nematodes can be accomplished by using crop rotation. The benefits of utilizing nematicides for leeks grown in Michigan are undetermined at this time.

## INSECTS

### SEED TREATMENT:

None presently registered.

### SOIL TREATMENT:

**ONION MAGGOT:** No insecticides are registered for this use.

Onion maggots are not as serious in leeks as they are in onions. Avoid planting leeks near onions that had onion maggot problems the previous year. Plant as late as is practical to reduce early-season problems.

### FOLIAR TREATMENT:

**CUTWORM, ARMYWORM:** Apply banded over the row.

*Bacillus thuringiensis*

Agree, Biobit, Dipel, Javelin, Lepinox, Mattch, MVP II, Vault, Xentari. (0 days)

or

Mustang Max, 2.2 to 4.0 oz. (7 days) (RUP)

or

Pyrellin EC, 1 to 2 pt. (0 days)

or

Pyrenone, 2 to 12 oz. (0 days)

or

Entrust, 1 to 2 oz. (1 day) Do not apply more than 9 oz per acre per crop. Do not make more than 5 applications per year.

or

SpinTor 2 SC, 3 to 6 oz. (1 day) Do not apply more than 29 oz per acre per crop. Do not make more than 5 applications per year.

or

Radiant SC, 5 to 10 fl oz. (1 day) Do not make more than 5 applications or exceed 30 fl oz/acre per season.

### THRIPS:

Mustang Max, 1.9 to 4.0 oz. (7 days) (RUP)

or

Pyrellin EC, 1 to 2 pt. (0 days)

or

Pyrenone, 2 to 12 oz. (0 days)

or

Entrust, 1 to 2 oz. (1 day) Suppression only. Do not apply more than 9 oz per acre per crop. Do not make more than 5 applications per year.

or

SpinTor 2 SC, 4 to 8 oz. (1 day) Suppression only. Do not apply more than 29 oz per acre per crop. Do not make more than 5 applications per year.

or

Radiant SC, 6 to 10 fl oz. (1 day) Do not make more than 5 applications or exceed 30 fl oz/acre per season.

## DISEASES

### SOIL TREATMENT:

**DAMPING OFF** (*Pythium* spp.):

\* Mefenoxam. Apply as a broadcast preplant incorporation or a surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate,

incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 1 in. of sprinkler irrigation.

*Ridomil* Gold SL, 0.5-1 pt.

*Ultra* Flourish, 1 to 2 pt.

### GREENHOUSE PREPLANT INCORPORATION:

**DAMPING OFF** (*Pythium* spp.), **ROOT ROT** (*Rhizoctonia* spp.):

*Gliocladium virens* GL-21

*SoilGard* 12 G, 1 to 1.5 lb per cubic yard.

Biological control product that needs to be applied before disease development. Control may be limited under heavy disease pressure.

### FOLIAR TREATMENT:

**BACTERIAL BLIGHT** (*Erwinia carotovora* subsp. *carotovora*, *Pseudomonas* spp.): Apply at 7 to 10 day intervals when plants are 4-6 in. tall. Can cause foliar phytotoxicity.

Copper Hydroxide

*Champ* DP, 2/3 to 1 lb. (0 days)

*Champ* Formula 2 F, 2/3 to 1 pt. (0 days)

*Kocide* 4.5 LF, 1 1/3 pt. (0 days)

**BOTRYTIS LEAF BLIGHT** (*Botrytis squamosa*), **PURPLE**

**BLOTCH** (*Alternaria porri*): Apply every 7 to 10 days after the 4 leaf stage.

\* Azoxystrobin

*Amistar*, 2 to 5 oz every 7 - 14 days. (0 days)

*Quadris*, 6.2 to 15.4 fl oz. (0 days)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* Chlorothalonil

*Bravo* Ultrex, 1.4 to 2.7 lb every 7 - 10 days. (14 days)

*Bravo* Weather Stik Zn, 1.5 to 3 pt. (14 days)

*Echo* 90 DF, 1.2 to 2.4 lb. (14 days)

or

*Echo* 720, *Equus* 720 SST, 1.5 to 3 pt every 7-10 days. (14 days)

or

\* Pyraclostrobin

*Cabrio*, 8-12 oz. (7 days) Do not apply more than three sequential applications

or

\* Pyraclostrobin/Boscalid

*Pristine*, 14.5 to 18.5 oz for *Botrytis*, 10.5 to 18.5 oz for *Alternaria*. (7 days)

or

Boscalid

*Endura*, 6.8 oz. (7 days)

or

Fenamidone

*Reason* 500 SC, 5.5 fl oz every 5 to 10 days. (7 days)

or

Neem Oil

*Trilogy*, 2 pt. (0 days)

or



Pyrimethanil

Scala, 9 to 18 fl oz. (7 days)

or

Propiconazole

Propimax EC, 4 fl oz. (14 days)

or

Tilt, 4-8 fl oz. (14 days)

**DOWNY MILDEW** (*Peronospora destructor*): Apply every 7 to 10 days after the 4 leaf stage.\* Dimethomorph

Acrobat 50 WP, 6.4 oz. (0 days)

Forum, 6 fl oz. (0 days)

or

\* Mefenoxam/Chlorothalonil

Ridomil Gold Bravo, 2 lb. (21 days) Maximum 3 applications.

or

\* Mefenoxam/Copper Hydroxide

Ridomil Gold Copper, 2 lb. (7 days) Maximum 3 applications.

or

Azoxystrobin

Amistar, 3 to 5 oz every 5 - 7 days. (0 days)

Quadris, 9.2 to 15.4 fl oz every 5 to 7 days. (0 days)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

Azoxystrobin/Chlorothalonil

Quadris Opti, 2.4 - 3.7 pt every 7 - 14 days. (14 days)

or

Chlorothalonil. Downy mildew suppression.

Bravo Ultrex, 1.4 to 2.7 lb every 7 - 10 days. (14 days)

Echo 720, Equus 720 SST, 1.5 to 3 pt every 7 days. (14 days)

Bravo Weather Stik Zn, 1.5 to 3 pt every 7 to 10 days. (14 days)

Echo 90 DF, 1.2 to 2.4 lb every 7 days. (14 days)

or

Fenamidone

Reason 500 SC, 5.5 fl oz every 5 to 10 days. (7 days)

or

Neem Oil

Trilogy, 2 pt. (0 days)

or

Pyraclostrobin

Cabrio, 12 oz. (7 days) Do not apply more than application before alternating with another chemical.

or

Pyraclostrobin/Boscalid

Pristine, 18.5 oz. (7 days)

or

Mandipropamid

Revus, 8 fl oz. (7 day)

**Note:** Most fungicides that protect against purple blotch or Botrytis leaf blight may also provide limited downy mildew protection.

# Lettuce

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

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

## FALL SOIL FUMIGATION (BROADCAST):

Fumigate in the fall when soil temperatures at a 6 inch depth are above 50F. 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. In some limited situations, soil fumigants can be applied in the spring in Michigan.

Correct soil moisture, temperature and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or by immediate tarping.

1,3-D

Telone II, 25 gal/A (muck soil), 9-18 gal/A (mineral soil).

or

Metam Sodium

Vapam HL, 37.5 to 75 gal/A. Use higher rate for muck soil) injected with shanks spaced 5 inches apart or to a depth of 4 to 10 inches in well prepared soil. Follow immediately with a roller to smooth and compact surface. Light watering to the treated surface helps to prevent escape of gas.

## INSECTS

### PLANTING TREATMENT:

#### APHIDS:

Venom, 5 to 6 oz. (21 days) See label for application methods.

#### APHIDS, LEAF MINERS, LEAFHOPPER, FLEA BEETLE:

Platinum, 5 to 11 oz. (30 days) See label for application methods.

### FOLIAR TREATMENT:

**CUTWORM, ARMYWORM:** Apply when damage is first seen and repeat as needed.

## \* Cypermethrin

Ammo 2.5 EC (2.5 to 5 oz) or Ammo WSB (1 to 2 bags) or

UP-Cyde 2.5 EC (2.5 to 5 oz) (5 days) Head lettuce only. (RUP)

or

\* Baythroid XL, 2.4 to 3.2 fl oz. (0 days) (RUP)

or

\* Mustang Max, 3.2 to 4.0 oz. (5 days) (RUP)

## Lettuce

or

\* Permethrin

*Ambush* 25 W, 6.4 to 12.8 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz)  
or *Pounce* 3.2 EC (4 to 8 oz) (1 day) (RUP)

or

\* *Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (5 days) (RUP)

or

*Lannate* LV (1 1/2 pt) or *Lannate* SP (1/2 lb) (7 days) (RUP)

or

*SpinTor* 2 SC, 4 to 8 oz. (1 day) Do not apply more than 3 times  
in 21 days.

or

*Entrust*, 1.3 to 2.5 oz. (1 day)

or

Lambda-cyhalothrin

*Lambda-Cy, Proaxis*, 2.6 to 3.8 fl oz. (1 day) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) Head lettuce only. (RUP)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6  
applications or exceed 34 fl oz/acre per season.

or

Bifenthrin

*Bifenture* EC, 2.1 to 6.4 oz. (7 days) Head lettuce only. (RUP)

or

*Brigadier*, 5.1 to 6.1 oz. (7 days) Head lettuce only.

### ASTER LEAFHOPPERS:

\* Cypermethrin

*Ammo* 2.5 EC (2.5 to 5 oz) or *Ammo* WSB (1 to 2 bags) or  
*UP-Cyde* 2.5 EC (2.5 to 5 oz) (5 days) Head lettuce only. (RUP)

or

\* *Mustang* Max, 2.2 to 4.0 oz. (5 days) Head lettuce only. (RUP)

or

\* Permethrin

*Ambush* 25 W, 6.4 to 12.8 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz)  
or *Pounce* 3.2 EC (4 to 8 oz) (1 day) (RUP)

or

\* *Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (1 day)

Head lettuce only. (RUP)

or

Acephate. Crisphead type only.

*Acephate* 97 UP, *Orthene* 97, 1/2 to 1 lb. (21 days) Do not  
apply more than 2-1/8 lb per season.

or

Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 to 2 qt) (14 days)

or

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

or

*Endosulfan* 3 EC, 2 pt. (14 days) Consult label for number of  
applications and other limitations.

or

*Lannate* LV (1 1/2 pt (7 days) to 3 pt (10 days)) or *Lannate*  
SP (1/2 lb (7 days) to 1 lb (10 days)) (RUP)

or

*Malathion* 57 EC, 2 pt (7 days for head lettuce; 14 days for leaf  
lettuce)

or

*Venom*, 1 to 3 oz. (7 days)

or

Lambda-cyhalothrin

*Lambda-Cy, Proaxis*, 2.6 to 3.8 fl oz. (1 day) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) Head lettuce only. (RUP)

or

*Actara*, 1.5 to 3 oz. (7 days) Do not exceed 11.0 oz/Acre per  
season. Do not exceed 11.0 oz/Acre per season.

or

Bifenthrin

*Bifenture* EC, 2.1 to 6.4 oz. (7 days) Head lettuce only. (RUP)

or

*Brigadier*, 3.8 to 6.1 oz. (7 days) Head lettuce only.

### APHIDS:

\* *Assail* 30 SG, 1.9 to 2.8 oz. (7 days)

or

\* *Fulfill*, 2.75 oz. (7 days) Do not exceed 5.5 oz/acre per season.  
May require 5 to 7 days for aphid mortality.

or

\* Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.75 fl oz. (7 days) Do not use if  
Imidacloprid was used at planting. Do not exceed 19.2 oz/Acre  
per season.

or

Acephate. Crisphead only.

*Acephate* 97 UP, *Orthene* 97, 1/2 to 1 lb. (21 days) Do not  
apply more than 2-1/8 lb per season.

or

*Diazinon* 50 WP (1 lb) or *Diazinon* AG 500 (1 pt) (14 days) (RUP)

or

*Dimethoate* 2.67 EC, 3/4 pt. (14 days) Leaf lettuce only.

or

*Endosulfan* 3 EC, 2 pt. (14 days) Consult label for number of  
applications and other limitations.

or

*Lannate* LV (1 1/2 pt (7 days) to 3 pt (10 days)) or *Lannate*  
SP (1/2 lb (7 days) to 1 lb (10 days)) (RUP)

or

*Malathion* 57 EC, 2 pt. (7 days for head lettuce; 14 days for leaf  
lettuce)

or

*Pyrenone*, 2 to 12 oz. (0 days)

or

*Venom*, 1 to 3 oz. (7 days)

or

*Beleaf* 50 SG, 2 to 2.8 oz. (0 days)

or

*Actara*, 1.5 to 3 oz. (7 days) Do not exceed 11.0 oz/acre per  
season.

or

Bifenthrin

*Bifenture* EC, 2.1 to 6.4 oz. (7 days) Head lettuce only. (RUP)

or

*Brigadier*, 3.8 to 6.1 oz. (7 days) Head lettuce only.



**TARNISHED PLANT BUG:**

\* Cypermethrin

*Ammo* 2.5 EC, *UP-Cyde* 2.5 EC, 2.5 to 5 oz. (5 days) Head lettuce only. (RUP)

or

\* *Baythroid* XL, 2.4 to 3.2 fl oz. (0 days) (RUP)

or

\* *Mustang* Max, 3.2 to 4.0 oz. (5 days) (RUP)

or

\* *Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (1 day) Head lettuce only. (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/4 to 2 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt) (14 days)

or

*Beleaf* 50 SG, 2 to 2.8 oz. (0 days)

or

*Hero*, 10.3 oz. (7 days) Head lettuce only. (RUP)

or

Bifenthrin

*Bifenture* EC, 5.1 to 6.4 oz. (7 days) Head lettuce only. (RUP)

or

*Brigadier*, 3.8 to 6.1 oz. (7 days) Head lettuce only.**CATERPILLARS:** Caterpillars (mainly cabbage loopers), are usually controlled with aster leafhopper program, but damage potential may require additional treatments.

\* Cypermethrin

*Ammo* 2.5 EC (2.5 to 5 oz) or *Ammo* WSB (1 to 2 bags) or *UP-Cyde* 2.5 EC (2.5 to 5 oz) (5 days) Head lettuce only. (RUP)

or

\* *Baythroid* XL, 1.6 to 2.4 fl oz. (0 days) (RUP)

or

\* Permethrin

*Ambush* 25 W, 6.4 to 12.8 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz) or *Pounce* 3.2 EC (4 to 8 oz) (1 day) (RUP)

or

Acephate. Crisphead type only.

*Acephate* 97 UP, *Orthene* 97, 1 lb. (21 days) Do not apply more than 2-1/8 lb per season.

or

*Avaunt*, 2.5 to 3.5 oz. (3 days)

or

*Bacillus thuringiensis**Agree*, *Biobit*, *Dipel*, *Javelin*, *Lepinox*. (0 days)

or

Carbaryl

*Sevin* 80 S (1 1/4 to 2 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt) (14 days)

or

*Endosulfan* 3 EC, 2 pt. (14 days) Consult label for numbers of applications and other restrictions.

or

*Lannate* LV (1 1/2 pt (7 days) to 3 pt (10 days)) or *Lannate* SP (1/2 lb (7 days) to 1 lb (10 days)) (7 days) (RUP)

or

Thiodicarb

*Larvin* 3.2 EC, 16 to 30 oz. (14 days)

or

*Proclaim*, 3.2 to 4.8 oz. (7 days) Head Lettuce only. (RUP)

or

*Entrust*, 1 to 2 oz. (1 day)

or

*Intrepid* 2 F, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

*Hero*, 4 to 10.3 oz. (7 days) Head lettuce only. (RUP)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

Bifenthrin

*Bifenture* EC, 2.1 to 6.4 oz. (7 days) Head lettuce only. (RUP)

or

*Brigadier*, 5.1 to 6.1 oz. (7 days) Head lettuce only.**VEGETABLE LEAFMINER:** Apply as soon as visible mines appear and repeat every 7 days as needed.*Agri-Mek* 0.15 EC, 8 to 16 fl oz. (7 days) (RUP)

or

*SpinTor* 2 SC, 6 to 10 oz. (1 day) Do not apply more than 3 times in 21 days.

or

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

or

*Venom*, 1 to 3 oz. (7 days)

or

*Entrust*, 2 to 3 oz. (1 day)

or

*Radiant* SC, 6 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.**SLUGS***Deadline* M-Ps 4% (20 to 40 lb) or *Metaldehyde* 3.5 G (30 to 40 lb) Apply between rows. Avoid contact to edible product.**DISEASES****SEED TREATMENT:****DAMPING OFF** (*Rhizoctonia* spp., *Pythium* spp. *Botrytis* spp.):*Bacillus subtilis* GB03*Kodiak*, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

*Fludioxinil**Maxim* 4 FS, 0.08 to 0.16 fl oz/100 lb seed (*Rhizoctonia*).

Commercial seed treatment plants only.

or

*Thiram*42-S *Thiram*, *Thiram* 50 WP Dyed, 8 oz/100 lb seed.**SEEDBED TREATMENT:****DAMPING OFF SEED and CROWN ROTS** (*Rhizoctonia* spp., *Pythium* spp., *Botrytis* spp., *Sclerotinia sclerotiorum*):**Note:** For seedbed protection programs, sterilize seedbed with steam or Chemicals (see Appendix A). Follow recommended procedures carefully.

## Melons

### PLANTING TREATMENT:

#### PYTHIUM DAMPING OFF:

Mefenoxam. Apply as a broadcast preplant incorporation or a surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting with 1/2 to 1 in. of sprinkler irrigation.

*Ridomil Gold GR*, 20 to 40 lb.

*Ridomil Gold WSP*, 1 to 2 lb.

*Ultra Flourish*, 2-4 pt.

### FOLIAR TREATMENT:

#### DROP (*Sclerotinia sclerotiorum* or *Sclerotinia minor*):

##### Boscalid

*Endura*, 8 to 11 oz. (14 days)

or

##### DCNA

*Botran 75 W*, 2 to 3 1/3 lb. (14 days) Apply at 2 lb preemergence in a 4- to 6-inch band over the transplanted or seeded row. Make a second application of 3 1/3 lb immediately after thinning. Do not use more than 5 1/3 lb per acre per season. For a single application, apply 5 1/3 lb immediately after thinning.

or

##### Iprodione

*Rovral 4 F*, 1 1/2 to 2 pt. (14 days) Apply at 3-leaf stage to just after thinning and again in 10 days. Make a third application 10 days later if conditions for disease remain favorable.

**Note:** See label for permissible crop rotations.

#### BOTTOM ROT (*Rhizoctonia solani*):

##### Boscalid

*Endura*, 8 to 11 oz (bottom rot suppression). (14 days)

or

##### Iprodione

*Rovral 4 F*, 1 1/2 to 2 pt. (14 days) Apply at 3-leaf stage to just after thinning and again in 10 days. Make a third application 10 days later if conditions for disease remain favorable.

**Note:** See label for permissible crop rotations.

#### DOWNY MILDEW (*Bremia lactucae*):

##### \* Dimethomorph

*Acrobat 50 WP*, 6.4 oz. (0 days)

*Forum*, 6 fl oz. (0 days)

or

##### \* Famoxadone/Cymoxanil

*Tanos*, 8 oz. (3 days) Head Lettuce only.

or

##### \* Fluopicolide

*Presidio*, 3-4 fl oz. (2 days)

or

##### \* Fosetyl-Aluminum

*Aliette WDG*, 2 to 5 lb at 7- to 21-day intervals. (3 days) Do not make more than 7 applications per season. Do not tank mix with copper fungicides.

or

##### \* Mefenoxam

*Ridomil Gold SL*, 0.125-0.25 pt. (7 days)

or

##### Azoxystrobin

*Amistar*, 4 to 5 oz every 7 - 14 days. (0 days)

*Quadris*, 12.3 to 15.4 fl oz. (0 days)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

##### Copper Hydroxide

*Champ Formula 2 F*, 2/3 to 1 1/3 pt. (0 days)

*Champion WP*, *Kocide DF*, *Nu-Cop 50 DF*, 1 to 2 lb. (0 days)

*Nu-Cop 3 L*, 2/3 to 2 2/3 pt. (0 days)

or

##### Fenamidone

*Reason 500 SC*, 5.5 to 8.2 fl oz every 5 to 10 days. (2 days)

or

##### Maneb

*Maneb 75 DF*, *Maneb 80 WP*, 1 1/2 to 2 lb. (10 days)

Do not apply more than 9.6 qt per season

or

*Manex 4 F*, 1 1/5 to 1 3/5 qt. (10 days)

or

##### Mono-, dibasic sodium, potassium and ammonium phosphites

*Phostrol*, 2.5 to 5 pt every 7 - 21 days. (0 days)

*Prophyt*, 2 to 4 pt. (0 days)

or

##### Propamocarb

*Previcur Flex*, 2 pt every 5 to 10 days. (2 days)

or

##### Cymoxanil

*Curzate 60 DF*, 3.2 to 5 oz. (30 days) Do not apply more than 30 oz/acre/season.

or

##### Mandipropamid

*Revus*, 8 fl oz. (1 day)

## Melons

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

Muskmelons and watermelons are hosts for root-knot and lesion nematodes. These nematodes can reduce melon yields but yield losses in Michigan have not been documented. If you suspect nematodes are reducing melon yields collect root and soil samples for analyses as described in Appendix C. If the numbers of nematodes recovered from those samples exceed damage thresholds; control options will be suggested. Vydate 2L is labeled for use in melons.



## INSECTS

### SEED TREATMENT:

If possible, buy treated seed.

**SEED CORN MAGGOT:** There is no chemical control currently available.

### SOIL TREATMENT:

**CUCUMBER BEETLE, APHIDS, THRIPS:** Apply to soil in a narrow band 14 or less days before planting, as an in-furrow spray at planting, as a post-seeding drench, as a sidedress after plants are established or in drip or trickle irrigation water. Do not make more than 1 application per year.

\* Imidacloprid

*Admire Pro*, 7.0 - 10.5 fl oz. (21 days)

*Nuprid 2 F*, 16 to 24 oz. (21 days)

**CUCUMBER BEETLE:** Apply in areas with high beetle populations.

\* *Furadan 4 F*, 2.4 oz/1000 ft of row. Apply at planting or transplanting in a 7-inch band, incorporated into the top 3 inches of soil, or apply into the furrow and mix with the covering soil. (Special Michigan SLN registration.) (RUP)

**APHIDS, FLEA BEETLE, CUCUMBER BEETLE, LEAFHOPPER, THRIPS:**

*Platinum*, 5 to 11 oz. (30 days) See label for application methods.

**APHIDS, THRIPS:**

*Venom*, 5 to 6 oz. (21 days) See label for application methods.

### FOLIAR TREATMENT:

Melon plants may be sensitive to certain insecticide formulations. Make certain a problem exists before treatment. Read and observe restrictions on the label. To avoid killing bees, do not treat melons during bloom.

**CUTWORM:** Apply if >1% of plants are injured.

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

or

\* *Baythroid XL*, 0.8 to 1.6 fl oz. (0 days) (RUP)

or

\* Bifenthrin (RUP)

*Bifenture EC*, *Brigade 2EC*, *Capture 2 EC*, 6.4 oz. (3 days)

or

\* Permethrin

*Ambush 25 W*, 12.8 oz. (0 days) (RUP)

or

*Perm-UP 3.2 EC* (8 oz) or *Pounce 25 WP* (12.8 oz) or *Pounce 3.2 EC* (8 oz) (0 days) (RUP)

or

*Lannate LV* (1 1/2 pt (1 day) or 3 pt (3 days)) or *Lannate SP* (1/2 lb (1 day) or 1 lb (3 days)) (1 day) (RUP)

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)

Do not exceed 23 fl oz/acre per season. (RUP)

**STRIPED and SPOTTED CUCUMBER BEETLE:** Apply if numbers exceed 0.1 to 1/plant. Repeat as needed. Use preplant Furadan treatment in fields with severe problems.

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

or

*Baythroid XL*, 2.4 to 2.8 fl oz. (0 days) (RUP)

or

Carbaryl

*Sevin 80 S* (1 1/4 lb) or *Sevin XLR Plus* (1 qt) (3 days)

or

Bifenthrin

*Bifenture EC*, *Brigade 2EC*, *Capture 2 EC*, 2.6 to 6.4 oz. (3 days) (RUP)

or

*Endosulfan 3 EC*, 2 pt. (2 days)

or

*Lannate LV* (1 1/2 pt (1 day) or 3 pt (3 days)) or *Lannate SP* (1/2 lb (1 day) or 1 lb (3 days)) (RUP)

or

Permethrin

*Ambush 25 W*, 6.4 to 12.8 oz. (0 days) (RUP)

or

*Perm-UP 3.2 EC* (4 to 8 oz) or *Pounce 25 WP* (6.4 to 12.8 oz) or *Pounce 3.2 EC* (4 to 8 oz) (0 days) (RUP)

or

*Danitol 2.4 EC*, 10 2/3 to 16 fl oz. (7 days) (RUP)

or

*Venom*, 3 to 4 oz. (1 day)

or

*Actara*, 3 to 5.5 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (1 day) Do not exceed 23 fl oz/acre per season. (RUP)

or

*Assail 30 SG*, 2.5 to 5.3 oz. (0 days)

**FLEA BEETLE:** Apply if needed.

Carbaryl

*Sevin 80 S* (1 1/4 lb) or *Sevin XLR Plus* (1 qt) (3 days)

or

*Endosulfan 3 EC*, 2 pt. (2 days)

or

*Lannate LV* (1 1/2 pt (1 day) or 3 pt (3 days)) or *Lannate SP* (1/2 lb (1 day) or 1 lb (3 days)) (RUP)

or

*Actara*, 1.5 to 3 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (1 day) Do not exceed 23 fl oz/acre per season. (RUP)

**LEAFHOPPERS:** Apply if insects and damage are present.

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

or

Carbaryl

*Sevin 80 S* (1 1/4 lb) or *Sevin XLR Plus* (1 qt) (3 days)

or

Bifenthrin

*Bifenture EC*, *Brigade 2EC*, *Capture 2 EC*, 2.6 to 6.4 oz. (3 days) (RUP)

or

*Diazinon 50 WP* (1 lb) or *Diazinon AG 500* (1 pt) (3 days) (RUP)

or

*Dibrom 8 EC*, 1 pt. (1 day)

or

## Melons

*Dimethoate* 2.67 EC, 3/4 to 1 1/2 pt. (3 days)

or

*Venom*, 1 to 4 oz. (1 day)

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)

Do not exceed 23 fl oz/acre per season. (RUP)

### APHIDS:

*Dimethoate* 2.67 EC, 3/4 to 1 1/2 pt. (3 days)

or

*Diazinon* 50 WP (1 lb) or *Diazinon* AG 500 (1 pt) (3 days) (RUP)

or

*Fulfill*, 2.75 oz. (0 days) Do not exceed 5.5 oz/acre per season.

May require 5 to 7 days for aphid mortality.

or

*Lannate* LV (1 1/2 pt (1 day) or 3 pt (3 days)) or *Lannate* SP (1/2 lb (1 day) or 1 lb (3 days)) (RUP)

or

*Malathion* 57 EC, 1 1/2 pt. (1 day)

or

*Venom*, 1 to 4 oz. (1 day)

or

*Beleaf* 50 SG, 2 to 2.8 oz. (0 days)

or

*Actara*, 1.5 to 3 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

*Assail* 30 SG, 2.5 to 4 oz. (0 days)

**THRIPS:** Apply when damage is seen. Repeat as needed.

*Diazinon* 50 WP (1 lb) or *Diazinon* AG 500 (1 pt) (3 days) (RUP)

or

*SpinTor* 2 SC, 6 to 8 oz. (3 days)

or

*Venom*, 1 to 4 oz. (1 day)

or

*Entrust*, 2 to 2.5 oz. (3 days)

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)

Do not exceed 23 fl oz/acre per season. (RUP)

### SQUASH BUG:

*Venom*, 3 to 4 oz. (1 day)

## MITES

Apply when needed. Watermelons are particularly susceptible.

Usually a problem only in hot, dry weather.

*Agri-Mek* 0.15 EC, 8 to 16 fl oz. (7 days) (RUP)

or

*Kelthane* 35, 1 to 1 1/2 lb. (2 days)

or

*Bifenthrin*

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 5.1 to 6.4 oz. (3 days) (RUP)

or

*Danitol* 2.4 EC, 10 2/3 fl oz. (7 days) (RUP)

or

*Diazinon* 50 WP (1 lb) or *Diazinon* AG 500 (1 pt) (3 days) (RUP)

or

*Dibrom* 8 EC, 1 pt. (1 day)

or

*Oberon* 2 SC, 7 to 8.5 fl oz. (7 days)

or

*Zeal*, 2 to 3 oz. (7 days)

## SLUGS

*Deadline* M-Ps 4% (20 to 40 lb) or *Metaldehyde* 3.5 G (30 to 40 lb) Apply between rows. Avoid contact with edible product.

## DISEASES

### SEED TREATMENT:

**DAMPING OFF** (*Pythium* spp., *Rhizoctonia solani*): If possible, buy treated seed. Use only as directed; over-treatment may cause injury.

*Bacillus subtilis* GB03

*Kodiak*, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

*Captan*

*Captan* 300, *Captan* 30-DD, 1 2/3 fl oz/100 lb seed.

*Captan* 400, 1 1/2 to 2 fl oz/100 lb seed.

or

*Fludioxinil*

*Maxim* 4 FS, 0.08 to 0.16 fl oz/100 lb seed (*Rhizoctonia*).

Commercial seed treatment plants only.

or

*Thiram*

42-S *Thiram*, *Thiram* 50 WP Dyed, 4 1/2 oz/100 lb seed.

### SEEDBED PREPARATION:

**DAMPING OFF, ROOT ROT** (*Pythium* spp., *Rhizoctonia solani*):

Grow transplants in disease-free soil (sterilized) and fumigate fields before planting. To sterilize soil use steam or fumigate with chemicals suggested for seedbed sterilization in Appendix A. Follow manufacturer's recommendations for use with particular crops. Avoid planting until soil is free of fumigant.

### PREPLANT SOIL FUMIGATION:

**DAMPING OFF, ROOT ROT**s (*Phytophthora* spp., *Pythium* spp., *Rhizoctonia solani*), **FUSARIUM WILT** or **ROOT ROT** (*Fusarium oxysporum*): See bulletin E-2099. This protects plants grown from seed or transplanted in the field.

Soil sterilization by fumigation is best achieved by proper application of material. Correct soil moisture, temperature, and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or immediate tarping.

*1,3 Dichloropropene/chloropicrin*

*Telone* C35, 13-136 gal. (RUP)

or

*Metam Sodium*

*Sectagon* 42, *Vapam* HL, 37.5-75 gal.

or

*Potassium N-methyldithiocarbamate*

*Sectagon-K54*, 30-60 gal.



## GREENHOUSE PREPLANT INCORPORATION:

**DAMPING OFF** (*Pythium* spp.), **ROOT ROT** (*Rhizoctonia* spp.):  
*Gliocladium virens* GL-21

*SoilGard* 12 G, 1 to 1.5 lb per cubic yard. Biological control product that needs to be applied before disease development. Control may be limited under heavy disease pressure.

## PREPLANT TREATMENT:

**DAMPING OFF and COTTONY LEAK** (*Pythium* spp.):

\* Mefenoxam. Apply as a broadcast preplant incorporation or a surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 1 in. of sprinkler irrigation.

*Ridomil* Gold SL, 1-2 pt.

*Ultra Flourish*, 2 to 4 pt.

## FOLIAR TREATMENT:

**POWDERY MILDEW** (*Sphaerotheca fuliginea*, *Erysiphe cichoracearum*):

\* Myclobutanil

*Rally* 40 WSP, 2.5 to 5 oz, 7 to 10 day schedule.. (0 days) Do not apply more than 1.5 lbs per acre per crop.

or

\* Pyraclostrobin

*Cabrio*, 12-16 oz. (0 days) Alternate one-to-one with fungicides having a different mode of action.

or

\* Pyraclostrobin/Boscalid

*Pristine*, 12.5 to 18.5 oz. (0 days) To avoid crop injury, do not add adjuvants.

or

\* Thiophanate-Methyl

*Topsin* M 70 WP, *Topsin* M WSB, 1/4 to 1/2 lb. (0 days) Apply at 7 to 14 day intervals after disease appears.

or

\* Trifloxystrobin

*Flint*, 1 1/2 to 2 oz, 7- to 14-day intervals. (0 days) Maximum 2 consecutive applications, 4 applications/year and 16 oz/season.

or

\* Quinoxifen

*Quintec*, 4 to 6 fl oz, 10- to 14-day intervals. (3 days)

or

Azoxystrobin

*Amistar*, 3.5 to 5 oz. (1 day)

*Quadris*, 11.0 to 15.4 fl oz. (1 day)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

Azoxystrobin/Chlorothalonil

*Quadris* Opti, 3.2 pt every 7 - 14 days. (1 day)

or

*Bacillus subtilis*

*Serenade*, 6 to 8 lb every 7 days. (0 days) Biological control product that needs to be applied before disease development. Control will be limited under heavy disease pressure.

or

*Serenade* Max, 1 - 3 lb every 7 to 10 days. (0 days)

or

Chlorothalonil

*Bravo* Ultrex, *Equus* DF, 1.8 to 2.7 lb. (0 days)

*Echo* 90 DF, 1.6 to 2.4 lb every 7 days. (0 days)

or

*Bravo* Weather Stik, or *Echo* 720 (2 to 3 pt, 7-day intervals)

or *Equus* 720 SST (2 to 3 pt every 7 days) (0 days)

or

Copper Ammonium Carbonate

*Copper* Count N, 1 to 2 qt. (0 days)

or

Copper Hydroxide

*Champ* DP, 1 1/3 lb. (0 days)

*Champ* Formula 2 F, *Kocide* 4.5 LF, 1 1/3 pt. (0 days)

*Champion* WP, 1.5 to 3 lb. (0 days)

*Kocide* 2000, 1 1/2 lb. (0 days)

*Nu-Cop* 3 L, 1 to 4 pt, 5- to 10-day intervals. (0 days)

or

Copper Sulfate

*Cuprofix* Ultra, 1.25 lb. (0 days)

or

Neem Oil

*Trilogy*, 2 pt. (0 days)

or

Sulfur

*Kumulus* DF, 20 to 25 lb. Do not use on sulfur-sensitive varieties. (0 days)

or

*Microthiol* Disperss, 5 to 10 lb. (0 days)

*Thiolux* Jet, 6 to 15 lb. (0 days)

or

Triflumizole

*Procure* 480 SC, 4 to 8 fl oz every 7-14 days. (0 days)

or

Copper Resinate

*Tenn-Cop* 5 E, 3 pt. (0 days)

or

Tebuconazole

*Folicur* 3.6F, 4-6 fl oz. (7 days) 12 hr REI.

**ALTERNARIA LEAF BLIGHT** (*Alternaria cucumerin*):

\* Azoxystrobin

*Amistar*, 3.5 to 5 oz. (1 day)

*Quadris*, 11.0 to 15.4 fl oz. (1 day)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* Azoxystrobin/Chlorothalonil

*Quadris* Opti, 3.2 pt every 7 - 14 days. (1 day)

or

\* Chlorothalonil

*Bravo* Ultrex, *Equus* DF, 1.8 to 2.7 lb. (0 days)

*Echo* 90 DF, 1.6 to 2.4 lb every 7 days. (0 days)

or

*Bravo* Weather Stik, *Echo* 720, *Equus* 720 SST, 2 to 3 pt. (0 days)

or

## Melons

### \* Mancozeb

*Dithane* DF Rainshield, *Dithane* M-45, *Dithane* WSP, 2 to 3 lb. (5 days)

or

*Dithane* F-45 Rainshield, 1 3/5 to 2 2/5 qt. (5 days)

*Manzate* 75 DF, 2 to 3 lb. (5 days)

*Penncozeb* 4 F, 1.2 to 2.4 qt. (5 days)

*Penncozeb* 75 DF, *Penncozeb* 80 WP, 2 to 3 lb. (5 days)

or

### \* Maneb

*Maneb* 75 DF, *Maneb* 80 WP, 1 to 2 lb. (5 days)

*Manex*, 1 1/5 to 1 3/5 qt. (5 days)

or

### \* Pyraclostrobin

*Cabrio*, 12-16 oz. (0 days) No more than 2 consecutive applications before alternating with a fungicide having a different mode of action.

or

### \* Pyraclostrobin/Boscalid

*Pristine*, 12.5 to 18.5 oz. (0 days) To avoid crop injury, do not add adjuvants.

or

### Copper Ammonium Carbonate

*Copper* Count N, 1 to 2 qt. (0 days)

or

### Mancozeb/Copper Hydroxide

*ManKocide*, 2.5 lb. (5 days)

or

### Copper Hydroxide

*Champ* DP, 1 1/3 lb. (0 days)

*Champ* Formula 2 F, *Kocide* 4.5 LF, 1 1/3 pt. (0 days)

*Champion* WP, 1.5 to 3 lb. (0 days)

*Kocide* 2000, 1 1/2 lb. (0 days)

*Nu-Cop* 3 L, 1 to 4 pt. (0 days)

or

### Copper Sulfate

*Cuprofix* Ultra, 1.25 lb. (0 days)

or

### Mancozeb/Copper Sulfate

*Cuprofix* MZ Disperss, 5 - 7.25 lb. (5 days)

or

### Neem Oil

*Trilogy*, 2 pt. (0 days)

or

### Copper Resinate

*Tenn-Cop* 5 E, 3 pt. (0 days)

**SCAB** (*Cladosporium cucumerinum*): Treat every 7 days beginning after the plants have flowered.

### \* Chlorothalonil

*Bravo* Ultrex, *Equus* DF, 1.8 to 2.7 lb. (0 days)

*Echo* 90 DF, 1.6 to 2.4 lb every 7 days. (0 days)

or

*Bravo* Weather Stik, *Echo* 720, *Equus* 720 SST, 2 to 3 pt. (0 days)

or

### \* Mancozeb

*Dithane* DF Rainshield (2 to 3 lb (watermelon)) or *Dithane* M-45 (2 to 3 lb (watermelon)) or *Dithane* WSP (2 to 3 lb (watermelon)) (5 days)

or

*Dithane* F-45 Rainshield, 1.6 to 2.4 qt (watermelon). (5 days)

*Manex* II, 1.6 to 2.4 qt every 7 to 10 days. (5 days)

or

### Copper Ammonium Carbonate

*Copper* Count N, 2 to 3 qt. (0 days)

or

### Neem Oil

*Trilogy*, 2 pt. (0 days)

or

### Copper Resinate

*Tenn-Cop* 5 E, 3 pt. (0 days)

**ANTHRACNOSE** (*Colletotrichum lagenarium*): Treat every 7 to 14 days after flowering.

### \* Azoxystrobin

*Amistar*, 3.5 to 5 oz. (1 day)

*Quadris*, 11.0 to 15.4 fl oz. (1 day)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

### \* Azoxystrobin/Chlorothalonil

*Quadris* Opti, 3.2 pt every 7 - 14 days. (1 day)

or

### \* Chlorothalonil

*Bravo* Ultrex, *Equus* DF, 1.4 to 1.8 lb. (0 days)

*Echo* 90 DF, 1.3 to 1.6 lb every 7 days. (0 days)

or

*Bravo* Weather Stik, *Echo* 720, *Equus* 720 SST, 1.5 to 2 pt. (0 days)

or

### \* Mancozeb

*Dithane* DF Rainshield, *Dithane* M-45, *Dithane* WSP, 2 to 3 lb. (5 days)

or

*Dithane* F-45 Rainshield, 1 3/5 to 2 2/5 qt. (5 days)

*Manzate* 75 DF, 2 to 3 lb. (5 days)

*Penncozeb* 4 F, 1.2 to 2.4 qt. (5 days)

*Penncozeb* 75 DF, *Penncozeb* 80 WP, 2 to 3 lb. (5 days)

or

### \* Maneb

*Maneb* 75 DF, *Maneb* 80 WP, 1 to 2 lb. (5 days)

*Manex*, 1 1/5 to 1 3/5 qt. (5 days)

or

### \* Pyraclostrobin

*Cabrio*, 12-16 oz. (0 days) No more than 2 consecutive applications before alternating with a fungicide having a different mode of action.

or

### \* Pyraclostrobin/Boscalid

*Pristine*, 18.5 oz. (0 days) To avoid crop injury, do not add adjuvants.

or



\* Thiophanate-Methyl

*Topsin M 70 WP, Topsin M WSB, 4 to 8 oz. (0 days)*

or

Copper Ammonium Carbonate

*Copper Count N, 1 to 2 qt. (0 days)*

or

Copper Hydroxide

*Champ DP, 1 1/3 lb. (0 days)*

*Champ Formula 2 F, 1 1/3 pt. (0 days)*

or

*Champion WP (1.5 to 3 lb) or Kocide DF (2 lb) (0 days) Watermelon.*

or

*Kocide 2000, 1 1/2 lb. (0 days)*

*Kocide 4.5 LF, 1 1/3 pt. (0 days) Watermelon.*

*Nu-Cop 3 L, 1 to 4 pt. (0 days)*

or

Mancozeb/Copper Hydroxide

*ManKocide, 2.5 lb. (5 days)*

or

Copper Oxychloride / Copper Sulfate

*C-O-C-S WDG, 2 to 4 lb every 7 days. (0 days)*

or

Copper Sulfate

*Basic Copper 53, Basicop, 2 lb. (0 days)*

*Cuprofix Ultra, 1.25 lb. (0 days)*

or

Mancozeb/Copper Sulfate

*Cuprofix MZ Disperss, 5 - 7.25 lb. (5 days)*

or

Neem Oil

*Trilogy, 2 pt. (0 days)*

**ANGULAR LEAF SPOT** (*Pseudomonas lachrymans*): Copper may be used for control of this bacterial disease. Spray every 7 days, starting before the first fruit form and continue to protect fruit at all stages of development.

