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Michigan Fruit Management Guide For Commercial Fruit Growers

Michigan State University Extension Service

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FOR COMMERCIAL FRUIT GROWERS

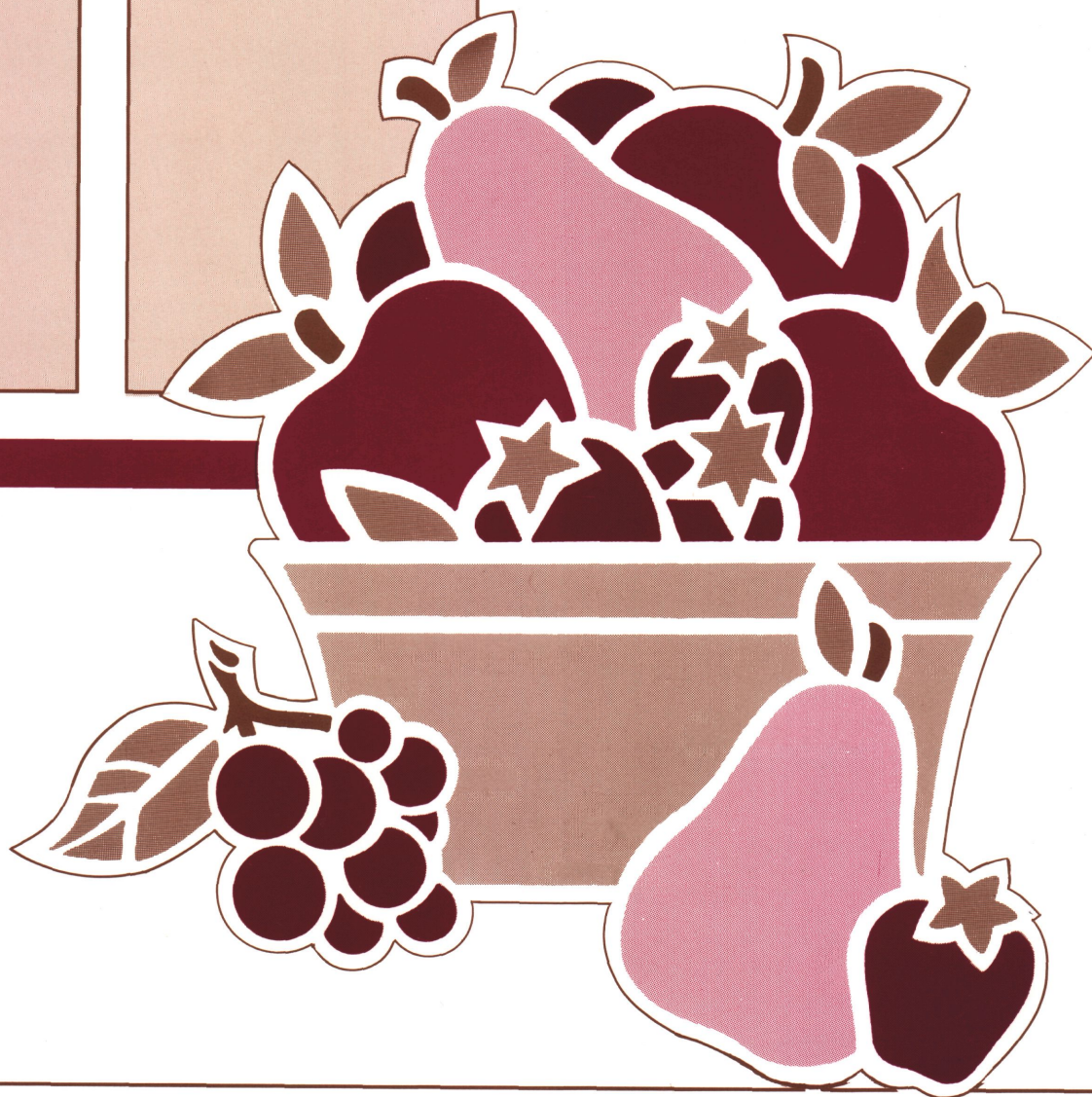
# Michigan Fruit Management Guide

(formerly Fruit Spraying Calendar)

# 2003

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# Fruit Extension and Research Agents in Michigan

The following contacts can provide fruit management assistance. The Code-A-Phone numbers listed provide taped messages for a specific cropping system and region of Michigan. Addresses of the agents are provided for further contacts.

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*For Commercial Fruit Growers*

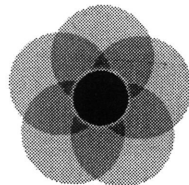
# Michigan Fruit Management Guide 2003

Available on the Internet at:  
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This publication contains pesticide recommendations based on research and pesticide regulations. However, changes in pesticide regulations occur constantly. Some pesticides mentioned may no longer be available, and some uses may no longer be legal. If you have questions about the legality and/or registration status for using pesticides, contact your county Extension office.

**The information contained herein does not supersede the label directions. To protect yourself, others and the environment, always read the label before applying any pesticide.**

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# 2003 Michigan Fruit Management Guide

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# Introduction

Successful pest management is based on a basic knowledge and understanding of:

- (1) The biology of the crop and its annual growth habits during the growing season.
- (2) The biology of the insects, diseases, nematodes, and weeds that will be encountered, and their life cycle during the growing season
- (3) The susceptibility of the different kinds and variations of fruit to pests and pesticides.
- (4) The environmental conditions that will favor the pest(s) injuring the fruit crops; and
- (5) The cultural, biological, and chemical control strategies that need to be used to optimize the economical production of the fruit.

This publication is intended only as a guide to assist fruit growers in the selection of pesticides and pest control tools as they plan their pest management programs for the growing season. The insects and diseases listed in this spray schedule are not always present or economically important in all fruit plantings each year. During every growing season, growers should adjust their pest control programs to fit their specific conditions. This requires a knowledge of conditions observed during past growing seasons and the conditions encountered during the present growing season.

To provide a more complete understanding of the complexities of fruit culture, Michigan State University provides a Fruit IPM newsletter, **Fruit Crop Advisory Team Alert Newsletter** (a subscription form is located in the back of this book). This newsletter is available on the Internet at <http://msue.msu.edu/ipm/fruitCAT.htm>. Other fruit information is available from the MSU Fruit Team <http://www.msue.msu.edu/fruit>.

We also recommend the following publications and videotapes: (available at your county Extension office and/or the MSU Bulletin Office). Bulletin Office ordering information is given in the back of this book.

E-0682	Commercial Strawberry Culture in Michigan
E-0840	Tractor-mounted Air Blast Sprayers
E-0852	Fertilizing Fruit Crops
E-1107	Cost of Producing Fresh Market Apples in Western Michigan, 1998
E-1108	Cost of Producing Tart Cherries in NW MI
E-1330	How to Recognize & Control Black Knot
E-1456	Highbush Blueberry Varieties for Michigan
E-1680	Propagating Highbush Blueberries
E-1728	Strawberry Diseases in Michigan
E-1730	Raspberry Diseases in Michigan
E-1731	Blueberry Diseases in Michigan
E-1732	Common Diseases of the Grapevine in MI
E-1759	Plum Pox Detection Guide
E-2011	Managing the Nutrition of Highbush Blueberries

E-2037	Fruit Crops Pest Management. Pesticide Applicator Cert. Manual
E-2195	Pesticide Applicator Core Training Manual (SP)
E-2215	Using Pesticides Safely: A Guide for the Applicator
E-2290	Minimize Apple Bruising in the Packing Line
E-2335	On-farm Agrichemical Storage & Handling
E-2341	Record-keeping System—
E-2343	Field File Folders-Recordkpng Syst for Crop Prod
E-2413	Washing Pesticide-Soiled Clothing (magnet) (SP)
E-2419	Avoidance/Mgmt—Nematode Problems in MI Tree Fruit Production
E-2470	Cost of Producing Plums in NW MI
E-2482	Plant Tissue Sampling to Determine Fruit Fertilizer Needs
E-2559	Lighting Systems for Fruit & Vegetable Sorting
E-2642	Table Grape Varieties for MI
E-2643	Wine Grape Varieties for MI
E-2644	Vineyard Establishment I - Preplant Decisions
E-2645	Vineyard Establishment II - Planting & Early Care of the Vineyard
E-2698	Pest Control in Small Vineyards
E-2712	Air Blast Orchard Spraying
E-2720	A Pocket Guide for IPM Scouting in Michigan Apples
E-2759	Fruit Crop Ecology and Management
E-2774	Growing Table Grapes in a Temperate Climate
FAS104	Orchard A Syst: Pesticide and Nutrition Management
FAS105	Seasonal IPM Checklist for Orchards
NB-12	Highbush Blueberry Production Guide
NCR-045	Diseases of Tree Fruits in the East
NCR-063	Common Tree Fruit Pests
NCR-394	Guide to Clearwing Borers (Sesiidae) of the N. Central U.S.
NCR-551	Biotechnology: Genetically Engineered Fruits & Vegetables
RR551	Short-term Costs and Returns to Michigan Apple, Blueberry
VT-018	Pruning Mature Fruit Trees, Videotape
VT-019	Pruning Blueberries, Videotape
VT-020	Pruning Raspberries, Videotape
VT-021	Pruning Grapes, Videotape
VT-043	Apple Packing House Operations (Video) (SP)

SP = available in Spanish

The following compendia on diseases of fruit crops are available from APS Press, 3340 Pilot Knob Road, St. Paul, MN 55121-2097; phone: 1-800-328-7560: Apple and Pear Diseases; Blueberry and Cranberry Diseases; Grape Diseases; Raspberry and Blackberry Diseases and Insects; Stone Fruit Diseases, and Strawberry Diseases.

# How to Use the Fruit Management Guide

The evaluation of how well certain pesticides control specific pests listed in the Fruit Management Guide was obtained from research data gathered over several years. The ratings can help growers determine which materials to use to control certain pests. The ratings may not be accurate in all orchards, as orchards differ due to past chemical application (which may lead to resistance), population levels at time of application and environmental conditions affecting pest susceptibility and pesticide activity or persistence.