Copper Ammonium Carbonate

*Copper Count N, 1 to 2 qt. (0 days)*

or

Copper Hydroxide

*Champ DP, 1 1/3 lb. (0 days)*

*Champ Formula 2 F, Kocide 4.5 LF, 1 1/3 pt. (0 days)*

*Champion WP, 1.5 to 3 lb. (0 days)*

*Kocide 2000, 1 1/2 lb. (0 days)*

*Nu-Cop 3 L, 1 to 4 pt. (0 days)*

or

Copper Sulfate

*Basic Copper 53, Basicop, 2 lb. (0 days)*

*Cuprofix Ultra, 1.25 lb. (0 days)*

or

Neem Oil

*Trilogy, 2 pt. (0 days)*

or

Copper Resinate

*Tenn-Cop 5 E, 3 pt. (0 days)*

**DOWNY MILDEW** (*Pseudoperonospora cubensis*): Treat plants when in the 2-leaf stage and continue at 7-14 day intervals.

\* Propamocarb

*Previcur Flex, 1.2 pt every 7 - 14 days. (2 days)*

or

\* Chlorothalonil

*Bravo Ultrex, Equus DF, 1.8 to 2.7 lb. (0 days)*

*Echo 90 DF, 1.6 to 2.4 lb every 7 days. (0 days)*

or

*Bravo Weather Stik, Echo 720, Equus 720 SST, 2 to 3 pt. (0 days)*

or

\* Cyazofamid

*Ranman, 2.1 to 2.75 fl oz every 7 to 10 days. (0 days)*

or

\* Cymoxanil

*Curzate 60 DF, 3.2 oz every 5 - 7 days. (3 days)*

or

\* Fluopicolide

*Presidio, 3-4 fl oz. (2 days)*

or

\* Mancozeb

*Dithane DF Rainshield, Dithane M-45, Dithane WSP, 2 to 3 lb. (5 days)*

or

*Dithane F-45 Rainshield, 1 3/5 to 2 2/5 qt. (5 days)*

*Manzate 75 DF, 2 to 3 lb. (5 days)*

*Penncozeb 4 F, 1.2 to 2.4 qt. (5 days)*

*Penncozeb 75 DF, Penncozeb 80 WP, 2 to 3 lb. (5 days)*

or

\* Famoxadone/Cymoxanil

*Tanos, 8 oz. (3 days)*

or

\* Mancozeb/Zoxamide

*Gavel 75 DF, 1.5-2.0 lb. (5 days)*

or

\* Propamocarb

*Previcur Flex, 1.2 pt every 7 - 14 days. (2 days)*

or

Azoxystrobin

*Amistar, 3.5 to 5 oz. (1 day)*

*Quadris, 11.0 to 15.4 fl oz. (1 day)*

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

Azoxystrobin/Chlorothalonil

*Quadris Opti, 3.2 pt every 7 - 14 days. (1 day)*

or

Dimethomorph

*Acrobat 50 WP, 6.4 oz every 5 to 7 days. (0 days)*

*Forum, 6 fl oz. (0 days)*

or

Fenamidone

*Reason 500 SC, 5.5 fl oz every 5 to 10 days. (14 days)*

or

Fosetyl-Aluminum

*Aliette WDG, 2 to 5 lb, 7- to 14-day intervals. (0 days) Do not tank mix with copper fungicides.*

## Melons

or

### Mancozeb/Copper Sulfate

*Cuprofix MZ Disperss*, 5 - 7.25 lb. (5 days)

or

### Mefenoxam/Chlorothalonil

*Ridomil Gold Bravo*, 2 lb. (0 days) Maximum 4 applications.

or

### Mefenoxam/Copper Hydroxide

*Ridomil Gold Copper*, 2 lb. (7 days) Maximum 4 applications.

or

### Mefenoxam/Mancozeb

*Ridomil Gold MZ*, 2 1/2 lb. (5 days) Maximum 4 applications.

or

### Mono-, dibasic sodium, potassium and ammonium phosphites

*Phostrol*, 2.5 to 5 pt every 7 - 14 days. (0 days)

*Prophyt*, 2 to 4 pt. (0 days)

or

### Neem Oil

*Trilogy*, 2 pt. (0 days)

or

### Pyraclostrobin/Boscalid

*Pristine*, 12.5 to 18.5 oz. (0 days) To avoid crop injury, avoid adding adjuvants.

or

### Trifloxystrobin

*Flint*, 4 oz, 7- to 14-day intervals. (0 days) Maximum 2 consecutive applications, 4 applications/year and 16 oz/season. Alternate with Ridomil Gold Bravo.

or

### Copper Resinate

*Tenn-Cop 5 E*, 3 pt. (0 days)

or

### Maneb

*Maneb 75 DF*, *Maneb 80 WP*, 1 to 2 lb. (5 days)

*Manex*, 1 1/5 to 1 3/5 qt. (5 days)

or

### Mono-, dibasic sodium salts of phosphorous acid

*Fosphite*, 1 to 3 qt per 20 gal (ground) or 10 gal (aerial) of water. (0 days)

or

### Mandipropamid

*Revus*, 8 fl oz. (0 day)

**Note:** Most fungicides that protect against *Alternaria* may also provide limited downy mildew protection.

**GUMMY STEM BLIGHT or BLACK ROT** (*Didymella bryoniae* also called *Mycosphaerella melonis*): Begin at the 2-leaf stage and apply every 7 days.

### \* Azoxystrobin

*Amistar*, 3.5 to 5 oz. (1 day)

*Quadris*, 11.0 to 15.4 fl oz. (1 day)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

### \* Azoxystrobin/Chlorothalonil

*Quadris Opti*, 3.2 pt every 7 - 14 days. (0 days)

or

### \* Chlorothalonil

*Bravo Ultrex* (1.8 to 2.6 lb) or *Equus DF* (1.8 to 2.7 lb) (0 days)

*Echo 90 DF*, 1.6 to 2.4 lb every 7 days. (0 days)

or

*Bravo Weather Stik*, *Echo 720*, *Equus 720 SST*, 2 to 3 pt. (0 days)

or

### \* Mancozeb

*Dithane DF Rainshield*, *Dithane M-45*, *Dithane WSP*, 2 to 3 lb. (5 days)

or

*Dithane F-45 Rainshield*, 1 3/5 to 2 2/5 qt. (5 days)

*Manzate 75 DF*, 2 to 3 lb. (5 days)

*Penncozeb 4 F*, 1.2 to 2.4 qt. (5 days)

*Penncozeb 75 DF*, *Penncozeb 80 WP*, 2 to 3 lb. (5 days)

or

### \* Maneb

*Maneb 75 DF*, *Maneb 80 WP*, 1 to 2 lb. (5 days)

*Manex*, 1 1/5 to 1 3/5 qt. (5 days)

or

### \* Pyraclostrobin

*Cabrio*, 12-16 oz. (0 days) No more than 2 consecutive applications before alternating with a fungicide having a different mode of action.

or

### \* Thiophanate-Methyl

*Topsin M 70 WP*, *Topsin M WSB*, 1/4 to 1/2 lb. (0 days)

or

### Copper Ammonium Carbonate

*Copper Count N*, 1 to 2 qt. (0 days)

or

### Mancozeb/Copper Hydroxide

*ManKocide*, 2.5 lb. (5 days)

or

### Copper Hydroxide

*Champ DP*, 1 1/3 lb. (0 days)

*Champ Formula 2 F*, *Kocide 4.5 LF*, 1 1/3 pt. (0 days)

*Champion WP*, 1.5 to 3 lb. (0 days)

*Kocide 2000*, 1 1/2 lb. (0 days)

*Nu-Cop 3 L*, 1 to 4 pt. (0 days)

or

### Copper Sulfate

*Cuprofix Ultra*, 1.25 lb. (0 days)

or

### Mancozeb/Copper Sulfate

*Cuprofix MZ Disperss*, 5 - 7.25 lb. (7 days)

or

### Pyraclostrobin/Boscalid

*Pristine*, 12.5 to 18.5 oz. (0 days) To avoid crop injury, avoid adding adjuvants.

or

### Tebuconazole

*Folicur 3.6F*, 8 fl oz. (7 days) Approved for gummy stem blight. Suppression only.



**PHYTOPHTHORA CROWN and FRUIT ROT**

(Phytophthora spp.):

**\* Dimethomorph***Acrobat* 50 WP, 6.4 oz every 7 days. (0 days)*Forum*, 6 fl oz. (0 days)

or

**\* Famoxadone/Cymoxanil***Tanos*, 8 - 10 oz every 5 - 7 days. (3 days)

or

**\* Fluopicolide***Presidio*, 3-4 fl oz. (2 days)

or

**\* Mancozeb/Zoxamide***Gavel* 75 DF, 1.5-2.0 lb. (5 days)

or

**\* Mandipropamid***Revus*, 8 fl oz. (0 day)

or

**Cyazofamid***Ranman*, 2.75 fl oz every 7 to 10 days. (0 days)

or

**Fosetyl-Aluminum***Aliette* WDG, 2 to 5 lb, 7- to 14-day intervals. (0 days) Do not tank mix with copper fungicides.

or

**Mono-, dibasic sodium, potassium and ammonium phosphites***Phostrol*, 2.5 to 5 pt every 7 - 14 days. (0 days)*Prophyt*, 4 pt. (0 days)

or

**Mono-, dibasic sodium salts of phosphorous acid***Fosphite*, 1 to 3 qt per 20 gal (ground) or 10 gal (aerial) of water. (0 days)**Note:** Most fungicides applied to control downy mildew may have limited efficacy against Phytophthora crown and fruit rot.

## Mint

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

Root-lesion, false root-lesion and needle nematodes can cause reduction in yields, especially in the presence of the Verticillium wilt fungus. Fields should be tested for nematodes prior to planting. If any of these nematodes exceed damage threshold estimates, soil fumigation in the fall may be recommended.

## FALL SOIL FUMIGATION (BROADCAST):

1,3-D

*Telone* II, 25 gal/A (muck soil). Fumigate in the fall when soil temperatures at an 8-inch depth are above 50F. Inject the fumigant to a depth of 6 inches and seal the soil with a drag

immediately after application. Use soil fumigants only as directed on the label.

Correct soil moisture, temperature and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or by immediate tarping.

or

**Metam Sodium***Vapam* HL, 37.5 to 75 gal/A (use higher rate for muck soil).

Inject with shanks spaced 5 inches apart or to a depth of 4 to 10 inches in well pre-prepared soil. Follow immediately with a roller to smooth and compact surface. Light watering to the treated surface helps to prevent escape of gas.

## INSECTS

### FOLIAR TREATMENT:

**MINT ROOT BORER:**

*Lorsban* 4 E / *Lorsban* Advanced, 2 to 4 pt. (90 days) Apply post-harvest when larvae are present. Follow with at least 1 inch of irrigation. (RUP)

**MINT FLEA BEETLE:** Apply prior to egg-laying activity (July 20 to August 10) if needed to control adult stage, which will reduce root-damaging populations of larvae the following year. Three applications, 7 to 10 days apart, may be needed to control severe infestations (common only in older fields). Timing is critical. *Actara*, 1.5 to 3 oz. (7 days) Do not exceed 12.0 oz/Acre per season.

or

*Lannate* LV (2 1/4 to 3 pt) or *Lannate* SP (3/4 to 1 lb) (14 days) (RUP)

or

*Malathion* 57 EC, 1 1/2 pt. (7 days)

**CUTWORM, LOOPERS:** Apply before worms are 3/4 inch long for best results.

**Acephate**

*Acephate* 97 UP, *Orthene* 97, 1 lb. (14 days) Do not apply more than 2-1/8 lb per season.

or

**Bacillus thuringiensis**

*Agree*, *Biobit*, *Dipel*, *Javelin*, *Lepinox*, *Xentari*. (0 days)

or

*Lannate* LV (3 pt) or *Lannate* SP (1 lb) (14 days) (RUP)

or

*Lorsban* 4 E / *Lorsban* Advanced, 2 to 4 pt. (90 days) One application only. (RUP)

or

*Avaunt*, 3.5 oz. (7 days) Do not exceed 14 oz/acre per crop.

or

*Radiant* SC, 4 to 12 fl oz. (7 days) Do not make more than 4 applications or exceed 60.5 fl oz/acre per season.

**APHIDS:** Apply when damage is first seen or when insects are noticeable.

**Acephate**

*Acephate* 97 UP, *Orthene* 97, 1 lb. (14 days) Do not apply more than 2-1/8 lb per season.

or

## Onions

*Actara*, 1.5 to 3 oz. (7 days) Do not exceed 12.0 oz/Acre per season.

or

*Malathion* 57 EC, 1 1/2 pt. (7 days)

## MITES

Apply if needed.

*Kelthane* MF, 1 3/4 to 2 1/2 pt. (30 days) Limited to one application per season.

or

*Agri-Mek* 0.15 EC, 8 to 12 fl oz. (28 days) (RUP)

## DISEASES

### PREPLANT SOIL FUMIGATION:

**VERTICILLIUM WILT** (*Verticillium dahliae*): See Bulletin E-2099.

Apply as a broadcast or row treatment, placing the fumigant at least 12 to 14 inches below the final soil surface.

Soil sterilization by fumigation is best achieved by proper application of material. Correct soil moisture, temperature, and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or immediate tarping.

1,3 Dichloropropene/chloropicrin

*Telone* C35, 13-35 gal. (RUP)

or

Metam Sodium

*Sectagon* 42, *Vapam* HL, 37.5-75 gal.

or

Potassium N-methylidithiocarbamate

*Sectagon-K54*, 30-60 gal.

### FOLIAR TREATMENT:

**MINT RUST** (*Puccinia menthae*): Apply to plants 4 to 8 inches tall at 7 to 10 day intervals. Do not apply more than 3 times. Do not feed hay to livestock.

Azoxystrobin

*Amistar*, 2 to 5 oz. (0 days fresh; 7 days processed)

*Quadris*, 6.2 to 15.4 fl oz. (0 days fresh; 7 days processed)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

Chlorothalonil

*Bravo* Ultrex, 1 lb. (80 days)

or

*Bravo* Weather Stik, *Echo* 720, *Equus* 720 SST, 1 3/8 pt. (80 days)

or

Myclobutanil

*Rally* 40 WSP, 4 to 5 oz. (30 days)

### POWDERY MILDEW (ERYSYPHE CICHORACEARUM):

Azoxystrobin

*Amistar*, 2 to 5 oz. (0 days fresh; 7 days processed)

*Quadris*, 6.2 to 15.4 fl oz. (0 days fresh; 7 days processed)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

Sulfur

*Kumulus* DF, 4 lb, 21-day intervals. (28 days) Do not apply unless buyer of oil has authorized use.

or

*Microthiol* Special, *Thiolux* Jet, 4 to 6 lb, 30-day intervals. (30 days) Maximum 3 applications.

or

Myclobutanil

*Rally* 40 WSP, 4 to 5 oz. (30 days)

## Onions

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

Northern root-knot, root-lesion, onion bloat, common needle and stubby-root nematodes can reduce onion yields. Fields with soil or root problems of undetermined cause should be tested for nematodes (see Appendix C). If the plant-parasitic nematodes are present in population densities above the economic threshold for onions, crop rotation or application of a nematicide is recommended. The following nematicides are suitable for control of northern root-knot, root-lesion, onion bloat and stubby-root nematodes in onion production.

### FALL SOIL FUMIGATION (BROADCAST):

1,3-D

*Telone* II, 25 gal/A (muck soil), 9-18 gal/A (mineral soil).

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

Correct soil moisture, temperature and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or by immediate tarping.

or

Metam Sodium

*Vapam* HL, 37.5 to 75 gal/A (use higher rate for muck soil).

Inject with shanks spaced 5 inches apart to a depth of 4 to 10 inches in well-prepared soil. Material should be applied with adequate water and the soil surface sealed (light watering) after the application.



**AT-PLANTING TREATMENT:**

Vydate L, 3/4 to 1 gal per acre. Apply at planting as an in-furrow drench using 100-150 gallons of water per acre or 1-1/2 to 2 gal per acre as an in-furrow band using 20-50 gallons of water per acre or 1/2 to 1 gal/A as an in-furrow spray followed by 1 to 2 postemergence band treatments at 1/2 to 1 gal/A in a minimum of 20 gal water per acre. Do not apply within 14 days of harvest. Do not apply more than 2 1/4 gal of Vydate L/acre/season. Do not use on green onions. (RUP)

**INSECTS****SEED TREATMENT:**

**ONION MAGGOT:** Trigard-treated seed is available as a pelleted or film-coated seed. Check with your seed supplier.

**AT-PLANTING TREATMENT:**

**ONION MAGGOT:** Apply to open furrow immediately after seeding but before furrow is closed. Use on dry bulb onions only. *Lorsban* 15 G, 3.7 oz per 1,000 ft of row. (RUP)

**FOLIAR TREATMENT:**

**ONION MAGGOT:** Apply as a directed spray or drench in a minimum of 100 gallons of water to the base of onion seedlings or transplants during peak egg laying of the onion maggot adults. Proper timing is critical.

*Lorsban* 4 E / *Lorsban* Advanced, 1 qt. (60 days) Use on dry bulb onions only. Maximum of 2 applications, maximum of 1 application if *Lorsban* 4 E or 15 G was used at planting (Special Michigan SLN label). (RUP)

**CUTWORM, ARMYWORM:** Apply in late evening when first seen. Repeat treatments if needed.

Cypermethrin

*Ammo* 2.5 EC (2 to 5 oz) or *Ammo* WSB (1 to 2 bags) or *UP-Cyde* 2.5 EC (2 to 5 oz) (7 days) (RUP)

or

*Lannate* LV (1 1/2 to 3 pt) or *Lannate* SP (1/2 to 1 lb) (7 days) (RUP)

or

*Mustang* Max, 2.2 to 4.0 oz. (7 days) (RUP)

or

*Warrior* with Zeon Technology, 1.9 to 3.8 fl oz. (14 days) (RUP)

or

*Entrust*, 1 to 2 oz. (1 day) Do not apply more than 9 oz per acre per crop. Do not make more than 5 applications per year.

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (14 days) (RUP)

or

*SpinTor* 2 SC, 3 to 6 oz. (1 day) Do not apply more than 29 oz per acre per crop. Do not make more than 5 applications per year.

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 5 applications or exceed 30 fl oz/acre per season

**THRIPS:** Usually appear around mid-summer. Damage is most severe on the new growth. Dry growing conditions usually intensify the problem. Treat when damage becomes visible or numbers exceed 10 to 15 per plant. Repeat as needed.

\* Cypermethrin

*Ammo* 2.5 EC (4 to 5 fl oz) or *Ammo* WSB (1 to 2 bags) or *UP-Cyde* 2.5 EC (4 to 5 fl oz) (7 days) (RUP)

or

\* *Lannate* LV (3 pt) or *Lannate* SP (1 lb) (7 days) (RUP)

or

\* *Mustang* Max, 2.9 to 4.0 oz. (7 days) (RUP)

or

\* *Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (14 days) (RUP)

or

*Diazinon* 50 WP (1 lb) or *Diazinon* AG 500 (1 pt) (10 days) (RUP)

or

*Malathion* 25 WP (4 lb) or *Malathion* 57 EC (1 1/2 pt) (3 days)

or

*PennCap-M* 2 F, 2 pt. (15 days) (RUP)

or

Permethrin

*Ambush* 25 W, 6.4 to 19.2 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (4 to 12 oz) or *Pounce* 25 WP (6.4 to 19.2 oz) or *Pounce* 3.2 EC (4 to 12 oz) (1 day) (RUP)

or

*Vydate* L, 1 to 2 pt. (14 days) Dry bulb onions only. (RUP)

or

*Entrust*, 1.25 to 2.5 oz. (1 day) Do not apply more than 9 oz per acre per crop. Do not make more than 5 applications per year.

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (14 days) (RUP)

or

*SpinTor* 2 SC, 4 to 8 oz. (1 day) Do not apply more than 29 oz per acre per crop. Do not make more than 5 applications per year.

or

*Radiant* SC, 6 to 10 fl oz. (1 day) Do not make more than 5 applications or exceed 30 fl oz/acre per season.

or

*Assail* 30 SG, 5.0 to 8.0 oz. (7 days) Do not make more than 4 applications per season.

**DISEASES****PREPLANT SOIL FUMIGATION:**

**PINK ROOT** (*Phoma terrestris*): See Bulletin E-2099. Apply as a broadcast or row treatment, placing the fumigant at least 12 to 14 inches below the final soil surface.

Soil sterilization by fumigation is best achieved by proper application of material. Correct soil moisture, temperature, and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or immediate tarping.

1,3 Dichloropropene/chloropicrin

*Telone* C35, 13-35 gal. (RUP)

or

Metam Sodium

*Sectagon* 42, *Vapam* HL, 37.5-75 gal.

or

Potassium N-methylidithiocarbamate

*Sectagon-K54*, 30-60 gal.

## Onions

### AT-PLANTING TREATMENT:

**SMUT** (*Urocystis cepulae*): Apply in planter box at seeding or purchase treated seed. **Note:** Use only as directed; overtreatment may cause injury.

#### Mancozeb

*Dithane DF Rainshield*, *Dithane M-45*, *Dithane WSP*, 3 lb per acre. Apply as an in-furrow drench at planting in 75 to 125 gallons of water per acre (field-seeded onions only).

or

*Dithane F-45 Rainshield*, 2 to 4 qt per acre. Apply as an in-furrow drench at planting in 75 to 125 gallons of water per acre (field-seeded onions only).

or

*Manzate 75 DF*, 3 lb per acre. Apply as an in-furrow drench at planting in 75 to 125 gallons of water per acre (field-seeded onions only).

or

*Penncozeb 4 F*, 2.4 qt. (7 days)

or

*Penncozeb 75 DF*, *Penncozeb 80 WP*, 3 lb per acre. Apply as an in-furrow drench at planting in 75 to 125 gallons of water per acre (field-seeded onions only).

or

#### Maneb

*Maneb 75 DF*, *Maneb 80 WP*, 3 lb per acre. Apply as an in-furrow drench at planting in 75 to 125 gallons of water per acre (field-seeded onions only).

or

*Manex*, 2.4 qt. Apply 75 to 100 gal as a furrow drench.

or

#### Thiophanate-Methyl

*Topsin M 70 WP*, *Topsin M WSB*, 2 lb (broadcast).

**DAMPING OFF** (*Pythium* spp. only): Apply as a seed treatment before planting.

\* Mefenoxam. Apply as a broadcast preplant incorporation or a surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 1 in. of sprinkler irrigation.

*Ridomil Gold SL*, 0.5-1 pt.

*Ultra Flourish*, 1 to 2 pt.

or

#### Thiram

42-S Thiram, 6 oz/100 lb seed.

### FOLIAR TREATMENT:

**BOTRYTIS LEAF BLIGHT** (*Botrytis squamosa*): Apply every 7 to 10 days after the 4-leaf stage or according to the onion leaf blight predictor.

#### \* Chlorothalonil

*Bravo Ultrex*, 0.9 to 2.7 lb. (7 days) May be applied through sprinkler irrigation systems. Applications of more than 9 lb of Bravo Ultrex per season may result in yield reductions.

or

*Bravo Weather Stik*, *Equus 720 SST*, 1 1/2 to 3 pt (green bunching) (14 days) or 1 to 3 pt (dry bulb) (7 days). Do not apply more than 3 times per season on green bunching onions.

or

*Bravo Weather Stik Zn*, 1 to 2 pt. (7 days dry bulb onions; 14 days green onions)

or

*Echo 720*, 1 to 2 pt. (7 days)

*Echo 90 DF*, 1.2 to 1.7 lb. (7 days)

*Equus DF*, 0.9 to 2.7 lb. (7 days)

or

#### \* DCNA

*Botran 75 W*, 1 1/2 to 2 2/3 lb. (14 days) Maximum 5 1/3 lb per season.

or

#### \* Iprodione

*Iprodione 4L AG*, 1.5 pt. (7 days)

or

*Rovral*, 1 lb as tank mix with another fungicide, 7-day intervals. (7 days) **Note:** See label for permissible crop rotations.

Maximum 5 applications.

or

*Rovral 4 F*, 1 1/2 pt, 14-day interval. (7 days) Or 1 pt as tank mix with another fungicide, 7-day intervals. **Note:** See label for permissible crop rotations. Maximum 5 applications.

or

#### \* Mancozeb

*Dithane DF Rainshield*, *Dithane M-45*, 3 lb. (7 days)

*Dithane F-45 Rainshield*, 2.4 qt. (7 days)

*Penncozeb 4 F*, 1.6 to 2.4 qt. (7 days)

*Penncozeb 75 DF*, *Penncozeb 80 WP*, 2 to 3 lb. (7 days)

or

*Manzate 75 DF*, 3 lb. (7 days) Do not apply to exposed bulbs. Maximum 30 lb/year.

or

#### \* Maneb

*Maneb 75 DF*, *Maneb 80 WP*, 2 to 3 lb. (7 days)

*Manex*, 1.6 to 2.4 qt. (7 days)

or

#### Azoxystrobin

*Amistar*, 3 to 5 oz. (0 days)

*Quadris*, 9.2 to 15.4 fl oz. (0 days)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

#### Boscalid

*Endura*, 6.8 oz. (7 days)

or

#### Mancozeb/Copper Hydroxide

*ManKocide*, 2 1/2 lb. (7 days)

or

#### Cyprodinil/Fludioxonil

*Switch 62.5 WG*, 11 - 14 oz every 7 to 10 days. (7 days)

or

#### Mancozeb/Copper Sulfate

*Cuprofix MZ Disperss*, 5 - 7.25 lb. (7 days)

or

#### Neem Oil

*Trilogy*, 2 pt. (0 days)

or

#### Pyraclostrobin/Boscalid

*Pristine*, 14.5 to 18.5 oz. (7 days)



or

Pyraclostrobin*Cabrio*, 12 oz. (0 days)

or

Pyrimethanil*Scala*, 9 to 18 oz. (7 days)

or

Copper Resinate*Tenn-Cop 5 E*, 3 pt. (0 days)

or

Propiconazole*Propimax EC*, 4 fl oz. (14 days)*Tilt*, 4-8 fl oz. (14 days)

**DOWNY MILDEW** (*Peronospora destructor*): Apply after the 4-leaf stage.

\* Fosetyl-Aluminum

*Aliette WDG*, 2 to 3 lb, 7- to 14-day intervals. (7 days) Do not make more than 7 applications per season. Do not tank mix with copper fungicides.

or

\* Mancozeb

*Dithane DF Rainshield*, *Dithane M-45*, 3 lb. (7 days) Do not apply to exposed bulbs. Maximum 30 lb/year.

or

*Dithane F-45 Rainshield*, 2.4 qt. (7 days)*Manzate 75 DF*, 3 lb. (7 days)*Penncozeb 4 F*, 1.6 to 2.4 qt. (7 days)*Penncozeb 75 DF*, *Penncozeb 80 WP*, 2 to 3 lb. (7 days)

or

\* Maneb*Maneb 75 DF*, *Maneb 80 WP*, 2 to 3 lb. (7 days)*Manex*, 1.6 to 2.4 qt. (7 days)

or

\* Mefenoxam/Chlorothalonil

*Ridomil Gold Bravo*, 2 lb. (7 days dry bulb onions, maximum 4 applications; 21 days green onion) Maximum 3 applications.

or

\* Mefenoxam/Copper Hydroxide

*Ridomil Gold Copper*, 2 lb. (10 days dry bulb onions, maximum 4 applications; 7 days green onion) Maximum 3 applications.

or

\* Mefenoxam/Mancozeb

*Ridomil Gold MZ*, 2.5 lb. (7 days - dry bulb, maximum 4 applications) (21 days - green onion, maximum 3 applications). (7 days) See label.

**Note:** It is not legal to plant any crop not on the *Ridomil Gold MZ* label for 12 months following the last application, except that wheat, barley, or oats may be planted 40 days after the last application. It is not legal to plant any crop not on the *Ridomil Gold-Bravo* label for 12 months following the last application. This restriction includes celery and carrots.

or

Dimethomorph

*Acrobat 50 WP*, 6.4 oz. (0 days) Tank mix with another fungicide.

or

*Forum*, 6 fl oz. (0 days)

or

Azoxystrobin*Amistar*, 3 to 5 oz every 5 - 7 days. (0 days)*Quadris*, 9.2 to 15.4 fl oz. (0 days)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

Chlorothalonil. Downy mildew suppression.*Bravo Ultrex*, 0.9 - 2.7 lb every 7 to 10 days. (7 days)*Echo 90 DF*, 1.2 to 2.4 lb. (7 days)

or

*Bravo Weather Stik*, *Equus 720 SST*, 1 to 3 pt. (7 days dry bulb onions; 14 days green bunching onions)

or

Fenamidone*Reason 500 SC*, 5.5 fl oz every 5 to 10 days. (7 days)

or

Mancozeb/Copper Sulfate*Cuprofix MZ Disperss*, 5 - 7.25 lb. (7 days)

or

Mono-, dibasic sodium, potassium and ammonium phosphites*Phostrol*, 2.5 to 3.75 pt every 7 - 14 days. (0 days)*Prophyt*, 4 pt. (0 days)

or

Pyraclostrobin

*Cabrio*, 12 oz. (7 days) Make no more than one application before alternating with fungicides that have a different mode of action.

or

Pyraclostrobin/Boscalid*Pristine*, 18.5 oz. (7 days)

or

Neem Oil*Trilogy*, 2 pt. (0 days)

or

Mandipropamid*Revus*, 8 fl oz. (7 day)

**Note:** Most fungicides that protect against purple blotch may also provide limited downy mildew protection.

**PURPLE BLOTCH** (*Alternaria porri*): Apply every 7 to 10 days after the 4-leaf stage.

\* Azoxystrobin*Amistar*, 2 to 4 oz every 7 - 14 days. (0 days)*Quadris*, 6.2 to 12.3 fl oz. (0 days)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* Chlorothalonil

*Bravo Ultrex*, 0.9 to 2.7 lb. (7 days) May be applied through sprinkler irrigation systems. Applications of more than 9 lb of *Bravo Ultrex* per season may result in yield reductions.

or

*Bravo Weather Stik*, *Equus 720 SST*, 1 1/2 to 3 pt (green bunching) (14 days) or 1 to 3 pt (dry bulb) (7 days). (14 days) Do not apply more than 3 times per season on green bunching onions.

or

## Onions

Bravo Weather Stik Zn, 1 to 2 pt. (7 days dry bulb onions;  
14 days green onions)

or

Echo 720, 1 to 2 pt. (7 days)

Echo 90 DF, 1.2 to 1.7 lb. (7 days)

Equus DF, 0.9 to 2.7 lb. (7 days)

or

\* Cyprodinil/Fludioxonil

Switch 62.5 WG, 11-14 oz. (7 days)

or

\* Iprodione

Iprodione, Rovral 4 F, 1.5 pt, 14-day intervals or 1 pt as tank  
mix with another fungicide, 7-day intervals. (7 days)

or

Rovral, 1 lb as tank mix with another fungicide, 7-day intervals.

**Note:** See label for permissible crop rotations. Maximum 5  
applications.

or

\* Mancozeb

Dithane DF Rainshield, Dithane M-45, Dithane WSP, 2 to 3 lb.  
(7 days)

or

Dithane F-45 Rainshield, 2.4 qt. (7 days)

Penncozeb 4 F, 1.6 to 2.4 qt. (7 days)

Penncozeb 75 DF, Penncozeb 80 WP, 2 to 3 lb. (7 days)

or

Manzate 75 DF, 3 lb. (7 days) Do not apply to exposed bulbs.  
Maximum 30 lb/year.

or

\* Maneb

Maneb 75 DF, Maneb 80 WP, 2 to 3 lb. (7 days)

Manex, 1.6 to 2.4 qt. (7 days)

or

\* Pyraclostrobin

Cabrio, 8-12 oz. (7 days) Do not apply more than three  
sequential applications.

or

\* Pyraclostrobin/Boscalid

Pristine, 12.5 to 18.5 oz. (7 days)

or

Copper Ammonium Carbonate

Copper Count N, 2 qt. (0 days)

or

Copper Hydroxide

Champ DP, 1 1/3 lb. (0 days)

Champ Formula 2 F, Kocide 4.5 LF, 1 1/3 pt. (0 days)

Kocide 2000, 1 1/2 lb. (0 days)

Nu-Cop 3 L, 1 1/3 to 2 2/3 pt. (0 days)

or

Champion WP, Kocide 101, Kocide DF, Nu-Cop 50 DF, 2 lb.  
(0 days)

or

Mancozeb/Copper Hydroxide

ManKocide, 2.5 lb. (7 days)

or

Copper Sulfate

Cuprofix Ultra, 1.25 to 3 lb. (0 days)

or

Fenamidone

Reason 500 SC, 5.5 fl oz every 5 to 10 days. (7 days)

or

Fosetyl-Aluminum

Aliette WDG, 2 to 3 lb, 7- to 14-day intervals. (7 days) Do not  
tank mix with copper fungicides.

or

Mancozeb/Copper Sulfate

Cuprofix MZ Disperss, 5 - 7.25 lb. (7 days)

or

Neem Oil

Trilogy, 2 pt. (0 days)

or

Pyrimethanil

Scala, 9 to 18 fl oz. (7 days)

or

Propiconazole

Propimax EC, 4 fl oz. (14 days)

or

Tilt, 4-8 fl oz. (14 days)

or

Tebuconazole

Folicur 3.6F, 4-6 fl oz. (7 days) Maximum 12 fl oz/acre/season.  
12 hr REI.

**NECK ROT (*Botrytis* spp.):**

*Bacillus subtilis*

Serenade, 6 to 10 lb. (0 days) Biological control product that  
needs to be applied before disease development. Control may  
be limited under heavy disease pressure.

or

Chlorothalonil

Bravo Ultrex, 1.25 - 2.7 lb every 7 days. (7 days)

or

Mancozeb

Penncozeb 4 F, 1.6 to 2.4 qt. (7 days)

or

Neem Oil

Trilogy, 2 pt. (0 days)

or

Copper Resinate

Tenn-Cop 5 E, 3 pt. (0 days)

**Note:** Treatments for onion leaf blight may retard or prevent  
symptomless spread in the field prior to harvest.

**BACTERIAL BLIGHT (*Erwinia carotovora* subsp. *carotovora*,  
*Pseudomonas* spp.):**

**Copper Hydroxide.** Apply at 7 to 10 day intervals when plants are  
4-6 in. tall. Can cause foliar phytotoxicity.

Champ DP, 1 1/3 lb. (0 days)

Champ Formula 2 F, Kocide 4.5 LF, 1 1/3 pt. (0 days)

Kocide 2000, 3/4 to 1 1/4 lb. (0 days)

or

Copper Sulfate

Cuprofix Ultra, 1.25 to 3 lb. (0 days)



## 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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

### 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 C). If the 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):

1,3-D

*Telone II*, 25 gal/A (muck soil), 9-18 gal/A (mineral soil). Fumigate in the fall when soil temperatures at a 6 inch depth are above 50F. 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.

In some limited situations soil fumigants can be applied in the spring in Michigan.

Correct soil moisture, temperature and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or by immediate tarping.

### INSECTS

#### SEED TREATMENT:

**WIREWORM, BEAN LEAF BEETLE, APHIDS:** No treatment currently available.

#### SOIL TREATMENT:

**APHIDS, FLEA BEETLE:** See label for application methods.

Imidacloprid

*Admire Pro*, 4.4 - 10.5 fl oz. (21 days)

or

*Platinum*, 5 to 12 fl oz. (30 days) See label for application methods.

#### FOLIAR TREATMENT:

**FLEA BEETLE:** Apply as needed, usually soon after plants emerge.

*Actara*, 1.5 to 3 oz. (7 days)

or

Carbaryl

*Sevin 80 S* (1 1/4 lb) or *Sevin XLR Plus* (1 qt) (7 days)

**LEAFHOPPERS:** Apply when first seen. Repeat as needed.

*Actara*, 1.5 to 3 oz. (7 days)

or

Carbaryl

*Sevin 80 S* (1 1/4 lb) or *Sevin XLR Plus* (1 qt) (7 days)

**ARMYWORM, CUTWORM:** Apply if needed. Repeat as needed.

Carbaryl

*Sevin 5 B* (40 lb) or *Sevin 80 S* (2 1/2 lb) or *Sevin XLR Plus* (2 qt) (7 days)

or

*Entrust*, 1 to 2 oz. (3 days)

or

*SpinTor 2 SC*, 3 to 6 oz. (3 days)

or

*Radiant SC*, 6 to 8 fl oz. (3 days) Do not make more than 3 applications or exceed 24 fl oz/acre per season.

**APHIDS:** Apply if necessary.

*Actara*, 1.5 to 3 oz. (7 days)

or

*Malathion 57 EC*, 2 pt. (7 days)

### DISEASES

#### SEED TREATMENT:

**DAMPING OFF** (*Pythium* spp.):

*Bacillus subtilis* GB03

*Kodiak*, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

*Fludioxinil*

*Maxim 4 FS*, 0.08 to 0.16 oz/100 lb seed (*Rhizoctonia*).

Commercial seed treatment plants only.

#### PREPLANT INCORPORATED:

**DAMPING OFF** (*Pythium* and *Phytophthora* spp., *Rhizoctonia solani*):

*Fludioxinil*

*Maxim 4 FS*, 0.08 to 0.16 oz/100 lb seed (*Rhizoctonia*).

Commercial seed treatment plants only.

or

\* *Mefenoxam*. Apply as a broadcast preplant incorporation or a surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 1 in. sprinkler irrigation.

*Ridomil Gold SL*, 1-2 pt.

*Ultra Flourish*, 2 to 4 pt.

#### FOLIAR TREATMENT:

**CERCOSPORA LEAF SPOT** (*Cercospora* spp.), **ALTERNARIA**

**LEAF SPOT** (*Alternaria* spp.): Apply at first sign of disease and repeat every 7 to 10 days.

\* *Azoxystrobin*

*Amistar*, 2 to 5 oz every 7 - 14 days. (0 days)

*Quadris*, 6.2 to 15.4 fl oz. (0 days)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* *Pyraclostrobin*

*Cabrio*, 8-12 oz. (0 days)

or

## Peas

### \* Trifloxystrobin

*Flint*, 2 to 3 oz. (7 days) Do not apply more than three sequential foliar applications of strobilurin fungicides before alternating with a fungicide that has a different mode of action.

or

### Chlorothalonil

*Bravo Ultrex*, *Equus DF*, 1.4 to 1.8 lb. (10 days) (Alternaria) Do not apply more than 4 times per season.

or

*Bravo Weather Stik*, *Echo 720*, *Equus 720 SST*, 1.5 to 2 pt. (10 days) (Alternaria) Do not apply more than 4 times per season.

or

*Echo 90 DF*, 1.2 to 1.7 lb. (10 days)

or

### Neem Oil

*Trilogy*, 2 pt. (0 days)

## Peas

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## INSECTS

### 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.

**APHIDS, BEAN LEAF BEETLE, MEXICAN BEAN BEETLE, LEAFHOPPERS, SEED CORN MAGGOT:** Early season protection.

*Cruiser 5 FS*, 1.28 fl oz/100 lb seed.

### SEED CORN MAGGOT:

*Diazinon 50 WP*, 1/2 oz per bushel of seed. Planter box treatment (RUP)

or

*Lorsban 50 SL*, 2 oz/100 lb seed. Use as a slurry. (RUP)

### SOIL TREATMENT:

#### LEAFHOPPERS, APHIDS:

Imidacloprid

*Admire Pro*, 7.0 - 10.5 fl oz. (21 days) See label for application methods.

or

*Nuprid 2 F*, 16 to 24 fl oz. (21 days) Apply preplant, in furrow, or as a post-planting drench.

or

*Di-Syston 15 G* (6.7 to 16.7 lb) or *Di-Syston 8 E* (1 to 2 1/2 pt) (50 days) Apply in a band (not in contact with seed) at planting time, or as a sidedress after emergence. (RUP)

## FOLIAR TREATMENT:

**ARMYWORM, LOOPERS, CUTWORM:** Apply if there are more than 1/25 sweeps. Pay special attention to grassy areas in the field.

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

or

\* *Baythroid XL*, 2.4 to 3.2 fl oz. (7 days) (RUP)

or

\* Bifenthrin

*Bifenture EC*, *Brigade 2EC*, *Capture 2 EC*, 2.1 to 6.4 oz. (3 days) (RUP)

or

\* *Warrior* with Zeon Technology, 2.6 to 3.8 fl oz. (7 days) (RUP)

or

Carbaryl

*Sevin 80 S* (1 7/8 lb) or *Sevin XLR Plus* (1 to 1 1/2 qt) (3 days) See label for pre-harvest intervals for forage and fodder.

or

*Dibrom 8 EC*, 1 pt. (1 day)

**Note:** Do not feed treated vines to livestock.

or

*Lannate LV* (1 1/2 to 3 pt) or *Lannate SP* (1/2 to 1 lb) (1 day; 5 days if forage is fed to livestock; 14 days if fed as hay) (RUP)

or

*SpinTor 2 SC*, 4 to 6 oz. (3 days)

or

*Entrust*, 1.25 to 2 oz. (3 days)

or

*Mustang Max*, 1.3 to 4.0 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (7 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (3 days) (RUP)

or

*Radiant SC*, 4 to 8 fl oz. (3 days) Do not make more than 6 applications or exceed 28 fl oz/acre per season.

**LEAFHOPPERS:** Apply as necessary

*Baythroid XL*, 0.8 to 1.6 fl oz. (0 days) (RUP)

or

Bifenthrin

*Bifenture EC*, *Brigade 2EC*, *Capture 2 EC*, 1.6 to 6.4 oz. (3 days) (RUP)

or

Carbaryl

*Sevin 80 S* (1 1/4 lb) or *Sevin XLR Plus* (1 qt) (3 days)

or

Imidacloprid

*Nuprid 1.6 F*, *Provado 1.6 F*, 3.5 fl oz. (7 days) Do not exceed 10.5 oz/Acre per season.

or

*Warrior* with Zeon Technology, 2.6 to 3.8 fl oz. (7 days) (RUP)

or

*Mustang Max*, 2.8 to 4.0 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (7 days) (RUP)

or



*Hero*, 4 to 10.3 oz. (3 days) (RUP)

or

*Assail* 30 SG, 2.5 to 5.3 oz. (7 days)

**APHIDS:** Apply if there are more than 1/pod or 10/sweep

*Diazinon* AG 500, 1 pt. (7 days) (RUP)

or

*Dibrom* 8 EC, 1 pt. (1 day) **Note:** Do not feed treated vines to livestock.

or

*Dimethoate* 2.67 EC, 1/2 pt. (0 days; 21 days if vines are fed to livestock)

or

*Lannate* LV (1 1/2 to 3 pt) or *Lannate* SP (1/2 to 1 lb) (1 day; 5 days if forage is fed to livestock; 14 days if fed as hay) (RUP)

or

*Malathion* 57 EC, 2 pt. (3 days; 7 days if vines are fed to livestock)

or

*Imidacloprid*

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.5 fl oz. (7 days) Do not exceed 10.5 oz/Acre per season.

or

*Assail* 30 SG, 2.5 to 5.3 oz. (7 days)

**PEA WEEVIL:** Apply when they appear at blossom time, usually at 10 to 50% bloom and 7 days later.

*Baythroid* XL, 1.6 to 2.4 fl oz. (7 days) (RUP)

or

*Bifenthrin*

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.1 to 6.4 oz. (3 days) (RUP)

or

*Carbaryl*

*Sevin* 80 S (1 7/8 lb) or *Sevin* XLR Plus (1 1/2 qt) (3 days)

See label for pre-harvest intervals for forage and fodder.

or

*Malathion* 57 EC, 2 pt. (3 days; 7 days if vines are fed to livestock)

or

*Mustang* Max, 2.8 to 4.0 oz. (1 day) (RUP)

or

*Hero*, 4 to 10.3 oz. (3 days) (RUP)

## MITES

Apply if necessary. Usually most serious in dry weather.

*Bifenthrin*

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 5.1 to 6.4 oz. (3 days) (RUP)

or

*Dibrom* 8 EC, 1 pt. (1 day) Do not feed treated vines to livestock.

or

*Danitol* 2.4 EC, 10 2/3 fl oz. (7 days) (RUP)

## DISEASES

### SEED TREATMENT:

**DAMPING OFF** (*Pythium* spp., *Rhizoctonia solani*): Use slurry or dust method. **Note:** If possible, buy fungicide treated seed instead of treating seed on the farm.

*Bacillus subtilis* GB03

*Kodiak*, 0.125 oz/100 lb seed (*Fusarium*, *Rhizoctonia*).

or

*Captan*

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

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

or

*Fludioxinil*

*Maxim* 4 FS, 0.08 to 0.16 fl oz/100 lb seed (*Rhizoctonia*).

Commercial seed treatment plants only.

or

*Mefenoxam*

*Apron* XL LS, 0.32 to 0.64 fl oz/100 lb seed (*Pythium* and *Phytophthora*) or 1.28 oz/100 lb seed (*Pythium* and systemic downy mildew).

or

*Metalaxyl*

*Allegiance*-FL, 0.75 fl oz/100 lb seed (*Pythium*) or 1.5 fl oz/100 lb seed (systemic down mildew).

or

*Apron* 50 W, 1/2 to 1 oz/100 lb seed (*Pythium* and *Phytophthora*) or 2 1/4 oz/100 lb seed (*Pythium* and systemic downy mildew).

or

*Apron* FS, 0.75 to 1.5 oz/100 lb seed (*Pythium*) or 3.4 oz/100 lb seed (*Pythium* and systemic downy mildew).

or

*Thiram*

42-S Thiram (3 oz/100 lb seed) or *Thiram* 50 WP Dyed (8 oz/100 lb seed)

### PREPLANT INCORPORATED:

**DAMPING OFF** (*Pythium* spp.):

\* *Mefenoxam*

*Ridomil* Gold SL, 0.5-1 pt.

or

*Azoxystrobin*

*Quadris*, 0.4 to 0.8 fl oz per 1000 ft in furrow.

### FOLIAR TREATMENT:

**POWDERY MILDEW** (*Erysiphe polygoni*): Apply every 7 to 10 days after disease appears.

*Sulfur*

*Kumulus* DF, 3 to 5 lb. (0 days)

*Thiolux* Jet, 3 to 10 lb. (0 days)

or

*Copper Hydroxide*

*Champ* DP, 1 to 2 lb every 7 days. (0 days)

*Champ* Formula 2 F, *Kocide* 4.5 LF, 1 to 2 pt. (0 days)

*Kocide* 2000, 1 1/4 to 2 1/4 lb.

*Nu-Cop* 3 L, 1 to 4 pt. (0 days)

or

*Champion* WP, *Kocide* 101, *Kocide* DF, *Nu-Cop* 50 DF, 1 1/2 to 3 lb. (7 days)

or

*Copper Sulfate*

*Cuprofix* Ultra, 1 to 2 lb. (0 days)

**ANTHRACNOSE** (*Colletotrichum lindemuthianum*),

**ALTERNARIA BLIGHT** (*Alternaria* spp.),

**RUST** (*Phakospora* spp.):

Azoxystrobin

*Quadris*, 6.2 - 15.4 fl oz every 7 - 14 days. Follow guidelines for resistance management.

## Peppers

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

### NEMATODES

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

Correct soil moisture, temperature and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or by immediate tarping.

### FALL SOIL TREATMENT (BROADCAST):

1,3-D

*Telone II*, 25 gal/A (muck soil), 9-18 gal/A (mineral soil).

Fumigate in the fall when soil temperatures at 6-inch depth are above 50F. Inject the fumigant to soil depth of 8 inches and lightly seal the soil immediately after application. Use soil fumigants only as directed on the label. In some limited situations soil fumigants can be applied in the spring in Michigan.

### SOIL INJECTION:

Metam Sodium

*Vapam HL*, 37.5 to 75 gal/A (use higher rate for muck soil).

Inject with injector, shanks spaced 5 inches apart at a depth of 4 to 10 inches. Roll and irrigate treated surfaces to prevent escape of gas.

### TRANSPLANT WATER TREATMENT:

Apply as needed.

*Vydate L*, 2 pt in at least 200 gallons of water. Do not apply during periods of slow plant growth, such as when temperatures are below 45F. (RUP)

This treatment should be followed by broadcast or band applications using ground equipment at 1 gal/A in 20-50 gal water. Response is usually best if application is made to seedling plants from flag leaf to 2 or 3 true leaves.

### CHEMIGATION TREATMENT:

Metam Sodium

*Vapam HL*, 37.5 to 75 gal/A (use higher rate for muck soil).

Apply with an irrigation system. Soil should be moist prior to treatment See Bulletin E-2099. Do not plant for 14 to 30 days after treatment (the wetter the soil, the longer the waiting period).

### INSECTS

#### AT PLANTING OR TRANSPLANTING:

**APHIDS:** For early season control.

Imidacloprid

*Admire Pro*, 7 - 14 fl oz. (21 days) Consult label for application methods, rotation restrictions and other requirements

or

*Nuprid 2 F*, 16 to 24 fl oz. (21 days)

or

*Platinum*, 5 to 11 fl oz. (30 days) Apply as in-furrow spray or narrow surface band, as a post seeding, transplant or hill drench, in trickle or drip irrigation, or shanked into root zone after establishment or transplanting.

or

*Venom*, 5 to 6 oz. (21 days) See label for application methods.

#### FOLIAR TREATMENT:

**FLEA BEETLE:**

*Actara*, 2 to 3 oz. (0 days) Do not apply if a neonicotinoid was used at planting. Do not exceed 11 oz/acre per season.

or

*Asana XL*, 5.8 to 9.6 oz. (7 days) (RUP)

or

Carbaryl

*Sevin 80 S* (1 1/4 lb) or *Sevin XLR Plus* (1 qt) (3 days)

or

*Endosulfan 3 EC*, 2 pt. (4 days) Consult label for rotation restrictions.

or

Permethrin. Bell peppers only.

*Ambush 25 W*, 6.4 to 12.8 oz. (3 days) (RUP)

or

*Perm-UP 3.2 EC* (4 to 8 oz) or *Pounce 25 WP* (6.4 to 12.8 oz)

or *Pounce 3.2 EC* (4 to 8 oz) (3 days) (RUP)

or

*Venom*, 1 to 4 oz. (1 day)

or

*Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (5 days) (RUP)

or

*Mustang Max*, 2.2 to 4.0 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (5 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

Bifenthrin

*Bifenture EC*, 2.1 to 6.4 oz. (7 days) (RUP)



**CUTWORM:** Apply as needed to protect new transplants.

\* Permethrin. Bell peppers only.

*Ambush* 25 W, 6.4 to 12.8 oz. (3 days) (RUP)

or

*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz) or *Pounce* 3.2 EC (4 to 8 oz) (3 days) (RUP)

or

\* *Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (5 days) (RUP)

or

Carbaryl

*Sevin* 80 S (2 1/2 lb) or *Sevin* XLR Plus (2 qt) (3 days)

or

*Lannate* LV (3/4 to 1 1/2 pt) or *Lannate* SP (1/2 lb) (3 days) (RUP)

or

*Intrepid* 2 F, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (5 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

Bifenthrin

*Bifenture* EC, 2.1 to 6.4 oz. (7 days) (RUP)

**APHIDS:** Apply if needed.

\* Acephate

*Orthene* 75 S, 2/3 to 1 2/3 lb for bell peppers, 2/3 lb for non-bell peppers. (7 days) Consult label for further restrictions regarding use on non-bell peppers.

or

\* *Assail* 30 SG, 1.9 to 2.8 oz. (7 days)

or

\* Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.8-6.2 fl oz. (0 days) Do not use if neonicotinoids were applied at planting. Do not exceed 19.2 oz/acre per season.

or

\* *Actara*, 2 to 3 oz. (0 days) Do not apply if a neonicotinoid was used at planting. Do not exceed 11 oz/acre per season.

or

*Dimethoate* 2.67 EC, 3/4 to 1 pt. (0 days)

or

*Endosulfan* 3 EC, 1 qt. (4 days; 1 day at 2/3 qt rate) Consult label for rotation restrictions.

or

*Fulfill*, 2.75 oz (0 days) May require 5-7 days for aphid mortality.

or

*Lannate* LV (1 1/2 pt) or *Lannate* SP (1/2 lb) (3 days) (RUP)

or

*Venom*, 1 to 4 oz. (1 day)

or

*Vydate* L, 2 to 4 pt. (7 days) (RUP)

or

*Beleaf* 50 SG, 2 to 2.8 oz. (0 days)

or

*Brigadier*, 3.8 to 9.8 oz. (7 days)

**EUROPEAN CORN BORER:** Apply treatments to coincide with fruit formation and second-brood egg-laying period (usually around July 20 to August 15) and continue as needed. Direct spray to underside of leaves and cap area of fruit.

\* Acephate

*Orthene* 75 S, 1 to 1 1/3 lb (2/3 lb on non-bell peppers). (7 days) Do not make more than two applications per season.

or

*Asana* XL, 5.8 to 9.6 oz. (7 days) (RUP)

or

*Baythroid* XL, 1.6 to 2.8 fl oz. (7 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/4 to 2 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt) (3 days)

or

Permethrin. Bell peppers only.

*Ambush* 25 W, 12.8 oz. (3 days) (RUP)

or

*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (12.8 oz) or *Pounce* 3.2 EC (4 to 8 oz) (3 days) (RUP)

or

*SpinTor* 2 SC, 4 to 8 oz. (1 day)

or

*Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (5 days) (RUP)

or

*Entrust*, 1 to 2 oz. (1 day)

or

*Intrepid* 2 F, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (5 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

Bifenthrin

*Bifenture* EC, 2.1 to 6.4 oz. (7 days) (RUP)

**MITES:** Apply if needed.

*Agri-Mek* 0.15 EC, 8 to 16 fl oz. (7 days) (RUP)

or

*Kelthane* MF, 3/4 to 1 1/2 pt. (2 days) Limited to 2 applications per season.

or

*Oberon* 2 SC, 7 to 8.5 fl oz. (7 days)

or

*Hero*, 10.3 oz. (7 days) (RUP)

or

Bifenthrin

*Bifenture* EC, 5.1 to 6.4 oz. (7 days) (RUP)

### DISEASES

#### SEED TREATMENT:

**PRE-EMERGENCE DAMPING OFF** (*Rhizoctonia solani*, *Pythium* spp., *Phytophthora* spp.):

*Bacillus subtilis* GB03

*Kodiak*, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

*Captan*

*Captan* 30-DD, 2 1/3 oz/100 lb seed.

*Captan* 400, 2 to 3 oz/100 lb seed.

or

*Thiram*

42-S *Thiram*, *Thiram* 50 WP Dyed, 8 oz/100 lb seed.

or

*Fludioxinil*

*Maxim* 4 FS, 0.08 to 0.16 fl oz/100 lb seed (*Rhizoctonia solani*).

#### SOIL FUMIGATION:

**VERTICILLIUM WILT, PHYTOPHTHORA:** Apply to production fields before planting. **Note:** Most fumigants applied to the soil for control of disease organisms will also control soil insects, nematodes and weed seeds.

Soil sterilization by fumigation is best achieved by proper application of material. Correct soil moisture, temperature, and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or immediate tarping.

1,3 Dichloropropene/chloropicrin

*Telone* C35, 13-35 gal. (RUP)

or

*Metam Sodium*

*Sectagon* 42, *Vapam* HL, 37.5-75 gal.

or

*Potassium N-methylidithiocarbamate*

*Sectagon-K54*, 30-60 gal.

#### GREENHOUSE PREPLANT INCORPORATION:

**DAMPING OFF** (*Pythium* spp.) and **ROOT ROT** (*Rhizoctonia* spp.):

*Gliocladium virens* GL-21

*SoilGard* 12 G, 1 to 1.5 lb per cubic yard. Biological control product that needs to be applied before disease development. Control may be limited under heavy disease pressure.

**ROOT/STEM ROT** (*Rhizoctonia solani*):

*PCNB*

*Terraclor* 400, see label for rates specific to soil depth.

#### PREPLANT OR AT PLANTING INCORPORATED:

**DAMPING OFF** (*Pythium* spp.), **PHYTOPHTHORA CROWN, STEM and FRUIT ROT** (*Phytophthora capsici*):

\* *Mefenoxam*. Ridomil and Ultra Flourish must be applied to the soil before the plants are infected with *Phytophthora* to obtain satisfactory disease control).

*Ridomil* Gold SL, 1 pt. (7 days)

*Ultra Flourish*, 2 pt. (7 days)

Incorporate mechanically before planting or move into root zone after planting with 1/2 to 1 inch sprinkler water. For banded applications, use 12- to 16-inch band. One supplemental directed application at 1 pt (*Ridomil* Gold EC) or 2 pt (*Ultra Flourish*) should be made 30 days later followed by foliar applications of *Ridomil* Gold/Copper (*MEFENOXAM/COPPER*), 2 1/2 lb (1/4 lb a.i.) (7 days). Make 3 to 4 applications of *Ridomil* Gold/Copper at 10 to 14 day intervals.

**Note:** Observe limit of active ingredient/crop on label.

#### FOLIAR TREATMENT:

**GRAY MOLD** (*Botrytis* spp.), **CLADOSPORIUM LEAF MOLD** (*Cladosporium capsici*), **SCLEROTINIA WHITE MOLD** (*Sclerotinia sclerotiorum*):

*Bacillus subtilis*

*Serenade*, 4 to 8 lb (*Botrytis*). (0 days) Biological control product that needs to be applied before disease development. Control may be limited under heavy disease pressure.

or

*Potassium Bicarbonate*

*Armcarb* 100, 2.5 to 5 lb (*Botrytis*). (0 days)

or

*Neem Oil*

*Trilogy*, 2 pt. (0 days)

**ANTHRACNOSE** (*Colletotrichum* spp.), **ALTERNARIA (RIPE) ROT** (*Alternaria tenuis*): Apply when disease threatens and every 7 to 10 days.

\* *Azoxystrobin*

*Amistar*, 2 to 5 oz every 7 - 14 days. (0 days)

*Quadris*, 6.2 to 15.4 fl oz. (0 days)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* *Maneb*

*Maneb* 75 DF, *Maneb* 80 WP, 1.5 to 3 lb. (7 days)

*Manex*, 1.2 to 2.4 qt. (7 days)

or

\* *Pyraclostrobin*

*Cabrio*, 8-12 oz. (0 days) No more than two applications before rotating to a different chemical.

or

\* *Trifloxystrobin*

*Flint*, 3 to 4 oz. (3 days) Do not apply more than three sequential foliar applications of strobilurin fungicides before alternating with a fungicide that has a different mode of action.

or

\* *Boscalid*

*Endura*, 2.5 to 3.5 oz. (0 days)

or

*Copper Sulfate*

*Basic Copper* 53, 3 to 4 lb. (0 days)

*Basicop*, 2 to 4 lb. (0 days)

*Cuprofix Ultra*, 1.25 to 3 lb. (0 days)

or

*Neem Oil*

*Trilogy*, 2 pt. (0 days)



or

Potassium Bicarbonate

Armcarb 100, 2.5 to 5 lb.

**BACTERIAL SPOT** (*Xanthomonas campestris* pv. *vesicatoria*):

Apply as needed every 5 to 7 days.

Copper Ammonium Carbonate

Copper Count N, 1 1/2 to 3 qt. (0 days)

or

Copper Hydroxide

Champ DP, 1 1/3 to 2 lb. (0 days)

Champ Formula 2 F, Kocide 4.5 LF, 1 1/3 to 2 pt. (0 days)

Kocide 2000, 1 1/2 to 2 1/4 lb. (0 days)

Nu-Cop 3 L, 1 1/3 to 4 pt, 7- to 10-day intervals. (0 days)

or

Champion WP, Kocide 101, Kocide DF, Nu-Cop 50 DF, 2 to 3 lb. (0 days)

or

Copper Resinate

Tenn-Cop 5 E, 3 to 4.5 pt. (0 days)

or

Copper Sulfate

Basic Copper 53, 3 to 4 lb. (0 days)

Basicop, 2 to 4 lb. (0 days)

Cuprofix Ultra, 1.25 to 3 lb. (0 days)

or

Famoxadone/Cymoxanil

Tanos, 8 - 10 oz every 5 - 7 days. (3 days)

**PHYTOPHTHORA BLIGHT** (*Phytophthora capsici*):\* Dimethomorph

Acrobat 50 WP, 6.4 oz every 5 to 10 days. (0 days)

Forum, 6 fl oz. (0 days)

or

\* Famoxadone/Cymoxanil

Tanos, 8 to 10 oz. (3 days)

or

Fluopicolide

Presidio, 3-4 fl oz. (2 days)

or

\* Mandipropamid

Revus, 8 fl oz. (1 day)

or

\* Mefenoxam/Copper Hydroxide

Ridomil Gold Copper, 1 lb. (7 days) Make 3-4 applications of Ridomil Gold Copper (2.5 lb) at 10 to 14 day intervals.

or

Maneb

Maneb 75 DF, Maneb 80 WP, 1 1/2 to 3 lb, 7- 10 day intervals. (7 days)

or

Manex, 1.2 to 2.4 qt, 7- to 10-day intervals. (7 days)

or

Mono-, dibasic sodium, potassium and ammonium phosphites

Phostrol, 1 to 2 qt every 14 - 21 days. (0 days)

Prophyt, 6 pt. (0 days)

or

Mono-, dibasic sodium salts of phosphorous acid

Fosphite, 1 to 3 qt per 20 gal (ground) or 10 gal (aerial) of water. (0 days)

## Potatoes

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

Root-lesion, root-knot and potato rot nematodes can reduce potato yields. Fields with soil or root problems of undetermined cause should be tested for nematodes (see Appendix C). If these plant-parasitic nematodes are present in population densities above the economic threshold for potatoes, crop rotation or application of a nematicide is recommended. Potato growers should not rely on a single strategy or tactic for their total nematode control program. The following nematicides are suitable for control of these nematodes in potato production.

Correct soil moisture, temperature and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or by immediate tarping.

## FALL SOIL TREATMENT (BROADCAST):

1,3-D

Telone II, 25 gal/A for muck soil, 9-18 gal/A for mineral soil.

or

1,3-D and chloropicrin

Telone C-17, 27-30 gal/A for muck soil, 10-21 gal/A for mineral soil. (RUP)

or

## Metam Sodium

Vapam HL, 37.5 to 75 gal/A (use higher rate for muck soil).

Inject with injector, shanks spaced 5 inches apart at a depth of 4 to 10 inches. Material should be applied with at least equal parts water or in a 2 to 1, water to fumigant, ratio. Seal surface after application.

Fumigate in the fall when soil temperatures at a 6-inch depth are above 50F. 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. In some limited situations, soil fumigants can be applied in the spring in Michigan.

## PREPLANT SOIL TREATMENT:

Mocap 6 EC, broadcast 1 to 1.5 gal/A within 2 weeks before planting until crop emergence. (RUP)

or

Mocap 15 G, broadcast 40 to 60 lb and incorporate to a depth of 2 to 4 inches. (RUP)

## SOIL TREATMENT AT PLANTING:

Mocap 15 G, 20 lb/acre (36 inch row spacing) or 1/4 lb/1000 row feet in a band 12 inches wide on the row at planting. Mix with the top 2-4 inches of soil

## Potatoes

**Note:** Mocap use may result in delayed emergence particularly if excessive quantities of material contact seed. (RUP)

or

*Vydate L*, 1 to 2 gal in at least 20 gallons of water in furrow at planting. May aid in early season insect control. (RUP)

### CHEMIGATION TREATMENT:

Metam Sodium

*Vapam HL*, 37.5 to 75 gal/A (use higher rate for muck soil) for mineral soil situations. Apply in the fall, although in some years spring application is possible.

Fall application in center pivot irrigation water. Have local product distributor provide additional application methodology and safety details from manufacturer. All recommended safety equipment must be installed to prevent groundwater contamination.

## INSECTS

### RESISTANCE MANAGEMENT.:

Insecticide resistance is a severe problem with Colorado potato beetle. Crop rotation is the single most effective practice for managing Colorado potato beetle and resistance problems. If a neonicotinoid insecticide is used at planting, foliar application of any neonicotinoid later in the season must be avoided. Likewise, repeated application of any insecticide is likely to result in resistance problems.

### SEED TREATMENT:

**COLORADO POTATO BEETLE, POTATO LEAFHOPPER, APHIDS:**

Imidacloprid

*Admire Pro*, 0.17 - 0.35 fl oz/100 lb seed. See label for application instructions.

or

*Nuprid 2 F*, 0.4 to 0.8 fl oz/100 lb seed.

or

*Cruiser 5 FS*, See label for application rates and methods.

or

*Gauche 480*, MZ, 0.75 lb/100 lb cut seed. Use a seed dust metering applicator. See label for application instructions. Includes the fungicide mancozeb.

### SOIL TREATMENT AT PLANTING:

**WIREWORM:** Broadcast evenly on soil surface and incorporate 4 to 6 inches deep prior to planting.

*Mocap 15 G* (27 to 40 lb) or *Mocap 20 G* (20 to 30 lb) (RUP)

**WHITE GRUBS:** Effective chemical control is not presently available. Rotation to a less sensitive crop like corn, with a soil insecticide, is recommended.

### FURROW TREATMENT:

**COLORADO POTATO BEETLE, POTATO LEAFHOPPER, APHIDS:**

\* Imidacloprid

*Admire Pro*, 5.7 - 8.7 fl oz. Apply in furrow, as side dress, or before hilling.

or

*Nuprid 2 F*, 0.9 to 1.3 oz per 1,000 row ft. Apply directly on seed in furrow. (Use high rate for muck soil. Consult label for rotation restrictions).

or

\* *Venom*, 6.5 to 7.5 oz. See label for application methods.

**APHIDS, FLEA BEETLE, LEAFHOPPERS:** Apply in seed furrow or with fertilizer band at planting. Check the package label for further directions and limitations.

Phorate

*Thimet 20 G*, 11.3 oz (for light, sandy soils) 17.3 oz (for heavy, clay soils) / 1,000 row ft. (90 days) May also help control Colorado potato beetle. (RUP)

**APHIDS, FLEA BEETLE, COLORADO POTATO BEETLE, LEAFHOPPER:**

*Platinum*, 5 to 8 fl oz. (30 days) Apply as an in-furrow spray on the seed piece, impregnated on dry, granular fertilizer before or during planting, at plant emergence or as a direct spray at base of plant during last hilling operation.

**COLORADO POTATO BEETLE:**

*Platinum Ridomil Gold*, 34 fl oz. (12 hour) Impregnate on fertilizer at planting. Do not use other neonicotinoids at planting.

### FOLIAR TREATMENT:

**FLEA BEETLE:** Apply if there are more than 50/25 sweeps. May occur soon after plants emerge and again in late July and August. *Asana XL*, 5.8 oz. (7 days) (RUP)

or

*Assail 30 SG*, 1.4 to 2.5 oz. (7 days)

or

*Baythroid XL*, 1.6 to 2.8 fl oz. (0 days) (RUP)

or

Carbaryl

*Sevin 80 S* (1 1/4 lb) or *Sevin XLR Plus* (1 qt) (7 days)

or

*Endosulfan 3 EC*, 2 pt. (1 day) Consult label for rotation restrictions.

or

*Furadan 4 F*, 1 pt. (14 days) Consult label for tighter restrictions. (RUP)

or

*Lannate LV* (1 1/2 pt) or *Lannate SP* (1/2 lb) (6 days) (RUP)

or

*Leverage 2.7*, 3 to 3.75 oz. (7 days) Do not use if a neonicotinoid was used at planting. (RUP)

or

*Monitor 4 EC*, 1.5 - 2 pt. (14 days) (RUP)

or

*PennCap-M 2 F*, 2 to 4 pt. (5 days) (RUP)

or

Permethrin

*Ambush 25 W*, 6.4 oz. (14 days) (RUP)

or

*Perm-UP 3.2 EC* (4 to 8 oz) or *Pounce 25 WP* (6.4 to 12.8 oz) or *Pounce 3.2 EC* (4 to 8 oz) (14 days) (RUP)

or

*Venom*, 1.5 oz. (7 days)

or



Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.8 fl oz. (7 days) Do not use if neonicotinoids were applied at planting. Do not exceed 19.2 oz/acre per season.

or

*Actara*, 1.5 to 3 oz. (14 days) Do not apply if a neonicotinoid was used at planting. Do not exceed 6 oz/acre per season.

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (7 days) Do not exceed 15.4 fl oz/acre per season. (RUP)

or

*Brigadier*, 4.8 to 6.1 oz. (21 days)

**COLORADO POTATO BEETLE:** Apply if there is more than 1 large larva or adult per plant. Piperonyl butoxide (Butacide, Prentox PBO-8, Incite) at 1/2 to 1 pt per acre may be effective as a synergist to block resistance to organophosphate (Guthion, Imidan, etc.) and pyrethroid (Asana, etc.) insecticides.

\* *Actara*, 1.5 to 3 oz. (14 days) Do not apply if a neonicotinoid was used at planting. Do not exceed 6 oz/acre per season.

or

\* *Agri-Mek* 0.15 EC, 8 to 16 fl oz. (14 days) (RUP)

or

\* *Assail* 30 SG, 1.5 to 4 oz. (7 days)

or

\* *Leverage* 2.7, 3 to 3.75 oz. (7 days) Do not use if Imidacloprid, Gaucho, Genesis or Platinum was used at planting. (RUP)

or

\* Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.75 fl oz. (7 days) Do not use if neonicotinoids were applied at planting. Do not exceed 19.2 oz/acre per season.

or

\* *Rimon*, 9 to 12 fl oz. (14 days) Small larvae only. 2 applications per year.

or

\* *SpinTor* 2 SC, 3 to 6 oz. (7 days)

or

\* *Entrust*, 1 to 2 oz. (7 days)

or

\* *Venom*, 1.5 oz. (7 days)

or

*Asana* XL, 9.6 oz. (7 days) (RUP)

or

*Baythroid* XL, 1.6 to 2.8 fl oz. (0 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/4 to 2 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt) (7 days)

or

*Endosulfan* 3 EC, 1 1/3 qt. (1 day)

or

*Furadan* 4 F, 2 pt. (14 days) Consult label for further restrictions. Do not use more than once per season or serious resistance problems may develop. (RUP)

or

*Imidan* 70 WP, 1 1/3 lb. (7 days)

or

*PennCap-M* 2 F, 2 to 6 pt. (5 days) (RUP)

or

Permethrin

*Ambush* 25 W, 8 oz. (14 days) (RUP)

or

*Perm-UP* 3.2 EC, *Pounce* 25 WP, *Pounce* 3.2 EC, 4 to 8 oz. (14 days) (RUP)

or

*Vydate* L, 2 to 4 pt. (7 days) (RUP)

or

*Clutch* 50 WGD, 1 to 1.5 oz. (14 days)

or

*Radiant* SC, 6 to 8 fl oz. (7 days) Do not make more than 4 applications or exceed 32 fl oz/acre per season.

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (7 days)

Do not exceed 15.4 fl oz/acre per season. (RUP)

or

*Brigadier*, 4.8 to 6.1 oz. (21 days)

**LEAFHOPPERS:** Apply if there are more than 0.5 adults/sweep or 1 nymph/10 leaves.

*Actara*, 1.5 to 3 oz. (14 days) Do not apply if a neonicotinoid was used at planting. Do not exceed 6 oz/acre per season.

or

*Asana* XL, 5.8 to 9.6 oz. (7 days) (RUP)

or

*Assail* 30 SG, 1.5 to 4 oz. (7 days)

or

*Baythroid* XL, 0.8 to 1.6 fl oz. (0 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 qt) (7 days)

or

*Dimethoate* 2.67 EC, 3/4 to 1 1/2 pt. (0 days)

or

*Endosulfan* 3 EC, 2 pt. (1 day)

or

*Furadan* 4 F, 1 pt. (14 days) Consult label for further restrictions. (RUP)

or

*Imidan* 70 WP, 1 1/3 lb. (7 days)

or

*Lannate* LV (1 1/2 to 3 pt) or *Lannate* SP (1/2 to 1 lb) (6 days) (RUP)

or

*Leverage* 2.7, 3 to 3.75 oz. (7 days) Do not use if a neonicotinoid was used at planting. (RUP)

or

*Malathion* 57 EC, 1 pt. (0 days)

or

*Monitor* 4 EC, 1.5 - 2 pt. (14 days) (RUP)

or

*PennCap-M* 2 F, 2 to 4 pt. (5 days) (RUP)

or

Permethrin

*Ambush* 25 W, 6.4 to 12.8 oz. (14 days) (RUP)

or

*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz) or *Pounce* 3.2 EC (4 to 8 oz) (14 days) (RUP)

or

## Potatoes

Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.75 fl oz. (7 days) Do not use if neonicotinoids were applied at planting. Do not exceed 19.2 oz/acre per season.

or

*Venom*, 1.5 oz. (7 days)

or

*Clutch* 50 WGD, 1 to 1.5 oz. (14 days)

or

*Warrior* with Zeon Technology, 1.9 to 3.2 fl oz. (7 days)

Do not exceed 15.4 fl oz/acre per season. (RUP)

or

*Brigadier*, 4.8 to 6.1 oz. (21 days)

**APHIDS:** Treat if numbers exceed 1 per leaf (1/10 leaves for seed potatoes). Control is especially important to reduce virus disease in seed potato production.

\* *Assail* 30 SG, 2.3 to 4 oz. (7 days)

or

\* *Fulfill*, 2.75 to 5.5 oz. (14 days) Do not apply more than 11.0 oz/acre per season. May require 5 to 7 days for aphid mortality.

or

\* *Leverage* 2.7, 3.75 oz. (7 days) Do not use if a neonicotinoid was used at planting. (RUP)

or

\* *Monitor* 4 EC, 1.5 - 2 pt. (14 days) (RUP)

or

\* Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.75 fl oz. (7 days) Do not use if neonicotinoids were applied at planting. Do not exceed 19.2 oz/acre per season.

or

*Dimethoate* 2.67 EC, 3/4 to 1 1/2 pt. (0 days)

or

*Endosulfan* 3 EC, 2 pt. (1 day)

or

*Lannate* LV (1 1/2 to 3 pt) or *Lannate* SP (1/2 to 1 lb) (6 days) (RUP)

or

*Beleaf* 50 SG, 2 to 2.8 oz. (7 days)

or

*Venom*, 1.5 oz. (7 days)

or

*Clutch* 50 WGD, 1 to 1.5 oz. (14 days)

or

*Actara*, 1.5 to 3 oz. (14 days) Do not apply if a neonicotinoid was used at planting. Do not exceed 6 oz/acre per season.

or

*Brigadier*, 4.8 to 6.1 oz. (21 days)

**TARNISHED PLANT BUG:**

*Asana* XL, 5.8 to 9.6 oz. (7 days) (RUP)

or

*Baythroid* XL, 1.6 to 2.8 fl oz. (0 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 qt) (7 days)

or

*Leverage* 2.7, 3 to 3.75 oz. (7 days) Do not use if a neonicotinoid was used at planting. (RUP)

or

*PennCap-M* 2 F, 2 to 4 pt. (5 days) (RUP)

or

*Beleaf* 50 SG, 2 to 2.8 oz. (7 days)

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (7 days)

Do not exceed 15.4 fl oz/acre per season. (RUP)

**CUTWORM, ARMYWORM, LOOPERS:** Apply if defoliation exceeds 10%.

\* *Asana* XL, 5.8 to 9.6 oz. (7 days) (RUP)

or

\* *Baythroid* XL, 1.6 to 2.8 fl oz. (0 days) (RUP)

or

\* *Leverage* 2.7, 3 to 3.75 oz. (7 days) Do not use if a neonicotinoid was used at planting. (RUP)

or

\* Permethrin

*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz)

or *Pounce* 3.2 EC (4 to 8 oz) (14 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/2 to 2 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt) (7 days)

or

*Endosulfan* 3 EC, 1 1/3 qt. (1 day)

or

*Lannate* LV (1 1/2 to 3 pt) or *Lannate* SP (1/2 to 1 lb) (6 days) (RUP)

or

*Monitor* 4 EC, 1.5 - 2 pt. (14 days) (RUP)

or

*PennCap-M* 4 F, 2 to 4 pt. (5 days) (RUP)

or

*SpinTor* 2 SC, 4.5 to 6 oz. (7 days)

or

*Entrust*, 1.5 to 3 oz. (7 days)

or

*Warrior* with Zeon Technology, 1.9 to 3.8 fl oz. (7 days)

Do not exceed 15.4 fl oz/acre per season. (RUP)

**EUROPEAN CORN BORER:** Plan treatment to coincide with first generation egg laying if there is more than 1 egg mass per 25 leaves.