To use the recommendations, determine the stage of fruit growth and look under that part of the schedule (example: pink stage of apples). Then determine which pests are present and if their populations are high enough to warrant a control measure (e.g.: you found green fruitworm larvae chewing leaves). Next, look under the columns titled "Efficiency" for that insect and read the numbers and letters there (e.g.: 26f). The number refers to the chemicals in the column headed "Suggested Chemicals," and the letter refers to a rating of e = excellent, g = good, f = fair and p = poor. In our example, Lannate is good and Thiodan is fair in controlling green fruitworm. Continue this procedure for all the insects

present at this time. After you have chosen the best control tool(s) to use for the complex of insects in your crop at that time, refer to the rates provided and apply them in calm weather conditions to achieve the best coverage possible.

Information on fungicide effectiveness can be found in the Fungicide section on pages **10** and **41**; and the Herbicide section starting on page **126**.

The schedule part of the handbook only lists performance ratings for products on labeled pests. Some insecticides/miticides may provide control of pests not currently listed on the label, or on non-target organisms. To attain further information about how a product may impact beneficial insects, predacious mites and/or other non-labeled pests, consult the "Effectiveness of Insecticides/Miticides in Controlling Pests" tables for apples (pg. 47), stone fruits (pg. 82), grapes (pg. 95) and blueberries (pg. 118). On the bottom of this table, these insecticides are rated as T = highly toxic, M = moderately toxic and S = relatively safe to the beneficial insects.

Products listed by the Organic Materials Review Institute (OMRI) for use in organic production will be marked with the following designation: ▲

## Guide to Abbreviations Used in This Bulletin

B = bait  
D = dust  
DF = dry flowable  
EC = emulsifiable concentrate or emulsion  
F = flowable  
G = granule  
L or LC = liquid concentrate  
LS = liquid solution

S = sprayable  
SC = suspension concentrate  
SP = soluble powder  
W or WP = wettable powder  
WDG = water-dispersible granules  
WSP = water soluble package  
XLR = extra low rate

# Guidelines for Safe Use of Pesticides

Lynnae Jess and Karen Renner

## Selecting Pesticides

Always thoroughly read the label and the supplemental labeling material for any pesticide that you may consider using. Understand the label instructions and limitations. Use the pesticide only for the purposes listed and in the manner directed on the label. Select only pesticides labeled for the crop you wish to use it on and the pest(s) you wish to control. To do otherwise will cost you in terms of effective and economical product performance and may lead to an unacceptable risk to humans, the crop, the surrounding environment, and later disposal problems of illegal material.

## Protecting Groundwater

Many people who live in rural Michigan get their drinking water from wells. Since well water is groundwater, it is easy to see why you should be concerned about keeping pesticides out of groundwater. There are several processes that determine the fate of pesticides and whether they will end up in your drinking supply.

**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, but it is also less available for uptake by plants.

**Volatilization** occurs when a solid or liquid turns into a gas. Pesticide volatilization increases with higher air temperature and air movement, higher temperature at the treated surface (soil, plant, etc.), low relative humidity, and when spray droplets are small. Pesticides also volatilize more readily from coarse-textured soils and from medium-to fine-textured soils with high moisture content. A pesticide in a gaseous state is invisible and carried away from a treated area by air currents. The movement of pesticide vapors in the atmosphere is called **vapor drift**. Unlike the drift of sprays and dusts that can sometimes be seen during an application, vapor drift is invisible.

**Runoff** is the movement of pesticides in water across the soil surface. It occurs as water moves over a sloping surface, carrying pesticides either mixed in the water or bound to eroding soil. The amount of pesticide runoff depends on the grade or slope of an area, the erodibility and texture of the soil, the soil moisture content, the amount and timing of irrigation or rainfall, and properties of the pesticide. Pesticide losses from runoff are greatest when heavy rainfall occurs shortly after a pesticide application. If heavy rainfall is expected, delay applying pesticides. Surface grading, drainage ditches and dikes, and the use of border vegetation can help reduce the amount and control the movement of runoff waters.

Surface water contamination is a major concern associated with the runoff of pesticides from treated

fields, mixing and rinsing sites, waste disposal areas, and manufacturing facilities. In the 1988 inventory of water quality, pesticides were ranked sixth as river and stream pollutants, behind siltation, nutrients, pathogens, organic enrichment, and metals. Refer to the section "Groundwater and Surface Water Contamination" for information on how to prevent contamination.

**Leaching** also moves pesticides in water. In contrast to runoff, leaching occurs as water moves downward through the soil. Factors that influence leaching include whether the pesticide dissolves easily in water, soil structure and texture, and the amount and persistence of pesticide adsorption to soil particles.

**Absorption** is the process by which chemicals are taken up by plants. Once absorbed, most pesticides are degraded within plants. However, some residues may persist inside the plant and be released back into the environment as the plant tissues decay.

**Crop removal** can transfer pesticides. When treated crops are harvested, the pesticide residues are removed with them and transferred to a new location. After harvest, many agricultural commodities are washed or processed, which can remove or degrade much of the remaining residue. However, the wash water may now be contaminated and should be disposed of as a potential contaminant.

**Microbial degradation** occurs when microorganisms such as fungi and bacteria use a pesticide as a food source. Conditions that favor microbial growth include warm temperatures, favorable pH levels, adequate soil moisture, aeration (oxygen), and fertility. Adsorbed pesticides are more slowly degraded because they are less available to some microorganisms.

**Chemical degradation** is the breakdown of a pesticide by processes not involving a living organism. The adsorption of pesticides to the soil, soil pH levels, soil temperature and moisture all influence the rate and type of chemical reactions that occur. Many pesticides, especially the organophosphate insecticides, are susceptible to degradation by hydrolysis in high pH (alkaline) soils or spray mixes.

**Photodegradation** is the breakdown of pesticides by sunlight.

## Groundwater and Surface Water Contamination

**Groundwater** is the water beneath the earth's surface occupying the saturated zone (the area where all the pores in the rock or soil are filled with water). It is stored in geological formations known as **aquifers**. Groundwater moves through aquifers and can be obtained at points of natural discharge such as springs or streams, or by drilling a well into the aquifer.

The upper level of the saturated zone in the ground is called the **water table**. The water table depth below the soil surface fluctuates throughout the year, depending on the amount of water removed from the ground and the

amount of water added by recharge and connected surface waters. **Recharge** is water that seeps through the soil from rain, melting snow, or irrigation. **Surface waters** are visible bodies of water such as lakes, rivers, and oceans.

Both surface water and groundwater are subject to contamination by **point source and nonpoint source pollution**. The key to preventing pesticides in groundwater and surface waters is identification of the source and route to the water. Point source contamination refers to situations where movement of a pesticide into water can be traced to a specific site. Nonpoint sources occur over a wide area, and most pesticides detected in groundwater and surface water are from nonpoint sources. This type of pollution generally results from land runoff, precipitation, acid rain, or percolation rather than from a discharge at a specific, single location (such as a single pipe or well head).

## Keeping Pesticides Out of Groundwater and Surface Water

A pesticide that is not volatilized, absorbed by plants, bound to soil, or broken down can potentially move through the soil to groundwater. The movement of groundwater is often slow and difficult to predict. Substances that enter groundwater in one location can turn up years later in other locations. A major difficulty in dealing with groundwater contaminants is that the sources of pollution are not easily recognizable. The problem is occurring underground, out of sight.

It is very difficult to clean contaminated groundwater or surface water. The best solution is to prevent contamination in the first place. The following pesticide application practices can reduce the potential for surface and groundwater practices.

**Use integrated pest management programs**—Keep pesticide use to a minimum by combining chemical control with other pest management practices.

**Reduce compaction**—Surface water runoff increases when soils are compacted.

**Utilize conservation practices that reduce erosion and surface runoff**—These practices include but are not limited to planting grass waterways to retard soil and water runoff and keeping buffer strips to protect surface water boundaries.

**Plant vegetative filter strips and grassed waterways**—These reduce pesticide runoff by trapping sediment and slowing water runoff, so that pesticides can interact with the vegetation and soil.

**Consider the geology of your area**—Be aware of the water table depth and the permeability of the geological layers between the surface soil and groundwater. Sinkholes can be especially troublesome because they allow surface water to quickly reach groundwater.

**Consider soil and field characteristics**—Determine the susceptibility of the soil or field site to leaching or runoff. Soil texture and organic matter content, in particular, influence chemical movement into groundwater while slope of the field influences surface runoff.

**Select pesticides carefully**—Pesticides that are highly soluble, relatively stable, and not readily adsorbed to soil tend to be the most likely to leach. Read labels carefully and consult a specialist from the Extension office, or your chemical dealer if necessary. The tables in this bulletin will also help you choose the best pesticide for your use.

**Follow label directions**—The label carries crucial information about the proper rate, timing, and placement of the pesticide.

**Calibrate accurately**—Calibrate equipment carefully and often to avoid over and under application.

**Measure accurately**—Carefully measure concentrates before they are placed into the spray tank. Do not “add a little extra” to ensure that 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 chemical into the water supply. Use an anti-backflow device when siphoning water directly from a well, pond, or stream.

**Consider weather and irrigation**—If you suspect heavy rain will occur, delay applying pesticides. Control the quantity of irrigation to minimize potential pesticide leaching and runoff.

**Avoid spills**—When spills do occur, contain and clean them up quickly with an absorbent material like cat litter.

**Change the location of mixing areas**—Mix and load pesticides on an impervious pad if possible, where spills can be contained and cleaned up. If mixing is done in the field, change the location of the mixing area regularly.

**Dispose of wastes properly**—Obey laws regulating the disposal of pesticide wastes. Triple rinse or pressure rinse containers. Pour the rinsewater into the spray tank and use for treating the site or the crop.

**Store and mix pesticides away from water sources such as wells, ponds, and springs.**

## The Michigan Groundwater Stewardship Program (MGSP)

The MGSP has been authorized through the year 2010 by the state legislature. It is funded by



assessments on the sale of nitrogen fertilizers and pesticides, generating \$3.5 million dollars each year. The program delivers educational programs, technical assistance and cost share that meet the needs and interests of local pesticide and fertilizer users. Growers may request an assisted farmstead pollution risk assessment (Farm\*A\*Syst), develop a groundwater stewardship plan, install groundwater stewardship practices using cost share funds, attend an on-farm demonstration and participate in an educational workshop sponsored by the MGSP.

The MGSP also sponsors the Spill Response Program (1-800-405-0101) to assist individuals dealing with pesticide, fertilizer and manure spills; Clean Sweep to dispose of unused and unwanted pesticides in an environmentally sound manner; and Container Recycling to boost the industry's efforts for collecting plastic and aerosol pesticide containers.

Contact your MSU Extension, Conservation District or USDA NRCS representative to learn more about the MGSP serving your county.