\* *Asana* XL, 5.8 to 9.6 oz. (7 days) (RUP)

or

\* *Baythroid* XL, 1.6 to 2.8 fl oz. (0 days) (RUP)

or

\* *Leverage* 2.7, 3 to 3.75 oz. (7 days) Do not use if a neonicotinoid was used at planting. (RUP)

or

\* Permethrin

*Ambush* 25 W, 6.4 to 12.8 oz. (14 days) (RUP)

or

*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz)

or *Pounce* 3.2 EC (4 to 8 oz) (14 days) (RUP)

or

*Avaunt*, 3.5 - 6.0 oz. (3 days)

or

Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 qt) (7 days)

or



*Endosulfan* 3 EC, 2 2/3 pt. (1 day) Consult label for rotation restrictions.

or

*Furadan* 4 F, 1 1/2 to 2 pt. (14 days) (RUP)

or

*Monitor* 4 EC, 1.5 - 2 pt. (14 days) (RUP)

or

*PennCap-M* 4 F, 2 to 4 pt. (5 days) (RUP)

or

*SpinTor* 2 SC, 3 to 6 oz. (7 days)

or

*Entrust*, 1 to 2 oz. (7 days)

or

*Radiant* SC, 6 to 8 fl oz. (7 days) Do not make more than 4 applications or exceed 32 fl oz/acre per season.

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (7 days)

Do not exceed 15.4 fl oz/acre per season. (RUP)

## DISEASES

### SEED TREATMENT:

**FUSARIUM TUBER ROT** (*Fusarium* spp.): Fall treatment. Treat seed going into storage or at the time of shipping. This must be done at least 6 weeks before planting.

#### Thiabendazole

*Mertect* 340, 0.42 fl oz/ton of potatoes. Apply in enough water for complete coverage. Apply as a spray to potato tubers (seed and table stock) at time of storage and again at removal. See manufacturer's recommendations for equipment and methods to use. Treatment may be applied to washed or unwashed potatoes.

**SOFT ROT and BLACK LEG** (*Pectobacterium carotovorum*):

#### Streptomycin sulfate

*Agri-mycin* 17, 100 ppm. Mix with Maxim 4FS or Maxim MZ.

*Bac-master*, 100 ppm. Mix with Maxim 4FS or Maxim MZ.

### SEED TREATMENT AND HANDLING:

**FUSARIUM TUBER ROT** (*Fusarium* spp.): Pre-planting treatment. Dust or spray cut or whole seed before planting.

#### Captan

*Captan* 10 Potato Seed Protectant, 0.75 lb per 100 lb cut seed pieces.

or

#### Mancozeb

*Dithane* F-45 Rainshield, 2 pt per 50 gal water. Treat as above.

*Dithane* M-45, 1.25 lb per 50 gal water. Treat as above.

or

*Manzate* 200 80 W, 2 1/2 lb per 100 gal water. Drain and plant as soon as possible.

or

*Penncozeb* 80 WP, 1 1/4 lb per 50 gal water.. (3 days) Treat as above.

or

*Evolve*, 0.75 lb per 100 lb seed potatoes.

or

#### Maneb

*Maneb* 80 WP, 1 lb per 10 gal water. Treat as above.

or

*Manex* 4 F, 1.6 pt per 10 gal water. Dip whole or cut tubers. Place in a clean container and plant as soon as possible after treatment.

or

#### Fludioxinil

*Maxim* MZ 0.5 D, 0.5 lb per 100 lb seed potatoes.

or

*Moncoat* MZ, 0.75-1.0 lb/100 lb of seed potatoes.

or

*Tops* 2.5 D, 1 lb/100 lb seed.

or

*Tops* MZ 8.5 DS, 0.5 lb per 100 lb seed.

Use only as directed. **Note:** DO NOT feed treated seed to livestock.

**RHIZOCTONIA DISEASE** (*Rhizoctonia solani*): Dust cut or whole seed just before planting.

*Evolve*, 0.75lb/100 lb seed.

or

#### Fludioxinil

*Maxim* 0.5 D, 0.5 lb per 100 lb seed potatoes.

or

*Maxim* 4 FS, 0.08 fl oz. **Note:** If Maxim 4 FS is used for potatoes for seed production, a labeled rate of mancozeb seed treatment dust must be applied to seed tubers after the Maxim 4 FS treatment. Alternatively, an in-furrow application of Quadris at 6.1 - 9.2 fl oz/A may be used (34" row spacing).

or

*Maxim* MZ 0.5 D, 0.5 lb per 100 lb seed potatoes.

or

*Moncoat* MZ, 0.75-1.0 lb/100 lb seed potatoes.

or

#### Flutoloniil

*Moncut*, 0.71 - 1.1 lb/A in-furrow at planting with a minimum of 3 gal/A. 1.1 lb maximum per season.

or

*Tops* 2.5 D, 1 lb/100 lb seed.

or

*Tops* MZ 8.5 DS, 0.5 lb/100 lb seed.

or

#### PCNB

*Blocker* 4 F, an in-furrow application 5 - 10 pt/A applying at a rate of 10 - 20 gal water/A. Maximum of 10 pt per season (12months).

**SILVER SCURF** (*Helminthosporium solani*):

#### Fludioxinil

*Maxim* 0.5 D, 0.5 lb per 100 lb seed potatoes.

or

*Maxim* 4 FS, 0.08 fl oz/100 lb seed potatoes. **Note:** If Maxim 4 FS is used for potatoes for seed production, a labeled rate of mancozeb seed treatment dust must be applied to seed tubers after the Maxim 4 FS treatment.

or

*Maxim* MZ 0.5 D, 0.5 lb per 100 lb seed potatoes.

or

*Moncoat* MZ, 0.75 - 1.0 lb pre-plant per 100 lb seed. Maximum 1.0 lb per season.

## Potatoes

**DISINFECTION OF CUTTING KNIVES:** Spray or mist surface of knives:

Quaternary ammonium compounds

*Green Shield*, 0.5 fl oz per gallon of water.

or

*Hypochlorite* 5.25% bleach, 1 part commercial formulation in 50 parts of water (2%).

## PRE-PLANT TREATMENT:

**WHITE MOLD** (*Sclerotinia sclerotiorum*):

Coniothyrium Minitans

*Contans*, 1 - 4 lb.

## IN FURROW AT PLANTING TREATMENTS:

For control of seed-borne and soil-borne diseases.

**BLACK DOT** (*Colletotrichum coccodes*):

Azoxystrobin

*Quadris*, in-furrow at planting at 6.1 - 9.2 fl oz/A (34" row spacing). Maximum 7.5 pt/A/per season. **Note:** A protectant partner such as an EDBC (mancozeb or metiram) or chlorothalonil product is recommended in the tank mixture to any strobilurine product. Strobilurines should also be used in rotation with a fungicide with a different mode of action.

**RHIZOCTONIA DISEASE** (*Rhizoctonia solani*):

Azoxystrobin

*Quadris*, in-furrow at planting at 6.1 - 9.2 fl oz/A (34" row spacing). Maximum of 7.5 pt/A/season. **Note:** A protectant partner such as an EDBC (mancozeb or metiram) or chlorothalonil product is recommended in the tank mixture to any strobilurine product. Strobilurines should also be used in rotation with a fungicide with a different mode of action.

or

Flutololil

*Moncut*, 0.71 - 1.1 lb/A with a minimum of 3 gal/A. Maximum of 1.1 lb/season.

**SILVER SCURF** (*Helminthosporium solani*):

Azoxystrobin

*Quadris*, 6.2 to 9.2 fl oz. Maximum 7.5 pt/A/season.

**Note:** A protectant partner such as an EDBC (mancozeb or metiram) or chlorothalonil product is recommended in the tank mixture to any strobilurine product. Strobilurines should also be used in rotation with a fungicide with a different mode of action.

**BLACK DOT, PINK ROT, PYTHIUM LEAK, PYTHIUM SEEDLING BLIGHT, RHIZOCTONIA STEM CANKER:**

*Quadris* Ridomil Gold, 12.6 fl oz. (48 hours) See label for plantback restrictions.

**PINK ROT** (*Phytophthora erythroseptica*), **PYTHIUM LEAK** (*Pythium ultimum*):

Mono-, dibasic sodium, potassium and ammonium phosphites

*Prophyt*, 4 - 10 pt. Apply at least 3 gallons of mix per acre. Add Ridomil.

or

Cyazofamid

*Ranman*, 0.42 fl oz.

## FOLIAR TREATMENT:

**BLACK DOT** (*Colletotrichum coccodes*):

Azoxystrobin/Chlorothalonil

*Quadris Opti*, 1.6 pt/A every 7 - 14 days. Maximum of 9.6 pt/season. (14 days).

or

Mandipropamid/Difenoconazole

*Revus Top*, 5.5-7 fl oz every 7-10 days. (14 days) Maximum 28 fl oz/A/season.

or

Potassium Bicarbonate

*Armcarb* 100, 2.5 to 5 lb every 5-14 days. (0 days)

**EARLY BLIGHT** (*Alternaria solani*): Apply every 5 to 7 days after emergence.

Iprodione

*Iprodione* 4L, 1 - 2 pt every 14-21 days. (14 days) Maximum 8 pt/A/season.

or

*Nevado* 4F, 1 - 2 pt every 14-21 days. (14 days) Maximum 8 pt/A/season.

or

*Rovral* 4 F, 1 to 2 pt. (7 days) See label for rotational crop and other restrictions.

or

*Rovral* 50 W, 2 lb. (14 days) See label for rotational crop restrictions.

**Note:** Garlic, dry bulb onions, broccoli, lettuce, peanuts, carrots, beans and potatoes can be rotated after harvest. Root crops, tomatoes and cotton may be rotated one month after last application.

or

Azoxystrobin

*Quadris*, 6.2 to 15.4 fl oz. Maximum 7.5 pt/A/per season.

**Note:** It is recommended that a protectant partner such as an EDBC (mancozeb or metiram) or chlorothalonil product is added in tank mixture to any strobilurine product. Strobilurines should also be used in rotation with a fungicide with a different mode of action.

or

Azoxystrobin/Chlorothalonil

*Quadris Opti*, 1.6 pt/A every 5 - 7 days. (14 days) Maximum of 9.6 pt/season.

or

Bacillus pumilis

*Sonata*, 4 - 8 pt/A every 5 - 7 days.

or

Bacillus subtilis

*Serenade*, 6 lb/A every 5 - 7 days.

or

Boscalid

*Endura*, 2.5 - 4.5 oz every 7 - 14 days. (30 days) Maximum of 20.5 oz/season.

or

Chlorothalonil

*Applause* 720, 1.0 to 1.5 pt. (7 days) Apply every 5-10 days. Do not apply more than 15 pt/A/season.

or



*Bravo Ultrex*, 0.9 to 1.4 lb. (7 days) Do not apply more than 14.5 lb in a growing season.

or

*Bravo Weather Stik*, 1 to 1.5 pt. (7 days) Do not apply more than 16 pt in a growing season.

or

*Echo Zn*, 1.5 to 2.2 pt. (7 days) Do not apply more than 21.5 pt in a growing season.

or

*Equus 720 SST*, 1 to 1.5 pt. (7 days) Do not apply more than 15 pt in a growing season.

or

*Initiate 720*, 1.0 to 1.5 pt. (7 days) Apply every 5-10 days. Maximum 15 pt/A/season.

**Note:** All chlorothalonil products may be applied through irrigation water.

or

#### Maneb

*Maneb 80 WP*, 1 1/2 to 2 lb. (3 days)

or

#### Mancozeb

*Dithane DF Rainshield*, *Dithane M-45*, 2 lb. (3 days) May be used through irrigation equipment.

or

*Manex II*, 3.2 pt. (3 days)

or

*Manzate 75 DF*, 1 to 2 lb. (3 days) May be used through irrigation equipment.

or

*Penncozeb 75 DF*, *Penncozeb 80 WP*, 2 lb. (3 days)

or

*Polyram 80 DF*, 2 lb. (3 days)

or

#### Famoxadone/Cymoxanil

*Tanos*, 6 oz/A every 7 to 10 days. (14 days) Maximum 3.0 lb/season.

or

#### Fenamidone

*Reason 500 SC*, 5.5 - 8.2 fl oz every 5 to 10 days. 24.6 fl oz maximum per season.. (7 days) **Note:** It is recommended that a protectant partner such as an EDBC (mancozeb or metiram) or chlorothalonil product is added in tank mixture to any strobilurine product. Strobilurines should also be used in rotation with a fungicide with a different mode of action.

or

#### Organotin-Based Compounds

*Agritin 80 WP*, *Supertin 80 WP*, 2.5 to 3.75 oz. (21 days) Use only in tank mixture with other fungicides. Do not apply more than 11.5 oz/acre in a growing season.

or

#### Pyraclostrobin

*Headline 2 SC*, 6-9 fl oz. (3 days) Do not apply more than 72 fl. oz per season. **Note:** It is recommended that a protectant partner such as an EDBC (mancozeb or metiram) or chlorothalonil product is added in tank mixture to any strobilurine product. Strobilurines should also be used in rotation with a fungicide with a different mode of action.

or

#### Pyrimethanil

*Scala*, 7 fl oz every 7 - 14 days. (7 days) Maximum of 35 fl oz per season. **Note:** It is recommended that a protectant partner such as an EDBC (mancozeb or metiram) or chlorothalonil product is added in tank mixture to any Qol product. Qol products should also be used in rotation with a fungicide with a different mode of action.

or

#### Trifloxystrobin

*Gem 25 WDG*, 6.0-8.0 oz. (7 days) Do not apply more than 48 oz. per season. **Note:** It is recommended that a protectant partner such as an EDBC (mancozeb or metiram) or chlorothalonil product is added in tank mixture to any strobilurine product. Strobilurines should also be used in rotation with a fungicide with a different mode of action.

or

#### Mancozeb/Zoxamide

*Gavel 75 DF*, 1.5 - 2.0 lb every 5 - 7 days. Maximum 12.0 lb/season.. (3 days)

or

#### Mandipropamid/Difenoconazole

*Revus Top*, 5.5-7 fl oz every 7-10 days. (14 days) Maximum 28 fl oz/A/season.

or

#### Potassium Bicarbonate

*Armcarb 100*, 2.5 to 5 lb every 5-14 days. (0 days)

or

#### Copper Hydroxide

*Badge SC*, 0.9 - 3.7 pt every 7-10 days.

*C-O-C-S WDG*, 1.5 to 4 lb every 7-10 days. (0 days)

*Kentan DF*, 3 lb every 7-10 days.

or

#### Copper Oxychloride / Copper Sulfate

*Badge SC*, 0.9 - 3.7 pt every 7-10 days.

*C-O-C-S WDG*, 1.5 to 4 lb every 7-10 days. (0 days)

*Kentan DF*, 3 lb every 7-10 days.

or

#### Copper Hydroxide/Copper Oxychloride

*Badge SC*, 0.9 - 3.7 pt every 7-10 days.

*C-O-C-S WDG*, 1.5 to 4 lb every 7-10 days. (0 days)

*Kentan DF*, 3 lb every 7-10 days.

or

#### Pyrimethanil/Trifloxystrobin

*Distinguish 480SC*, 10 fl oz every 7-14 days. (7 days) Maximum 50 fl oz/A/season.

or

#### Fluoxastrobin

*Evito 480SC*, 3.8 fl oz every 7-10 days. It is recommended that a protectant partner such as an EDBC (mancozeb or metiram) or chlorothalonil product is added in tank mixture to any strobilurine product.

Strobilurines should also be used in rotation with a fungicide with a different mode of action.

**LATE BLIGHT** (*Phytophthora infestans*): Apply after plants are 6 inches tall and every 5-7 days until vines are completely dead.

#### Mefenoxam/Chlorothalonil

*Ridomil Gold Bravo*, 2 lb. (7 days)

*Ridomil Gold MZ*, 2.5 lb. (7 days)

## Potatoes

or

*Ridomil Gold Copper*, 2 lb. (7 days) Apply when foliage meets within the row and may be applied once more after 14 days. Use protectant fungicides between applications.

or

### Mefenoxam/Copper Hydroxide

*Ridomil Gold Bravo*, 2 lb. (7 days)

*Ridomil Gold MZ*, 2.5 lb. (7 days)

or

*Ridomil Gold Copper*, 2 lb. (7 days) Apply when foliage meets within the row and may be applied once more after 14 days. Use protectant fungicides between applications.

or

### Mefenoxam/Mancozeb

*Ridomil Gold Bravo*, 2 lb. (7 days)

*Ridomil Gold MZ*, 2.5 lb. (7 days)

or

*Ridomil Gold Copper*, 2 lb. (7 days) Apply when foliage meets within the row and may be applied once more after 14 days. Use protectant fungicides between applications.

or

### Azoxystrobin

*Quadris*, 6.2-15.4 fl oz.

**Note:** It is recommended that a protectant partner such as an EDBC (mancozeb or metiram) or chlorothalonil product is added in tank mixture to any strobilurine product. Strobilurines should also be used in rotation with a fungicide with a different mode of action.

or

### Azoxystrobin/Chlorothalonil

*Quadris Opti*, 1.6 pt/A every 5 - 7 days. (14 days) Maximum 9.6 pt/season.

or

### Bacillus subtilis

*Serenade*, 6 lb/A every 5 - 7 days.

or

### Bacillus pumilis

*Sonata*, 4 - 8 pt/A every 5 - 7 days.

or

### Boscalid

*Endura*, 2.5 - 4.5 oz every 7 - 14 days. (30 days) Maximum 20.5 oz/season.

or

### Chlorothalonil

*Applause 720*, 1.0 to 1.5 pt. (7 days) Apply every 5-10 days. Do not apply more than 15 pt/A/season.

or

*Bravo Ultrex*, 0.9 to 1.4 lb. (7 days)

or

*Bravo Weather Stik*, 1 to 1.5 pt. (7 days) Do not apply more than 16 pt in a growing season.

or

*Bravo Weather Stik Zn*, 1.0 to 1.5 pt. (7 days) Do not apply more than 16 pt in a growing season.

or

*Echo Zn*, 1.5 to 2 pt/A. (7 days) Do not apply more than 21.5 pt in a growing season.

or

*Equus 720 SST*, 1 to 1.5 pt. (7 days) Do not apply more than 15 pt in a growing season.

or

*Initiate 720*, 1.0 to 1.5 pt. (7 days) Apply every 5-10 days.

Maximum 15 pt/A/season.

**Note:** All chlorothalonil products may be applied through irrigation water.

or

### Copper Hydroxide

*Badge SC*, 0.9 - 3.7 pt every 7-10 days.

*Champ Formula 2 F*, 1 1/3 to 2 pt. (0 days)

*C-O-C-S WDG*, 1.5 to 4 lb every 7-10 days. (0 days)

*Kocide 2.4 LF*, 2 lb. (0 days)

**Note:** During growing season, use copper-based compounds in mixture with chlorothalonil.

or

### Copper-based compounds

*Badge SC*, 0.9 - 3.7 pt every 7-10 days.

*Champ Formula 2 F*, 1 1/3 to 2 pt. (0 days)

*C-O-C-S WDG*, 1.5 to 4 lb every 7-10 days. (0 days)

*Kocide 2.4 LF*, 2 lb. (0 days)

**Note:** During growing season, use copper-based compounds in mixture with chlorothalonil.

or

### Copper Oxychloride / Copper Sulfate

*Badge SC*, 0.9 - 3.7 pt every 7-10 days.

*Champ Formula 2 F*, 1 1/3 to 2 pt. (0 days)

*C-O-C-S WDG*, 1.5 to 4 lb every 7-10 days. (0 days)

*Kocide 2.4 LF*, 2 lb. (0 days)

**Note:** During growing season, use copper-based compounds in mixture with chlorothalonil.

or

### Copper Hydroxide/Copper Oxychloride

*Badge SC*, 0.9 - 3.7 pt every 7-10 days.

*Champ Formula 2 F*, 1 1/3 to 2 pt. (0 days)

*C-O-C-S WDG*, 1.5 to 4 lb every 7-10 days. (0 days)

*Kocide 2.4 LF*, 2 lb. (0 days)

**Note:** During growing season, use copper-based compounds in mixture with chlorothalonil.

or

### Cymoxanil

*Curzate 60 DF*, 0.21 lb. (14 days) Use only in tank mixture with other fungicides from when foliage meets within rows to early senescence. May be used to prevent spread to uninfected foliage from within infected fields. Must be mixed with a fungicide partner such as an EDBC or chlorothalonil

or

### Dimethomorph

*Acrobat 50 WP*, 4 to 6.4 oz. (4 days) Use from when foliage meets within rows to late senescence. May be used to prevent spread to uninfected foliage from within infected fields. Must be mixed with a fungicide partner such as an EDBC or chlorothalonil.

or

*Acrobat MZ*, 2.25 lb. (14 days) Use from when foliage meets within rows to late senescence. May be used to prevent spread to uninfected foliage from within infected fields.

or



*Forum*, 4 to 6 fl oz. (4 days) Use from when foliage meets within rows to late senescence. May be used to prevent spread to uninfected foliage from within infected fields. Must be mixed with a fungicide partner such as an EBDC or chlorothalonil.

or

Dimethomorph and Mancozeb

*Acrobat* 50 WP, 4 to 6.4 oz. (4 days) Use from when foliage meets within rows to late senescence. May be used to prevent spread to uninfected foliage from within infected fields. Must be mixed with a fungicide partner such as an EBDC or chlorothalonil.

or

*Acrobat* MZ, 2.25 lb. (14 days) Use from when foliage meets within rows to late senescence. May be used to prevent spread to uninfected foliage from within infected fields.

or

*Forum*, 4 to 6 fl oz. (4 days) Use from when foliage meets within rows to late senescence. May be used to prevent spread to uninfected foliage from within infected fields. Must be mixed with a fungicide partner such as an EBDC or chlorothalonil.

or

Mancozeb

*Dithane* DF Rainshield (2 lb) or *Manzate* 75 DF (1 to 2 lb) (3 days) May be used through irrigation equipment.

or

*Manex* II, 3.2 pt. (3 days)

or

*Penncozeb* 75 DF (2 lb) or *Penncozeb* 80 WP (1 to 2 lb) (3 days)

or

*Polyram* 80 DF, 2 lb. (3 days)

or

Famoxadone/Cymoxanil

*Tanos*, 6 - 8 oz/A every 7 to 10 days. (14 days)  
Maximum 3.0 lb/season.

or

Fenamidone

*Reason* 500 SC, 5.5 - 8.2 fl oz every 5 to 10 days. (7 days) Maximum 24.6 fl oz/season.

**Note:** It is recommended that a protectant partner such as an EBDC (mancozeb or metiram) or chlorothalonil product is added in tank mixture to any strobilurine product. Strobilurines should also be used in rotation with a fungicide with a different mode of action.

or

Organotin-Based Compounds

*Agritin* 80 WP, *Supertin* 80 WP, 2.5 to 3.75 oz. (21 days) Use only in tank mixture with other fungicides. Do not apply more than 11.5 oz per growing season.

or

Mono-, dibasic sodium, potassium and ammonium phosphites

*Phostrol*, 3.75 - 10 pt/A every 5 to 10 days. **Note:** It is recommended that a protectant partner such as an EBDC (mancozeb or metiram) or chlorothalonil product is added in tank mixture.

or

*Prophyt*, 4 pt every 5-10 days.

or

Propamocarb

*Previcur* Flex, 0.9 to 1.2 pt/acre depending on disease pressure; with chlorothalonil-based product at 2/3 rate or with EBDC-based product at 2/3 rate. (14 days)

or

Pyraclostrobin

*Headline* 2 SC, 6-9 fl oz. (3 days) Do not apply more than 72 fl. oz per season. **Note:** It is recommended that a protectant partner such as an EBDC (mancozeb or metiram) or chlorothalonil product is added in tank mixture to any strobilurine product. Strobilurines should also be used in rotation with a fungicide with a different mode of action.

or

Trifloxystrobin

*Gem* 25 WDG, 6.0-8.0 oz. (7 days) Do not apply more than 48 oz. per season. **Note:** It is recommended that a protectant partner such as an EBDC (mancozeb or metiram) or chlorothalonil product is added in tank mixture to any strobilurine product. Strobilurines should also be used in rotation with a fungicide with a different mode of action.

or

Mancozeb/Zoxamide

*Gavel* 75 DF, 1.5 - 2.0 lb every 5 - 7 days. (3 days) Maximum 12.0 lb/season.

or

Maneb

*Maneb* 80 WP, 1 1/2 to 2 lb. (3 days)

or

Fluazinam

*Omega* 500 F, 5.5 fl oz/A. (14 days) Do not apply more than 3.5 pt in a growing season.

or

Mandipropamid/Difenoconazole

*Revus* Top, 5.5-7 fl oz every 7-10 days. (14 days) Maximum 28 fl oz/A/season.

or

Fluoxastrobin

*Evito* 480SC, 3.8 fl oz every 7-10 days. It is recommended that a protectant partner such as an EBDC (mancozeb or metiram) or chlorothalonil product is added in tank mixture to any strobilurine product. Strobilurines should also be used in rotation with a fungicide with a different mode of action.

or

Fluopicolide

*Presidio*, 3-4 fl oz every 10 days. (7 days)

or

Cyazofamid

*Ranman*, 1.4 to 2.75 fl oz every 7 to 10 days. (7 days) Maximum 27.5 fl oz/A/season.

**LATE BLIGHT TUBER ROT** (*Phytophthora infestans*), **LEAK**

(*Phythium* spp.), **PINK ROT** (*Phytophthora erythroseptica*): Apply at flowering and again 14 days later.

Mefenoxam/Chlorothalonil

*Ridomil* Gold Bravo, or *Ridomil* Gold Copper (2 lb) or *Ridomil* Gold MZ (2.5 lb) (21 days) Apply when foliage meets within the row and may be applied once more after 14 days. Use protectant fungicides between applications.

## Potatoes

or

### Mefenoxam/Copper Hydroxide

*Ridomil Gold Bravo*, or *Ridomil Gold Copper* (2 lb) or *Ridomil Gold MZ* (2.5 lb) (21 days) Apply when foliage meets within the row and may be applied once more after 14 days. Use protectant fungicides between applications.

or

### Mefenoxam/Mancozeb

*Ridomil Gold Bravo*, or *Ridomil Gold Copper* (2 lb) or *Ridomil Gold MZ* (2.5 lb) (21 days) Apply when foliage meets within the row and may be applied once more after 14 days. Use protectant fungicides between applications.

**BOTRYTIS BLIGHT** (*Botrytis cinerea*): Apply after mid-season when disease symptoms are likely to appear.

### Chlorothalonil

*Applause 720*, 1.0 to 1.5 pt. (7 days) Apply every 5-10 days. Do not apply more than 15 pt/A/season.

or

*Bravo Ultrex*, 0.9 to 1.4 lb. (7 days) Do not apply more than 21.5 lb in a growing season.

or

*Bravo Weather Stik*, *Equus 720 SST*, 1 to 1.5 pt. (7 days) Do not apply more than 15 pt in a growing season.

or

*Echo Zn*, 1.5 to 2.2 pt. (7 days) Do not apply more than 21.5 pt in a growing season.

or

*Initiate 720*, 1.0 to 1.5 pt. (7 days) Apply every 5-10 days. Maximum 15 pt/A/season.

**Note:** All chlorothalonil products may be applied through irrigation water.

or

### Mancozeb

*Dithane DF Rainshield*, 2 lb. (3 days) May be used through irrigation equipment.

or

*Manzate 75 DF*, 1 to 2 lb. (3 days)

or

*Penncozeb 75 DF* (2 lb) or *Penncozeb 80 WP* (1 to 2 lb) (3 days)

or

*Polyram 80 DF*, 2 lb. (3 days)

or

### Maneb

*Maneb 80 WP*, 1 1/2 to 2 lb. (3 days)

*Manex 4 F*, 3.2 pt. (3 days)

**WHITE MOLD** (*Sclerotinia sclerotiorum*): Apply at first sign of disease or immediately prior to row closing, and again 28 days later if needed.

### Fluazinam

*Omega 500 F*, 5.5 fl oz. (14 days) Do not apply more than 3.5 pt in a growing season.

or

### Iprodione

*Iprodione 4L*, 1 - 2 pt every 14-21 days. (14 days) Maximum 8 pt/A/season.

or

*Nevado 4F*, 1 - 2 pt every 14-21 days. (14 days) Maximum 8 pt/A/season.

or

*Rovral 4 F*, 2 pt in at least 10 gallons of water per acre. (14 days) See label for rotational crop restrictions.

or

### Thiophanate-Methyl

*Topsin M 70 WSB*, 1-2 lb. (21 days) Do not apply more than 4 lb per season.

or

### Boscalid

*Endura*, 5.5 - 10 oz/A every 14 days. (30 days) Maximum 20.5 oz/season.

**BROWN LEAF SPOT** (*Alternaria alternata*):

### Mandipropamid/Difenoconazole

*Revus Top*, 5.5-7 fl oz every 7-10 days. (14 days) Maximum 28 fl oz/A/season.

or

### Famoxadone/Cymoxanil

*Tanos DF*, 6 oz every 7-10 days. (14) Maximum 3 lb/A/season. It is recommended that a protectant partner such as an EBDC (mancozeb or metiram) or chlorothalonil product is added in tank mixture to any strobilurine product. Strobilurines should also be used in rotation with a fungicide with a different mode of action.

## PRE-HARVEST SPRAYS:

**LATE BLIGHT:** When vines are seriously infected at harvest time. Apply as necessary.

*Blue Viking Star Glow Powder 100 SC*, 10 lb.

*Blue Viking Star Shine Crystals 100 SC*, 10 lb.

**Note:** The Blue Viking Concentrates should only be applied at vine-kill as they are phytotoxic.

or

### Copper Hydroxide

*Champ Formula 2 F*, 2 to 5 pt.

or

### Copper-based compounds

*Kocide 2.4 LF*, 2 lb.

## STORAGE DISINFECTION:

To disinfect storages, boxes, truck beds, bags and equipment (tools, farm machinery), spray or drench surfaces with one of the following compounds:

### Sodium Hypochlorite

*Chlorine* solution, 1,000 to 2,000 ppm concentration.

Commercial formulations vary in concentration; therefore, follow manufacturer's recommendation when mixing solutions.

Example: Perchlorin is a granule containing 70% calcium hypochlorite.

It takes 5 teaspoons in 3 gallons of water to make a solution of 1,000 ppm. Rinse food containers and implements that come in contact with food after treatment.

or

### Quaternary ammonium compounds

*Aquahyme (E-Z Flo)*, Use according to manufacturer's recommendations.

or



Green Shield, 0.5 fl oz per gallon of water.

or

Hy 2389 (Rohm & Haas), Use according to manufacturer's recommendations.

or

Odorless Disinfectant (Haviland), Use according to manufacturer's recommendations.

The addition of a wetting agent with quaternary ammonium sprays or drenches is suggested to obtain more uniform coverage of surfaces. Use only those wetting agents recommended by the manufacturer because some are not compatible. Rinse food containers and implements that come in contact with food after treatment.

or

Soluble copper sulfate (blue vitriol; bluestone; etc.), 10 to 15 lb in 100 gallons of water.

or

Hydrogen peroxide

Oxidate, 1.5 to 2.5 fl oz per 100 gal water. Apply at 1 gal of solution per 2000 lb of tubers.

**Note:** It is important to remove all dirt and trash from surfaces to be treated.

## PRE-STORAGE TREATMENTS FOR STORAGE DISEASES:

**BACTERIAL SOFT ROT** (*Erwinia carotovora*): Wash potatoes in chlorinated water to (1) disinfect tuber surfaces; (2) cauterize wounds; and (3) promote rapid formation of protective tissue over injured surfaces.

Hydrogen peroxide

Oxidate, 1.5 to 2.5 fl oz per 100 gal water. Apply at 1 gal of solution per 2000 lb of tubers. May also be applied in humidification water (see manufacturers' recommendations).

or

Sodium Hypochlorite

Chlorine solution. Add a concentrated stock solution of chlorine to wash water to give a concentration of 200 ppm (= 2 pt household bleach (5.25% sodium hypochlorite) per 60 gallons of water or 1 gal of bleach per 240 gallons of water).

Mix stock solutions of chlorine in earthen-ware crocks or plastic containers. DO NOT USE metal containers. Dry washed potatoes before bagging or bulk storing by passing hot air over the end of the sorting table. Usually, the sponge drying technique is inadequate without the addition of heat.

**FUSARIUM DRY ROT** (*Fusarium* spp.):

Hydrogen peroxide

Oxidate, 1.5 to 2.5 fl oz per 100 gal water. Apply at 1 gal of solution per 2000 lb of tubers. May also be applied in humidification water (see manufacturers' recommendations).

or

Thiabendazole

Mertect 340, 42 oz flowable formulation in 100 gallons of water.

Apply as a spray to potato tubers (seed and table stock) at time of storage and again at removal; 1 gal of solution per 2,000 lb of tubers. See manufacturer's recommendations for equipment and methods to use. Treatment may be applied to washed or unwashed potatoes. Addition of chlorine (200 ppm) to solution

will help control bacterial soft rot. It is advisable to add a wetting agent when treating before storage to ensure good coverage.

**LATE BLIGHT** (*Phytophthora infestans*):

Mono-, dibasic sodium, potassium and ammonium phosphites

Phostrol, 0.1 gal/ton. Apply at 2-4 pt/2000 lb of tubers.

or

Prophyt, 13 fl oz/ton.

**PINK ROT** (*Phytophthora erythroseptica*):

Mono-, dibasic sodium, potassium and ammonium phosphites

Phostrol, 0.1 gal/ton. Apply at 2-4 pt/2000 lb of tubers.

Prophyt, 13 fl oz/ton.

**PYTHIUM LEAK** (*Pythium ultimum*):

Mono-, dibasic sodium, potassium and ammonium phosphites

Phostrol, 0.1 gal/ton. Apply at 2-4 pt/2000 lb of tubers.

## Pumpkins

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

Pumpkins are hosts for root-knot and lesion nematodes. These nematodes can reduce pumpkin yields but yield losses in Michigan have not been documented. If you suspect nematodes are reducing pumpkin yields collect root and soil samples for analysis as described in Appendix C. If the numbers of nematodes recovered from those samples exceed damage thresholds; control options will be suggested. Vydate 2L is labeled for use in pumpkins.

## INSECTS

### SEED TREATMENT:

#### SEED CORN MAGGOT:

Lorsban 50 SL, 2 oz/100 lb seed. See label for directions. (RUP)

### SOIL TREATMENT:

#### CUCUMBER BEETLE (STRIPED and SPOTTED), APHIDS,

**THRIPS:** Apply to soil in a narrow band 14 or less days before planting, as an in-furrow spray at planting, as a post-seeding drench, as a sidedress after plants are established or in drip or trickle irrigation water. Do not make more than 1 application per year.

Imidacloprid

Admire Pro, 7.0 - 10.5 fl oz. (21 days)

Nuprid 2 F, 16 to 24 oz. (21 days)

#### CUCUMBER BEETLE:

Furadan 4 F, 2.4 oz/1000 ft of row. Apply at planting or transplanting in a 7-inch band, incorporate into the top 3 inches of soil, or apply into the furrow and mix with the covering soil. (Special Michigan SLN label.) (RUP)

## Pumpkins

### APHIDS, FLEA BEETLE, LEAFHOPPER, THRIPS, CUCUMBER BEETLE:

*Platinum*, 5 to 11 oz. (30 days) See label for application methods.

### APHIDS, THRIPS, SQUASH BUG:

*Venom*, 5 to 6 oz. (21 days) See label for application methods

### FOLIAR TREATMENT:

Pumpkin plants may be sensitive to insecticide formulations under certain conditions. Be sure a problem exists before treatment. Read and observe restrictions or the label. To avoid killing bees, do not treat pumpkins during bloom. See the Insecticide Effectiveness table for bee toxicity.

**CUTWORM:** Apply when damage is first seen and repeat as needed.

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

or

\* *Baythroid* XL, 0.8 to 1.6 fl oz. (0 days) (RUP)

or

\* Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.6 to 6.4 oz. (3 days) (RUP)

or

\* Permethrin

*Ambush* 25 W, 12.8 oz. (0 days) (RUP)

or

*Perm-UP* 3.2 EC (8 oz) or *Pounce* 25 WP (12.8 oz) or *Pounce* 3.2 EC (8 oz) (0 days) (RUP)

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)

Do not exceed 23 fl oz/acre per season. (RUP)

**STRIPED and SPOTTED CUCUMBER BEETLE:** Apply as soon as beetle are seen and repeat as needed to prevent bacterial wilt disease.

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

or

*Baythroid* XL, 2.4 to 2.8 fl oz. (0 days) (RUP)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.6 to 6.4 oz. (3 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 qt) (3 days)

or

*Endosulfan* 3 EC, 1 qt. (2 days)

or

Permethrin

*Ambush* 25 W, 6.4 to 12.8 oz. (0 days) (RUP)

or

*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz) or *Pounce* 3.2 EC (4 to 8 oz) (0 days) (RUP)

or

*Danitol* 2.4 EC, 10 2/3 to 16 fl oz. (7 days) (RUP)

or

*Venom*, 3 to 4 oz. (1 day)

or

*Actara*, 3 to 5.5 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)

Do not exceed 23 fl oz/acre per season. (RUP)

or

*Assail* 30 SG, 2.5 to 5.3 oz. (0 days)

**FLEA BEETLE:** Apply as needed.

Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 qt) (3 days)

or

*Actara*, 1.5 to 3 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)

Do not exceed 23 fl oz/acre per season. (RUP)

**LEAFHOPPERS:** Apply when damage is seen.

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

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.6 to 6.4 oz. (3 days) (RUP)

or

*Venom*, 1 to 4 oz. (1 day)

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)

Do not exceed 23 fl oz/acre per season. (RUP)

**SQUASH BUG:** Apply as needed.

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

or

\* Permethrin

*Ambush* 25 W, 12.8 oz. (0 days) (RUP)

or

*Perm-UP* 3.2 EC (8 oz) or *Pounce* 25 WP (12.8 oz) or *Pounce* 3.2 EC (8 oz) (0 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 qt) (3 days)

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.6 to 6.4 oz. (3 days) (RUP)

or

*Venom*, 3 to 4 oz. (1 day)

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)

Do not exceed 23 fl oz/acre per season. (RUP)

or

*Assail* 30 SG, 5.3 oz. (0 days)

**SQUASH VINE BORER:** Apply to base of plants when moths are active, usually starting when plants start to vine. Repeat every 3 to 5 days for 3 weeks.

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

or

Bifenthrin

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.6 to 6.4 oz. (3 days) (RUP)

or

*Endosulfan* 3 EC, 1 qt. (2 days)

or



**Permethrin**

*Ambush* 25 W, 6.4 to 12.8 oz. (0 days) (RUP)

or

*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz)  
or *Pounce* 3.2 EC (4 to 8 oz) (0 days) (RUP)

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)

Do not exceed 23 fl oz/acre per season. (RUP)

or

*Assail* 30 SG, 5.3 oz. (0 days)

**APHIDS:** Apply as needed to prevent disease transmission to plants. Repeat as needed.

*Endosulfan* 3 EC, 1 qt. (2 days)

or

*Fulfill*, 2.75 oz. (0 days) Do not exceed 5.5 oz/acre per season.

May require 5 to 7 days for aphid mortality.

or

*Malathion* 57 EC, 1 1/2 pt. (3 days)

or

*Venom*, 1 to 4 oz. (1 day)

or

*Beleaf* 50 SG, 2 to 2.8 oz. (0 days)

or

*Actara*, 1.5 to 3 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

*Assail* 30 SG, 2.5 to 4 oz. (0 days)

**MITES**

Apply when needed. Usually a problem only in hot dry weather.

*Agri-Mek* 0.15 EC, 8 to 16 fl oz. (7 days) (RUP)

or

*Bifenthrin*

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 5.1 to 6.4 oz.  
(3 days) (RUP)

or

*Danitol* 2.4 EC, 10 2/3 fl oz. (7 days) (RUP)

or

*Malathion* 57 EC, 1 1/2 pt. (3 days)

or

*Oberon* 2 SC, 7 to 8.5 fl oz. (7 days)

**SLUGS**

*Deadline* M-Ps 4% (20 to 40 lb) or *Metaldehyde* 3.5 G (30 to 40 lb) Apply between rows. Avoid contact with edible product.

**DISEASES****SEED TREATMENT:**

**DAMPING OFF** (*Pythium* spp., *Phytophthora* spp., *Rhizoctonia solani*): Use only as directed; over-treatment may cause injury.

*Bacillus subtilis* GB03

*Kodiak*, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

*Fludioxinil*

*Maxim* 4 FS, 0.08 to 0.16 fl oz/100 lb seed (*Rhizoctonia*).

Commercial seed treatment plants only.

or

**Captan**

*Captan* 30-DD, 1 2/3 oz/100 lb seed.

*Captan* 400, 1 1/2 to 2 oz/100 lb seed.

or

**Thiram**

42-S Thiram, *Thiram* 50 WP Dyed, 4 1/2 oz/100 lb seed.

**PRE-PLANT FUMIGATION:**

**PHYTOPHTHORA:** Apply to production fields before planting.

**Note:** Most fumigants applied to the soil for control of disease organisms will also control soil insects, nematodes and weed seeds.

Soil sterilization by fumigation is best achieved by proper application of material. Correct soil moisture, temperature, and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or immediate tarping.

1,3 Dichloropropene/chloropicrin

*Telone* C35, 13-35 gal. (RUP)

or

Metam Sodium

*Sectagon* 42, *Vapam* HL, 37.5-75 gal.

or

Potassium N-methylidithiocarbamate

*Sectagon-K54*, 30-60 gal.

Do not plant for 14 to 30 days after treatment (the wetter the soil, the longer the waiting period).

**GREENHOUSE PREPLANT INCORPORATION:**

**DAMPING OFF** (*Pythium* spp.), **ROOT ROT** (*Rhizoctonia* spp.):

*Gliricladium virens* GL-21

*SoilGard* 12 G, 1 to 1.5 lb per cubic yard.

Biological control product that needs to be applied before disease development. Control may be limited under heavy disease pressure.

**PREPLANT INCORPORATED:**

**DAMPING OFF and COTTONY LEAK** (*Pythium* spp.):

\* Mefenoxam. Apply as a broadcast preplant incorporation or a surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 1 in. of sprinkler irrigation.

*Ridomil* Gold SL, 1-2 pt.

*Ultra* Flourish, 2 to 4 pt.

**FOLIAR TREATMENT:**

**ALTERNARIA LEAF SPOT** (*Alternaria cucumerina*),

**ANTHRACNOSE** (*Colletotrichum lagenarium*): Apply every 7 to 14 days after disease appears.

\* Azoxystrobin

*Amistar*, 3.5 to 5 oz. (1 day)

*Quadris*, 11.0 to 15.4 fl oz. (1 day)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

## Pumpkins

or

\* Azoxystrobin/Chlorothalonil

*Quadris* Opti, 3.2 pt every 7 - 14 days. (1 day)

or

\* Chlorothalonil

*Bravo Ultrex* (1.4 to 1.8 lb (*Anthrachnose*) or 1.8 to 2.7 lb (*Alternaria*)) or *Equus* DF (1.4 to 1.8 lb) (0 days)

or

*Bravo Weather Stik*, *Echo* 720, *Equus* 720 SST, 1.5 to 2 pt, (*Anthrachnose*) or 2 to 3 pt (*Alternaria*). (0 days)

or

*Echo* 90 DF, 1.3 to 1.6 lb every 7 days. (0 days)

or

\* Pyraclostrobin

*Cabrio*, 12-16 oz. (0 days) No more than 2 consecutive applications before alternating with a fungicide having a different mode of action.

or

\* Pyraclostrobin/Boscalid

*Pristine*, 12.5 to 18.5 oz for *Alternaria*, 18.5 oz for *Anthrachnose*. (0 days)

or

\* Thiophanate-Methyl

*Topsin* 4.5 FL, 10 fl oz. (1 day)

or

*Topsin* 70 W, *Topsin* M WSB 1/4 to 1/2 lb (*Anthrachnose*) (0 days)

or

Copper Ammonium Carbonate

*Copper* Count N, 1 to 2 qt. (0 days)

or

Copper Hydroxide

*Champ* DP, 1 1/3 lb. (0 days)

*Champ* Formula 2 F, *Kocide* 4.5 LF, 1 1/3 pt. (0 days)

*Champion* WP, 1.5 to 3 lb. (0 days)

*Kocide* 2000, 1 1/2 lb. (0 days)

*Nu-Cop* 3 L, 1 to 4 pt. (0 days)

or

Copper Oxychloride / Copper Sulfate

C-O-C-S WDG, 2 to 4 lb every 7 days. (0 days)

or

Copper Sulfate

*Cuprofix* Ultra, 1.25 lb. (0 days)

or

Famoxadone/Cymoxanil

*Tanos*, 8 oz. (3 days)

or

Neem Oil

*Trilogy*, 2 pt. (0 days)

or

Potassium Bicarbonate

*Armcarb* 100, 2.5 to 5 lb.

or

Copper Resinate

*Tenn-Cop* 5 E, 3 pt. (0 days)

**ANGULAR LEAF SPOT** (*Pseudomonas lachrymans*): Spray every 7 days, starting before the first fruit forms and continue to protect fruit at all stages of development.

Copper Ammonium Carbonate

*Copper* Count N, 1 to 2 qt. (0 days)

or

Copper Hydroxide

*Champ* DP, 1 1/3 lb. (0 days)

*Champ* Formula 2 F, *Kocide* 4.5 LF, 1 1/3 pt. (0 days)

*Champion* WP, 1.5 to 3 lb. (0 days)

*Kocide* 2000, 1 1/2 lb. (0 days)

*Nu-Cop* 3 L, 1 to 4 pt. (0 days)

or

Copper Sulfate

*Cuprofix* Ultra, 1.25 lb. (0 days)

or

Neem Oil

*Trilogy*, 2 pt. (0 days)

or

Copper Resinate

*Tenn-Cop* 5 E, 3 pt. (0 days)

**SCAB** (*Cladosporium cucumerinum*): Apply every 7 to 10 days after plants are 2 to 3 inches tall.

\* Chlorothalonil

*Bravo Ultrex*, *Equus* DF, 1.8 to 2.7 lb. (0 days)

*Echo* 90 DF, 1.6 to 2.4 lb every 7 days. (0 days)

or

*Bravo Weather Stik*, *Echo* 720, *Equus* 720 SST, 2 to 3 pt. (0 days)

or

Neem Oil

*Trilogy*, 2 pt. (0 days)

or

Copper Resinate

*Tenn-Cop* 5 E, 3 pt. (0 days)

**POWDERY MILDEW** (*Sphaerotheca fuliginea*, *Erysiphe cichoracearum*): Treat at disease appearance and at 7-day intervals.

\* Myclobutanil

*Rally* 40 WSP, 2.5 to 5 oz, 7 to 10 day schedule. (0 days) Do not apply more than 1.5 lb per acre per crop.

or

\* Pyraclostrobin

*Cabrio*, 12-16 oz. (0 days) Alternate one-to-one with fungicides having a different mode of action.

or

\* Pyraclostrobin/Boscalid

*Pristine*, 12.5 to 18.5 oz. (0 days)

or

\* Thiophanate-Methyl

*Topsin* 4.5 FL, 10 fl oz. (1 day)

*Topsin* 70 W, *Topsin* M WSB, 1/4 to 1/2 lb. (0 days)

or

\* Trifloxystrobin

*Flint*, 1 1/2 to 2 oz, 7- to 14-day intervals. (0 days) Maximum 2 consecutive applications, 4 applications/year and 16 oz/season.

or

Azoxystrobin

*Amistar*, 3.5 to 5 oz. (1 day)

*Quadris*, 11.0 to 15.4 fl oz. (1 day)



Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

Azoxystrobin/Chlorothalonil

Quadris Opti, 3.2 pt every 7 - 14 days. (1 day)

or

Bacillus subtilis

Serenade, 6 to 8 lb every 7 days. (0 days)

Serenade Max, 1 - 3 lb every 7 to 10 days. (0 days)

Biological control product that needs to be applied before disease development. Control will be limited under heavy disease pressure.

or

Chlorothalonil

Bravo Ultrex, Equus DF, 1.8 to 2.7 lb (*Sphaerotheca*). (0 days)

Echo 90 DF, 1.6 to 2.4 lb every 7 days. (0 days)

or

Bravo Weather Stik, Echo 720, Equus 720 SST, 2 to 3 pt (*Sphaerotheca*). (0 days)

or

Copper Ammonium Carbonate

Copper Count N, 1 to 2 qt. (0 days)

or

Copper Hydroxide

Champ DP, 1 1/3 lb. (0 days)

Champ Formula 2 F, Kocide 4.5 LF, 1 1/3 pt. (0 days)

Kocide 2000, 1 1/2 lb. (0 days)

Nu-Cop 3 L, 1 to 4 pt. (0 days)

or

Champion WP, Kocide 101, Kocide DF, Nu-Cop 50 DF, 1 1/2 to 3 lb. (0 days)

or

Copper Sulfate

Cuprofix Ultra, 1.25 lb. (0 days)

or

Neem Oil

Trilogy, 2 pt. (0 days)

or

Potassium Bicarbonate

Armcarb 100, 2.5 to 5 lb. (0 days)

or

Sulfur

Microthiol Disperss, 5 to 10 lb. (0 days)

Thiolux Jet, 4 to 6 lb, 10- to 14-day intervals. (0 days)

or

Triflumizole

Procure 480 SC, 4 to 8 fl oz every 7-14 days. (0 days)

or

Copper Resinate

Tenn-Cop 5 E, 3 pt. (0 days)

or

Tebuconazole

Folicur 3.6F, 4-6 fl oz. (7 days) 12 hr REI.

**GUMMY STEM BLIGHT, BLACK ROT** (*Didymella bryoniae* also called *Mycosphaerella melonis*): Begin at the 2-leaf stage and apply every 7 to 14 days.

\* Azoxystrobin

Amistar (3.5 to 5 oz) or Quadris (11.0 to 15.4 fl oz) (1 day) Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action

or

\* Azoxystrobin/Chlorothalonil

Quadris Opti, 3.2 pt every 7 - 14 days. (1 day)

or

\* Chlorothalonil

Bravo Ultrex, Equus DF, 1.8 to 2.7 lb. (0 days)

Echo 90 DF, 1.6 to 2.4 lb every 7 days. (0 days)

or

Bravo Weather Stik, Echo 720, Equus 720 SST, 2 to 3 pt. (0 days)

or

\* Thiophanate-Methyl

Topsin 4.5 FL, 10 fl oz. (1 day)

Topsin M 70 WP, Topsin M WSB, 1/4 to 1/2 lb. (0 days)

or

Copper Ammonium Carbonate

Copper Count N, 1 to 2 qt. (0 days)

or

Copper Hydroxide

Champ DP, 1 1/3 lb. (0 days)

Champ Formula 2 F, Kocide 4.5 LF, 1 1/3 pt. (0 days)

Champion WP, 1.5 to 3 lb. (0 days)

Kocide 2000, 1 1/2 lb. (0 days)

Nu-Cop 3 L, 1 to 4 pt. (0 days)

or

Copper Sulfate

Cuprofix Ultra, 1.25 lb. (0 days)

or

Pyraclostrobin/Boscalid

Pristine, 12.5 to 18.5 oz. (0 days)

or

Tebuconazole

Folicur 3.6F, 8 fl oz. (7 days) Approved for gummy stem blight. Suppression only.

**DOWNY MILDEW** (*Pseudoperonospora cubensis*): Begin applications when conditions are favorable for disease, but before infection.

\* Propamocarb

Previcur Flex, 1.2 pt every 7 - 14 days. (2 days)

or

\* Cyazofamid

Ranman, 2.1 to 2.75 fl oz every 7 to 10 days. (0 days)

or

\* Cymoxanil

Curzate 60 DF, 3.2 oz every 5 - 7 days. (3 days)

or

\* Famoxadone/Cymoxanil

Tanos, 8 oz. (3 days)

or

\* Chlorothalonil

Bravo Ultrex, Equus DF, 1.8 to 2.7 lb. (0 days)

Echo 90 DF, 1.6 to 2.4 lb every 7 days. (0 days)

or

## Radishes

*Bravo Weather Stik*, *Echo 720*, *Equus 720 SST*, 2 to 3 pt.  
(0 days)

or

\* Fluopicolide

*Presidio*, 3-4 fl oz. (2 days)

or

Azoxystrobin

*Amistar*, 3.5 to 5 oz. (1 day)

*Quadris*, 11.0 to 15.4 fl oz. (1 day)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

Azoxystrobin/Chlorothalonil

*Quadris Opti*, 3.2 pt every 7 - 14 days. (1 day)

or

Dimethomorph

*Acrobat 50 WP*, 6.4 oz. (0 days) Tank mix with other fungicide.

*Forum*, 6 fl oz. (0 days)

or

Fenamidone

*Reason 500 SC*, 5.5 fl oz every 5 to 10 days. (14 days)

or

Fosetyl-Aluminum

*Aliette WDG*, 2 to 5 lb, 7- to 14-day intervals. (0 days) Do not tank mix with copper fungicides.

or

Maneb

*Maneb 75 DF*, *Maneb 80 WP*, 1.5 to 2 lb. (5 days)

*Manex*, 2.4 to 3.2 pt. (5 days)

or

Mefenoxam/Chlorothalonil

*Ridomil Gold Bravo*, 2 lb. Do not apply to mature or senescent plants. Maximum 4 applications.

or

Mefenoxam/Copper Hydroxide

*Ridomil Gold Copper*, 2 lb. (5 days) Maximum 4 applications.

or

Mono-, dibasic sodium, potassium and ammonium phosphites

*Phostrol*, 2.5 to 5 pt every 7 - 14 days. (0 days)

*Prophyt*, 2 to 4 pt. (0 days)

or

Neem Oil

*Trilogy*, 2 pt.

or

Potassium Bicarbonate

*Armcarb 100*, 2.5 to 5 lb.

or

Pyraclostrobin

*Cabrio*, 8-12 oz. (0 days) Alternate one-to-one with fungicides having a different mode of action.

or

Pyraclostrobin/Boscalid

*Pristine*, 12.5 to 18.5 oz. (0 days)

or

Trifloxystrobin

*Flint*, 4 oz, 7- to 14-day intervals. (0 days) Maximum 2 consecutive applications, 4 applications/year and 16 oz/season. Alternate with Ridomil Gold Bravo.

or

Mono-, dibasic sodium salts of phosphorous acid

*Fosphite*, 1 to 3 qt per 20 gal (ground) or 10 gal (aerial) of water. (0 days)

or

Mandipropamid

*Revus*, 8 fl oz. (0 day)

**PHYTOPHTHORA ROOT and FRUIT ROT (*Phytophthora* spp.):**

\* Dimethomorph

*Acrobat 50 WP*, 6.4 oz every 7 days. (0 days)

*Forum*, 6 fl oz. (0 days)

or

\* Famoxadone/Cymoxanil

*Tanos*, 8 - 10 oz every 5 - 7 days. (3 days)

or

\* Fluopicolide

*Presidio*, 3-4 fl oz. (2 days)

or

\* Fosetyl-Aluminum

*Aliette WDG*, 2 to 5 lb, 7- to 14-day intervals. (0 days) Do not tank mix with copper fungicides.

or

\* Mandipropamid

*Revus*, 8 fl oz. (0 day)

or

Cyazofamid

*Ranman*, 2.75 fl oz every 7 to 10 days. (0 days)

or

Mono-, dibasic sodium, potassium and ammonium phosphites

*Phostrol*, 2.5 to 5 pt every 7 - 14 days. (0 days)

*Prophyt*, 4 pt. (0 days) See label.

or

Mono-, dibasic sodium salts of phosphorous acid

*Fosphite*, 1 to 3 qt per 20 gal (ground) or 10 gal (aerial) of water. (0 days)

**Note:** Most fungicides applied to control downy mildew may have limited efficacy against Phytophthora root and fruit rot.

## Radishes

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

Root-knot nematodes can reduce radish yields. Fields with soil or root problems of undetermined cause should be tested for nematodes (see Appendix C). If the root-knot nematode is present at a population density above the economical threshold for radishes, crop rotation or application of a nematicide is recommended. The following nematicide is suitable for control of root-knot nematodes in radish production. Application is only needed before the first crop. The radish life cycle is shorter than



that of the northern root-knot nematode and radishes serve as a good trap crop for this nematode.

## FALL SOIL TREATMENT (BROADCAST): 1,3-D

*Telone II*, 25 gal/A (muck soil).

Fumigate in the fall when soil temperatures at a 6 inch depth are above 50F. Inject the fumigant to soil depth of 6 inches and lightly seal the soil immediately after application. Use soil fumigants only as directed on the label. In some limited situations soil fumigants can be applied in the spring in Michigan.

Correct soil moisture, temperature and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or by immediate tarping.

## INSECTS

### SOIL TREATMENT:

#### CABBAGE MAGGOT:

*Lorsban 15 G* (3.3 oz/1,000 ft of row, in row with seed at time of planting) or *Lorsban 4 E / Lorsban Advanced* (1 fl oz/1,000 ft of row, in row with seed at time of planting) (RUP)

**APHIDS, FLEA BEETLE:** See label for application method.

Imidacloprid

*Admire Pro*, 4.4 - 10.5 fl oz. (21 days)

*Nuprid 2 F*, 10 to 24 oz. (21 days)

or

*Platinum*, 5 to 6.5 fl oz.

### FOLIAR TREATMENT:

**ARMYWORM, CUTWORM:** Apply as needed.

*Asana XL*, 5.8 to 9.6 oz. (7 days) (RUP)

or

*Baythroid XL*, 1.6 to 2.8 fl oz. (0 days) (RUP)

or

Carbaryl

*Sevin 80 S* (1 1/4 to 2 1/2 lb) or *Sevin XLR Plus* (1 to 2 qt) (7 days)

or

*Entrust*, 1 to 2 oz. (3 days)

or

*SpinTor 2 SC*, 3 to 6 oz. (3 days)

or

*Radiant SC*, 6 to 8 fl oz. (3 days) Do not make more than 3 applications or exceed 24 fl oz/acre per season.

**FLEA BEETLE:** Apply when damage is first seen. Repeat if needed.

*Actara*, 1.5 to 3 oz. (7 days)

or

*Asana XL*, 5.8 to 9.6 oz. (7 days) (RUP)

or

*Baythroid XL*, 1.6 to 2.8 fl oz. (0 days) (RUP)

or

Carbaryl

*Sevin 80 S* (2/3 to 1 1/4 lb) or *Sevin XLR Plus* (1/2 to 1 qt) (7 days)

or

*Diazinon AG 500*, 1 pt. (14 days) (RUP)

or

Imidacloprid

*Nuprid 1.6 F*, *Provado 1.6 F*, 3.5 fl oz. (7 days) Do not exceed 3.5 oz/Acre per season.

**CABBAGE "WORM":** Apply as needed.

*Bacillus thuringiensis*

*Agree*, *Biobit*, *Dipel*, *Javelin*, *Lepinox*. (0 days)

**APHIDS:** Apply as necessary.

*Actara*, 1.5 to 3 oz. (7 days)

or

*Diazinon AG 500*, 1 pt. (14 days) (RUP)

or

*Malathion 57 EC*, 2 pt. (7 days)

or

Imidacloprid

*Nuprid 1.6 F*, *Provado 1.6 F*, 3.5 fl oz. (7 days) Do not exceed 3.5 oz/Acre per season.

## SLUGS

*Deadline M-PS 4%* (20 to 40 lb) or *Metaldehyde 3.5 G* (30 to 40 lb) Apply between rows. Avoid contact with edible product.

## DISEASES

### SEED TREATMENT:

**DAMPING OFF** (*Pythium* spp., *Rhizoctonia solani*):

*Bacillus subtilis* GB03

*Kodiak*, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

*Fludioxinil*

*Maxim 4 FS*, 0.08 to 0.16 fl oz/100 lb seed (*Rhizoctonia*).

Commercial seed treatment plants only.

or

*Captan*

*Captan 30-DD*, 1 1/4 oz/100 lb seed.

*Captan 400*, 1 to 2 oz/100 lb seed.

or

*Thiram*

42-S *Thiram*, *Thiram 50 WP Dyed*, 8 oz/100 lb seed.

### SOIL TREATMENT:

**DAMPING OFF** (*Pythium* and *Phytophthora* spp.):

\* *Mefenoxam*. Apply as a broadcast preplant application or a surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 1 in. of sprinkler irrigation.

*Ridomil Gold SL*, 1-2 pt.

*Ridomil Gold WSP*, 1 to 2 lb.

### FOLIAR TREATMENT:

**ALTERNARIA LEAF SPOT** (*Alternaria raphani*):

\* *Azoxystrobin*

*Amistar*, 2 to 5 oz every 7 - 14 days. (0 days)

*Quadris*, 6.2 to 15.4 fl oz. (0 days)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

## Rhubarb

or

\* Pyraclostrobin

*Cabrio*, 8 to 12 oz. (0 days)

**WHITE RUST** (*Albugo candida*): Apply foliar spray 40 to 50 days following Ridomil at-planting application and make 2 to 4 applications on a 14-day schedule depending on disease development.

Mefenoxam/Chlorothalonil

*Ridomil Gold Bravo*, 2 lb. (7 days)

or

Pyraclostrobin

*Cabrio*, 8 to 16 oz. (0 days)

## Rhubarb

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## INSECTS

### AT PLANTING OR SIDE DRESS:

**APHIDS:** Apply preplant, in furrow or as a post-planting drench. Imidacloprid

*Admire Pro*, 4.4 - 10.5 fl oz. (45 days)

*Nuprid 2 F*, 10 to 24 fl oz. (45 days)

or

*Venom*, 5 to 6 oz. (21 days) See label for application method.

or

*Platinum*, 5 to 11 oz. (30 days) See label for application methods.

### FOLIAR TREATMENT:

#### CUTWORM, LOOPERS:

*Baythroid XL*, 1.6 to 3.2 fl oz. (0 days) (RUP)

or

Thiodicarb

*Larvin 3.2 EC*, 16 to 30 oz. (14 days)

or

Permethrin

*Ambush 25 W*, 6.4 to 12.8 oz. (1 day) (RUP)

or

*Perm-UP 3.2 EC* (4 to 8 oz) or *Pounce 25 WP* (6.4 to 12.8 oz)

or *Pounce 3.2 EC* (4 to 8 oz) (1 day) (RUP)

or

*SpinTor 2 SC*, 3 to 6 oz. (1 day)

or

*Entrust*, 1 to 2 oz. (1 day)

or

*Intrepid 2 F*, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day) or

*Radiant SC*, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

#### APHIDS:

*Assail 30 SG*, 1.9 to 2.8 oz. (7 days)

or

*Fulfill*, 2.75 oz. (7 days) Do not exceed 5.5 oz/acre per season.

May require 5 to 7 days for aphid mortality.

or

*Venom*, 1 to 3 oz. (7 days)

or

*Beleaf 50 SG*, 2 to 2.8 oz. (0 days)

or

*Actara*, 1.5 to 3 oz. (7 days) Do not exceed 11.0 oz/Acre per season.

#### RHUBARB CURCULIO:

No materials are currently registered for this use.

## DISEASES

### SEED TREATMENT:

**DAMPING OFF** (*Pythium* spp., *Rhizoctonia solani*):

*Bacillus subtilis* GB03

*Kodiak*, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

Fludioxinil

*Maxim 4 FS*, 0.08 to 0.16 fl oz/100 lb seed (*Rhizoctonia*).

Commercial seed treatment plants only.

### PREPLANT INCORPORATED:

**DAMPING OFF** (*Pythium* spp.):

\* Mefenoxam. Apply as a broadcast preplant incorporation or a surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 1 in. of sprinkler irrigation.

*Ridomil Gold GR*, 20 to 40 lb.

*Ridomil Gold SL*, 1-2 pt.

*Ridomil Gold WSP*, 1 to 2 lb.

*Ultra Flourish*, 2 to 4 pt.

### FOLIAR TREATMENT:

**LEAF ROT, BOTRYTIS GRAY MOLD** (*Botrytis cinerea*):

Azoxystrobin

*Quadris*, 6 to 15.5 fl oz every 5 - 14 days. (0 days)

or

DCNA

*Botran 75 W*, 1 1/3 lb (for greenhouse use only). (3 days)



## Rutabagas

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

### INSECTS

#### SOIL TREATMENT:

**CABBAGE MAGGOT:** Apply in a 4- to 6-inch band around seed at time of planting so plants grow in treated soil.

*Lorsban* 15 G (4.6 to 9.2 oz per 1,000 ft of row) or *Lorsban* 4 E / *Lorsban* Advanced (1.6 to 3.3 fl oz per 1,000 ft of row) (RUP)

**APHIDS, FLEA BEETLE:** See label for application methods.

Imidacloprid

*Admire* Pro, 4.4 - 10.5 fl oz. (21 days)

*Nuprid* 2 F, 10 to 24 fl oz. (21 days) Apply pre-plant or in furrow.

or

*Platinum*, 5 to 12 fl oz. (30 days) See label for application methods.

#### FOLIAR TREATMENT:

**FLEA BEETLE:** Apply if necessary.

*Actara*, 1.5 to 3 oz. (7 days)

or

Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 qt) (7 days)

or

Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.5 fl oz. (7 days) Do not exceed 10.5 oz/Acre per season.

**CABBAGE "WORM":** Apply if damage is severe.

\* *Bacillus thuringiensis*

*Agree*, *Biobit*, *Dipel*, *Javelin*, *Lepinox*. (0 days)

**APHIDS:** Apply as needed to prevent population build up.

*Actara*, 1.5 to 3 oz. (7 days)

or

*Malathion* 57 EC, 1 1/2 pt. (1 day)

or

Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.5 fl oz. (7 days) Do not exceed 10.5 oz/Acre per season.

### DISEASES

#### SEED TREATMENT:

**DAMPING OFF** (*Pythium* and *Phytophthora* spp.):

*Bacillus subtilis* GB03

*Kodiak*, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

Fludioxinil

*Maxim* 4 FS, 0.08 to 0.16 fl oz/100 lb seed (*Rhizoctonia*).

Commercial seed treatment plants only.

#### SOIL TREATMENT:

**DAMPING OFF** (*Pythium* spp.):

\* *Mefenoxam*. Apply as a broadcast preplant incorporation or a surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 1 in. of sprinkler irrigation.

*Ridomil* Gold SL, 1-2 pt.

*Ridomil* Gold WSP, 1 to 2 lb.

*Ultra* Flourish, 2 to 4 pt.

#### FOLIAR TREATMENT:

**LEAF ROT, BOTRYTIS GRAY MOLD** (*Botrytis cinerea*):

*Azoxystrobin*

*Quadris*, 6 to 15.5 fl oz. (0 days)

or

*Pyraclostrobin*

*Cabrio*, 8 to 12 oz. (0 days)

## Spinach

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

### INSECTS

#### SOIL TREATMENT:

**APHIDS:**

Imidacloprid

*Admire* Pro, 4.4 - 10.5 fl oz. (21 days) See label for application methods.

or

*Venom*, 5 to 6 oz. (21 days) See label for application methods.

**APHIDS, FLEA BEETLE, LEAF MINERS, LEAFHOPPER:**

*Platinum*, 5 to 11 oz. (30 days) See label for application methods.

#### FOLIAR TREATMENT:

**FLEA BEETLE:** May be a problem on young seedlings. Apply as needed.

*Baythroid* XL, 2.4 to 3.2 fl oz. (0 days) (RUP)

or

Carbaryl

*Sevin* 80 S (2/3 to 1 1/4 lb) or *Sevin* XLR Plus (1/2 to 1 qt) (14 days)

or

*Mustang* Max, 2.4 to 4.3 oz. (1 day) (RUP)

or

## Spinach

### Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.75 fl oz. (7 days) Do not use if Imidacloprid was used at planting. Do not exceed 19.2 oz/Acre per season.

or *Venom*, 2 to 3 oz. (7 days)

or

*Actara*, 1.5 to 3 oz. (7 days) Do not exceed 11.0 oz/Acre per season.

or

### Bifenthrin

*Bifenture* EC, 2.1 to 6.4 oz. (7 days) (RUP)

**CROWN MAGGOTS** (Several species are involved):  
Chemical control is not presently available for this use.

**LEAFHOPPERS:** Apply as necessary.

*Baythroid* XL, 0.8 to 1.6 fl oz. (0 days) (RUP)

or

### Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 qt) (14 days)

or

*Mustang* Max, 2.4 to 4.3 oz. (1 day) (RUP)

or

### Permethrin

*Ambush* 25 W, 6.4 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (4 oz) or *Pounce* 25 WP (6.4 oz) or *Pounce* 3.2 EC (4 oz) (1 day) (RUP)

or

### Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.8 fl oz. (7 days) Do not exceed 19.2 oz/Acre per season.

or

*Actara*, 1.5 to 3 oz. (7 days) Do not exceed 11.0 oz/Acre per season.

or

*Brigadier*, 5.1 to 6.1 oz. (40 days)

**LOOPERS, ARMYWORM:** Apply when insects are small.

\* *Baythroid* XL, 2.4 to 3.2 fl oz. (0 days) (RUP)

or

\* *Lannate* LV (1 1/2 to 3 pt) or *Lannate* SP (1/2 to 1 lb) (7 days) Do not apply to seedlings less than 3 inches in diameter. (RUP)

or

### \* Permethrin

*Ambush* 25 W, 6.4 to 12.8 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz) or *Pounce* 3.2 EC (4 to 8 oz) (1 day) (RUP)

or

### *Bacillus thuringiensis*

*Agree*, *Biobit*, *Dipel*, *Javelin*, *Lepinox*, *Xentari*. (0 days)

or

### Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 qt) (14 days)

or

### Thiodicarb

*Larvin* 3.2 EC, 16 to 30 oz. (14 days)

or

*Mustang* Max, 3.4 to 4.3 oz. (1 day) (RUP)

or

*SpinTor* 2 SC, 4 to 8 oz. (1 day)

or

*Entrust*, 1 to 2 oz. (1 day)

or

*Intrepid* 2 F, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

*Avaunt*, 3.5 oz. (3 days) Do not exceed 14 oz/acre per crop.

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

**APHIDS:** Apply as needed to avoid contamination at harvest.

\* *Assail* 30 SG, 1.9 to 2.8 oz. (7 days)

or

*Diazinon* 50 WP (1 lb) or *Diazinon* AG 500 (1 pt) (14 days) (RUP)

or

*Dibrom* 8 EC, 1 pt. (1 day) Ground application only.

or

*Endosulfan* 3 EC, 1 qt. (21 days) Maximum of one application.

or

*Malathion* 57 EC, 2 pt. (7 days)

or

### Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.75 fl oz. (7 days) Do not use if Imidacloprid was used at planting. Do not exceed 19.2 oz/Acre per season.

or

*Venom*, 1 to 3 oz. (7 days)

or

*Beleaf* 50 SG, 2 to 2.8 oz. (0 days)

or

*Actara*, 1.5 to 3 oz. (7 days) Do not exceed 11.0 oz/Acre per season.

or

*Fulfill*, 2.75 oz. (7 days) Do not exceed 5.5 oz/acre per season. May require 5 to 7 days for aphid mortality.

**LEAF MINERS:** Apply when eggs are first seen on undersides of leaves to prevent miners from entering leaves. Treatment after larvae are in the leaf is generally unsuccessful. Early-planted spinach is less susceptible to damage than when planted late.

*Dimethoate* 4 EC, 1/2 pt. (14 days)

or

*Diazinon* 50 WP (1 lb) or *Diazinon* AG 500 (1 pt) (10 days) (RUP)

or

*Dibrom* 8 EC, 1 pt. (1 day)

or

### Permethrin

*Ambush* 25 W, 6.4 to 12.8 oz. (1 day) (RUP)

or

*Perm-UP* 3.2 EC (4 to 8 oz) or *Pounce* 25 WP (6.4 to 12.8 oz) or *Pounce* 3.2 EC (4 to 8 oz) (1 day) (RUP)

or

*SpinTor* 2 SC, 6 to 10 oz. (1 day)

or

*Venom*, 1 to 3 oz. (7 days)

or

*Entrust*, 2 to 3 oz. (1 day)

or



Radiant SC, 6 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.  
or

Bifenthrin

*Bifenture* EC, 2.1 to 6.4 oz. (7 days) (RUP)

or

*Brigadier*, 5.1 to 6.1 oz. (40 days)

### LOOPERS:

Bifenthrin

*Bifenture* EC, 2.1 to 6.4 oz. (7 days) (RUP)

or

*Brigadier*, 5.1 to 6.1 oz. (40 days)

## SLUGS

*Deadline* M-Ps 4% (20 to 40 lb) or *Metaldehyde* 3.5 G (30 to 40 lb) Apply between rows. Avoid contact to edible product.

## DISEASES

### SEED TREATMENT:

**DAMPING OFF** (*Pythium* spp., *Rhizoctonia solani*):

*Bacillus subtilis* GB03

*Kodiak*, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

*Captan*

*Captan* 30-DD, 4 3/4 oz/100 lb seed.

*Captan* 400, 4 to 6 oz/100 lb seed.

or

*Fludioxinil*

*Maxim* 4 FS, 0.08 to 0.16 fl oz/100 lb seed (*Rhizoctonia*).

Commercial seed treatment plants only.

or

*Metalaxyl*

*Allegiance-FL*, 0.75 fl oz/100 lb seed (*Pythium*).

or

*Apron* 50 W, 1/2 to 1 oz/100 lb seed (*Pythium*).

or

*Mefenoxam*

*Apron* XL LS, 0.32 to 0.64 fl oz/100 lb seed (*Pythium*).

or

*Thiram*

42-S Thiram, *Thiram* 50 WP Dyed, 8 oz/100 lb seed.

### PREPLANT INCORPORATED:

**WHITE RUST** (*Albugo occidentalis*), **DAMPING OFF** (*Pythium* spp.), **DOWNY MILDEW** (*Peronospora effusa*):

\* *Mefenoxam*. Apply as a broadcast preplant incorporation or a surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 1 in. of sprinkler irrigation. Observe limit of amount of a.i./A per season.

*Ridomil* Gold GR, 20 to 40 lb.

*Ridomil* Gold WSP, 1 to 2 lb.

*Ultra* Flourish, 2 to 4 pt.

or

*Ridomil* Gold SL, 1-2 pt (*Pythium*) or 0.25 pt (downy mildew or white rust; 7 day PHI).

## FOLIAR TREATMENT:

**DOWNY MILDEW** (*Peronospora effusa*):

\* *Fosetyl-Aluminum*

*Aliette* WDG, 2 to 5 lb, 7- to 21-day intervals. (3 days) Do not tank mix with copper fungicides.

or

\* *Fluopicolide*

*Presidio*, 3-4 fl oz. (2 days)

or

\* *Mefenoxam*

*Ridomil* Gold GR, 5 lb as a side-dressing. (21 days) Apply first as a preplant incorporated. Then apply shanked in 21 days after planting or after first cutting. One other application may be shanked in after the next cutting. A total of 2 supplemental applications may be used on a 21-day interval. Observe limit of amount of a.i./A per season.

or

*Ridomil* Gold WSP, 1/4 lb. (21 days)

or

\* *Mefenoxam/Copper Hydroxide*

*Ridomil* Gold Copper, 2 1/2 lb, 14-day intervals. (21

days) Maximum 2 applications. **Note:** Apply 21 days after *Ridomil* Gold at planting or after each repeated cutting.

or

*Mono-*, dibasic sodium, potassium and ammonium phosphites

*Phostrol*, 2.5 to 5 pt every 7 - 21 days. (0 days)

*Prophyt*, 2 to 4 pt. (0 days)

or

*Acibenzolar-S-methyl*

*Actigard*, 3/4 oz per 20 gal (ground) or 10 gal (aerial) of water. (14 days) Do not apply more than 2-1/4 oz of *Actigard* per acre per season.

or

*Mono-*, dibasic sodium salts of phosphorous acid

*Fosphite*, 1 to 3 qt per 20 gal (ground) or 10 gal (aerial) of water. (0 days)

or

*Mandipropamid*

*Revus*, 8 fl oz. (1 day)

**Note:** Fungicides that protect against Anthracnose and *Cercospora* leaf spot provide limited downy mildew protection.