## **Pesticide Emergency Preparedness**

At the time that the pesticide is purchased, ask the chemical dealer for a complete specimen label 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.)

## **Transporting Pesticides**

Have pesticides delivered by your dealer directly to your pesticide storage facility if possible. Transporting pesticides, especially large quantities, can involve a high degree of assumed liability by the grower. Department of Transportation shipping rules must be followed for transporting large quantities of pesticides, including proper placarding of the vehicle, liability insurance, special handling requirements, etc.

## **Storing Pesticides**

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 feed, seed, food, or fertilizer with pesticides. Do not store any protective clothing or equipment in the pesticide storage facility. Store herbicides 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*, and MSU Bulletin E-2335, *On-Farm Agrichemical Storage and Handling*.

## **Handling and Mixing Pesticides**

Always wear protective clothing and equipment when handling, mixing, and applying pesticides and during cleanup of application equipment. Always wear what is required on the 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 when you handle pesticides.

## **Applying Pesticides**

Prior to any application, the equipment used must be thoroughly checked for sound operation and accurately calibrated. Poor maintenance and calibration practices lead to excessive residues on the crop and could harm humans, animals, crops, and other parts of the environment. Inspect the equipment during use to prevent the unintentional misapplication of chemicals. If equipment needs repair, stop spraying and fix the problem immediately.

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 away from the target area. Make every effort to AVOID PESTICIDE DRIFT!

## Handling and Disposing of Pesticide Containers

Pesticide containers are considered hazardous waste unless they are triple or pressure rinsed and the rinsate is used as additional dilution in the spray mixture. After triple or pressure rinsing all emptied pesticide containers, perforate both ends so that the container cannot be reused. All metal and plastic triple rinsed containers should be offered for recycling. 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.

## Cleaning Pesticide Application Equipment

Follow all specific label directions for cleaning application equipment. If such instructions are not given on the pesticide label, then triple rinse the entire inside of the application equipment, spraying the rinsate on a labeled site not exceeding labeled rates. Wash off the outside of the equipment in the target area. Only after rinsing out the equipment with fresh water should you clean the spray system with an appropriate cleaning solution. Do not spray any cleaning solution onto any crop; dispose of the cleaning solution as you would any municipal waste. Follow the equipment manufacturer's guidelines for routine and year-end cleaning and maintenance.

## Unused and Unwanted Pesticides

Unused and unwanted pesticides are considered hazardous waste by both federal and state regulations. To be exempt from the stringent requirements for the disposal of hazardous pesticide waste, make every effort to purchase the exact amount of pesticides that will be needed during the growing season. Take extreme care in the calibration and application of any pesticide so that leftovers are not generated at the end of the job. Use any pesticide containing rinsates and unused pesticides exactly according to labeled use directions. If these procedures cannot be met, contact Michigan Department of Environmental Quality Hazardous Waste Management Division for instructions on the legal disposal of pesticide waste.

## Protect Nontarget Organisms

The transfer of pollen from one flower to another by **bees** is a basic requirement for the production of practically all fruit. Many insecticides are highly toxic to pollinating bees and wild bees. Be aware of how bee poisonings can occur from applying pesticides and how to prevent them. Take the following precaution to reduce the chance of bee poisoning:

- Do not apply pesticides toxic to bees if the site contains a crop or weeds which are in bloom. Mow cover crops and weeds to remove the blooms before spraying.
- Select pesticides that are least harmful to bees

and select the safest formulation. Dusts are more hazardous to bees than sprays. Wettable powders are more hazardous than emulsifiable concentrates or water soluble formulations. Granular insecticide formulations are generally the least hazardous to bees. Microencapsulated insecticides are extremely hazardous because the minute capsules can be carried to the hive.

- 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 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 whenever 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 or use contaminated water; or feed on pesticide-contaminated prey.

## Worker Protection Standard

New federal rules for worker protection have been in effect since 1995. The Worker Protection Standard (WPS) covers pesticides that are used in the production of agricultural plants on farms, forests, nurseries, and greenhouses. The operators of these businesses are required to provide employees with:

- Information in the form of pesticide safety training, pesticide safety poster, access to labeling information, and access to an application list of pesticide treatments on the establishment.
- Protection to ensure that employees will be protected from exposures to pesticides. Employers are required to prohibit handlers from applying pesticides in any way that will expose workers or others; exclude workers from areas being treated with pesticides; exclude workers from areas that remain under a Restricted Entry Interval (REI); protect early entry workers who are doing permitted tasks in an area under REI; notify workers about treated areas; monitor

handlers who are using highly toxic pesticides; and provide instruction for use of personal protective equipment.

- Mitigation in the form of decontamination sites for washing up in the field, and emergency assistance to make transportation available to a medical facility in the event of a pesticide-related injury or illness.

Details for compliance with the Worker Protection Standard as well as other regulations affecting worker safety can be obtained at the county MSU Extension 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.

The spray record sheet at the end of this publication, or E-2340 to E-2345 which includes directions and forms for a complete farm record keeping system, can be used for recording your sprays. 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 \$1000 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.

### **Endangered Species Act**

To minimize the adverse impact of pesticides on endangered species, the EPA has initiated The Endangered Species Act. The Michigan Department of Natural Resources (MDNR) administers the Michigan Endangered Species Act and maintains the federal and state endangered species lists in the state. Pesticide applications are a potential problem, particularly affecting birds, butterflies and moths. Alteration of the farm landscape can also negatively affect resident endangered species.

The Environmental Protection Agency (EPA) has determined threshold pesticide application rates that may affect listed species. This information is or will be included on pesticide labels. Counties with vulnerable endangered or threatened species will be identified on pesticide labels. Farmers must take the initiative and consult with the MDNR and the Fish and Wildlife Service (FWS) to be sure there are no endangered species in their area. The Nature Conservancy, a private land and habitat conservation organization, is working with the

MDNR and the FWS and is conducting a landowner contact program to work with landowners who own property important for endangered species protection.

### **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 if 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 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.

### **Right to Farm**

Farmers in Michigan are protected from nuisance lawsuits under the Right to Farm Act if they follow specific 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.

# Fungicides and Bactericides for Fruit Crops

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(Each compound has been assigned a number to be used in the calendar sections for efficiency ratings)

The arsenal of fungicides and bactericides for disease control in fruit crops has changed somewhat from last year. The registration of new materials with unique chemistries has increased the options for disease control and resistance management. Integration of crop protection chemicals with disease scouting and good cultural practices to minimize disease problems will increase their effectiveness. Growers are advised to read labels carefully for use instructions and restrictions. *Some products listed here have not been thoroughly tested in Michigan or have not shown levels of control sufficient to warrant their recommendation in the specific fruit sections. However, we feel that growers should know about these materials to be able to make informed decisions on their use. Some products listed here may be of interest to organic growers or growers who wish to use a more environmentally friendly approach to fruit production.*

**12. Abound** (azoxystrobin) is a strobilurin-type fungicide with limited post-infection activity registered on *grapes, blueberries, currants, gooseberries, apricots, cherries, nectarine, peaches, plums, plumcots, and prunes*. Abound is extremely phytotoxic to some apple varieties, causing damage from either spray drift or residue left in the tank. Do not use equipment used to spray Abound to also spray apples and avoid drift to susceptible apple varieties. Abound is labeled for control of black rot, Phomopsis, downy mildew and powdery mildew on grapes where it has a 14-day PHI. Of the strobilurin fungicides, Abound is the most effective against downy mildew. On blueberries, Abound has excellent activity against anthracnose fruit rot, and moderate activity against Phomopsis and mummy berry. The PHI for blueberries is 0 days. On stone fruit, Abound is fair to good against brown rot and excellent against powdery mildew and has a 0-day PHI. Because of its unique mode of action, Abound is an excellent product for use in rotation with SI fungicides. To limit the potential for resistance development, make no more than 2 sequential applications of Abound or other strobilurins. A maximum of 4 applications per year is allowed on wine and table grapes, and 3 applications per year on all other grapes. A maximum of 4 applications is also prescribed for stone fruit, blueberries, and other berries.

**Agrimycin** (streptomycin sulfate) is an antibiotic labeled for control of fire blight in *apples* and *pears*. Recommended use rates are 24-48 oz/acre. The PHI is 30 days on pears and 50 days on apples.

**15. Aliette** (fosetyl-AL) is a systemic fungicide registered for control of red stele and leather rot in *strawberries*; Phytophthora root rot, fruit rots and cankers in *blueberries*, and Phytophthora root rot in *brambles*. Aliette is also labeled for control of downy mildew in *grapes* and

Phytophthora collar rot of *apples* and *pears* and *non-bearing stone fruit*. It has protectant and curative properties. The PHI is 60 days for brambles, 0 days (12 hours) for strawberries and blueberries, 15 days for grapes, and 14 days for apples and pears. Do not tank-mix Aliette with copper products, surfactants, or foliar fertilizers, or spray Aliette within several days of a copper application.

**AQ10** (*Ampelomyces quisqualis*) is a biofungicide registered for control of powdery mildew in *grapes, strawberries, blueberries, raspberries, blackberries, currants, gooseberries, cranberries, apples, apricots, cherries, nectarines, peaches, pears, plums, prunes, and quince*. *A. quisqualis* is a fungus that parasitizes powdery mildew fungi. Preliminary results in grapes in Michigan show a moderate level of disease control. Adding an adjuvant such as Nufilm (0.02% v/v) enhances its efficacy. Application should start as soon as susceptible tissue becomes available and continue on a 7- to 14-day schedule. A minimum of 2 sequential applications is needed to maintain the population of *A. quisqualis*. The following chemicals cannot be tank-mixed with AQ10: sulfur, dithiocarbamates, potassium salts of fatty acids, and strobilurins. The PHI is 0 days.

**64. Armicarb 100** (potassium bicarbonate) is an environmentally friendly protectant (contact) fungicide. Armicarb 100 is registered for control of powdery mildew and other diseases in *grapes, blueberries, strawberries, brambles, apples, cherries, pears, peaches, and plums*. Trial results in Michigan indicate moderate control of powdery mildew and good control of black rot in Concord grapes. This material has not been tested on other fruit crops in Michigan. For powdery mildew, start applications at the first sign of disease and continue on a 7-14 day schedule. For black rot of juice grapes, start first spray at immediate pre-bloom and continue on a 7-14 day schedule until 5 weeks after bloom. The PHI on all crops is 0 days. An OMRI listing for organic production is expected before the 2003 season.