**ANTHRACNOSE** (*Colletotrichum spinaciae*), **CERCOSPORA**

**LEAF SPOT** (*Cercospora beticola*): Apply at 7 to 10 day intervals.

\* *Azoxystrobin*

*Amistar*, 2 to 5 oz. (0 days)

*Quadris*, 6.2 to 15.4 fl oz. (0 days)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

*Copper Ammonium Carbonate*

*Copper Count* N, 1 1/2 qt. (0 days)

or

*Copper Hydroxide*

*Champ* Formula 2 F, *Nu-Cop* 3 L, 1 1/3 to 2 2/3 pt. (0 days)

*Champion* WP, *Nu-Cop* 50 DF, 2 to 4 lb. (0 days)

*Kocide* 101, 1 to 2 lb. (0 days)

*Kocide* 2000, 1 1/2 to 2 1/4 lb. (0 days)

## Squash

or

*Kocide* 4.5 LF, 1 1/3 to 2 pt. (0 days)

*Kocide* DF, 2 to 3 lb. (0 days)

or

### Copper Sulfate

*Basicop* 53 WP, 2 to 4 lb. (0 days)

*Cuprofix* Ultra, 1.25 to 2 lb. (0 days)

### **WHITE RUST** (*Albugo occidentalis*):

#### Azoxystrobin

*Amistar*, 2 to 5 oz every 7 - 14 days. (0 days)

*Quadris*, 6.2 - 15.4 fl oz every 7 - 14 days. (0 days)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

### Copper Hydroxide

*Champ* Formula 2 F, *Nu-Cop* 3 L, 1 1/3 to 2 2/3 pt, 7- to 10-day intervals. (0 days)

or

*Champion* WP, *Nu-Cop* 50 DF, 2 to 4 lb, 7- to 10-day intervals. (0 days)

or

*Kocide* 101, 1 to 2 lb. (0 days)

*Kocide* 2000, 1 1/2 to 2 1/4 lb. (0 days)

*Kocide* 4.5 LF, 1 1/3 to 2 pt. (0 days)

*Kocide* DF, 2 to 3 lb. (0 days)

or

### Copper Sulfate

*Basicop* 53 WP, 2 to 4 lb, 7- to 10-day intervals. (0 days)

*Cuprofix* Ultra, 1.25 to 2 lb. (0 days)

or

### Fosetyl-Aluminum

*Aliette* WDG, 2 to 5 lb, 7- to 10-day intervals. (0 days)

or

### Mefenoxam/Copper Hydroxide

*Ridomil* Gold Copper, 2 1/2 lb, 14-day intervals. (21 days) Maximum 2 applications. **Note:** Apply 21 days after *Ridomil* Gold at planting or after each repeated cutting.

or

### Fluopicolide

*Presidio*, 3-4 fl oz. (2 days)

## Squash

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

Squash are hosts for root-knot and lesion nematodes. These nematodes can reduce squash yields but yield losses in Michigan have not been documented. If you suspect nematodes are reducing squash yields collect root and soil samples for analysis

as described in Appendix C. If the numbers of nematodes recovered from those samples exceed damage thresholds; control options will be suggested. *Vydate* 2L is labeled for use in squash.

## INSECTS

### SOIL TREATMENT:

#### **CUCUMBER BEETLE (STRIPED and SPOTTED), APHIDS, THRIPS:**

\* *Imidacloprid*

*Admire* Pro, 7.0 - 10.5 fl oz. (21 days)

or

*Nuprid* 2 F, 16 to 24 oz. (21 days) Apply to soil in a narrow band 14 or less days before planting, as an in-furrow spray at planting, as a post-seeding drench, as a sidedress after plants are established or in drip or trickle irrigation water. Do not make more than 1 application per year. Cucumber beetle. Use on hard squash in areas with high beetle populations to control bacterial wilt disease.

or

\* *Furadan* 4 F, 2.4 oz/1000 ft of row. Apply at planting or transplanting in a 12- to 15-inch band, incorporate into the top 3 inches of soil or apply into the furrow and mix with the covering soil. (Special Michigan SLN label.) (RUP)

#### **APHIDS, FLEA BEETLE, CUCUMBER BEETLE, LEAFHOPPER, THRIPS:**

*Platinum*, 5 to 11 oz. (30 days) See label for application methods.

#### **APHIDS, THRIPS, SQUASH BUG:**

*Venom*, 5 to 6 oz. (21 days) See label for application methods.

### FOLIAR TREATMENT:

Summer and winter squash plants may be sensitive to certain insecticide formulations. Make certain a problem exists before treatment. Read and observe restrictions on the label. To avoid killing bees, do not treat plants during bloom.

**CUTWORM:** Apply if >1% of plants are injured.

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

or

\* *Baythroid* XL, 0.8 to 1.6 fl oz. (0 days) (RUP)

or

\* *Bifenthrin*

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 2.6 to 6.4 oz. (3 days) (RUP)

or

\* *Permethrin*

*Ambush* 25 W, 12.8 oz. (0 days) (RUP)

or

*Perm-UP* 3.2 EC (8 oz) or *Pounce* 25 WP (12.8 oz) or *Pounce* 3.2 EC (8 oz) (0 days) (RUP)

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)

Do not exceed 23 fl oz/acre per season. (RUP)

**STRIPED and SPOTTED CUCUMBER BEETLE:** Apply to hard squash if numbers exceed 0.1 to 1/plant to prevent bacterial wilt disease.

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

or

*Baythroid* XL, 2.4 to 2.8 fl oz. (0 days) (RUP)



or  
 Bifenthrin  
*Bifenture EC, Brigade 2EC, Capture 2 EC, 2.6 to 6.4 oz.*  
 (3 days) (RUP)

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

or  
*Dibrom 8 EC, 1 pt. (1 day) Use on summer squash only.*

or  
*Endosulfan 3 EC, 1 qt. (2 days)*

or  
*Lannate LV (1 1/2 to 3 pt (1 1/2 pt, 1 day; over 1 1/2, pt 3 days))*  
*or Lannate SP (1/2 to 1 lb (1/2 lb, 1 day; over 1/2 lb, 3 days))*  
 Use on summer squash only. (RUP)

or  
 Permethrin  
*Ambush 25 W, 6.4 to 12.8 oz. (0 days) (RUP)*

or  
*Perm-UP 3.2 EC (4 to 8 oz) or Pounce 25 WP (6.4 to 12.8 oz)*  
*or Pounce 3.2 EC (4 to 8 oz) (0 days) (RUP)*

or  
*Danitol 2.4 EC, 10 2/3 to 16 fl oz. (7 days) (RUP)*

or  
*Venom, 3 to 4 oz. (1 day)*

or  
*Actara, 3 to 5.5 oz. (0 days) Do not exceed 11.0 oz/Acre per season.*

or  
*Warrior with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)*  
 Do not exceed 23 fl oz/acre per season. (RUP)

or  
*Assail 30 SG, 2.5 to 5.3 oz. (0 days)*

**FLEA BEETLE:** Apply if needed.

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

or  
*Endosulfan 3 EC, 1 qt. (2 days)*

or  
*Lannate LV (1 1/2 to 3 pt (1 1/2 pt, 1 day; over 1 1/2, pt 3 days))*  
*or Lannate SP (1/2 to 1 lb (1/2 lb, 1 day; over 1/2 lb, 3 days))*  
 Use on summer squash only. (RUP)

or  
*Actara, 1.5 to 3 oz. (0 days) Do not exceed 11.0 oz/Acre per season.*

or  
*Warrior with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)*  
 Do not exceed 23 fl oz/acre per season. (RUP)

**LEAFHOPPERS:** Apply if necessary.  
*Asana XL, 5.8 to 9.6 oz. (3 days) (RUP)*

or  
 Bifenthrin  
*Bifenture EC, Brigade 2EC, Capture 2 EC, 2.6 to 6.4 oz.*  
 (3 days) (RUP)

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

or  
*Venom, 1 to 4 oz. (1 day)*

or  
*Warrior with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)*  
 Do not exceed 23 fl oz/acre per season. (RUP)

**SQUASH BUG:** Apply if egg masses exceed 1/plant. Large nymphs and adults are difficult to control.  
 \* *Asana XL, 5.8 to 9.6 oz. (3 days) (RUP)*

or  
 Bifenthrin  
*Bifenture EC, Brigade 2EC, Capture 2 EC, 2.6 to 6.4 oz.*  
 (3 days) (RUP)

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

or  
*Endosulfan 3 EC, 1 qt. (2 days)*

or  
 Permethrin  
*Ambush 25 W, 12.8 oz. (0 days) (RUP)*

or  
*Perm-UP 3.2 EC (8 oz) or Pounce 25 WP (12.8 oz) or Pounce 3.2 EC (8 oz) (0 days) (RUP)*

or  
*Venom, 3 to 4 oz. (1 day)*

or  
*Warrior with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)*  
 Do not exceed 23 fl oz/acre per season. (RUP)

or  
*Assail 30 SG, 5.3 oz. (0 days)*

**SQUASH VINE BORER:** Apply to base of plants when moths are active, or when the first tunnels appear, usually starting when plants start to vine. Repeat in 5 to 7 days.  
*Asana XL, 5.8 to 9.6 oz. (3 days) (RUP)*

or  
 Bifenthrin  
*Bifenture EC, Brigade 2EC, Capture 2 EC, 2.6 to 6.4 oz.*  
 (3 days) (RUP)

or  
*Endosulfan 3 EC, 1 qt. (2 days)*

or  
 Permethrin  
*Ambush 25 W, 6.4 to 12.8 oz. (0 days) (RUP)*

or  
*Perm-UP 3.2 EC (4 to 8 oz) or Pounce 25 WP (6.4 to 12.8 oz)*  
*or Pounce 3.2 EC (4 to 8 oz) (0 days) (RUP)*

or  
*Warrior with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)*  
 Do not exceed 23 fl oz/acre per season. (RUP)

or  
*Assail 30 SG, 5.3 oz. (0 days)*

**APHIDS:** Apply if numbers are high.  
*Dibrom 8 EC, 1 pt. (1 day) Use on summer squash only.*

or  
*Endosulfan 3 EC, 1 qt. (2 days)*

or  
*Fulfill, 2.75 oz. (0 days) Do not exceed 5.5 oz/acre per season.*  
 May require 5 to 7 days for aphid mortality.

or  
*Malathion 57 EC, 1 1/2 pt. (1 day)*

or

## Squash

*Venom*, 1 to 4 oz. (1 day)

or

*Beleaf* 50 SG, 2 to 2.8 oz. (0 days)

or

*Actara*, 1.5 to 3 oz. (0 days) Do not exceed 11.0 oz/Acre per season.

or

*Assail* 30 SG, 2.5 to 4 oz. (0 days)

**THRIPS:** Apply when damage is seen. Repeat as needed.

*Dibrom* 8 EC, 1 pt. (1 day) Summer squash only.

or

*Venom*, 1 to 4 oz. (1 day)

or

*Entrust*, 2 to 2.5 oz. (3 days)

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (1 day)

Do not exceed 23 fl oz/acre per season. (RUP)

## MITES

Apply when needed. Usually a problem only in hot, dry weather.

*Agri-Mek* 0.15 EC, 8 to 16 fl oz. (7 days) (RUP)

or

*Bifenthrin*

*Bifenture* EC, *Brigade* 2EC, *Capture* 2 EC, 5.1 to 6.4 oz. (3 days) (RUP)

or

*Danitol* 2.4 EC, 10 2/3 fl oz. (7 days) (RUP)

or

*Oberon* 2 SC, 7 to 8.5 fl oz. (7 days)

## SLUGS

*Deadline* M-Ps 4% (20 to 40 lb) or *Metaldehyde* 3.5 G (30 to 40 lb) Apply between rows. Avoid contact to edible product.

## DISEASES

### SEED TREATMENT:

**DAMPING OFF** (*Pythium* spp., *Rhizoctonia solani*):

*Bacillus subtilis* GB03

*Kodiak*, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

*Captan*

*Captan* 30-DD, 1 2/3 oz/100 lb seed.

*Captan* 400, 1 1/2 to 2 oz/100 lb seed.

or

*Fludioxinil*

*Maxim* 4 FS, 0.08 to 0.16 fl oz/100 lb seed (*Rhizoctonia*).

Commercial seed treatment plants only.

or

*Thiram*

42-S *Thiram*, *Thiram* 50 WP Dyed, 4 1/2 oz/100 lb seed.

### PRE-PLANT FUMIGATION:

**PHYTOPHTHORA:** Apply to production fields before planting.

**Note:** Most fumigants applied to the soil for control of disease organisms will also control soil insects, nematodes and weed seeds.

Soil sterilization by fumigation is best achieved by proper application of material. Correct soil moisture, temperature, and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or immediate tarping.

1,3 Dichloropropene/chloropicrin

*Telone* C35, 13-35 gal. (RUP)

or

Metam Sodium

*Sectagon* 42, *Vapam* HL, 37.5-75 gal.

or

Potassium N-methylidithiocarbamate

*Sectagon-K54*, 30-60 gal. Do not plant for 14 to 30 days after treatment (the wetter the soil, the longer the waiting period).

## GREENHOUSE PREPLANT INCORPORATION:

**DAMPING OFF** (*Pythium* spp.), **ROOT ROT** (*Rhizoctonia* spp.):

*Gliocladium virens* GL-21

*SoilGard* 12 G, 1 to 1.5 lb per cubic yard. Biological control product that needs to be applied before disease development. Control may be limited under heavy disease pressure.

## PREPLANT INCORPORATED:

**DAMPING OFF and COTTONY LEAK** (*Pythium* spp.):

\* *Mefenoxam*. Apply as a broadcast preplant incorporation or a surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 1 in. of sprinkler irrigation.

*Ridomil* Gold SL, 1-2 pt.

*Ridomil* Gold WSP, 1 to 2 lb.

*Ultra* Flourish, 2 to 4 pt.

## FOLIAR TREATMENT:

**POWDERY MILDEW** (*Sphaerotheca fuliginea* or *Erysiphe cichoracearum*): Treat at disease appearance.

\* *Myclobutanil*

*Rally* 40 WSP, 2.5 to 5 oz, 7 to 10 day schedule. (0 days) Do not apply more than 1.5 lb per acre per crop.

or

\* *Pyraclostrobin*

*Cabrio*, 12-16 oz. (0 days) Alternate one-to-one with fungicides having a different mode of action.

or

\* *Pyraclostrobin/Boscalid*

*Pristine*, 12.5 to 18.5 oz. (0 days)

or

\* *Thiophanate-Methyl*

*Topsin* 4.5 FL, 10 fl oz. (1 day)

*Topsin* 70 W, *Topsin* M WSB, 1/4 to 1/2 lb. (0 days)

or

\* *Trifloxystrobin*

*Flint*, 1 1/2 to 2 oz, 7- to 14-day intervals. (0 days) Maximum 2 consecutive applications, 4 applications/year and 16 oz/season.

or

*Azoxystrobin*

*Amistar*, 3.5 to 5 oz. (1 day)



or

*Quadris*, 11.0 to 15.4 fl oz. (1 day)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

Azoxystrobin/Chlorothalonil*Quadris* Opti, 3.2 pt every 7 - 14 days. (1 day)

or

*Bacillus subtilis*

*Serenade*, 6 to 8 lb every 7 days. (0 days) Biological control product that needs to be applied before disease development. Control will be limited under heavy disease pressure.

or

*Serenade* Max, 1 - 3 lb every 7 to 10 days. (0 days)

or

Chlorothalonil*Bravo* Ultrex (1.8 to 2.7 lb) or *Equus* DF (1.8 to 2.7 lb (*Sphaerotheca*)) (0 days)

or

*Bravo* Weather Stik, or *Echo* 720 (2 to 3 pt, 7-day intervals) or *Equus* 720 SST (2 to 3 pt every 7 days) (0 days) *Sphaerotheca*.

or

*Echo* 90 DF, 1.6 to 2.4 lb every 7 days. (0 days)

or

Copper Ammonium Carbonate*Copper* Count N, 1 to 2 qt. (0 days)

or

Copper Hydroxide*Champ* DP, 1 1/3 lb. (0 days)*Kocide* 2000, 1 1/2 lb. (0 days)*Nu-Cop* 3 L, 1 to 4 pt, 5- to 10-day intervals. (0 days)

or

*Champ* Formula 2 F, *Kocide* 4.5 LF, 1 to 2 pt, 7-day intervals. (0 days)

or

*Champion* WP, *Kocide* 101, *Kocide* DF, *Nu-Cop* 50 DF, 1 1/2 to 3 lb, 7-day intervals. (0 days)

or

Copper Sulfate*Cuprofix* Ultra, 1.25 lb. (0 days)

or

Neem Oil*Trilogy*, 2 pt. (0 days)

or

Sulfur*Kumulus* DF, *Micro* Sulf, *Microthiol* Disperss, *Microthiol* Special, 5 to 10 lb. (0 days)

or

*Thiolux* Jet, 4 to 10 lb, 10- to 14-day intervals. (0 days)

or

Triflumizole*Procur* 50 WS, 4 to 8 oz every 7 - 14 days. (0 days)

or

Tebuconazole*Folicur* 3.6F, 4-6 fl oz. (7 days) 12 hr REI.

**SCAB** (*Cladosporium cucumerinum*): Treat every 7 to 10 days after plants are 2 to 3 inches tall.

Chlorothalonil*Bravo* Ultrex, *Equus* DF, 1.8 to 2.7 lb. (0 days)*Echo* 90 DF, 1.6 to 2.4 lb every 7 days. (0 days)

or

*Bravo* Weather Stik, *Echo* 720, *Equus* 720 SST, 2 to 3 pt. (0 days)

or

Copper Ammonium Carbonate*Copper* Count N, 2 to 3 qt. (0 days)

or

Neem Oil*Trilogy*, 2 pt. (0 days)

**ALTERNARIA LEAF SPOT** (*Alternaria cucumerina*): Treat every 7 to 10 days when conditions favor disease.

\* Azoxystrobin*Amistar*, 3.5 to 5 oz. (1 day)*Quadris*, 11.0 to 15.4 fl oz. (1 day)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* Azoxystrobin/Chlorothalonil*Quadris* Opti, 3.2 pt every 7 - 14 days. (1 day)

or

\* Chlorothalonil*Bravo* Ultrex, *Equus* DF, 1.8 to 2.7 lb. (0 days)*Echo* 90 DF, 1.6 to 2.4 lb every 7 days. (0 days)

or

*Bravo* Weather Stik, *Echo* 720, *Equus* 720 SST, 2 to 3 pt. (0 days)

or

\* Pyraclostrobin

*Cabrio*, 12-16 oz. (0 days) No more than 2 consecutive applications before alternating with a fungicide having a different mode of action.

or

\* Pyraclostrobin/Boscalid*Pristine*, 12.5 to 18.5 oz. (0 days)

or

Copper Ammonium Carbonate*Copper* Count N, 1 to 2 qt. (0 days)

or

Copper Hydroxide*Champ* DP, 1 1/3 lb. (0 days)*Champ* Formula 2 F, *Kocide* 4.5 LF, 1 1/3 pt. (0 days)*Champion* WP, 1.5 to 3 lb. (0 days)*Kocide* 2000, 1 1/2 lb. (0 days)*Nu-Cop* 3 L, 1 to 4 pt. (0 days)

or

Copper Sulfate*Cuprofix* Ultra, 1.25 lb. (0 days)

or

Famoxadone/Cymoxanil*Tanos*, 8 oz. (3 days)

or

Neem Oil*Trilogy*, 2 pt. (0 days)

## Squash

**ANTHRACNOSE** (*Colletotrichum lagenarium*): Treat every 7 to 14 days after disease appears.

\* Azoxystrobin

*Amistar*, 3.5 to 5 oz. (1 day)

*Quadris*, 6.2 to 15.4 fl oz. (1 day)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* Azoxystrobin/Chlorothalonil

*Quadris Opti*, 3.2 pt every 7 - 14 days. (1 day)

or

\* Chlorothalonil

*Bravo Ultrex*, 1.4 to 1.8 lb. (0 days)

*Echo 90 DF*, 1.3 to 1.6 lb every 7 days. (0 days)

or

*Bravo Weather Stik*, *Echo 720*, *Equus 720 SST*, 1.5 to 2 pt. (0 days)

or

\* Mancozeb. Summer squash.

*Dithane DF Rainshield*, *Manzate 75 DF*, *Penncozeb 75 DF*, 2 to 3 lb. (5 days)

or

*Penncozeb 4 F*, 1.6 to 2.4 qt. (5 days)

or

\* Maneb

*Maneb 75 DF*, *Maneb 80 WP*, 1 1/2 to 2 lb. (5 days)

*Manex*, 1 1/5 to 1 3/5 qt. (5 days)

or

\* Pyraclostrobin

*Cabrio*, 12-16 oz. (0 days) No more than 2 consecutive applications before alternating with a fungicide having a different mode of action.

or

\* Pyraclostrobin/Boscalid

*Pristine*, 18.5 oz. (0 days)

or

\* Thiophanate-Methyl

*Topsin 4.5 FL*, 10 fl oz. (1 day)

*Topsin 70 W*, *Topsin M WSB*, 1/4 to 1/2 lb. (0 days)

or

Copper Ammonium Carbonate

*Copper Count N*, 1 to 2 qt. (0 days)

or

Copper Hydroxide

*Champ DP*, 1 1/3 lb. (0 days)

*Champ Formula 2 F*, *Kocide 4.5 LF*, 1 1/3 pt. (0 days)

*Champion WP*, 1.5 to 3 lb. (0 days)

*Kocide 2000*, 1 1/2 lb. (0 days)

*Nu-Cop 3 L*, 1 to 4 pt. (0 days)

or

Copper Oxychloride / Copper Sulfate

*C-O-C-S WDG*, 2 to 4 lb every 7 days. (0 days)

or

Copper Sulfate

*Basic Copper 53*, *Basicop*, 2 lb. (0 days)

*Cuprofix Ultra*, 1.25 lb. (0 days)

or

Famoxadone/Cymoxanil

*Tanos*, 8 oz. (3 days)

or

Mancozeb/Copper Sulfate

*Cuprofix MZ Disperss*, 5 - 7.25 lb. (5 days)

or

Mefenoxam/Chlorothalonil

*Ridomil Gold Bravo*, 2 to 3 lb, 10- to 14-day intervals. Maximum 4 applications. Do not apply to mature or senescent plants.

or

Neem Oil

*Trilogy*, 2 pt. (0 days)

**ANGULAR LEAF SPOT** (*Pseudomonas lachrymans*): Spray every 7 days, starting before the first fruit forms and continue to protect fruit at all stages of development.

Copper Ammonium Carbonate

*Copper Count N*, 1 to 2 qt. (0 days)

or

Copper Hydroxide

*Champ DP*, 1 1/3 lb. (0 days)

*Champ Formula 2 F*, *Kocide 4.5 LF*, 1 1/3 pt. (0 days)

*Champion WP*, 1.5 to 3 lb. (0 days)

*Kocide 2000*, 1 1/2 lb. (0 days)

*Nu-Cop 3 L*, 1 to 4 pt. (0 days)

or

Copper Sulfate

*Basic Copper 53*, *Basicop*, 2 lb. (0 days)

*Cuprofix Ultra*, 1.25 lb. (0 days)

or

Neem Oil

*Trilogy*, 2 pt.

**GUMMY STEM BLIGHT** (*Didymella bryoniae* also called *Mycosphaerella melonis*):

\* Azoxystrobin/Chlorothalonil

*Quadris Opti*, 3.2 pt every 7 - 14 days. (1 day)

or

\* Chlorothalonil

*Bravo Ultrex*, *Equus DF*, 1.8 to 2.7 lb. (0 days)

*Echo 90 DF*, 1.6 to 2.4 lb every 7 days. (0 days)

or

*Bravo Weather Stik*, *Echo 720*, *Equus 720 SST*, 2 to 3 pt. (0 days)

or

\* Pyraclostrobin

*Cabrio*, 12-16 oz. (0 days) No more than 2 consecutive applications before alternating with a fungicide having a different mode of action.

or

\* Pyraclostrobin/Boscalid

*Pristine*, 12.5 to 18.5 oz. (0 days)

or

\* Thiophanate-Methyl

*Topsin 4.5 FL*, 10 fl oz. (1 day)

or

*Topsin 70 W*, *Topsin M WSB*, 1/4 to 1/2 lb, at 7-14 day intervals. (0 days)

or



\* Azoxystrobin*Amistar*, 3.5 to 5 oz. (1 day)

or

*Quadris*, 6.2 to 15.4 fl oz. (1 day)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

Copper Ammonium Carbonate*Copper Count N*, 1 to 2 qt. (0 days)

or

Copper Hydroxide*Champ DP*, 1 1/3 lb. (0 days)*Champ Formula 2 F*, *Kocide 4.5 LF*, 1 1/3 pt. (0 days)*Champion WP*, 1.5 to 3 lb. (0 days)*Kocide 2000*, 1 1/2 lb. (0 days)*Nu-Cop 3 L*, 1 to 4 pt. (0 days)

or

Copper Sulfate*Cuprofix Ultra*, 1.25 lb. (0 days)

or

Tebuconazole*Folicur 3.6F*, 8 fl oz. (7 days) Suppression only.**DOWNY MILDEW** (*Pseudoperonospora cubensis*):\* Famoxadone/Cymoxanil*Tanos*, 8 oz. (3 days)

or

\* Propamocarb*Previcur Flex*, 1.2 pt every 7 - 14 days. (2 days)

or

\* Cyazofamid*Ranman*, 2.1 to 2.75 fl oz every 7 to 10 days. (0 days)

or

\* Cymoxanil*Curzate 60 DF*, 3.2 oz every 5 - 7 days. (3 days)

or

\* Fluopicolide*Presidio*, 3-4 fl oz. (2 days)

or

\* Mancozeb. Summer squash only.*Dithane DF Rainshield*, *Manzate 75 DF*, *Penncozeb 75 DF*, 2 to 3 lb. (5 days)

or

*Penncozeb 4 F*, 1.6 to 2.4 qt. (7 days) Summer squash only.

or

\* Chlorothalonil*Bravo Ultrex*, *Equus DF*, 1.8 to 2.7 lb. (0 days)*Echo 90 DF*, 1.6 to 2.4 lb every 7 days. (0 days)

or

*Bravo Weather Stik*, *Echo 720*, *Equus 720 SST*, 2 to 3 pt. (0 days)

or

Azoxystrobin*Amistar*, 3.5 to 5 oz. (1 day)*Quadris*, 11.0 to 15.4 fl oz. (1 day)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

Azoxystrobin/Chlorothalonil*Quadris Opti*, 3.2 pt every 7 - 14 days. (1 day)

or

Fenamidone*Reason 500 SC*, 5.5 fl oz every 5 to 10 days. (14 days)

or

Fosetyl-Aluminum*Aliette WDG*, 2 to 5 lb, 7- to 14-day intervals. (0 days) Do not tank mix with copper fungicides.

or

Mancozeb/Copper Sulfate. Summer squash.*Cuprofix MZ Disperss*, 5 - 7.25 lb. (5 days)

or

Maneb*Maneb 75 DF*, *Maneb 80 WP*, 1.5 to 2 lb. (5 days)*Manex*, 1.2 to 1.6 qt. (5 days)

or

Mefenoxam/Chlorothalonil*Ridomil Gold Bravo*, 2 lb. Maximum 4 applications. Do not apply to mature or senescent plants.

or

Mefenoxam/Copper Hydroxide*Ridomil Gold Copper*, 2 to 2 1/2 lb. (5 days) Maximum 4 applications.

or

Mefenoxam/Mancozeb. Summer squash.*Ridomil Gold MZ*, 2 1/2 lb. (5 days) Maximum 4 applications.

or

Mono-, dibasic sodium, potassium and ammonium phosphites*Phostrol*, 2.5 to 5 pt every 7 - 14 days. (0 days)*Prophyt*, 2 to 4 pt. (0 days)

or

Neem Oil*Trilogy*, 2 pt. (0 days)

or

Pyraclostrobin*Cabrio*, 8-12 oz. (0 days) Alternate one-to-one with fungicides having a different mode of action.

or

Pyraclostrobin/Boscalid*Pristine*, 12.5 to 18.5 oz. (0 days)

or

Trifloxystrobin*Flint*, 4 oz, 7- to 14-day intervals. (0 days) Maximum 2 consecutive applications, 4 applications/year and 16 oz/season. Alternate with Ridomil Gold Bravo.

or

Mono-, dibasic sodium salts of phosphorous acid*Fosphite*, 1 to 3 qt per 20 gal (ground) or 10 gal (aerial) of water. (0 days)

or

Mandipropamid*Revus*, 8 fl oz. (0 day)

**Note:** Most fungicides that protect against Alternaria, anthracnose and gummy stem blight may also provide limited downy mildew protection.

## Sweet Potatoes

### PHYTOPHTHORA CROWN and FRUIT ROT

(*Phytophthora* spp.):

\* Dimethomorph

*Acrobat* 50 WP, 6.4 oz every 7 days. (7 days)

or

\* Fluopicolide

*Presidio*, 3-4 fl oz. (2 days)

or

\* Mancozeb/Zoxamide

*Gavel* 75 DF, 1.5-2.0 lb. (5 days) Summer squash only.

or

\* Famoxadone/Cymoxanil

*Tanos*, 8 - 10 oz every 5 - 7 days. (3 days)

or

\* Mandipropamid

*Revus*, 8 fl oz. (0 day)

or

Cyazofamid

*Ranman*, 2.75 fl oz every 7 to 10 days.

or

Fosetyl-Aluminum

*Aliette* WDG, 2 to 5 lb, 7- to 14-day intervals. (0 days) Do not tank mix with copper fungicides.

or

Mono-, dibasic sodium, potassium and ammonium phosphites

*Phostrol*, 2.5 to 5 pt every 7 - 14 days. (0 days)

*Prophyt*, 2 to 4 pt. (see label)

or

Mono-, dibasic sodium salts of phosphorous acid

*Fosphite*, 1 to 3 qt per 20 gal (ground) or 10 gal (aerial) of water. (0 days)

**Note:** Most fungicides applied to control downy mildew may have limited efficacy against *Phytophthora* crown and fruit rot.

## Sweet Potatoes

Amount of chemical formulation to apply per acre (unless otherwise directed). Apply no closer to harvest than number or days given in parentheses. (RUP) = Restricted Use Pesticide. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

### NEMATODES

Root-lesion, root-knot and other nematodes are associated with sweet potato. If you believe you have a nematode problem associated with sweet potato production, a sample should be tested (see Appendix C). If plant-parasitic nematodes are present in population densities above estimated damage thresholds for sweet potatoes, management recommendations will be provided at that time. Vydate L and Mocap 15G are labeled for use on sweet potatoes for nematode control.

Correct soil moisture, temperature and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or by immediate tarping.

## INSECTS

### SOIL TREATMENT:

#### APHIDS, FLEA BEETLE:

Imidacloprid

*Admire* Pro, 4.4 - 10.5 fl oz. (21 days) See label for application methods.

#### APHIDS, FLEA BEETLE, LEAFHOPPER:

*Platinum*, 5 to 8 fl oz. (30 days) See label for application methods.

### FOLIAR TREATMENT:

**FLEA BEETLE:** Apply when damage is first seen.

*Assail* 30 SG, 1.4 to 2.5 oz. (7 days)

or

Carbaryl

*Sevin* 80 S (1 1/4 to 2 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt) (7 days)

or

*Baythroid* XL, 1.6 to 2.8 fl oz. (0 days) (RUP)

or

Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.5 fl oz. (7 days) Do not exceed 10.5 oz/Acre per season.

or

*Actara*, 1.5 to 3 oz. (14 days) Do not exceed 6 oz/acre per season.

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (7 days)

Do not exceed 15.4 fl oz/acre per season. (RUP)

or

Bifenthrin

*Bifenture* EC, 2.1 to 6.4 oz. (21 days) (RUP)

or

*Brigadier*, 5.1 to 7.7 oz. (21 days)

**ARMYWORM, CUTWORM:** Apply at first feeding damage.

Carbaryl

*Sevin* 80 S (2 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt) (7 days)

or

*SpinTor* 2 SC, 4.5 to 6 oz. (7 days)

or

*Entrust*, 1.5 to 3 oz. (7 days)

or

*Rimon*, 9 to 12 fl oz. (14 days)

or

*Radiant* SC, 6 to 8 fl oz. (7 days) Do not make more than 4 applications or exceed 32 fl oz/acre per season.

or

*Warrior* with Zeon Technology, 2.56 to 3.84 fl oz. (7 days)

Do not exceed 15.4 fl oz/acre per season. (RUP)

**LEAFHOPPER:** Treat as necessary.

*Actara*, 1.5 to 3 oz. (14 days) Do not exceed 6 oz per season.

or

*Malathion* 57 EC, 2 pt. (3 days)

or

*Baythroid* XL, 1.6 to 2.8 fl oz. (0 days) (RUP)

or



Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.5 fl oz. (7 days) Do not exceed 10.5 oz/Acre per season.

or

*Warrior* with Zeon Technology, 1.9 to 3.2 fl oz. (7 days)

Do not exceed 15.4 fl oz/acre per season. (RUP)

or

*Brigadier*, 3.8 to 7.7 oz. (21 days)

#### APHIDS:

\* *Assail* 30 SG, 2.3 to 4 oz. (7 days)

or

\* *Fulfill*, 2.75 to 5.5 oz. (14 days) Do not apply more than 11.0 oz/acre per season. May require 5 to 7 days for aphid mortality.

or

*Malathion* 57 EC, 2 pt. (3 days)

or

Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.5 fl oz. (7 days) Do not exceed 10.5 oz/Acre per season.

or

*Actara*, 3 oz. (14 days) Do not exceed 6 oz/acre per season.

or

*Brigadier*, 3.8 to 7.7 oz. (21 days)

## DISEASES

### SEED (ROOT) TREATMENT:

**BLACK ROT, SCURF** (*Ceratostomella simbrata*, *Monilochaetes infusans*): Dip roots and sprouts in one of the following suspensions. Plant immediately.

#### DCNA

*Botran* 75 W, 1 lb/7 1/2 gal water, dip for 10 to 15 seconds, drain and plant immediately.

or

#### Thiabendazole

*Mertect* 340, 53 1/2 oz per 50 gal of water (8 fl oz per 7 1/2 gal) dip for 1 to 2 minutes. Do not use treated roots for food or feed.

### PYTHIUM DAMPING OFF:

#### Mefenoxam

*Apron* XL, 0.085 - 0.64 fl oz/100 lb seed. (0 days)

### PREPLANT INCORPORATED:

**DAMPING OFF** (*Pythium* and *Phytophthora* spp.):

\* *Mefenoxam*. Apply as a preplant incorporation or a surface application. For banded applications use a 7" band.

**Note:** If natural rainfalls not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 1" of sprinkler irrigation.

*Ridomil* Gold SL, 1-2 pt.

*Ridomil* Gold WSP, 1 to 2 lb.

### EARLY BLIGHT (*Alternaria solani*):

#### Pyrimethanil

*Scala*, 7 fl oz every 7 - 14 days. (7 days) Maximum 35 fl oz/season.

### WHITE RUST (Albugo ipomoeae-panduratae):

#### Fenamidone

*Reason* 500 SC, 5.5 - 8.2 fl oz every 5 to 10 days. (7 days)

**Note:** It is recommended that a protectant partner such as an EDBC (mancozeb or metiram) or chlorothalonil product is added in tank mixture to any strobilurine product. Strobilurines should also be used in rotation with a fungicide with a different mode of action.

### FOLIAR TREATMENT:

#### WHITE RUST (Albugo tragoponsis):

#### Azoxystrobin

*Heritage*, 3.2 - 10.5 oz every 5-7 days. (0 days) Maximum 3 lb/A/season.

## Tomatoes

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## NEMATODES

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

#### 1,3-D

*Telone* II, 9-18 gal/A (mineral soil).

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

Correct soil moisture, temperature and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or by immediate tarping.

or

#### Metam Sodium

*Vapam* HL, 37.5 to 75 gal/A (use higher rate for muck soil).

Inject with shanks spaced 5 inches apart or to a depth of 4 to 10 inches in well prepared soil. Follow immediately with a roller to smooth and compact surface. Light watering to the treated surface helps to prevent escape of gas.

## INSECTS

### SEEDBED TREATMENT:

**APHIDS, FLEA BEETLE, LEAFHOPPERS:** Apply evenly over soil surface and incorporate 2 to 3 inches, or apply evenly over soil surface after plant emergence and water thoroughly.

### SOIL TREATMENT:

**COLORADO POTATO BEETLE, APHIDS, FLEA BEETLE:** Apply at planting or transplanting. Consult label for rotation restrictions and application methods.

\* Imidacloprid

*Admire Pro*, 7.0 - 10.5 fl oz. (21 days)

*Nuprid 2 F*, 16 to 24 fl oz.

or

\* *Venom*, 5 to 6 oz. (21 days) See label for application methods.

**WIREWORM, CUTWORM:** Apply treatments evenly to soil surface before planting and incorporate to a 4- to 6-inch depth.

*Diazinon 4 EC*, 4 qt. Preplant treatment only. (RUP)

or

*Brigadier*, 3.4 to 6.8 oz. See label for application methods.

**LEAFHOPPER, THRIPS, FLEA BEETLE, WHITEFLIES, APHIDS, COLORADO POTATO BEETLE:**

*Platinum*, 5 to 11 fl oz. (30 days) Apply as an in-furrow spray or narrow surface band, as a post seeding, transplant or hill drench, in trickle or drip irrigation, or shanked into root zone after establishment or transplanting.

### FOLIAR TREATMENT:

**CUTWORM, ARMYWORM:** Apply if there is more than 1 cutworm per 100 plants on transplants or if defoliation is >10% on larger plants.

\* *Asana XL*, 5.8 to 9.6 oz. (1 day) (RUP)

or

\* *Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (5 days) (RUP)

or

*Baythroid XL*, 2.1 to 2.8 fl oz. (0 days) (RUP)

or

Carbaryl

*Sevin 20 B* (10 lb) or *Sevin 5 B* (40 lb) or *Sevin 80 S* (2 lb)

or *Sevin XLR Plus* (1 to 2 qt) (3 days)

or

*Danitol 2.4 EC*, 10 2/3 fl oz. (3 days) (RUP)

or

*SpinTor 2 SC*, 4 to 8 fl oz. (0 days)

or

*Entrust*, 1.25 to 2.5 oz. (1 day)

or

*Intrepid 2 F*, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

*Mustang Max*, 2.2 to 4.0 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (5 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant SC*, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

Bifenthrin

*Bifenture EC*, 2.1 to 6.4 oz. (1 day) (RUP)

or

*Brigadier*, 5.1 to 7.5 oz. (1 day)

**FLEA BEETLE:** Apply if necessary.

*Actara*, 2 to 3 oz. (0 days) Do not apply if a neonicitinoid was used at planting. Do not exceed 11 oz/acre per season.

or

*Baythroid XL*, 2.8 fl oz. (0 days) (RUP)

or

Carbaryl

*Sevin 80 S*, 1 1/4 lb. (3 days)

or

*Endosulfan 3 EC*, 1 1/3 pt. (1 day) Consult label for rotation restrictions.

or

Imidacloprid

*Nuprid 1.6 F*, *Provado 1.6 F*, 3.8-6.2 fl oz. (0 days) Do not use if neonicitinoids were used at planting. Do not apply more than 19.2 oz/acre per season.

or

*Venom*, 1 to 4 oz. (1 day) Do not use if neonicitinoids were used at planting.

or

*Warrior* with Zeon Technology, 1.9 to 3.2 fl oz. (5 days) (RUP)

or

*Mustang Max*, 2.2 to 4.0 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 1.9 to 3.2 fl oz. (5 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

Bifenthrin

*Bifenture EC*, 2.1 to 6.4 oz. (1 day) (RUP)

or

Bifenthrin

*Bifenture EC*, 2.1 to 6.4 oz. (1 day) (RUP)

or

*Brigadier*, 5.1 to 7.5 oz. (1 day)

**COLORADO POTATO BEETLE:** Apply to entire field or field borders if needed to protect new transplants or if defoliation on larger plants is greater than 10%.