**Aspire** (*Candida oleophila*) is a biofungicide for control of pathogens that cause post-harvest decay in pome fruit, stone fruit, and berry crops. *C. oleophila* is a naturally occurring yeast which was isolated from the peel of a tomato. It cannot survive at temperatures above 90°F, which makes it safe for human handling and exposure. It competes with pathogens on the fruit surface for space and nutrients. The technical bulletin lists efficacy against blue mold, gray mold, green mold, sour rot, and stem end rot. Aspire can be applied as a drench or in-line application at a rate of 1 lb product per 20 tons of fruit in a sufficient volume of water to get good coverage.



Sodium hypochlorite should not be co-mixed in the same tank with Aspire. Aspire has only been tested on blueberries in Michigan and was not able to control post-harvest anthracnose fruit rot. Further testing is required to assess its efficacy against other diseases.

**13. Bayleton** (triadimefon) is a systemic, sterol-inhibitor (SI) fungicide with some post-infection activity. It is registered on *grapes* for control of powdery mildew and black rot, on *apples* for cedar-apple rust and powdery mildew, and on *pears* for powdery mildew. Bayleton may be used on a protective or post-infection schedule (within 72 hours of the beginning of an infection period; at the higher rate). Alternating or tank-mixing Bayleton with a non-SI fungicide is recommended for resistance management. Bayleton has a 14-day PHI on grapes and a 45-day PHI on apples and pears.

**Benlate** (benomyl) has been withdrawn by the manufacturer, but existing stocks can be used up. Benlate is a locally systemic benzimidazole fungicide that should be used in combination with a nonbenzimidazole fungicide (e.g., Captan or Ziram, where labelled) to reduce the risk of resistance development. Benlate is labeled for use in *blueberries, brambles, grapes, strawberries, currants, apples, pears, cherries, peaches, nectarines, plums, and apricots*. Benlate is labeled for control of Botrytis blossom blight, Phomopsis, anthracnose, and mummyberry on blueberry (PHI=21 days); on brambles for control of Botrytis, powdery mildew and Penicillium rots (PHI=3 days); on grapes for control of powdery mildew, black rot, bitter rot, and Botrytis bunch rot (PHI=50 days); and on strawberries for control of powdery mildew, leaf scorch, leaf blight, Mycosphaerella leaf spot, and anthracnose (PHI=1 day). Benlate is also effective against spur blight, anthracnose, and fruit rots in brambles even though these diseases are not specified on the label. Benlate is used on apples for sooty blotch/flyspeck, on pears for scab and leafspot, and cherries for leaf spot. Benlate is *not* labeled for container-grown blueberries, home plantings, or after "U-pick" operations have started.

**4. Bravo** (chlorothalonil) is a protectant fungicide registered on *blueberries* for control of anthracnose and Phomopsis canker, and suppression of mummy berry, and on *cranberries* for control of fruit rots and Lophodermium leaf and twig blight. Bravo is also registered on *peaches, nectarines, cherries, apricots, and plums* for control of brown rot blossom blight, cherry leaf spot, black knot, scab, shothole, and peach leaf curl. Do not use Bravo on blueberries after early bloom, or fruit spotting may result. In cranberries, do not apply to bogs when flooded or allow release of irrigation water from bogs for at least 3 days following application. The PHI is 42 days for blueberries and 50 days for cranberries. In stone fruit, do not apply Bravo in the period after shuck split and before harvest. Applications after harvest may be made for cherry leaf spot.

**20. Cabrio** (pyraclostrobin) is a strobilurin fungicide that recently received a label for use on *blueberries, strawberries, brambles, currants, gooseberries, and cherries*. On blueberries, the target diseases are anthracnose, Phomopsis, rust, Alternaria, powdery mildew, Botrytis gray mold (suppression) and mummy berry (suppression). On strawberries, the target diseases are anthracnose, powdery mildew, leaf spot, and Botrytis gray mold (suppression). On brambles, the target diseases are anthracnose, powdery mildew, spur blight, leaf spot and blotch, rust, and Botrytis gray mold (suppression). On gooseberries and currants, the target diseases are powdery mildew and rusts. On cherries, the target diseases are brown rot and powdery mildew. The PHI is 0 days on all crops. To prevent resistance development, a maximum of 5 sprays per season is allowed for strawberries and cherries, and 4 sprays for blueberries and brambles. In small plot trials in Michigan, Cabrio provided excellent control of anthracnose in blueberries, anthracnose and leaf spot in raspberries, and scorch in strawberries. Cabrio also suppressed Botrytis. Cabrio is weak on brown rot and leaf spot on cherries, but may have usefulness in nurseries to control powdery mildew.

**50. Captan** (captan) is a protectant fungicide with a broad spectrum of activity labeled for *blueberries, strawberries, grapes, apples, cherries, plums/prunes, and peaches*. Captan can be used on *brambles* under a Section 24C (Special Local Needs label) in Michigan. Captan is **not** labeled on pears. Captan can cause leaf injury to certain sweet cherry varieties and to leaves and fruit of plums, especially on young tissue under slow-drying conditions. Captan, like other sulfur-containing compounds, can cause phytotoxicity in combination with oil applications. Captan is labeled for control of scab, white rot, bitter rot, black rot, sooty blotch/flyspeck in apples; for control of brown rot, peach scab, and cherry leaf spot in stone fruit; for control of fruit rots and suppression of mummy berry in blueberries; for control of Botrytis gray mold and leaf spot in strawberries; for control of Phomopsis cane and leaf spot, downy mildew and suppression of black rot in grapes; and for control of anthracnose, cane blight, spur blight, and Botrytis gray mold in brambles. Captan is not effective against powdery mildew or rust diseases. Many processors will not accept grapes sprayed with Captan at any time during the season. The PHI is 0 days for all crops, except brambles, which has a 3-day PHI.

**50. Captec** (captan) is a liquid (flowable) formulation of captan. See Captan. Captec should not be used within 10-14 days following oil sprays.

**53. Carbamate** (ferbam). See ferbam.

**57/58. Copper compounds** (copper hydroxide, copper oxychloride, copper sulfate (COCS), tribasic copper sulfate, and copper salts of fatty & rosin acids) are used as protectants against a wide array of fungal and bacterial diseases in *grapes, strawberries, raspberries,*

*blackberries, blueberries, cranberries, currants, gooseberries, apples, pears, peaches, and nectarines.*

Fresh hydrated lime is commonly added as a safener to help prevent foliar injury. Lime is not compatible with Tenn-cop, a liquid formulation composed of copper salts of fatty & rosin acids. Bordeaux Mixture is powdered bluestone (copper sulfate) plus lime. There are many easy-to-use commercially formulated copper products on the market. Kocide, Champ, and Cuprofix are examples. Cuprofix does not need added lime. Fixed copper formulations and lime should *not* be used with Bayleton, Benlate, Captan, Carbamate, Karathane, Guthion, Imidan Sevin, or Thiodan. Grape varieties differ in copper sensitivity (see table in grape section). Copper injury can occur even on tolerant varieties under cool, slow-drying conditions. Copper is OMRI listed for organic fruit production, although specific formulations may not be. Copper has a negative effect on earthworm populations.

**59. Dithane** (mancozeb) is a protectant EBDC (ethylene bisdithiocarbamate) fungicide labeled on *apples, pears, grapes, and cranberries*. EBDCs are used on apples and pears for control of scab, rusts, fly speck and sooty blotch, and Fabrea leaf spot ; on grapes for control of downy mildew, Phomopsis black rot, and bunch rot; and on cranberries for control of fruit rots. Many processors will not accept grapes sprayed with EBDCs after the onset of bloom, and at least one apple and pear processor allows use only through petal fall. When applying multiple EBDC products, the total amount of all such products must not exceed the lowest amount of active ingredient specified for an individual product per acre per season. The pre-harvest interval for grapes and cranberries is 66 days and for apples and pears is 77 days.

**4. Echo** (chlorothalonil) is similar to Bravo. There are two formulations labeled for fruit: Echo 720 and Echo 90 DF. The latter is a dry flowable with a higher rate of active ingredient.

**65. Elevate** (fenhexamid) is a reduced-risk, protectant fungicide registered for control of Botrytis diseases in *strawberries, grapes, blueberries, gooseberries, currants, and brambles*; and brown rot/blossom blight in *stone fruit*. Elevate also suppresses powdery mildew in grapes. It has a unique chemistry, which makes it useful for fungicide resistance management. Avoid making more than 2 consecutive applications before switching to a fungicide with a different mode of action. A maximum of 3 lb product per acre per season may be applied to grapes, and 6 lb per acre per season to strawberries, brambles, blueberries, gooseberries, currants, and stone fruit. The PHI for all crops is 0 days.

**8. Elite** (tebuconazole) is a systemic SI fungicide registered on *cherries and peaches* for control of brown rot, powdery mildew, and cherry leaf spot; and on *grapes* for control of powdery mildew and black rot (similar to Nova). Elite also enhances control of Botrytis bunch rot by other fungicides on grapes. Elite can be used on a preventive or post-infection schedule (within 72 hours of an infection period) and has a 14-day PHI for grapes and

0-day PHI for cherries and peaches. Elite should be alternated or tank-mixed with a non-SI fungicide for resistance management purposes.

**53. Ferbam** (ferbam) is a broad-spectrum protectant fungicide registered on *apples, cherries, peaches, nectarines, grapes, and cranberries*. Ferbam is used on apples for control of scab, rust, black rot, bitter rot, sooty blotch, and fly speck; on pears for control of scab; on peaches and nectarines for control of peach leaf curl; and on cherries in combination with sulfur against brown rot and leaf spot. On grapes, Ferbam provides control of black rot and suppression of downy mildew. On cranberries, it controls fruit rots, Lophodermium twig blight, and fairy ring. Ferbam may leave a dark residue on fruit, is incompatible with lime, and may increase russetting of some apples. The PHI is 0 days for cherries; 7 days for apples, pears, and grapes; and 21 days for peaches. In cranberries, Ferbam should not be applied later than 28 days after mid bloom.

**Flint** (trifloxystrobin) is a strobilurin-type fungicide registered on *grapes, apples, pears* and more recently on *peaches, plums/prunes, and cherries*. Flint is phytotoxic to Concord grapes. Flint is best used as a protectant. In general, Flint is effective against powdery mildew but weak against rusts. On grapes, Flint provides control of powdery mildew and black rot, and suppression of downy mildew. Flint also provides good control of Phomopsis. On apples, Flint is good against scab, powdery mildew, black rot, and excellent against sooty blotch and flyspeck, and on pears is labeled against scab. Flint is only fair for brown rot control on stone fruit, and cherry leaf spot. To limit the potential for resistance development, make no more than 2 sequential applications of Flint or other strobilurin fungicides. A maximum of 4 applications per year is allowed on wine and table grapes, and 3 applications per year on all other grapes. Rotation with non-strobilurin fungicides is recommended. The PHI is 14 days on grapes, apples and pears, and 1 day on peaches, plums/prunes, and cherries.

**Gallex** (2,4-Xylenol and meta-Cresol) is an eradicant paint for crown gall on *apples, pears, peaches, nectarines, cherries, plums, grapes, blueberries, and brambles*. Gallex is painted on existing galls in the spring and early summer. Expose below-ground galls by hosing away with water and allow to dry for 1 or 2 days before treatment. Large galls may be partially or completely removed before treatment. Gallex also reduces burr knot of apple. Do not mix or combine Gallex with other pesticides. No PHI is indicated.

**Galltrol** (*Agrobacterium radiobacter* strain K84) is a bacterial inoculant for control of crown gall disease in *apples, pears, peaches, nectarines, cherries, plums/prunes, blueberries, and brambles*. Galltrol is similar to Norbac. *Agrobacterium radiobacter* is a naturally occurring bacterium that is widespread in soil and produces a toxic compound that prevents other

*Agrobacterium* species from causing crown gall disease. Galltrol is used as a pre-plant dip or spray of planting material and is sold as a live bacterial culture on a Petriplate. Galltrol may also be applied as a soil drench. Do not use chlorinated water or combine with Captan, Nemacur, Vydate or other pesticides or fertilizers. Generally one pre-plant application will give good control. Galltrol **will not** control crown gall of grape, which caused by a different strain.

**Gavel** (zoxamide and mancozeb) is a new protectant fungicide which is expected to receive a label for grapes sometime in 2003. In grape trials in Michigan, it provided excellent downy mildew control. However, because of the mancozeb component, it will have a 66-day PHI and be restricted from use after bloom by some processors. This will limit its usefulness for downy mildew control in grapes.

**2. Indar** (fenbuconazole) is a systemic SI fungicide labeled for *peaches* and *cherries* for control of brown rot, peach powdery mildew, peach scab, and leaf spot. Indar has been used on blueberries under a Section 18 (emergency exemption) label for the past few years, and is expected to get an exemption also in 2003. On blueberries, Indar has good activity against both the shoot strike and fruit infection stages of mummy berry. However, it should be mostly used a protectant, since it does not have much kick-back action. When disease pressure is high, spray on a 7-day schedule. Indar also has good activity against Phomopsis twig blight when applied on the same schedule as recommended for mummy berry. The use of spray adjuvants with Indar is not labeled for blueberries, but is permitted for stone fruit. The PHI is 0 days for peaches and cherries, and 30 days for blueberries.

**66. JMS Stylet Oil** (paraffinic oil) is a low-toxicity product registered for control of powdery mildew and a host of insect pests on *apples*, *pears*, *peaches*, and *cherries*; for control of powdery mildew, Botrytis bunch rot, mealybugs, mites, leafhoppers, and whiteflies on *grapes*; for control of powdery mildew, rust, and mites on *blueberries*, *gooseberries*, *currants*, and *brambles*; and for control of Botrytis, powdery mildew, leafminers and mites on *strawberries*. Good spray coverage is necessary for effective control. Applications can also be made post harvest to reduce overwintering of insects. Do not spray JMS Stylet Oil on sensitive varieties as it can burn the foliage. Oil will temporarily remove bloom on grapes. Table grapes should not be sprayed within 14 days of harvest. No pre-harvest intervals are indicated for other crops. An organic formulation of JMS Stylet Oil is OMRI listed.

**Kaligreen** (potassium bicarbonate) is similar to Armicarb. It is a contact fungicide labeled for powdery mildew control on *apples*, *pears*, *cherries*, *nectarines*, *peaches*, *plums/prunes*, *grapes*, *blueberries*, *strawberries*, *brambles*, *gooseberries*, and *currants*. Kaligreen has a 1-day PHI on all crops, and may also be applied post-harvest to remaining foliage to decrease overwintering inoculum. Kaligreen is OMRI-approved for organic fruit production.

**64. Lime sulfur** (calcium polysulfide) is registered for use on *apples*, *pears*, *cherries*, *peaches*, *plums/prunes*, *grapes*, *blueberries*, and *brambles*. Different formulations may be labeled for different crops, so check the label before applying. When applied in the fall and/or spring (bud break), this product can reduce overwintering pathogen inoculum in and on perennial wood. It should not be used as a stand-alone treatment. Target diseases are scab and leaf curl in tree fruit; anthracnose, spur blight, cane blight, powdery mildew, and rust in brambles; anthracnose, powdery mildew, and black rot in grapes; and Phomopsis, Fusicoccum and other canker/dieback diseases in blueberries. Lime sulfur also controls hatching eggs and nymphs of scale insects, pear psylla, aphids, and mites. It is a very caustic material with a smell of rotten eggs. Timing is critical, and crop injury may result if sprayed on expanded foliage.

**Maneb** (maneb = mancozeb without zinc) is an EBDC fungicide with a similar spectrum of control and use restrictions as Dithane. See Dithane.

**59. Manzate** (mancozeb) is an EBDC fungicide. See Dithane.

**Messenger** (harpin) is a reduced-risk product registered for use on *grapes*, *blueberries*, *cranberries*, *strawberries*, *brambles*, *currants*, *apples*, *pears*, *cherries*, *nectarines*, *peaches*, *plums*, and *prunes*. The active ingredient is a protein which stimulates natural plant defenses, which means that Messenger has no direct effect on pathogens. Application of Messenger must be 5 to 7 days in advance of an infection period to allow the plant to build up its defenses. In trials in blueberries in Michigan, a moderate level of control was seen against Phomopsis twig blight. The efficacy of this material has not been sufficiently tested for other diseases in Michigan. Messenger has a 0-day PHI.

**Mycoshield** (oxytetracycline calcium complex) is an antibiotic labeled for control of fire blight on *pears*, and bacterial spot on *peaches* and *nectarines*. Frequent applications are necessary for control. The PHI is 60 days for pears, and 3 weeks for peaches and nectarines.

**NoGall** (*Agrobacterium radiobacter* strain K1026) is a bacterial inoculant for control of crown gall disease in *apples*, *pears*, *peaches*, *nectarines*, *cherries*, *plums/prunes*, *blueberries*, and *brambles*. Strain K1026 is similar in activity to strain K84 (Galltrol or Norbac) but has been genetically modified so that its resistance to the toxin cannot get transferred to the crown gall pathogen. NoGall is used as a pre-plant dip or spray and is sold as a live bacterial culture on a finely ground peat medium. It has a much better shelf life than the gel formulation, but should still be refrigerated. NoGall **will not** control crown gall of grape, which is caused by a different strain.



**Norbac** is similar to Galltrol. See Galltrol.

**5. Nova** (myclobutanil) is a systemic SI fungicide that provides excellent control of powdery mildew and black rot in *grapes*. Nova also controls powdery mildew, common leaf spot and Phomopsis leaf blight in *strawberries*; cane and leaf rust, orange rust, yellow rust, leaf spot, and powdery mildew in *raspberries*; cane and leaf rust, orange rust, yellow rust, and powdery mildew in *blackberries*; anthracnose and powdery mildew in *gooseberries*; and powdery mildew in *currants*. In *apples* Nova is very effective against powdery mildew, rust, and foliar infections of apple scab. Like other SI fungicides, Nova is less effective for protection against fruit scab infections. In *cherries* and *peaches*, Nova is also very effective against blossom infections of brown rot and cherry leaf spot, but is not labeled for protection against fruit brown rot. Nova is **not** labeled for use on pears. The PHI is 14 days for grapes and apples, 7 days for peaches and cherries, and 0 days for all other crops. It is advisable to alternate Nova with fungicides with a different mode of action as a resistance management strategy.

**Oxidate** (hydrogen dioxide) is registered as a broad-spectrum bactericide/fungicide for use in *grapes*, *blueberries*, *cranberries*, *strawberries*, *brambles*, *apples*, *pears*, *cherries*, *peaches*, *nectarines*, and *plums*. The label lists control of a broad range of diseases. Oxidate works like hydrogen peroxide, killing fungal and bacterial cells upon contact. However, the material appears to be rather short-lived on the plant surface, so that timing becomes crucial. Trials on grapes in Michigan showed limited control of powdery mildew and Botrytis, even with weekly applications. The efficacy of the material for control of other diseases has not been confirmed in Michigan.

**59. Penncozeb** (mancozeb) is an EBDC fungicide. See Dithane.

**54. Procure** (triflumizole) is a systemic SI fungicide with excellent activity against powdery mildew on *grapes*. Procure also provides control of black rot and suppression of Phomopsis cane and leaf spot. Procure is also labeled in *apples* and *pears* for control of scab and powdery mildew. It has less post-infection activity than Nova or Rubigan. In contrast to Rubigan, Procure can be used before petal fall on pears. The PHI is 14 days on apples and pears and 7 days in grapes.

**55, 60, 61. Ridomil Gold** (mefenoxam) is a systemic fungicide with excellent activity against *Pythium* and *Phytophthora* diseases. This fungicide is registered on *strawberries* for control of red stele and leather rot; and on *raspberries* and *blueberries* for control of Phytophthora root rot. It is also registered for Phytophthora crown rot control for all non-bearing and bearing *tree fruit*, except *pears* where it is available only for non-bearing trees. Ridomil Gold will not revitalize plants showing moderate to severe root rot symptoms. A maximum of 2 applications may be made per season in blueberries and raspberries, and 3 in strawberries. A PHI of 45 days applies to

raspberries. See the label for timing information for Ridomil application to tree fruit plantings. In *grapes*, Ridomil formulations with copper (Ridomil Gold/Copper) and mancozeb (Ridomil Gold/MZ) are registered for control of downy mildew. The PHI is 66 days, so for late-season downy mildew control other registered fungicides should be used. If, in addition to Ridomil Gold/MZ, other fungicides containing EBDC active ingredients are used during the growing season, do not exceed a total of 19.2 lbs of EBDC active ingredient per acre.