\* *Actara*, 2 to 3 oz. (0 days) Do not apply if a neonicitinoid was used at planting. Do not exceed 11 oz/acre per season.

or

\* *Assail 30 SG*, 1.9 to 2.8 oz. (7 days)

or

\* Imidacloprid

*Nuprid 1.6 F*, *Provado 1.6 F*, 3.8-6.2 fl oz. (0 days) Do not use if neonicitinoids were used at planting. Do not apply more than 19.2 oz/acre per season.

or

\* *Venom*, 1 to 4 oz. (1 day) Do not use if neonicitinoids were used at planting.

or



*Agri-Mek* 0.15 EC, 8 to 16 fl oz. (7 days) (RUP)

or

*Asana* XL, 5.8 to 9.6 oz. (1 day) (RUP)

or

*Bacillus thuringiensis tenebrionis*

*Novodor*, 1 to 4 qts. (0 days) Small larvae only.

or

*Baythroid* XL, 1.6 to 2.8 fl oz. (0 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/4 to 2 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt) (3 days)

or

*Endosulfan* 3 EC, 2/3 qt. (2 days)

or

*SpinTor* 2 SC, 2.25 to 4.5 oz. (1 day)

or

*Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (5 days) (RUP)

or

*Entrust*, 1 to 2 oz. (1 day)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 2.6 to 3.8 fl oz. (5 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant* SC, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 5.1 to 7.5 oz. (1 day)

**APHIDS:** Apply as needed. May be a problem on transplants.

*Assail* 30 SG, 1.9 to 2.8 oz. (7 days)

or

*Diazinon* 50 WP (1/2 lb) or *Diazinon* AG 500 (1/2 pt) (1 day) (RUP)

or

*Dimethoate* 2.67 EC, 3/4 to 1 1/2 pt. (7 days)

or

*Endosulfan* 3 EC, 2/3 qt. (2 days)

or

*Fulfill*, 2.75 oz. (0 days) May require 5 to 7 days for aphid mortality.

or

*Lannate* LV (1 1/2 to 3 pt) or *Lannate* SP (1/2 to 1 lb) (1 day) (RUP)

or

Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.8-6.2 fl oz. (0 days) Do not use if neonicotinoids were used at planting. Do not apply more than 19.2 oz/acre per season.

or

*Venom*, 1 to 4 oz. (1 day) Do not use if neonicotinoids were used at planting.

or

*Beleaf* 50 SG, 2 to 2.8 oz. (0 days)

or

*Actara*, 1.5 to 3 oz. (0 days) Do not apply if a neonicotinoid was used at planting. Do not exceed 11 oz/acre per season.

or

*Brigadier*, 3.8 to 9.85 oz. (1 day)

**LEAFHOPPERS:** Occasionally a problem early in the season.

Apply as needed.

Carbaryl

*Sevin* 80 S (1 1/4 lb) or *Sevin* XLR Plus (1 qt) (3 days)

or

*Dimethoate* 2.67 EC, 3/4 to 1 1/2 pt. (7 days)

or

Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.8-6.2 fl oz. (0 days) Do not use if neonicotinoids were used at planting. Do not apply more than 19.2 oz/acre per season.

or

*Venom*, 1 to 4 oz. (1 day) Do not use if neonicotinoids were used at planting.

or

*Warrior* with Zeon Technology, 1.9 to 3.2 fl oz. (5 days) (RUP)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy*, *Proaxis*, 1.9 to 3.2 fl oz. (5 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

Bifenthrin

*Bifenture* EC, 2.1 to 6.4 oz. (1 day) (RUP)

or

*Brigadier*, 3.8 to 9.85 oz. (1 day)

**HORNWORMS:** Apply if numbers exceed 1/plant.

*Asana* XL, 2.9 to 5.8 oz. (1 day) (RUP)

or

*Avaunt*, 2.5 to 3.5 oz. (3 days)

or

*Bacillus thuringiensis*

*Agree*, *Biobit*, *Dipel*, *Javelin*, *Lepinox*. (0 days)

or

*Baythroid* XL, 1.6 to 2.8 fl oz. (0 days) (RUP)

or

Carbaryl

*Sevin* 80 S (1 1/4 to 2 1/2 lb) or *Sevin* XLR Plus (1 to 2 qt) (3 days)

or

*Endosulfan* 3 EC, 2/3 qt. (2 days)

or

*Warrior* with Zeon Technology, 1.9 to 3.2 fl oz. (5 days) (RUP)

or

*Danitol* 2.4 EC, 10 2/3 fl oz. (3 days) (RUP)

or

*Entrust*, 1 to 2 oz. (1 day)

or

*Intrepid* 2 F, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

*Mustang* Max, 2.2 to 4.0 oz. (1 day) (RUP)

or

## Tomatoes

Lambda-cyhalothrin

*Lambda-Cy, Proaxis*, 1.9 to 3.2 fl oz. (5 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant SC*, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

Permethrin

*Perm-UP 3.2 EC*, 2 to 8 oz. (0 days) (RUP)

**CABBAGE LOOPERS:** Apply to prevent larvae from pupating on ripe fruit or if defoliation is greater than 10%.

\* *Asana XL*, 5.8 to 9.6 oz. (1 day) (RUP)

or

\* *Avaunt*, 2.5 to 3.5 oz. (3 days)

or

\* *Baythroid XL*, 2.1 to 2.8 fl oz. (0 days) (RUP)

or

\* *Warrior* with Zeon Technology, 1.9 to 3.2 fl oz. (5 days) (RUP)

or

*Bacillus thuringiensis*

*Agree, Biobit, Dipel, Javelin, Lepinox*. (0 days)

or

*Endosulfan 3 EC*, 2/3 qt. (2 days)

or

*Lannate LV* (1 1/2 to 3 pt) or *Lannate SP* (1/2 to 1 lb) (1 day) (RUP)

or

*SpinTor 2 SC*, 3 to 6 oz. (1 day)

or

*Entrust*, 1 to 2 oz. (1 day)

or

*Intrepid 2 F*, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

*Mustang Max*, 3.2 to 4.0 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy, Proaxis*, 1.9 to 3.2 fl oz. (5 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant SC*, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

Bifenthrin

*Bifenture EC*, 2.1 to 6.4 oz. (1 day) (RUP)

or

*Brigadier*, 5.1 to 7.5 oz. (1 day)

**TOMATO FRUITWORM:** Occasionally a problem after fruit begins to form. Apply if damage is observed.

\* *Asana XL*, 5.8 to 9.6 oz. (1 day) (RUP)

or

\* *Warrior* with Zeon Technology, 1.3 to 3.8 fl oz. (5 days) (RUP)

or

*Avaunt*, 3.5 oz. (3 days)

or

*Baythroid XL*, 1.6 to 2.8 fl oz. (0 days) (RUP)

or

Carbaryl

*Sevin 80 S* (1 1/4 to 2 1/2 lb) or *Sevin XLR Plus* (1 to 2 qt) (3 days)

or

*Danitol 2.4 EC*, 10 2/3 fl oz. (3 days) (RUP)

or

*Endosulfan 3 EC*, 2/3 qt. (2 days)

or

*Lannate LV* (1 1/2 to 3 pt) or *Lannate SP* (1/2 to 1 lb) (1 day) (RUP)

or

*SpinTor 2 SC*, 3 to 6 oz. (1 day)

or

*Entrust*, 1 to 2 oz. (1 day)

or

*Intrepid 2 F*, 4 to 8 fl oz (early-season applications to young, small crops) or 8 to 10 fl oz (mid- to late-season applications). (1 day)

or

*Mustang Max*, 2.2 to 4.0 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy, Proaxis*, 2.6 to 3.8 fl oz. (5 days) (RUP)

or

*Hero*, 4 to 10.3 oz. (7 days) (RUP)

or

*Radiant SC*, 5 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

Bifenthrin

*Bifenture EC*, 2.1 to 6.4 oz. (1 day) (RUP)

or

Permethrin

*Perm-UP 3.2 EC*, 2 to 8 oz. (0 days) (RUP)

or

*Brigadier*, 5.1 to 7.5 oz. (1 day)

**FRUIT FLIES:** May be a problem on certain varieties during harvest season. Eggs are laid in cracks of ripening fruit. Apply as needed.

*Diazinon 50 WP* (1 lb) or *Diazinon AG 500* (1 pt) (1 day) (RUP)

or

*Malathion 57 EC*, 2 1/2 pt. (1 day)

**THRIPS:**

*Assail 30 SG*, 4 oz. (7 days)

or

*Baythroid XL*, 2.1 to 2.8 fl oz. (0 days) (RUP)

or

*Venom*, 1 to 4 oz. (1 day) Do not use if neonicotinoids were used at planting.

or

*Warrior* with Zeon Technology, 2.6 to 3.8 fl oz. (5 days) (RUP)

or

*Mustang Max*, 3.2 to 4.0 oz. (1 day) (RUP)

or

Lambda-cyhalothrin

*Lambda-Cy, Proaxis*, 2.6 to 3.8 fl oz. (5 days) (RUP)

or

*Hero*, 10.3 oz. (7 days) (RUP)

or



*Agri-Mek* 0.15 EC, 8 to 16 fl oz. (7 days) (RUP)

or

*Radiant* SC, 6 to 10 fl oz. (1 day) Do not make more than 6 applications or exceed 34 fl oz/acre per season.

or

*Brigadier*, 3.8 to 9.8 oz. (1 day)

#### WHITEFLIES:

*Actara*, 3 to 5 oz. (0 days) Do not apply if a neonicotinoid was used at planting. Do not exceed 11 oz/acre per season.

or

*Assail* 30 SG, 0.8 to 1.2 oz. (7 days)

or

*Baythroid* XL, 1.6 to 2.8 fl oz. (0 days) (RUP)

or

Imidacloprid

*Nuprid* 1.6 F, *Provado* 1.6 F, 3.8-6.2 fl oz. (0 days) Do not use if imidacloprid or thiamethoxam were used at planting. Do not apply more than 19.2 oz per season

or

*Venom*, 1 to 4 oz. (1 day) Do not use if neonicotinoids were used at planting.

or

*Mustang* Max, 3.2 to 4.0 oz. (1 day) (RUP)

or

*Oberon* 2 SC, 7 to 8.5 fl oz. (7 days)

or

*Hero*, 10.3 oz. (7 days) (RUP)

#### CUTWORM:

Carbaryl

*Sevin* XLR Plus, 2 qt. (3 days)

#### MITES

Usually two-spotted. May become a problem in hot, dry weather.

*Agri-Mek* 0.15 EC, 8 to 16 fl oz. (7 days) (RUP)

or

*Danitol* 2.4 EC, 10 2/3 fl oz. (3 days) (RUP)

or

*Kelthane* MF, 3/4 to 1 1/2 pt. (2 days) Limited to 2 applications per season.

or

*Oberon* 2 SC, 7 to 8.5 fl oz. (7 days)

or

*Hero*, 10.3 oz. (1 day) (RUP)

#### SLUGS

*Deadline* M-Ps 4% (20 to 40 lb) or *Metaldehyde* 3.5 G (30 to 40 lb) Apply between rows. Avoid contact to edible product.

#### DISEASES

##### SEED TREATMENT:

**DAMPING OFF, PRE-EMERGENCE** (*Pythium* spp., *Rhizoctonia solani*, *Phytophthora* spp.):

*Bacillus subtilis* GB03

*Kodiak*, 0.1 to 0.5 oz/100 seed (*Pythium*).

or

*Captan*

*Captan* 30-DD, 2 1/3 oz/100 lb seed.

*Captan* 400, 2 1/2 to 3 oz/100 lb seed.

or

*Thiram*

42-S *Thiram*, *Thiram* 50 WP Dyed, 6 oz/100 lb seed. Apply to seed before planting.

#### GREENHOUSE SOIL DRENCH:

**ROOT/STEM ROT** (*Rhizoctonia solani*):

*PCNB*

*Terraclor* 400, see label for rates specific to soil depth.

#### PREPLANT SOIL FUMIGATION:

**FUSARIUM WILT** (*Fusarium oxysporum*), **VERTICILLIUM WILT** (*Verticillium albo-atrum*): Apply to production fields in the spring before planting. **Note:** Most fumigants applied in the soil for control of disease organisms will also control soil insects, nematodes and weed seeds.

Soil sterilization by fumigation is best achieved by proper application of material. Correct soil moisture, temperature, and soil structure is needed for effective control of soil-borne pests. Special care is needed to seal fumigants in target zone for required time periods. This can be achieved by soil packing or immediate tarping.

1,3 Dichloropropene/chloropicrin

*Telone* C35, 13-35 gal. (RUP)

or

*Metam* Sodium

*Sectagon* 42, *Vapam* HL, 37.5-75 gal.

or

Potassium N-methylidithiocarbamate

*Sectagon*-K54, 30-60 gal.

#### GREENHOUSE PREPLANT INCORPORATION:

**DAMPING OFF** (*Pythium* spp.), **ROOT ROT** (*Rhizoctonia* spp.):

*Gliocladium virens* GL-21

*SoilGard* 12 G, 1 to 1.5 lb per cubic yard. Biological control product that needs to be applied before disease development. Control may be limited under heavy disease pressure.

#### PREPLANT INCORPORATED:

**DAMPING OFF** (*Pythium* spp.):

\* *Mefenoxam*. Apply as a broadcast preplant incorporation or a surface application. For banded applications use a 7 in. band.

**Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 1 in. of sprinkler irrigation.

*Ridomil* Gold GR, 20 lb.

*Ridomil* Gold SL, 1 pt. (7 days)

*Ultra* Flourish, 2 to 4 pt.

**ROOT and FRUIT ROT** (*Pythium* spp., *Phytophthora* spp.):

\* *Mefenoxam*. Apply *Ridomil* 4 to 6 weeks after planting as a surface application or a soil surface spray under vines followed by 1/2 to 1 in. of water or injected based on a 7 in. band. A second application before the last irrigation may be made up to 4 weeks before harvest.

*Ridomil* Gold GR, 20 lb (4 weeks). (4 weeks) A third application can be made 4 weeks before harvest.

or

## Tomatoes

*Ridomil* Gold SL, 1 pt. (7 days)

*Ultra Flourish*, 2 to 4 pt (4 weeks). (4 weeks)

**Note:** Observe limit of active ingredient/crop on label.

or

Mono-, dibasic sodium, potassium and ammonium phosphites

*Phostrol*, 2.5 to 5 pt every 7 - 14 days. (0 days)

### GREENHOUSE TREATMENT:

**BACTERIAL CANKER** (*Clavibacter michiganensis* subsp.

*michiganensis*), **BACTERIAL SPOT** (*Xanthomonas vesicatoria*),

**BACTERIAL SPECK** (*Pseudomonas tomato*): Apply every 7 to 10 days after disease appearance.

Copper Ammonium Carbonate

*Copper Count N*, 4 tablespoons (speck) or 4 to 8 tablespoons (spot) per 1000 sq ft.

or

Copper Hydroxide

*Champ DP*, *Champ Formula 2 F*, *Kocide 2000*, 1 1/2 to 2 1/4 tablespoons per 1000 sq ft (speck and spot).

or

*Champion WP*, *Kocide 101*, 4 tablespoons (speck) or 4 to 8 tablespoons (spot) per 1000 sq ft.

or

*Kocide 4.5 LF*, 1 to 2 tablespoons per 1000 sq ft.

or

*Kocide DF*, 2 tablespoons (speck) or 2 to 4 tablespoons (spot) per 1000 sq ft.

or

Mancozeb

*Dithane DF Rainshield*, *Dithane M-45*, 1 1/2 to 3 lb. (5 days) Tank mix 1/2 to full rate of Dithane with a full rate of fixed copper fungicide, and apply at intervals recommended by the copper fungicide label (speck and spot).

or

*Dithane F-45 Rainshield*, 1.2 to 2.4 qt. Tank mix 1/2 to full rate of Dithane with a full rate of fixed copper fungicide, and apply at intervals recommended by the copper fungicide label (speck and spot)

or

Acibenzolar-S-methyl

*Actigard*, 1/3 to 3/4 oz per 100 gal of water. (14 days) Do not apply more than 6 oz of Actigard per acre per season.

**Note:** Most fungicides that protect against bacterial speck and/or spot may provide protection against bacterial canker.

### FOLIAR TREATMENT:

**ROOT ROT** (*Phytophthora* spp.), **DAMPING OFF** (*Pythium* spp.):

Fosetyl-Aluminum

*Aliette WDG*, 2.5 to 5 lb, 7- to 14-day intervals. (14 days)

**Note:** Do not tank mix with copper products.

**LEAF MOLD** (*Cladosporium fulvum*), **WHITE MOLD** (*Sclerotinia sclerotiorum*), **GRAY MOLD** (*Botrytis cinerea*): Apply weekly as a foliar spray. May have reduced efficacy against *Botrytis* gray mold as a result of resistant strains of *B. cinerea*.

\* Chlorothalonil

*Bravo Ultrex*, 1.3 to 1.8 lb. (0 days)

or

*Bravo Weather Stik*, *Equus 720 SST*, 1 3/8 to 2 pt; 2 to 3 pt (*Botrytis*). (0 days)

or

*Echo 720*, 2 to 3 pt (*Botrytis*). (0 days)

*Echo 90 DF*, 1.2 to 1.7 lb; 1.7 to 2.3 lb (*Botrytis*). (0 days)

*Equus DF*, 1.3 to 2.6 lb (*Botrytis*). (0 days)

or

\* Mancozeb

*Dithane DF Rainshield*, *Dithane M-45*, *Dithane WSP*, 1 1/2 to 3 lb. (5 days)

or

*Dithane F-45 Rainshield*, 1 1/5 to 2 2/5 qt. (5 days)

*Manzate 75 DF*, 1 1/2 to 3 lb, 7- to 10-day intervals. (5 days)

or

*Penncozeb 75 DF* (3/4 to 3 lb (*Cladosporium*)) or *Penncozeb 80 WP* (3/4 to 3 lb (*Cladosporium*)) (5 days)

or

\* Maneb

*Maneb 75 DF*, *Maneb 80 WP*, 1 1/2 to 3 lb. (5 days)

*Manex*, 1 1/5 to 2 2/5 qt. (5 days)

or

Boscalid

*Endura*, 9 to 12.5 oz. (0 days)

or

Famoxadone/Cymoxanil

*Tanos*, 8 oz. (3 days)

or

Neem Oil

*Trilogy*, 2 pt. (0 days)

or

Potassium Bicarbonate

*Armcarb 100*, 2.5 to 5 lb (*Botrytis*). (0 days)

or

Pyrimethanil

*Scala*, 7 fl oz. (1 day)

**BACTERIAL CANKER** (*Clavibacter michiganensis* subsp.

*michiganensis*), **BACTERIAL SPOT** (*Xanthomonas vesicatoria*),

**BACTERIAL SPECK** (*Pseudomonas tomato*):

*Bacillus subtilis*

*Serenade*, 4 to 8 lb every 7 days. (0 days) Biological control product that needs to be applied before disease development. Control will be limited under heavy disease pressure.

or

*Serenade Max*, 1 - 3 lb every 7 to 10 days. (0 days)

or

Copper Ammonium Carbonate

*Copper Count N*, 1 to 3 qt (speck, spot). (0 days)

or

Copper Hydroxide

*Champ DP*, 1 1/3 lb 10 to 30 day intervals (speck) or 1 1/3 to 2 2/3 lb (spot), 7-to 10-day intervals. (0 days)

or

*Champ Formula 2 F*, 1 1/3 pt (speck), 1 1/3 to 2 2/3 pt (spot). (0 days)

or

*Champion WP*, 2 to 4 lb (spot) or 2 lb (speck). (0 days)

*Kocide 101*, *Kocide DF*, 2 to 4 lb (speck, spot). (0 days)

*Kocide 2000*, 1 1/2 to 3 lb. (0 days)

*Kocide 4.5 LF*, 1 1/3 to 2 2/3 pt (speck, spot). (0 days)

or



*Nu-Cop* 3 L, 1 1/3 to 2 2/3 pt, 10- to 30-day intervals (speck) or 1 1/3 to 5 1/3 pt, 7- to 10-day intervals (spot). (0 days)

or

*Nu-Cop* 50 DF, 2 to 3 lb (speck) or 2 to 4 lb (spot), 7- to 10-day intervals. (0 days)

or

Mancozeb/Copper Hydroxide

*ManKocide*, 2.5 to 5 lb (speck, spot). (5 days)

or

Copper Oxychloride / Copper Sulfate

C-O-C-S WDG, 2 to 6 lb every 7 days. (0 days)

or

Copper Resinate

*Tenn-Cop* 5 E, 3 pt (speck, spot).

or

Copper Sulfate

*Basic Copper* 53, *Basicop*, 2 to 4 lb (canker, spot). (0 days) May be used through irrigation equipment.

or

*Cuprofix* Ultra, 1.25 to 3 lb. (0 days)

or

Famoxadone/Cymoxanil

*Tanos*, 8 oz. (3 days)

**Note:** Fungicides that protect against bacterial speck and/or spot may provide protection against bacterial canker.

**EARLY BLIGHT** (*Alternaria solani*):

\* Azoxystrobin

*Amistar*, 1.6 to 2.0 oz every 7 - 21 days. (0 days)

*Quadris*, 5 to 6.2 fl oz. (0 days)

Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* Azoxystrobin/Chlorothalonil

*Quadris* Opti, 1.6 pt every 7 - 21 days. (0 days)

or

\* Boscalid

*Endura*, 2.5 to 3.5 oz. (0 days)

or

\* Chlorothalonil

*Bravo Ultrex*, 1.3 to 1.8 lb (foliage) or 1.8 to 2.7 (fruit) every 7 - 14 days. (0 days)

or

*Bravo Weather Stik*, *Echo* 720, *Equus* 720 SST, 1 3/8 to 2 pt (foliage) or 2 to 2.75 pt (fruit). (0 days)

or

*Echo* 90 DF, 1.2 to 1.7 lb. (0 days)

*Equus* DF, 1.3 to 2.6 lb. (0 days)

or

\* Mancozeb

*Dithane* DF Rainshield, *Dithane* M-45, *Dithane* WSP, 1 1/2 to 3 lb. (5 days)

or

*Dithane* F-45 Rainshield, 1 1/5 to 2 2/5 qt. (5 days)

*Manzate* 75 DF, *Manzate* 80 WP, 1 1/2 to 3 lb. (5 days)

*Penncozeb* 4 F, 0.6 to 2.4 qt. (5 days)

*Penncozeb* 75 DF, *Penncozeb* 80 WP, 1 1/2 to 3 lb. (5 days)

or

\* Maneb

*Maneb* 75 DF, or *Maneb* 80 WP (1 1/2 to 3 lb) or *Manex* (1 1/5 to 2 2/5 qt) (5 days)

or

\* Mandipropamid/Difenoconazole

*Revus* Top, 5.5-7 fl oz. (1 day)

or

\* Pyraclostrobin

*Cabrio*, 8-12 oz. (0 days) No more than 3 sequential applications should be made before alternating with fungicides having a different mode of action.

or

\* Trifloxystrobin

*Flint*, 2 to 3 oz. (3 days)

or

\* Ziram

*Ziram* 76 DF, 3 to 4 lb, 7- to 14-day intervals. (7 days) Do not use on cherry tomatoes.

or

*Bacillus subtilis*

*Serenade*, 4 to 8 lb every 7 days. (0 days) Biological control product that needs to be applied before disease development. Control will be limited under heavy disease pressure.

or

Copper Ammonium Carbonate

*Copper Count* N, 3 qt. (0 days)

or

Copper Hydroxide

*Champ* DP, 1 1/3 to 2 lb. (0 days)

*Champ* Formula 2 F, 1 1/3 to 2 pt. (0 days)

*Champion* WP, 2 to 4 lb. (0 days)

*Kocide* 101, *Kocide* DF, *Nu-Cop* 50 DF, 2 to 3 lb. (0 days)

*Kocide* 2000, 1 1/2 to 3 lb. (0 days)

*Kocide* 4.5 LF, 1 1/3 to 2 2/3 pt. (0 days)

*Nu-Cop* 3 L, 1 1/3 to 4 pt. (0 days)

or

Mancozeb/Copper Hydroxide

*ManKocide*, 2.5 to 5 lb. (5 days)

or

Copper Sulfate

*Basic Copper* 53, *Basicop*, 2 to 4 lb. (0 days)

*Cuprofix* Ultra, 1.25 to 3 lb. (0 days)

or

Famoxadone/Cymoxanil

*Tanos*, 8 oz. (3 days)

or

Fenamidone

*Reason* 500 SC, 5.5 to 8.2 fl oz every 5 to 10 days. (14 days)

or

Mancozeb/Copper Sulfate

*Cuprofix* MZ Disperss, 1.75 - 7.25 lb. (5 days)

or

Neem Oil

*Trilogy*, 2 pt. (0 days)

or

Potassium Bicarbonate

*Armcarb* 100, 2.5 to 5 lb. (0 days)

or

## Tomatoes

### Pyrimethanil

*Scala*, 7 fl oz. (1 day)

or

### Copper Resinate

*Tenn-Cop 5 E*, 3 pt. (0 days)

### **LATE BLIGHT** (*Phytophthora infestans*):

#### \* Azoxystrobin/Chlorothalonil

*Quadris Opti*, 1.6 pt every 7 - 21 days. (0 days)

or

#### \* Chlorothalonil

*Bravo Ultrex*, 1.3 to 1.8 lb (foliage) or 1.8 to 2.6 lb (fruit).

(0 days)

or

*Bravo Weather Stik*, *Echo 720*, *Equus 720 SST*, 1 3/8 to 2 pt (foliage) or 2 to 2.75 pt (fruit). (0 days)

or

*Echo 90 DF*, 1.2 to 1.7 lb. (0 days)

*Equus DF*, 1.3 to 2.6 lb.

or

#### \* Cyazofamid

*Ranman*, 2.1 to 2.75 fl oz every 7 to 10 days. (5 days)

or

#### \* Cymoxanil

*Curzate 60 DF*, 3.2 to 5 oz every 5 - 7 days. (3 days)

or

#### \* Dimethomorph

*Acrobat 50 WP*, 6.4 oz. (0 days)

*Forum*, 6 fl oz. (0 days)

or

#### \* Fluopicolide

*Presidio*, 3-4 fl oz. (2 days)

or

#### \* Mancozeb/Zoxamide

*Gavel 75 DF*, 1.5-2.0 lb. (5 days)

or

#### \* Mandipropamid/Difenoconazole

*Revus Top*, 5.5-7 fl oz. (1 day)

or

#### \* Propamocarb

*Previcur Flex*, 0.7 to 1.5 pt every 7 to 10 days. (5 days)

or

#### \* Pyraclostrobin

*Cabrio*, 8-12 oz. (0 days) Apply in a strict one-to-one alternation program with fungicides having a different mode of action.

or

#### \* Mefenoxam/Chlorothalonil

*Ridomil Gold Bravo*, 2 lb, 14-day intervals. (14 days) Maximum 3 applications.

or

#### \* Mefenoxam/Copper Hydroxide

*Ridomil Gold Copper*, 2 lb, 14-day intervals. (14 days) Maximum 3 applications.

or

#### \* Mefenoxam/Mancozeb

*Ridomil Gold MZ*, 2.5 lb, 14-day intervals. (14 days) Maximum 3 applications.

or

### Azoxystrobin

*Amistar*, 1.6 to 2.0 oz every 5 - 7 days. (0 days)

*Quadris*, 5 to 6.2 fl oz. (0 days)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action

or

### Bacillus subtilis

*Serenade*, 4 to 8 lb. (0 days) Provides suppression. Biological control product that needs to be applied before disease development. Control may be limited under heavy disease pressure.

or

### Copper Ammonium Carbonate

*Copper Count N*, 1 to 3 qt. (0 days)

or

### Copper Hydroxide

*Champ DP*, 1 1/3 to 2 lb. (0 days)

*Champ Formula 2 F*, 1 1/3 to 2 pt. (0 days)

*Champion WP*, 2 to 4 lb. (0 days)

*Kocide 101*, *Kocide DF*, 2 to 3 lb. (0 days)

*Kocide 2000*, 1 1/2 to 3 lb. (0 days)

*Kocide 4.5 LF*, 1 1/3 to 2 2/3 pt. (0 days)

*Nu-Cop 3 L*, 1 1/3 to 5 1/3 pt, 7- to 10-day intervals. (0 days)

or

### Mancozeb/Copper Hydroxide

*ManKocide*, 2.5 to 5 lb. (5 days)

or

### Copper Sulfate

*Basic Copper 53*, *Basicop*, 2 to 4 lb. (0 days)

*Cuprofix Ultra*, 1.25 to 3 lb. (0 days)

or

### Famoxadone/Cymoxanil

*Tanos*, 8 oz. (3 days)

or

### Fenamidone

*Reason 500 SC*, 5.5 to 8.2 fl oz every 5 to 10 days. (14 days)

or

### Maneb

*Maneb 75 DF*, *Maneb 80 WP*, 1 1/2 to 3 lb, 7- to 10-day intervals. (5 days)

or

*Manex*, 1 1/5 to 2 2/5 qt. (0 days)

or

### Mancozeb

*Dithane DF Rainshield*, *Dithane M-45*, *Dithane WSP*, 1 1/2 to 3 lb. (5 days)

or

*Manzate 75 DF*, 1 1/2 to 3 lb. Maximum 22.4 lb/season. (5 days)

or

*Dithane F-45 Rainshield*, 1 1/5 to 2 2/5 qt. (5 days)

*Penncozeb 4 F*, 0.6 to 2.4 qt. (5 days)

*Penncozeb 75 DF*, *Penncozeb 80 WP*, 1 1/2 to 3 lb. (5 days)

or

### Mancozeb/Copper Sulfate

*Cuprofix MZ Disperss*, 1.75 - 7.25 lb. (5 days)

or



Neem Oil*Trilogy*, 2 pt. (0 days)

or

Potassium Bicarbonate*Armcarb* 100, 2.5 to 5 lb. (0 days)

or

Trifloxystrobin*Flint*, 4 oz. (3 days)

or

Mono-, dibasic sodium salts of phosphorous acid*Fosphite*, 3 to 5 qt per 20 gal (ground) or 10 gal (aerial) of water. (0 days)**Note:** Most fungicides that protect against early blight also provide limited late blight protection.**SEPTORIA LEAF SPOT** (*Septoria lycopersici*):\* Azoxystrobin*Amistar*, 1.6 to 2.0 oz every 7 - 21 days.*Quadris*, 5 to 6.2 fl oz.Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* Azoxystrobin/Chlorothalonil*Quadris Opti*, 1.6 pt every 7 - 21 days. (0 days)

or

\* Chlorothalonil*Bravo Ultrex*, 1.3 to 1.8 lb. (0 days)*Echo* 90 DF, 1.2 to 1.7 lb. (0 days)*Equus* DF, 1.3 to 2.6 lb. (0 days)

or

*Bravo Weather Stik*, *Echo* 720, *Equus* 720 SST, 1 3/8 to 2 pt. (0 days)

or

\* Mancozeb*Dithane* DF Rainshield, *Dithane* M-45, *Dithane* WSP, 1 1/2 to 3 lb. (5 days)

or

*Manzate* 75 DF, 1 1/2 to 3 lb. Maximum 22.4 lb/season. (5 days)

or

*Dithane* F-45 Rainshield, 1 1/5 to 2 2/5 qt. (5 days)*Penncozeb* 75 DF, *Penncozeb* 80 WP, 1 1/2 to 3 lb. (5 days)

or

\* Maneb*Maneb* 75 DF, *Maneb* 80 WP, 1 1/2 to 3 lb. (5 days)*Manex*, 1 1/5 to 2 2/5 qt. (5 days)

or

\* Pyraclostrobin*Cabrio*, 8-12 oz. (0 days) No more than 3 sequential applications should be made before alternating with fungicides having a different mode of action.

or

\* Trifloxystrobin*Flint*, 3 to 4 oz suppressed. (3 days)

or

\* Ziram*Ziram* 76 DF, 3 to 4 lb, 7- to 14-day intervals. (7 days) Do not use on cherry tomatoes.

or

Copper Hydroxide*Champ* DP, 1 1/3 to 2 2/3 lb. (0 days)*Kocide* 2000, 1 1/2 to 3 lb. (0 days)

or

*Champ* Formula 2 F, *Kocide* 4.5 LF, 1 1/3 to 2 2/3 pt, 7- to 10-day intervals. (0 days)

or

*Champion* WP, *Kocide* 101, *Kocide* DF, 2 to 4 lb, 7- to 10-day intervals. (0 days)

or

Mancozeb/Copper Hydroxide*ManKocide*, 2.5 to 5 lb. (5 days)

or

Copper Sulfate*Basic* Copper 53, *Basicop*, 2 to 4 lb. (0 days)*Cuproxif* Ultra, 1.25 to 3 lb. (0 days)

or

Fenamidone*Reason* 500 SC, 5.5 to 8.2 fl oz every 5 to 10 days. (14 days)

or

Mancozeb/Copper Sulfate*Cuproxif* MZ Disperss, 1.75 - 7.25 lb. (5 days)

or

Copper Resinate*Tenn-Cop* 5 E, 3 pt. (0 days)

or

Mandipropamid/Difenoconazole*Revus* Top, 5.5-7 fl oz. (1 day)**ANTHRACNOSE** (*Colletotrichum coccodes*):\* Azoxystrobin*Amistar*, 1.6 to 2.0 oz every 7 - 21 days. (0 days)*Quadris*, 5 to 6.2 fl oz. (0 days)Do not apply more than one foliar application of *Amistar* and *Quadris* or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

\* Chlorothalonil*Bravo* Ultrex, 1.8 to 2.6 lb. (0 days)*Echo* 90 DF, 1.7 to 2.3 lb. (0 days)*Equus* DF, 1.3 to 2.6 lb. (0 days)

or

*Bravo* Weather Stik, *Echo* 720, *Equus* 720 SST, 2 to 2.75 pt. (0 days)

or

\* Mancozeb*Dithane* DF Rainshield, *Dithane* M-45, *Dithane* WSP, 1 1/2 to 3 lb. (5 days)

or

*Dithane* F-45 Rainshield, 1 1/5 to 2 2/5 qt. (5 days)*Penncozeb* 4 F, 0.6 to 2.4 qt. (5 days)*Penncozeb* 75 DF, *Penncozeb* 80 WP, 1 1/2 to 3 lb. (5 days)

or

*Manzate* 75 DF, 1 1/2 to 3 lb. Maximum 22.4 lb/season. (5 days)

or

\* Maneb*Maneb* 75 DF, *Maneb* 80 WP, 1 1/2 to 3 lb. (5 days)

or

## Turnips

*Manex* 4 F, 1 1/5 to 2 2/5 qt. Maximum of 16.8 qt/season. (5 days)

or

\* Pyraclostrobin

*Cabrio*, 8-12 oz. (0 days) No more than 3 sequential applications should be made before alternating with fungicides having a different mode of action.

or

\* Ziram

*Ziram* 76 DF, 3 to 4 lb, 7- to 14-day intervals. (7 days) Do not use on cherry tomatoes.

or

Mancozeb/Copper Hydroxide

*ManKocide*, 2.5 to 5 lb. (5 days)

or

Copper Hydroxide

*Champ* DP, 1 1/3 to 2 2/3 lb. (0 days)

or

*Champ* Formula 2 F, *Kocide* 4.5 LF, 1 1/3 to 2 2/3 pt, 7- to 10-day intervals. (0 days)

or

*Champion* WP, *Kocide* 101, *Kocide* DF, 2 to 4 lb, 7- to 10-day intervals. (0 days)

or

*Kocide* 2000, 1 1/2 to 3 lb. (0 days)

*Nu-Cop* 3 L, 1 1/3 to 5 1/3 pt, 7- to 10-day intervals. (0 days)

*Nu-Cop* 50 DF, 2 to 3 lb, 7- to 10-day intervals. (0 days)

or

Copper Sulfate

*Basic* Copper 53, *Basicop*, 2 to 4 lb. (0 days)

*Cuprofix* Ultra, 1.25 to 3 lb. (0 days)

or

Famoxadone/Cymoxanil

*Tanos*, 8 oz. (3 days)

Or

Mancozeb/Copper Sulfate

*Cuprofix* MZ Disperss, 1.75 - 7.25 lb. (0 days)

or

Neem Oil

*Trilogy*, 2 pt. (0 days)

or

Potassium Bicarbonate

*Armicarb* 100, 2.5 to 5 lb. (0 days)

or

Copper Resinate

*Tenn-Cop* 5 E, 3 pt. (0 days)

or

Mandipropamid/Difenoconazole

*Revus* Top, 5.5-7 fl oz. (1 day)

**BUCKEYE FRUIT ROT** (*Phytophthora parasitica*):

\* Trifloxystrobin

*Flint*, 3 to 4 oz suppressed. (3 days) Suppressed.

or

\* Fluopicolide

*Presidio*, 3-4 fl oz. (2 days)

or

\* Mefenoxam/Copper Hydroxide

*Ridomil* Gold Copper, 2 lb, 14-day intervals. (14 days) Maximum 3 applications.

or

\* Mefenoxam/Chlorothalonil

*Flouronil*, 2 lb, 14-day intervals. (14 days) Maximum 3 applications.

or

*Ridomil* Gold Bravo, 2 lb, 14-day intervals. (14 days) 3 applications maximum.

or

Azoxystrobin

*Amistar*, 1.6 to 2.0 oz every 7 - 21 days. (0 days)

*Quadris*, 5 to 6.2 fl oz. (0 days)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

Azoxystrobin/Chlorothalonil

*Quadris* Opti, 1.6 pt every 7 - 21 days. (0 days)

## Turnips

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. Consult bulletin E-959 for pictures of insects, life history and damage. See current Vegetable Crop Advisory Team Newsletter for up-to-date information on pest status and control. (Visit [www.ipm.msu.edu/vegCAT.htm](http://www.ipm.msu.edu/vegCAT.htm) or use the order form in the back of the book to subscribe.)

## INSECTS

### SOIL TREATMENT:

#### CABBAGE MAGGOT:

*Lorsban* 15 G (4.6 to 9.2 oz/1,000 ft of row) or *Lorsban* 4 E / *Lorsban* Advanced (1.6 to 2.75 fl oz / 1,000 ft of row) Apply in a 4-inch band over row at time of seeding. (RUP)

#### APHIDS, FLEA BEETLE: See label for application methods.

#### Imidacloprid

*Admire* Pro, 4.4 - 10.5 fl oz. (21 days) See label for application methods.

or

*Nuprid* 2 F, 10 to 24 fl oz. (21 days) Apply preplant, in furrow, or as a post-planting drench.

or

*Platinum*, 5 to 12 fl oz. (30 days) See label for application methods.