**62. Quadris** (azoxystrobin) is a reduced-risk strobilurin fungicide with the same active ingredient as Abound. Quadris is registered for use in *strawberries* against anthracnose, powdery mildew, and Rhizoctonia root rot. In Michigan, Quadris has shown efficacy against anthracnose fruit rot and foliar diseases. Its efficacy as a soil drench against Rhizoctonia root rot has not been evaluated in Michigan. Because of the potential for resistance development, do not apply more than 2 sequential applications of a Quadris or any other strobilurin fungicide before switching to a fungicide with a different mode of action. A maximum of four Quadris or other strobilurin applications per season is allowed. Resistant strains of the anthracnose fungus are suspected already in Florida strawberry fields, so careful use is warranted in Michigan to prolong the useful life of this and other strobilurins. The PHI is 0 days.

**3. Rovral** (iprodione) is a protectant fungicide registered on *grapes*, *blueberries*, *brambles*, *gooseberries*, and *currants* for control of Botrytis diseases; on *strawberries* for control of Botrytis diseases, stem end rot, Phomopsis soft rot, purple leaf spot, and anthracnose; and on *cherries*, *peaches*, *nectarines*, and *plums* for brown rot, scab and shot hole. On cherries, Rovral provides excellent control of brown rot and fair control of cherry leaf spot. Alternating Rovral with fungicides with a different mode of action may delay the buildup of resistant strains. Where resistant strains are already present, control may be less than expected. A maximum of one application is allowed on strawberries, two applications on stone fruit, and four applications on grapes, blueberries, brambles, currants, and gooseberries. The PHI is 0 days for blueberries, brambles, gooseberries, and currants; and 7 days for grapes. Rovral is not allowed past first fruiting flower on strawberries and petal fall on cherries.

**10. Rubigan** (fenarimol) is a locally systemic SI fungicide registered on *grapes*, *apples*, *pears*, and *cherries*. It has protectant and curative activity. Rubigan is used to control scab and powdery mildew in apples and scab in *pears*. It is not labeled for use before petal fall on pears. In cherries, Rubigan has good activity against powdery mildew and fair activity against leaf spot, and poor activity against brown rot. Rubigan should be tank-mixed or alternated with a non-SI fungicide to reduce the risk of resistance development. Tank-mixing with copper-containing products may result in reduced effectiveness



of Rubigan. The PHI is 30 days on grapes, apples, and pears; and 0 days in cherries.

**Scholar** (fludioxonil) is a new fungicide from Syngenta expected to receive a label for post-harvest use in 2003. Scholar has been used in several states over the past few years under Section 18 permits. It is effective against brown rot, gray mold, and Rhizopus rot on stone fruit as a post-harvest spray or dip.

**Serenade** (*Bacillus subtilis*) is a biocontrol product registered on *grapes*, *apples*, and *pears*. Trial results in grapes show a moderate level of control of Botrytis bunch rot, powdery mildew, and downy mildew. Serenade is also labeled for fire blight, scab, and powdery mildew on apple and pear. However, fungicide trials on tree fruit with this material have not been very promising. Serenade has no maximum seasonal application rate and has a 0-day PHI. Serenade is OMRI listed for organic fruit production.

**16. Sovran** (kresoxim-methyl) is a reduced-risk strobilurin fungicide labeled for *grapes*, *apples*, and *pears*. Sovran is phytotoxic to some sweet cherry cultivars, which warrants caution when spraying near sweet cherry orchards. On grapes, it is used for control of powdery mildew, downy mildew, black rot and Phomopsis cane and leaf spot. On tree fruit, Sovran controls scab, sooty blotch, flyspeck, and black rot on apple and pear and powdery mildew of apple. Sovran has surface-systemic activity, which means that it is distributed in and over the waxy layers of the plant surface, and has good weathering resistance. Although Sovran has some post-infection activity, it is better suited as a protectant. Because of their single-site mode of action, strobilurins are naturally prone to resistance development. Therefore, make no more than 2 sequential, and no more than 4 total applications of Sovran or any other strobilurin fungicide per season. A total of 3 applications per season is allowed on juice grapes. Alternation with non-strobilurin fungicides is recommended. Do not use more than 25.6 oz of product per acre per season and allow a minimum of 7 days between sequential sprays of Sovran. The pre-harvest interval for apples and pears is 30 days and for grapes 14 days.

**14 Sulfur** (elemental sulfur) is used as a protectant for control of powdery mildew on *grapes*, *strawberries*, *blueberries*, *brambles*, *apples*, *cherries*, and *peaches*. Sulfur is also moderately effective against brown rot, apple scab, and cherry leaf spot. Sulfur is available in dust, wettable powder, and liquid formulations. Examples of sulfur products are: Wettable Sulfur, Microthiol Special, Microthiol Disperss, Microfine Dispersible Sulfur, Microspense Wettable Sulfur, Kumulus, Sungro Wettable Sulfur, Wettable Sulfur Fine Grind, Yellow Jacket Wettable Dusting Sulfur, Liquid Sulfur Six, and Dusting Sulfur. Generally, wettable and liquid formulations are easier to apply than dusts, and formulations with finer particles are more effective. Sulfur is also effective against plant-feeding mites, but can be damaging to predatory mite

populations. Sulfur can injure sensitive fruit crop varieties, such as Concord grapes (see Table 2 in the grape section). Sulfur injury may also occur in tolerant varieties when temperatures of 85°F or above occur soon after application and on strawberries under certain climatic conditions. The efficacy of sulfur is reduced at temperatures below 65°F. Sulfur is incompatible with oil and should not be used within two weeks before and after an oil spray. No pre-harvest intervals are listed, however, late applications of sulfur may leave undesirable residues on grapes which can interfere with the wine-making process. Sulfur products can also be used as a micronutrient supplement, since sulfur is an essential nutrient for plant growth. Sulfur is OMRI listed for organic fruit production, although specific formulations may not be.

**67. Switch** (cyprodinil and fludioxonil) is a reduced-risk fungicide with systemic and protectant properties. It is registered on *strawberries* for control of Botrytis gray mold. Switch has also been reported to suppress anthracnose in strawberries. The PHI is 0 days. No more than 56 oz of product may be applied per acre per year. Do not plant rotation crops other than strawberries and onions for 12 months following the last application of Switch.

**Syllit** (dodine) is a protectant fungicide with post-infection and some eradicant activity. It is labeled on *apples* for scab, on *peaches* for bacterial spot, and on *cherries* for leaf spot control. It is also registered on *strawberries* for control of leaf scorch, leaf spot, and leaf blight. Resistance of apple scab and cherry leaf spot pathogens to Syllit is common in Michigan. Syllit is not compatible with fixed coppers, Bordeaux mixture, lime or lime sulfur. Russetting of yellow apples may occur if Syllit is used during cool, slow drying conditions or close to freezing temperature episodes. The PHI for Syllit is 7 days for apples, 15 days for peaches, 0 days for cherries, and 14 days for strawberries.

**19. Thiram** (thiram) is a protectant fungicide registered on *strawberries* for control of Botrytis gray mold; and on *apples* and *peaches* for a broad spectrum of fungal diseases. On apples, the activity is much like Ferbam. Target diseases on apple are: apple scab, apple blotch, bitter rot, black pox, black rot, Brook's spot, bull's eye rot, fly speck, gray mold, sooty blotch, white rot, and cedar apple rust. On peaches, Thiram is used for control of peach leaf curl, and is fair to good on brown rot and peach scab. The PHI on 3 days for strawberries, 0 days for apples, and 7 days for peaches. Thiram also has animal-repellent properties.

**9, 56. Topsin-M** (thiophanate-methyl) is a broad-spectrum systemic fungicide registered on *strawberries* and *grapes*. A Section 18 (emergency exemption) for use in *blueberries* is expected again in 2003 as a Benlate replacement. Topsin-M is also labeled for use in *apples*, *cherries*, *plums*, and *peaches*. The

target diseases are Botrytis, leaf blight, and leaf scorch in strawberries; Phomopsis twig blight and canker, Fusicoccum canker, mummy berry, and anthracnose in blueberries, powdery mildew and Botrytis in grapes; apple scab, flyspeck, powdery mildew, sooty blotch, black rot, and Brook's fruit rot in apples; and brown rot, cherry leaf spot, powdery mildew, and peach scab in stone fruit. Fungicide resistance can be a problem with this fungicide. Topsin-M should be tank-mixed with a non-benzimidazole fungicide (e.g., Captan or Ziram) to reduce the risk of resistance development. If benomyl-resistant strains are already present in a field, they are likely to also be resistant to Topsin M. The PHI is 1 day on strawberries, 7 days on blueberries, 14 days on grapes, and 0 days on apples.

**6. Vanguard** (cyprodinil) is a reduced-risk systemic fungicide with protectant and post-infection activity, registered on *grapes* for control of Botrytis bunch rot and suppression of powdery mildew; on *apples* for scab control; and on *peaches, tart cherries, and plums* for brown rot blossom blight control. Do **not** apply Vanguard to sweet cherries. Vanguard shows no cross-resistance to other currently available fungicides, which makes it a useful tool for fungicide resistance management. It is rainfast 2 hours after application. Vanguard on apples is best used as an early-season spray due to its weak protection of fruit against apple scab. Under heavy disease pressure, other registered fungicides should be used in combination or rotation with Vanguard. A maximum of two applications of Vanguard per season is allowed on grapes and stone fruit. A maximum amount of 22 oz per acre per season is allowed on apples. The PHI is 7 days for grapes, and 72 days for apples. Vanguard should not be applied past bloom in stone fruit.

**51. Ziram** (ziram) is a broad-spectrum protectant fungicide registered on *grapes* for control of black rot, downy mildew, Phomopsis cane and leaf spot, and suppression of Botrytis bunch rot; and on *blueberries* for control of fruit rots and suppression of mummy berry. Ziram is useful as a non-EDBC substitute on *apples* and *pears* with good control of sooty blotch and flyspeck, and provides moderately good control of scab on both crops. Ziram provides some control of necrotic leaf blotch of Golden Delicious, plus it is a source of zinc as a nutrient. Ziram is an effective peach leaf curl control. Ziram is **not** labeled on plums/prunes and can cause leaf damage on this crop. Ziram is available as a dry flowable (Ziram 76 DF) and water-dispersible granules (Ziram Granuflo). Ziram 76 DF has a Special Local Needs label for use on blueberries, allowing a maximum rate of 4 lb per application and a 14-day PHI. Ziram Granuflo can only be applied at 3 lb and up to three weeks after full bloom. The PHI for grapes is 21 days for both formulations and 14 days for tree fruit.

fungi to build up over time. Reduced sensitivity may occur naturally in some strains due to random **mutations** in their genes. Gene mutations may change the affinity of the fungicide target site within the cells, thereby reducing fungicide efficacy. When exposed to a particular fungicide, these strains have a selective advantage over sensitive strains. A buildup of resistant strains will eventually result in diminished levels of disease control with the same amount of chemicals applied. This is generally referred to as **field resistance**. It should be noted that reduced disease control may also be caused by improper fungicide application, extremely high disease pressure, or other factors not related to the presence of resistant pathogen strains.