### FOLIAR TREATMENT:

**FLEA BEETLE:** Apply if foliar injury is observed to prevent larval injury to roots.

*Actara*, 1.5 to 3 oz. (7 days)

or

*Baythroid* XL, 1.6 to 2.8 fl oz. (0 days) (RUP)

or



## Carbaryl

Sevin 80 S, 1 1/4 lb. (7 days; 14 days if tops are eaten)

or

## Imidacloprid

Nuprid 1.6 F, Provado 1.6 F, 3.5 fl oz. (7 days) Do not exceed 10.5 oz/Acre per season.

**CABBAGE "WORM":** Apply if needed.

*Bacillus thuringiensis*

Agree, Biobit, Dipel, Javelin, Xentari. (0 days)

or

Malathion 57 EC, 2 pt. (7 days)

or

## Permethrin

Perm-UP 3.2 EC, 2 to 4 oz. (1 day) (RUP)

**APHIDS:** Apply as needed to prevent population buildup.

Actara, 1.5 to 3 oz. (7 days)

or

Malathion 57 EC, 2 pt. (3 days)

or

## Imidacloprid

Nuprid 1.6 F, Provado 1.6 F, 3.5 fl oz. (7 days) Do not exceed 10.5 oz/Acre per season.

## DISEASES

## SEED TREATMENT:

**DAMPING OFF** (*Pythium* spp., *Rhizoctonia solani*): Apply treatment as dust or slurry.

*Bacillus subtilis* GB03

Kodiak, 0.1 to 0.5 oz/100 lb seed (*Pythium*).

or

## Fludioxinil

Maxim 4 FS, 0.08 to 0.16 fl oz/100 lb seed (*Rhizoctonia*).

Commercial seed treatment plants only.

or

## Captan

Captan 30-DD, 1 1/4 oz/100 lb seed.

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

or

## Thiram

42-S Thiram, Thiram 50 WP Dyed, 8 oz/100 lb seed.

## PREPLANT INCORPORATED:

**DAMPING OFF** (*Pythium* and *Phytophthora* spp.):

\* **Mefenoxam.** Apply as a broadcast preplant incorporation or a surface application. For banded applications use a 7" band. **Note:** If natural rainfall is not expected before seeds germinate, incorporate mechanically before planting or water into the seed zone after planting with 1/2 to 1" of sprinkler irrigation.

Ridomil Gold SL, 1-2 pt.

## FOLIAR TREATMENT:

**ALTERNARIA LEAF SPOT** (*Alternaria* spp.), **DOWNY MILDEW** (*Peronospora parasitica*):

*Azoxystrobin*

Amistar (2 to 5 oz (*Alternaria*)) or Quadris (6.2 to 15.4 fl oz (*Alternaria*)) (0 days)

Do not apply more than one foliar application of Amistar and Quadris or other strobilurin fungicide before alternating with a fungicide that has a different mode of action.

or

*Pyraclostrobin*

Cabrio, 8 to 12 oz. (0 days)

or

*Trifloxystrobin*

Flint, 2 to 3 oz. (7 days) Do not apply more than three sequential foliar applications of strobilurin fungicides before alternating with a fungicide that has a different mode of action.

or

*Acibenzolar-S-methyl*

Actigard, 1 oz per 20 gal (ground) or 10 gal (aerial) of water. (7 days) Do not apply more than 4 applications / crop per year.

**CERCOSPORA LEAF SPOT** (*Cercospora* spp.):

*Tebuconazole*

Folicur 3.6F, 4-7.2 fl oz. (7 days) Maximum 28.8 fl oz/acre/season. 12 hr REI.

## APPENDIX A

### Seedbed Preparation

#### SEEDBED PREPARATION

Clean soil is necessary for good seedbed production. Organisms that cause damage to vegetable seedlings may be present in any soil or growing mixture. Soils may be sterilized by a number of chemical or physical techniques, such as steam or dry heat.

**Warnings:** All the listed fumigants may be used both in the seedbeds and to treat soils in which vegetables are grown to maturity, with the following exceptions: 1) METHYL BROMIDE and FORMALDEHYDE can be used only for seedbeds. 2) None of the materials can be used where living plants are growing. Carefully read the directions in the table below, and especially those of manufacturers, to avoid danger and to obtain successful results.

#### SEED TREATMENT

Dust method—place the seed and suggested wettable powders in a closed container and agitate vigorously for several minutes or until seed is coated with dust. For best results, use a container with twice the capacity of the seed treated.

Slurry method—to suggested wettable powders, add enough water to make a sloppy paste or slurry. Treat by stirring or swirling seed in the slurry until thoroughly coated. Dry the seed before planting. Slurries are preferred to dusts because they adhere to the seed better and are less irritating to use.

#### CHEMICALS SUGGESTED FOR SEEDBED STERILIZATION

CHLOROPICRIN  
(E.G. CHLOR-O-PIC, PICFUME)

**Warnings:** Fumes are very irritating to eyes and are poisonous to growing plants. Wear full coverage protective clothing and a MSHA/NIOSH-approved respirator with the proper carbon filter.

##### Rate and Method of Application

Inject 1.6 to 2.3 cc of material 6 inches deep and at 8-inch intervals using a hand operated fumigation gun. Treat only when soil temperature 6 inches deep is above 65°F. Pack treated soil and apply water seal (wet to a depth of several inches) or cover with plastic for 48 hours. Cultivate to speed aeration and avoid planting for 2 weeks, or until odor of fumigant is no longer detectable.

#### FORMALDEHYDE

**NOTE:** Not effective for nematodes. Especially suited for cabbage and cauliflower.

**Warnings:** Fumes are irritating to eyes and nasal passages and poisonous to growing plants. Avoid prolonged contact with skin. Wash off with soap and water. Wear goggles, rubber footwear and rubber gloves when handling. Wear full coverage protective clothing and a MSHA/NIOSH-approved respirator with the proper carbon filter. Ventilate when treating a confined area. Rate of Method of Application

Mix 1 pt (37% to 40% strength) with 5 gallons of water and apply with a sprinkling can at the rate of 1/2 gal/sq ft of soil surface. Treat only if soil temperature 6 inches deep is above 60°F. Cover treated soil with a plastic cover. Leave undisturbed for 48 hours, then cultivate one or more times. Avoid planting for 2 weeks or until odor of fumigant is no longer detectable. Do not use near living plants. As a disinfectant for equipment and storage interiors or greenhouses, spray surfaces with a mixture of 1 pt (37% to 40% strength) in 5 gallons of water. Cover equipment with plastic and keep storage or greenhouse closed for 24 to 48 hours after treatment, then air out well before planting.

1,3-D (DICHLOROPROPENE; TELONE II)

**Warnings:** Fumes are irritating to eyes and nasal passages. Prolonged inhalation is dangerous; poisonous to growing plants. Avoid contact with skin. Wash off with soap and water. Wear goggles, rubber footwear and rubber gloves when handling. Wear full coverage protective clothing and a MSHA/NIOSH-approved respirator with the proper carbon filter.

##### Rate and Method of Application

Apply as a preplant broadcast treatment at least 14 to 21 days prior to planting. Late summer or early autumn is usually best for applying fumigants in Michigan. Inject at 8 inches deep with chisels spaced 10 to 12 inches apart when soil temperature is between 50° and 80°F. Seal immediately after application. If soil is waterlogged or temperature is below 60°F, allow additional time before planting. Use only on crops listed on the respective label.

1,3-D AND CHLOROPICRIN (E.G., TELONE C-17)

**Warnings:** Fumes are irritating to eyes and nasal passages. Prolonged inhalation is dangerous; poisonous to growing plants. Avoid contact with skin. Wash off with soap and water. Wear goggles, rubber footwear and rub-



ber gloves when handling. Wear full coverage protective clothing and a MSHA/NIOSH-approved respirator with the proper carbon filter.

#### **Rate and Method of Application**

Apply as a preplant broadcast treatment at least 14 to 21 days prior to planting. Late summer or early autumn is usually best for applying soil fumigants in Michigan. Inject 8 inches deep with chisels spaced 10 to 12 inches apart when soil temperature is between 50° and 80°F. Seal immediately after application. If soil is waterlogged or temperature is below 60°F, allow additional time before planting. Use only on crops listed on the respective label.

SODIUM METHYLDITHIOCARBAMATE  
(METHAM) (E.G., VAPAM OR VAPAM HL)

**Warnings:** Avoid breathing vapor or spray mist. Do not get in eyes, on skin, or clothing. Causes skin irritation. May be fatal if absorbed through skin. Wash with soap and water. Wear full coverage protective clothing and a MSHA/NIOSH-approved respirator to reduce exposure.

#### **Rate and Method of Application**

With a sprinkling can, fill with 1 to 1 1/2 pt metham and water and sprinkle uniformly over 50 sq ft of well-prepared soil. Sprinkle immediately with water until soil is sealed, or tarp for 48 hours. Seven days after treatment cultivate area to a depth of 2 inches to aerate soil. Do not seed earlier than 21 days after application if tarp is used. For soil injection, space injectors 5 inches apart and inject metham 4 inches into well-prepared soil. Follow immediately with a roller to smooth and compact the soil surface. Light watering or a tarp after rolling helps to prevent gas escape. For seedbeds, 75 to 100 gal/A (1 1/2 pt to 2 pt per 100 sq ft) is recommended.

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## **APPENDIX B**

### **Nematodes and Michigan Vegetable Production**

George W. Bird, Professor  
Michigan State University  
East Lansing, MI 48824

Nematodes are believed to be the most common animals on our planet. They inhabit most soil, fresh water and marine environments. At least 12 types of nematodes are known to parasitize or cause infectious diseases of Michigan vegetable crops. Hundreds of other species are involved in making nutrients available for plant growth. The objectives of this article are to: 1) provide an overview of the nematode problems associated with vegetable production in Michigan, 2) discuss the management options for plant-parasitic nematodes, 3) describe how nematodes are involved in nitrogen mineralization and 4) provide some recommendations on how to enhance the role of nematodes in making nutrients available for plant growth.

The 12 types of plant parasitic nematodes that feed on vegetable crops in Michigan cause diverse symptoms, attack a wide variety of crops and have different behaviors.

#### **ROOT-KNOT NEMATODES**

Only one species, the Northern Root-Knot Nematode is known to over-winter under Michigan conditions. Other species can be brought into the state on transplants produced in the south.

**Crop Symptoms** -Root galls, yellowing, wilting, stunted top growth, stunted root growth, low crop yield and poor crop quality.

**Crops Attacked** -Beets, Broccoli, Brussels Sprouts, Cabbage, Carrots, Cauliflower, Celery, Cucumber, Eggplant, Garlic, Leeks, Lettuce, Melons, Onions, Parsnips, Peppers, Potatoes, Pumpkins, Squash, Tomatoes.

**Nematode Behavior** -Second-stage juveniles invade root tissue a short distance behind the root tip. They migrate towards the root tip, stop, turn and then migrate to where the vascular cylinder is being formed. Here, the plant forms nurse cells for use by the nematodes for their

growth and development. The plant also forms root galls for protection of the hundreds of eggs in each egg mass. Extensive amounts of plant matter and energy are used in this process, resulting in unsatisfactory crop growth and development. A close relative, the False Root-Knot Nematode, has been found associated with sugar beets in Michigan and has the potential to feed on beets and potato. This species, however, has not been detected in Michigan during the last 25 years.

## CYST NEMATODES

Michigan is the home to nine different species of cyst nematodes. Three of them, Carrot Cyst Nematode, Soybean Cyst Nematode and Sugar Beet Cyst Nematode can be serious problems in Michigan vegetable production.

**Crop Symptoms** -Yellowing, stunted top growth, stunted root growth, poor nodulation, pinhead size white females on root tissue, poor crop yield and poor crop quality.

**Crops Attacked** -Carrot Cyst Nematode (carrots), Soybean Cyst Nematode (Snap Beans, Peas) and Sugar Beet Cyst Nematode (Beets, Broccoli, Brussels Sprouts, Cabbage).

**Nematode Behavior** -Second-stage juveniles invade root tissue about one half of an inch behind the root tip. They burrow to where the vascular cylinder is being formed and induce the plant to form nurse cells for nematode feeding. The female swells and breaks through the root tissue. When she has filled her body with eggs, she dies and drops from the root. Her body hardens to become a protective cyst that can survive in soil in the absence of a host for up to 12 years. Extensive amounts of plant matter and energy are used in this process, resulting in poor crop growth and development.

## ROOT-LESION NEMATODES

The Penetrans Root-Lesion Nematode is the most common plant parasitic nematode in Michigan and feeds on the root systems of many crops. A second nematode, the False Root-Lesion Nematode causes damage to mint grown in muck soil.

**Crop Symptoms** -Yellowing, stunted top growth, stunted root growth, root lesions, poor crop yield and poor crop quality.

**Crops Attacked** -Beets, Broccoli, Brussels Sprouts, Cabbage, Carrots, Cauliflower, Celery, Corn, Cucumber, Eggplant, Garlic, Leeks, Lettuce, Melons, Mint, Onions, Parsnips, Peppers, Potatoes, Pumpkins, Squash, and Tomatoes.

**Nematode Behavior** -All stages of root-lesion nematodes are mobile and penetrate root tissue as endoparasites. After root penetration, the nematodes migrate throughout the root cortex, where females deposit their eggs. This migration, combined with chemical exudates,

results in reduced uptake and transport of water and nutrients throughout the plant. Root-lesion nematodes are known to interact with soil-borne fungi to cause disease complexes. The best known of these is the Potato Early-Die Disease Complex.

## NEEDLE NEMATODES

There are two types of Needle Nematodes in Michigan, the Common Needle Nematode and the Corn Needle Nematode. They can exist in both muck and mineral soil.

**Crop Symptoms** -Greatly stunted top growth, barren areas, swollen root-tips, reduced crop yield and poor crop quality.

**Crops Attacked** -Celery, Corn, Garlic, Onions.

**Nematode Behavior** -Needle nematodes are large ectoparasites and only the nematodes' stylets penetrate root tissue. The Corn Needle Nematode feeds early in the growing season and then migrates deep into the soil. Its distribution is limited to very coarse textured sandy soils. The Corn Needle Nematode has a narrow host range and can easily be managed through crop rotation. Needle nematodes have the ability to vector viruses.

## BULB AND STEM NEMATODES

Bulb and Stem Nematodes feed on shoot and not root tissue. There are two very different species associated with Michigan vegetable production systems. One attacks onion and celery, and the other feeds in potato tubers. Both are rarely detected in vegetable fields in Michigan.

**Crop Symptoms** -Yellowing, stunted top growth, a highly characteristic odor, bloated leaves and bulbs or tuber rot, reduced yields and unsatisfactory crop quality.

**Crops Attacked** -Onions, Garlic and Potato.

**Nematode Behavior** -The Bulb and Stem Nematode is a migratory endoparasite of shoot tissue. Fourth-stage juveniles penetrate onion tissue at the junction of the root and shoot system. They migrate through leaf and bulb tissue resulting in greatly deformed growth.

## PIN NEMATODES

There are two types of Pin Nematodes associated with Michigan vegetable production, one limited to muck vegetable production and the other associated with mineral soil production systems. Crop Symptoms -Stunted top growth, no feeder roots (witches-broom), reduced yield.

**Crops Attacked** -Carrots, Celery and Corn.

**Nematode Behavior** -Pin Nematodes are small ectoparasites that feed only from the outside of root tissue. These nematodes have a long stylet that can be inserted into the central vascular system of roots.



## STUBBY-ROOT NEMATODES

Although several species of Stubby-Root Nematodes are known to exist in Michigan, they have not been detected as often recently as in the past. Crop Symptoms - Yellowing, stunted tops, stubby roots and poor yields. Crops Attacked - Corn and Onions. Nematode Behavior - Stubby-Root Nematodes are small ectoparasites. They feed close to the root-tip and prevent cell division and root elongation.

## MANAGEMENT OF PLANT PARASITIC NEMATODES IN MICHIGAN VEGETABLE PRODUCTION

The first part of any pest management program is proper identification of the problem. While the cause of some nematode problems can be confirmed under field conditions, a laboratory analysis is usually needed. Michigan growers are encouraged to submit soil and plant tissue samples to MSU Diagnostic Services for confirmation of the cause of an existing problem or information for use in problem avoidance. MSU has two Nematode Diagnosticians responsible for nematode analyses. Additional details about this service can be obtained by contacting [www.cips.msu.edu/diagnostics](http://www.cips.msu.edu/diagnostics) or the County Office of MSU Extension.

As with all pest issues, problem avoidance is always the first-line defense and best strategy. This can be achieved by growing or purchasing high-quality nematode-free transplants or propagation material. Most of the other tactics related to problem avoidance or exclusion are based on common sense. For example, a field with a documented nematode infestation should not be worked immediately before moving equipment to a high quality nematode-free site. With proper planning, it is often possible to isolate or contain a nematode problem to a single field without infesting the rest of the farm. When this fails, control or nematode population reduction is usually required. In many cases this is expensive and results in a significant reduction in potential profits.

Once a Michigan vegetable production site is infested, crop rotation is the first control tactic that should be considered. For example, corn and wheat are not hosts for the Northern Root-Knot Nematode and can be used to reduce population densities of this species below its damage threshold. Crop rotation with agronomic crops is the main reason that current Michigan mineral soil carrot producers have very few nematode problems. In general, muck soil carrot growers have not had this option and have had to contend with serious nematode problems. Although the only known host in Michigan for the Carrot Cyst Nematode is carrots, this species can survive for up to a decade in the absence of a host, making the use of crop rotation impractical. Corn Needle Nematode prob-

lems can be resolved with a year or two of a non-host crop. Cover, trap and green manure crops that produce decomposition chemicals with nematicidal properties have been used in Michigan vegetable production. Cover crops, however, are variety specific in relation to their suitability for use in nematode management systems. For example, Adagio or Colonel oil seed radish are excellent trap crops for control of the sugar beet cyst nematode, but are good hosts of the Northern Root-Knot and Root-Lesion nematodes. Because of this complexity, it is often necessary to interact with a consultant or MSU Diagnostic Services for assistance in designing of the best possible nematode management program.

Nematode population reduction can also be achieved through the use of nematicides. There are basically two types, fumigant and non-fumigant nematicides. Telone II and metham are the most commonly used soil fumigants in Michigan vegetable production. Telone II must be injected into the soil; whereas, metham (Vapam and others) can be injected or applied as a chemigant in irrigation water. Methyl bromide, Telone C-17, Telone C-35 and chloropicrin can also be used under special circumstances. The non-fumigant options are organophosphates or organocarbamates. Vydate, Nemacur, Mocap, Counter and Furadan are the most commonly used non-fumigant nematicides. These materials are all very different in relation to the best methods of application and suitability for specific nematode species. Information about the use of nematicides is present in this MSU Extension Bulletin (E-312).

## ROLE OF NEMATODES IN NITROGEN MINERALIZATION

Plants take-up inorganic forms of nitrogen from soil for use in their growth and development. While we often think that the fertilizers applied serves this role, the situation is often more indirect and complex. Fertilizers often feed microbes and subsequently the microbes feed the plants. Bacterial and fungal feeding nematodes play important roles in this process. For example, plant root-exudates or decomposing organic matter serve as food for bacteria. The bacteria serve as food for bacterial feeding nematodes which receive excess organic nitrogen from this process. The excess nitrogen is transformed into an inorganic form and excreted from the nematode into the area immediately adjacent to the root surface when it is taken-up by the plant for use in the growth and development process. It is important to maintain high population densities of bacterial and fungal feeding nematodes. Most of these species have relatively short life cycles (72 hours); whereas, life cycles of plant-parasitic nematode range from 30 days to two years, with the exception of the cysts which may remain viable in the absence of a host for up to 12 years.



## NEMATODES AND SOIL QUALITY

Soil quality can be defined as the ability of a soil to resist degradation and respond to management. Soils with nematode problems are not high quality soils. Anything that can be done to increase quality soil organic matter (SOM) will decrease risk to plant parasitic nematodes and enhance soil quality. What is quality organic matter? Quality SOM is composed of active soil carbon and active soil nitrogen. The term active refers to the ability of the SOM to mineralize soil carbon and soil nitrogen, respectively. Much of this is done by microbes and soil fauna such as bacterial and fungal feeding nematodes. The best way to create an appropriate environment for these organisms

and their essential functions is to maintain a diversity of plants and organic amendments in the system. Mixtures of grass and legume cover crops supplemented with manure or compost can be used to create a biologically active soil that is highly productive and devoid of problems caused by plant parasitic nematodes. Do not hesitate to contact me at [birdg@msu.edu](mailto:birdg@msu.edu) or (517) 353-3890 if you have any questions about nematodes and their relationship to soil quality. The MSU Nematode Diagnosticians, Fred Warner (517-432-1333) and Angela Tenney (517-353-8563) are available to provide information about management of plant-parasitic nematodes.

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## Appendix C

### Detecting and Avoiding Nematode Problems

Plant-parasitic nematodes are microscopic round-worms that live in soil and feed on roots or foliage of economically important plants. Nematode feeding can result in diseased plants with symptoms such as stunting, yellowing, wilting, yield reduction, root galling and the formation of root lesions. Although damage from plant parasitic nematodes costs Michigan vegetable growers millions of dollars annually, many of these losses are never correctly diagnosed. This appendix provides instructions for the nematode detection methods necessary to avoid or diagnose nematode problems.

A laboratory analysis of soil and root or shoot system tissue is usually necessary for diagnosis or long-term avoidance of plant-parasitic nematode problems. In Michigan, this service is provided by the Michigan State University Nematode Laboratory within Diagnostic Services. There are also private sector laboratories that provide nematode detection services. A \$25 fee is charged by MSU for analyzing each combined soil and root sample.

Samples for nematode analysis should be forwarded to:

Diagnostic Services  
101 CIPS  
Michigan State University  
East Lansing, MI 48824-1311

Samples taken directly to MSU should be delivered to Room 101 in the Center for Integrated Plant Systems (formerly the Pesticide Research Center). All samples must be submitted with a completed sample information form. These forms are available at county MSU Extension

offices or can be downloaded from the Diagnostic Services web site at [www.pestid.msu.edu](http://www.pestid.msu.edu).

#### Sample objective

The results from the samples are used to decide how to deal with nematode problems and how to avoid problems.

#### Diagnosing problems

When plants exhibit symptoms such as stunting, yellowing, wilting, early-die, yield reduction, root-galling, root-lesions or plant mortality that cannot be attributed to other causes, take samples of appropriate soil, root system, or shoot systems, and submit them for nematode analysis.

#### Avoiding nematode problems

Generally soil from Michigan agricultural sites should be analyzed for nematodes every 3-5 years at the minimum. If nematodes are a major limiting factor in the production of particular crops (e.g. northern root-knot nematodes on carrot), sites should be sampled every fall or spring prior to the growing of these crops. The test results are used to make decisions for avoiding nematode problems.

#### When to sample

Generally, soil and root samples can be taken, submitted and reliably processed whenever the soil is not frozen. For the best possible results, however, do not take samples until 45 days after annual root growth, and not



after the soil is frozen in late fall or winter. When considering fall soil fumigation, collect and submit samples between August and November. To determine if non-fumigant nematicide use is warranted, sample between March and May.

## How to sample

**Sampling instrument:** Take samples with a soil sampling tube, trowel, or narrow-bladed shovel at a 2-to 12-inch depth. Include as many feeder roots as possible.

Feeder roots or shoot tissue must always be included for samples submitted for best assessing the population densities of endoparasitic nematodes.

**Sample size:** Each sample should consist of a pint to a quart of soil taken from a larger sample composed of 10 or more subsamples. The number of samples needed depends on the size, history, and uniform soil texture of the area being investigated.

- Small area (less than 5,000 sq. ft.), take at least 10 subsamples (soil cores or borings).
- Medium area (5,000 sq. ft. to 1 acre), take at least 25 subsamples.
- Large area (1 to 80 acres), take at least 50 subsamples. In Michigan, no one sample should represent more than 80 acres, and each sample should be from an area of uniform soil texture.

The sampling pattern depends on the commodity and field history. Mix subsamples in a clean pail or a plastic bag and submit one pint to a quart for nematode analysis.

Subsamples from problem area: Plant-parasitic nematodes feed only on living tissues and are rarely found in dead roots. Therefore, take samples from the margin of the problem areas where the plants are still living.

**Sampling container:** A plastic bag can be used for nematode samples. Place samples in plastic bags as soon as possible. Nematodes will be killed if the sample is allowed to dry, and it is important that nematodes are living when the sample arrives at the laboratory.

**Sample storage:** Soil and root samples should be regarded as perishable. Handle accordingly, and process as quickly as possible. Ideally, they should be stored at 10-15C (50-58F). Do not expose them to direct sunlight or store them in hot areas, such as the trunk of your car. Temperatures greater than 40C (100F) will kill nematodes.

## How to submit samples

Samples are usually submitted to the MSU Nematode Laboratory through the local extension office, accompanied by a completed form. The information required on the form is essential for diagnosing nematode problems and proper recommendations for nematode population management.

It generally takes two weeks from the time a sample is taken until the results are returned to the grower. The results may be returned through the local extension agent, a private consultant, or directly. The rapid root and soil assays used for mineral soils, however, are not always satisfactory for analysis of organic soils. In a few cases, a bioassay that requires a 45-day incubation period is used to analyze organic soils. When this procedure is recommended, the grower will be immediately notified of the delay and will receive the results within two months after the sample was received.

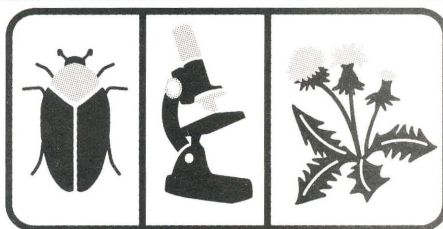
## Results and recommendations

The types and numbers of nematodes will be recorded on the assay form along with an indication of whether or not nematodes are a problem. If nematodes appear to be a problem, you will be occasionally referred to an appropriate extension bulletin for a recommendation. The recommendation should be discussed in detail with the local extension agent or private consultant.

# MICHIGAN STATE UNIVERSITY EXTENSION

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# How to submit a sample to MSU Diagnostic Services



## Diagnostic Services

### Sample Submission

Accurate diagnosis depends on the rapid receipt of fresh and representative samples along with pertinent information relating to the problem. A completed submittal form should accompany all samples. Submittal forms are available at MSU Diagnostic Services or your local Extension office. Submittal forms can also be downloaded from [www.pestid.msu.edu](http://www.pestid.msu.edu). Samples can be dropped off at our reception area between 8 a.m. and 5 p.m. or shipped overnight delivery by U.S. mail, FedEx, or UPS. To preserve the quality of the sample, do not package samples in envelopes. Also avoid mailing samples on Friday.

#### Submit samples to:

Michigan State University  
Diagnostic Services  
101 Center for Integrated Plant Systems  
East Lansing, MI 48824-1311  
Phone: (517) 355-4536 Fax: (517) 432-0899

### Plant Health Analysis Samples:

**Herbaceous Plants:** Send whole plants, including roots and soil. Roots and soil should be in a plastic bag tied off at the soil line to prevent soil from touching foliage.

**Tree Decline/Wilt:** Send 6 to 12 branch sections .5 inch to 1 inch diameter and ~ 8 inches long. Samples should be taken from live areas of tree with symptoms, not from completely dead branches. Seal branches in plastic to retain moisture.

**Seedlings:** Leave plants in plug sheets or trays if possible. Send a minimum of 12 seedlings.

**Turf:** Include a 6" square of turf from the margin of the diseased area so that both healthy and diseased turf is included. An intact layer of soil should be included. Wrap sample in newspaper and pack in a box for shipment. Include a detailed description of cultural practices. Do not add moisture to the turf prior to shipment.

**Leaf spot and Fruit Rot:** Send several affected samples representing the early and moderate stages of the symptom progression.

**Herbicide Injury:** Submit both injured and apparently healthy crop plants. Plants should be dug carefully from the soil so roots, if injured, will remain intact. Roots and soil should be placed in a plastic bag, pot, or small bucket to prevent soil from touching the foliage. A pint of soil from both "good" and "bad" area should also be submitted. Any patterns in the field should be noted on the submittal form, along with past crop and pesticide history.

### Weed/Plant Samples:

**Herbaceous Plant Identification:** Submit whole plants, including roots, vegetative structures, and flowers. Plants may be pressed flat between paper or cardboard to prevent leaf crinkling. For best results, plants should be submitted immediately after digging. Roots and soil should be in a plastic bag to prevent soil from touching the foliage.

**Woody Plant Identification:** Submit a large section of the terminal end of the stem or branch. Where possible, include any flower or fruiting structures, roots, and leaves. Leaves may be pressed flat between paper or cardboard to prevent crinkling. Woody plants may be wrapped in plastic to retain moisture.

**Herbicide Resistance:** Weeds will be screened for herbicide resistance using one of several techniques. Typically, a whole plant pot assay established from seed will be our standard test for resistance confirmation. Mature, high quality seed or seedheads should be collected from suspicious plants in late summer or fall and submitted in a paper bag. Do not seal in plastic. Screens will be designed by herbicide site of action (ie: ACCase inhibitors, ALS inhibitors, Photosynthesis inhibitors). Other resistance confirmation tests may be utilized but will depend upon weed species, herbicide, and mechanism of resistance. Extensive tests include but are not limited to: petri-dish germination, chlorophyll fluorescence, leaf disc flotation, and enzyme sensitivity assays, as well as molecular diagnostic testing.



# How to submit a sample to MSU Diagnostic Services (continued)

## Nematode Samples:

Refer to MSU Extension Bulletin E-2199, "Detecting and Avoiding Nematode Problems."

Always store nematode samples in plastic bags or other containers that retain moisture. Submit a pint to a quart of soil.

**Problem Diagnosis:** Collect soil & roots (or foliage) from the margins of diseased areas. Submit samples of diseased plants and apparently healthy ones.

**Problem Avoidance:** Collect soil & roots (if available) by walking a zigzag or w-shaped pattern. The more sub-samples (soil, cores, probes, etc.) collected the "better" the sample.

## Insect/Arthropod Samples:

Precise identification of insects or other arthropods requires specimens to be undamaged upon arrival. It is very important to kill and ship the specimens in a manner that will not damage the delicate structures that facilitate their identification. Dried and unprotected insects crumble easily during mail processing. Kill and ship specimens in a small, leak proof vial filled with rubbing alcohol.

**Moths/Butterflies:** Place specimens in the freezer for half an hour to kill them and gently pack in a small box or vial with tissue paper.

**Ants/Other Adult Arthropods:** Ant specimens should only include worker ants (i.e. those without wings). Submit all specimens in alcohol. Other adult and hard-bodied specimens: Submit in alcohol.

**Larvae (Caterpillar, grub, maggot, etc.):** Whenever possible, soft-bodied larvae should be lightly boiled for a few minutes before placing them in alcohol. This prevents the specimens from shriveling and becoming discolored, however it only works if the larvae are alive when dropped in the boiling water.

## Pesticide Analysis Samples:

Soil, water, and plant vegetation can be tested for the presence of pesticides using appropriate analytical instruments and techniques. Pesticides will be tested on an individual basis or, if available, in multi-pesticide screens. Samples should be submitted in leak-proof, glass containers and kept cold or frozen until arrival.

## Services and Fees for MSU Diagnostic Services

**Note: Fees for out-of-state samples are higher. Contact laboratory for pricing.**

### Plant Health Analysis

- Visual inspection for infectious and non-infectious diseases, insect injury and herbicide injury; pathogen culturing; pH and soluble salts: \$20.00
- INSV / TSWV ELISA tests: \$20.00
- Bacterial ID (BIOLOG™): \$25.00
- Special laboratory analysis: \*

### Weeds/Plants

- Common plant ID: N/C
- Keyout plant ID: \$10.00
- Herbicide resistance in weeds
  - Standard test:
    - Single site of action \$50.00
    - Each additional site of action \$20.00
  - Extensive test: \*
- Special identification/diagnosis \*

### Nematodes

- Basic nematode analysis: \$25.00
- Total nematode community analysis: \$50.00
- HG Type testing \$50.00
- *Verticillium* analysis
  - Wet sieving: \$25.00
  - Dilution plating: \$20.00

### Insects/Arthropods

- Common insect ID: N/C
- Keyout insect ID: \$10.00
- Special identification/diagnosis \*

### Pesticide Analysis

- Individual pesticide tests/  
multi-pesticide tests
  - Water: \$90.00 / \$125.00
  - Vegetation: \$100.00 / \$150.00
  - Soil: \$125.00 / \$175.00

\* Variable costs requiring client approval. Contact laboratory for pricing.

**DIAGNOSTIC SERVICES**  
 101 Center for Integrated Plant Systems  
 East Lansing, MI 48824-1311  
 Office: 517-355-4536 FAX: 517-432-0899  
 www.pestid.msu.edu



Case No.: \_\_\_\_\_  
 Date Received: \_\_\_\_\_  
 Amount Paid: \_\_\_\_\_  
 Check/Receipt No.: \_\_\_\_\_  
 MSU Account #: \_\_\_\_\_  
 Diagnostic Fee: \_\_\_\_\_

Name: \_\_\_\_\_  
 Business Name: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 City/State/Zip: \_\_\_\_\_  
 Work: \_\_\_\_\_ FAX: \_\_\_\_\_ Home: \_\_\_\_\_  
 Email: \_\_\_\_\_ Cell: \_\_\_\_\_  
 Sample Reference: \_\_\_\_\_

**Plant Disease Diagnosis Fees**  
 Plant health analysis: \$20  
 INSV / TSW V ELISA tests: \$20  
 Bacterial ID (BIOL OGI™): \$25

**Insect / Plant Identification Fees**  
 Common ID: N/C  
 Keyout ID: \$10

**Herbicide Resistance/ Pesticide Analysis:** contact lab  
**Nematode Sample Fees** (see below)  
 Out of State Fees Triple  
 Fees subject to change

**SEND RESULTS TO:** CLIENT COUNTY AGENT KEEP RESULTS CONFIDENTIAL Fax: \_\_\_\_\_  
 MSU Extension Agent: \_\_\_\_\_ County: \_\_\_\_\_ Email: \_\_\_\_\_

**SAMPLE** (ex. Tomato, Insect, Pine, etc.): \_\_\_\_\_

**GENERAL INFORMATION** (indicate all that apply)

<b>PLANT PARTS AFFECTED</b>	<b>TYPE OF PLANTING</b>	Good Fair Poor	Sunny or Shaded?
Entire Plant Stems	Field Garden	<b>PROBLEM DISTRIBUTION</b>	<b>HERBICIDE HISTORY</b>
Leaves/Needles Trunk	Nursery House Plant	Upland Near Drive/Road	This year: _____
Roots Twigs/Limbs	Greenhouse Pasture	Slopes Edge of Field	_____
Fruit Flowers	Orchard Natural Area	Low Areas Near a Residence	Last year: _____
	Turf/Lawn		_____
	City/Recreation	<b>OTHER BACKGROUND</b>	<b>INSECTICIDE HISTORY</b>
<b>NATURE OF THE INJURY</b>		How long at site?	This year: _____
Poor or Abnormal Growth		Height of plant?	_____
Spots Yellowing	<b>PREVALENCE</b>	How many plants affected?	<b>FUNGICIDE HISTORY</b>
Wilting Boring	Entire Planting	How often watered?	This year: _____
Plant Death Cupping	Single Localized Area	How fertilized?	<b>CROP HISTORY</b>
Chewing Dieback	Several Localized Areas		Last year: _____
Galls/Cankers Rot	Few Scattered Plants		This year: _____
Leaf/Needle Drop			_____
<b>SOIL TYPE</b>	<b>EXTENT OF THE DAMAGE</b>		
Sandy Clay	Light Moderate Severe		
Muck Silt Loam	<b>DRAINAGE</b>		

**INSECT / ARTHROPOD ID SAMPLES ONLY** (indicate all that apply)

Where was the insect found? \_\_\_\_\_ What was the insect doing there? \_\_\_\_\_  
 How many insects are there? One Few Several Hundreds Do you have small children living with you? \_\_\_\_\_

**PLANT / WEED ID SAMPLES ONLY** (indicate all that apply)

<b>PLANT TYPE</b>	<b>PLANT SIZE</b>	<b>GROWTH HABIT</b>	<b>FLOWERS</b>	<b>PLANT AGE</b>
Tree Groundcover	Height: _____	Upright/Erect	Color: _____	Annual: _____
Shrub Herbaceous	Width: _____	Prostrate/Low-Growing	Size: _____	Perennial: _____
Vine Aquatic	Few Leaves Many Leaves	Climbing	List any unique features: _____	

**NEMATODE SAMPLES ONLY** (indicate type of analysis requested)

Soil and root analysis (\$25/sample)	Foliar nematode analysis (\$25/sample)	No. of samples: _____
Total nematode community structure analysis (\$50/sample)		Sample/Field ID: _____
Hg Type test (\$50/sample)		
<i>Verticillium dahliae</i> analysis (potato soil / stem only)	Dilution (\$20/sample)	Wet-sieving (\$25/sample)
		Both (\$40/sample)





# PESTICIDE EMERGENCY INFORMATION

For any type of an emergency involving a pesticide, immediately contact the following emergency information centers for assistance.

Current as of November 2008



## Human Pesticide Poisoning

### POISON CONTROL

From anywhere in the United States, call

**1 - 8 0 0 - 2 2 2 - 1 2 2 2**

## Special Pesticide Emergencies

### Animal Poisoning

.....  
Your veterinarian:

Phone No.

**or**

Animal Poison Control  
Center (\$55 consultation  
fee per case)

**\*1-888-426-4435**

**www.aspca.org**

**\* Telephone Number Operated 24 Hours**

### Pesticide Fire

.....  
Local fire department:

Phone No.

**and**

**\*911**

### Traffic Accident

.....  
Local police department or  
sheriff's department:

Phone No.

**and**

**\*911**

### Environmental Pollution

.....  
District Michigan  
Department of  
Environmental Quality  
(MDEQ) Office Phone No.

Phone No.

**and**

MDEQ Pollution  
Emergency Alerting System  
(PEAS):

**\*1-800-292-4706**

also

**\*1-800-405-0101**

Michigan Department of  
Agriculture Spill Response  
(for fertilizer, pesticide,  
and manure spills)

### Pesticide Disposal Information

.....  
Michigan Clean Sweep, Michigan  
Department of Agriculture Environmental  
Stewardship Division.

**Monday – Friday: 8 a.m.–5 p.m.**

**(517) 335-2874**

### National Pesticide Information Center

Provides advice on recognizing  
and managing pesticide poisoning,  
toxicology, general pesticide  
information and emergency response  
assistance. Funded by EPA, based at  
Oregon State University

**7 days a week; excluding holidays**  
**6:30 a.m. – 4:30 p.m. Pacific Time Zone**

**1-800-858-7378**

**FAX: 1-541-737-0761**

**Web: npic.orst.edu**