Chemicals with a very specific or single-site **mode of action** are more likely to lead to development of resistance than broad-spectrum chemicals, since a single mutation may allow the fungus to survive. For instance, Captan, a broad-spectrum fungicide, has been used extensively for decades without the development of field resistance, whereas resistance to SI fungicides, which specifically inhibit sterol biosynthesis, has been widely reported. A pathogen shows **cross-resistance** when it has reduced sensitivity to two or more fungicides. Usually these fungicides belong to the same chemical group and therefore have the same mode of action. For instance, a fungus strain resistant to Rubigan may also show resistance to Nova, since both are SI fungicides. A sensible approach, therefore, is to combine or alternate fungicides with different modes of action in a spray program. This will help prolong the effective life of the fungicides as well as optimize disease control. It is also important to incorporate alternative methods of disease control, such as host plant resistance, cultural methods, and disease predictions, to reduce the total amount of fungicide used and thereby the selection pressure on fungal populations. Table 1 shows the various fungicides available for disease control in fruit crops. An "X" indicates a shared mode of action.

## Fungicide Resistance

The repeated and exclusive use of certain fungicides may allow less sensitive (**fungicide-resistant**) strains of target



# Insecticides and Miticides for Fruit Crops

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(Each compound has been assigned a number to be used in the calendar sections for efficiency ratings)

**61. Acramite** (bifenazate) belongs to a new class of miticides called carbazates and is registered for use in pome fruits, stone fruits, grapes and strawberries for control of mites. Acramite is a contact miticide that is primarily active against motile stages of European red mite and two spotted spider mite, but also nymphal stages that hatch after application. For best performance maintain spray tank water at or near pH 7.0.

**59. Actara** (thiamethoxam) belongs to a new class of insecticides called neonicotinoids (thianicotinyl subclass). Actara is registered for use in apples and pears, targeting aphids, leafhoppers, leafminers, psylla and plum curculio. This translaminar (locally systemic) material has long residual inside the foliage, and is particularly effective on piercing/sucking insect pests, as well as the sap-feeding stage of leafminers. Because most of Actara's surface residue is quickly absorbed into the plant, negative impact on natural enemies is minimized.

**41. Agri-Mek** (avermectin) is registered on apples for the control of mites, white apple leafhopper and spotted tentiform leafminer, on pears for the control of pear psylla and pear rust mite, on grapes for two-spotted spider mite, and on strawberries for mite control. Though not a labeled use, Agri-Mek has moderate activity on apple rust mite and San Jose scale. The active ingredient is a by-product of a soil fungus that has insecticidal activity. Agri-Mek is a translaminar (locally systemic) insecticide, and when applied before leaf tissue is mature and hard has long residual inside the foliage. Agri-Mek will also control spider mites on pear foliage when applied for pear psylla at first cover. On pears this product must be applied with 1 gallon of paraffinic spray oil to effectively penetrate the leaf tissue. The same is recommended on apples, but the label allows for the use of some other penetrating surfactants or with no addition of an oil at all. For grapes a nonionic surfactant needs to be added to improve wetting of foliage and smooth out spray deposits. For best mite control apply when mites first appear and before populations build beyond threshold.

**17. Apollo** (clofentezine) is a miticide labeled for control of European red mite and spider mites on apples, pears, peaches, nectarines and cherries. Apollo is an active mite ovicide, providing control ranging from 10 weeks to full season depending on mite pressure, the extent of tree vegetative growth and predator mite populations. Control is achieved both from direct contact with the spray and contact with treated plant surfaces, but can also affect adult female mites by rendering their eggs inviable. On apples it can be used at the traditional tight-cluster stage or with the recent label amendment it can be applied later in

the season up to a 45-day PHI. In all cases, it may be applied ONLY once per year. Apollo is not toxic to predator mites.

**40. Asana XL** (esfenvalerate) is a synthetic pyrethroid insecticide registered for use on apples, pears, stone fruits and blueberries. Because of its compatibility with oil it can be used for pre-bloom insect control. In blueberries Asana should not be sprayed within 7 days of pollination to avoid risk of bee repellency. This material is also highly toxic to mite predators and should be used carefully to prevent mite population buildup.

**60. Assail** (acetamiprid) belongs to a new class of insecticides called neonicotinoids (chloronicotinyl subclass). Assail is registered for use in apples and pears, targeting aphids, leafhoppers, leafminers, psylla and codling moth. This translaminar (locally systemic) material has long residual inside the foliage, and is particularly effective on piercing/sucking insect pests, as well as the sap-feeding stage of leafminers. Assail's WSP formulation is registered on grapes for leafhoppers and aphids.

**55. Avaunt** (indoxacarb) is a member of the new Oxadi-azine class of insecticides with a novel mode of action that acts by inhibiting sodium ion entry into nerve cells, resulting in paralysis and death of the pest species. The primary route of entry into the target pest is by ingestion, although the product is also absorbed through the insect cuticle. Because of this, thorough coverage of the crop is critical for good pest control. Avaunt is relatively short-lived in the environment, but has particularly good rain-fast characteristics. Avaunt is registered for use in apples and pears for control of oriental fruit moth, redbanded leafroller, plum curculio, tarnished plant bug, apple maggot and leafhoppers.

**20. Brigade** (bifenthrin) is a synthetic pyrethroid registered for use on strawberry for the control of many insect and mite pests, including strawberry sap beetle and spider mites. This product has a short period of activity after application and is disruptive to natural enemies. For sap beetles it should be applied as soon as beetles are detected, to target them before they enter the fruit.

**43. B.t.'s**, *Bacillus thuringiensis*, bioinsecticides like Dipel, Javelin, Agree, Biobit and Crymax control lepidopteran larvae but must be ingested by susceptible larvae to be effective. Time applications for early egg hatch, and two or three applications are generally required. Effectiveness varies depending on thoroughness of coverage, rate applied, weather conditions and plant vigor. B.t.'s can be used during bloom and do not impact most natural enemies. B.t.'s are most effective when applied during warm weather



conditions, when daily highs are in the 70's F. Dipel and Javelin are listed by the Organic Materials Review Institute (OMRI) for use in organic production.

**3. Carzol** (formetanate hydrochloride) is a non-phosphate miticide-insecticide registered for use on apples, pears and peaches to control European red or two-spotted spider mites, white apple leafhopper, tentiform leafminer, stink bugs and pear rust mite. It is most effective for controlling immature and adult forms of European red and two-spotted mites.

No more than 1.25 lbs/acre can be applied in any one crop season and cannot be applied after petal fall. Since this product is not stable in alkaline water, its spray mixture must be freshly prepared just before application. This material is moderately toxic to honeybees, highly toxic to mite predators and comparatively non-toxic to fish, birds, man and animals.

**49. Confirm** (tebufenozide) is an insect growth regulator insecticide registered for use on apples, pears, caneberries and blueberries for the control of lepidopterous insect pests such as the tufted apple budmoth, obliquebanded leafroller, redbanded leafroller, codling moth, and cranberry fruitworm. This compound works by mimicking the action of the natural insect hormone 20-hydroxyecdysone, the physiological inducer of the molting and metamorphosis process in insects. It must be ingested by the larvae, and may take several days to cause mortality. The addition of an agricultural adjuvant (such as Latron B-1956) to Confirm 2F is recommended to improve initial spray deposition.

**13. Cythion ULV** is a formulation of 95% technical material of malathion. Its only uses are for Ultra Low Volume applications by air to control cherry fruit fly and blueberry maggot.

**44. Danitol** (fenpropathrin) is a pyrethroid insecticide/miticide registered for use on apples, pears, strawberries and grapes with activity against a broad spectrum of insects as well as certain mites. To reduce the risk of resistance developing to this product and to conserve natural enemies, restrict post-bloom applications to a single spray. Successive sprays against the same pest should be alternated to a different insecticide class. Danitol is restricted to 2 2/3 pints per season (no more than two applications in strawberries). If Danitol is tank-mixed with Ziram, a suspension agent is required.

**5. Diazinon** is active against a variety of fruit pests, offering residual activity of 10 to 14 days and has clearance for use on apples, blueberries, pears, cherries, peaches, plums, prunes, strawberries, grapes and some brambles. It will not control organophosphate resistant strains of white apple leafhopper, spotted tentiform leafminer or obliquebanded leafroller, which are common in Michigan.

**6. Dimethoate** is marketed as *Cygon* and *De-Fend* for control of a wide range of insects on bearing apples and pears. Sold as a 2.67 lb/gal or 4 EC emulsifiable

concentrate or 25% wettable powder, its systemic properties have specific value in aphid control. When applied for aphids, it provides excellent control of tarnished plant bug. It also controls apple maggot. Compared to many insecticides, it is practically without compatibility problems. While toxic to bees, the product is one of the least poisonous of the organophosphates to humans and animals.

**52. Esteem** (pyriproxifen) is an Insect Growth Regulator (IGR) insecticide that acts by suppressing embryo-genesis within the insect egg and by inhibiting metamorphosis and adult emergence of target insects. Esteem has no activity on adult insects, but hatching of eggs laid by treated adults will be suppressed. Esteem is registered for use in apples and pears, for the control of codling moth, San Jose scale, spotted tentiform leafminer, rosy apple aphid, and pear psylla, and in peaches, plums, apricots and cherries for the control of scale insects and suppression of Oriental fruitmoth. Esteem is also registered in blueberries (bushberry crop group) for the control of fruitworms and lecanium scale. Since Esteem is an insect growth regulator, and activity depends on the insect's development, evidence of activity will be slower than with conventional contact insecticides. To optimize insecticide resistance management practices, use of Esteem is restricted to two applications per season. Esteem may be used in alternation with other IGR materials possessing dissimilar modes of action and/or other chemical classes of insecticides.

**8. Guthion** (azinphos-methyl) is an organophosphate (OP) insecticide registered for use in all fruit crops. It provides good broad-spectrum control of many primary fruit pests with a residual action of 10-14 days. It will not provide commercial control of insects that have attained resistance to OPs, like the white apple leafhopper, spotted tentiform leafminer, and obliquebanded leafroller. It is also known to be of general low toxicity to predacious mites, which are important as biological control agents for mite pests of fruit. The maximum yearly amount of Guthion 50 WP to be applied has been reduced to 9 lbs on apples and pears, and 6.75 lbs on peaches and nectarines. The Pre-Harvest Interval (PHI) for apple use has also been increased to 14 days, with a 21-day PHI if the last application is greater than 2 lbs of Guthion 50 WP per acre.

**9. Imidan** (phosmet) is a phosphate chemical with a low toxicity to mammals comparable to Sevin. It is formulated as a 70% wettable powder for pre-bloom and post-bloom applications on apples, pears, peaches, cherries, plums, prunes, blueberries, grapes and apricots. It is phytotoxic on sweet cherries. It provides good broad-spectrum control of many fruit pests in Michigan. It will not control organophosphate resistant strains of white apple leafhopper, spotted tentiform leafminer and obliquebanded leafroller, which are common in Michigan. To prevent premature product breakdown, spray-tank water may need to be buffered if pH is greater than 7.0.

**50. Intrepid** (methoxyfenozide) is an insect growth

regulator in the diacylhydrazine class of insecticides registered for use on apples and pears for the control of lepidopterous insect pests such as the obliquebanded leafroller, codling moth, oriental fruitworm, spotted tentiform leafminer and tufted apple budmoth. This compound works by mimicking the action of the natural insect hormone 20-hydroxyecdysone, the physiological inducer of the molting and metamorphosis process in insects. It must be ingested by the larvae, and may take several days to cause mortality. The addition of an agricultural adjuvant (such as Latron B-1956) to Intrepid 2F is recommended to improve initial spray deposition.

**10. Kelthane** (dicofol) is a miticide registered for use in apples, pears, grapes, and strawberries, and is available as a 50% wettable powder. It is a chlorinated hydrocarbon so it can be used in rotation with other miticides to prevent resistance buildup. Kelthane is a contact miticide that is primarily active against motile stages of European red mite and two spotted spider mite, but also nymphal stages that hatch after application. Kelthane is moderately toxic to mite predators, and temperature does not affect its activity against pest mites. To avoid the possibility of resistance, use only 1 to 2 times a season, and only once against the same generation of mites. Good spray coverage is necessary for good performance of Kelthane. Use of a spreader-sticker is advised.

**11. Lannate** (methomyl) is registered for use on apples, peaches, grapes, strawberries and blueberries and is primarily effective as a contact insecticide, though some systemic activity is also evident. Methomyl residues remain effective for about 3-7 days, so timing is important. Methomyl controls green fruitworm, certain leafroller and leafminer pests, which are difficult to control with other broad-spectrum compounds. It also controls indirect pests such as aphids. This material is highly toxic to mite predators and should be used carefully to prevent mite population buildup. Methomyl may be somewhat phytotoxic to early McIntosh, Wealthy, and Duchess cultivars. Toxicity of Methomyl, while less than parathion, still requires the safety precautions necessary for such highly toxic compounds. **Methomyl may not be used in U-Pick plantings.** Methomyl is extremely toxic to fish and bees, so avoid use when bees are active and keep out of any body of water. CAUTION: Outbreaks of woolly apple aphid may result from a season-long (multiple applications) of Methomyl.

**32. Lorsban** (chlorpyrifos) is an organophosphorous insecticide that has great affinity for organic matter such as bark or soil. It is registered for use as a trunk spray on apples and cherries (also peaches and nectarines for Lorsban 4E), and it effectively controls American plum borer, dogwood borer and peachtree borers. Foliar applications may be used pre-bloom for scale and rosy aphid control, either alone or in combination with oil. Lorsban is NO LONGER registered as a broad-spectrum pesticide for post-bloom foliar use on apples. Lorsban also has a special local needs 24(c) label in grapes for pre-bloom control

of climbing cutworms (effective till 2004), targeted at the trunks of the vines. Lorsban 4E is best timed at the start of bud feeding, and repeated 10-14 days later if cutworm feeding continues.

**13. Malathion** is a mild organophosphate insecticide that is registered for use in apples, pears, apricots, cherries, blueberries, grapes, peaches, caneberrries, strawberries, and nectarines, and controls an unusual variety of fruit insects and is especially useful against several species of aphids. However, its residual effectiveness seldom exceeds 2 to 4 days. Thus, it can often be employed to best advantage in late season sprays. Its use is particularly indicated where a high degree of safety to man and animals becomes desirable. It is generally compatible with every insecticide and fungicide in common usage.

**14. MPEDE** is an insecticidal fatty acid (soap) concentrate that controls soft bodied adult insects such as aphids, leafhoppers, and mite adults and eggs. Good coverage is necessary for effective control. Use rates are based on a volume to volume basis, and growers must be careful to use the correct concentration to prevent phytotoxicity. This insecticide penetrates the insect cuticle, and kills it by allowing body fluids to evaporate quickly. Once dried, the residual has no effect on insects or mites.

**54. NEEM-based** (azadirachtin) products are available for use on most all Michigan fruit crops for a wide range of pests, marketed as *Ecozin*, *AzaDirect* and *Neemix*. The active ingredient of NEEM was originally derived from extracts of the Neem tree, a native plant of India. This compound controls insects in the larval, pupal and nymphal stages by interfering with the metabolism of ecdysone, therefore preventing normal development. It also works as a repellent on the adult stage of many insect pests. Because of its short residual life, it may need to be re-applied every 5-10 days if pest populations persist. This pesticide is toxic to fish and aquatic invertebrates, and to bees exposed to direct treatment or residues on blooming crops or weeds. The recommended tank water PH range is between 5.5 and 6.5. *AzaDirect* and *Neemix* are listed by the Organic Materials Review Institute (OMRI) for use in organic production.

**34/35. Permethrin** (Ambush and Pounce) is a synthetic pyrethroid. These compounds exhibit low mammalian toxicity while having high insecticidal activity. They act as stomach and contact poisons. Permethrin is cleared for seasonal use on peaches and cherries, and may be used before petal fall on apples and pre-bloom on pears. This material is highly toxic to mite predators and should be used carefully to prevent mite population buildup.

**19. Provado** (imidacloprid) belongs to a new class of insecticides called neonicotinoids (chloronicotinyl subclass). Provado is registered on apples and pears as a 1.6 F and on grapes as a 75% WP in a SoluPak. This translaminar (locally systemic) material has long residual inside the foliage, and is effective on sucking

insect pests such as leafhoppers, psylla and aphids. It will also control organophosphate-resistant pests such as white apple leafhopper, and spotted tentiform leafminer, but must be applied at early petal fall for effective timing on the first generation STLM sap-feeding larvae. Because most of Provado's surface residue is quickly absorbed into the plant, negative impact on natural enemies is minimized.

**45. Pyramite** (pyridaben) is an insecticide/miticide registered for use in apples, pears, grapes, and stone fruits. Pyramite 60 WP works as a contact miticide/insecticide that provides good knockdown and residual control of mites, leafhoppers and psylla, and should be applied when pest populations are beginning to build and before they reach economic thresholds. It is effective on a broad spectrum of mite pests (European red mites, two spotted spider mites, pear rust mites, apple rust mites), but requires thorough coverage to ensure pests will contact the product. Pyramite is restricted to post-harvest use (300 day PHI) in apricots and cherries, whereas it has a lot of in-season flexibility for use in apples, pears, plums, prunes, peaches and grapes.

**57/58. Pyrethrum** (PyGanic and Evergreen) is a botanical insecticide produced primarily in the flowers of *Tanacetum cinerariaefolium*, a species of the chrysanthemum plant family. Pyrethrum is an ancient insecticide that is still used to control insects because of its benefits of being non-persistent, decomposing rapidly in the environment. Pyrethrum is low in acute toxicity to man and other vertebrate animals, is non-carcinogenic, causes no adverse reproductive effects and is non-mutagenic. PyGanic is listed by the Organic Materials Review Institute (OMRI) for use in organic production. Evergreen is another pyrethrum based compound, which includes piprinol butoxide (PBO) to enhance its insecticidal activity, but consequently results in exclusion from the OMRI listing. PyGanic and Evergreen insecticides have the typical pyrethrum-flush, rapid knockdown, and pest kill attributes that are characteristic of pyrethrin-based compounds. PyGanic and Evergreen are approved for use on most all fruit crops. Some of the pests controlled by PyGanic and Evergreen include; leafhoppers, stink bugs, aphids, thrips, Japanese beetle and loopers.

**42. Savey** (hexythiazox) is a miticide for control of European red mites and two-spotted spider mites on apples, cherries, peaches, plums and strawberries. It is an active mite ovicide and larvacide, providing control ranging from 10 weeks to full season depending on mite pressure, the extent of vegetative growth and predator mite populations. Control is achieved when eggs come into direct contact with the spray or contact with treated plant surfaces. On apples it can be used at the traditional pink stage or with the recent label amendment it can be applied later in the season up to a 28-day PHI. For stone fruits it can be used after bloom up to a 28-day PHI. In all cases, it may be applied ONLY once per year. It is not effective against rust mites and is not toxic to predator mites.

**23. Sevin** (carbaryl) is formulated as a 50 WP, 80 S and 4 lb/gal flowable (XLR Plus) and is labeled for use in nearly every fruit crop grown in Michigan. Its residual effectiveness varies from 5 to 14 days, depending on the target pest to control. The pre-harvest intervals for fruit crops range from 3 - 7 days, making it in many cases an effective tool for near-harvest pest control. Sevin may encourage aphid buildups and is toxic to bees. This material is highly toxic to mite predators and should be used carefully to prevent flaring mite populations. It is compatible with most pesticides and offers a high degree of safety to animals and plants. There is the added advantage of its low toxicity to man and fish, lessening the hazards from spray drift that are associated with many pesticide chemicals. Sevin is a fruit thinning agent if used in apples within 30 days after full bloom.

**46. SpinTor** (spinosad) is registered on apples, strawberries, blueberries and stone fruits for control of leafrollers, codling moth, oriental fruit moth, green fruit worm, spotted tentiform leafminer, and thrips. The active ingredient, spinosad, is a waste metabolite produced during the growth of a bacteria, therefore belongs to the Naturalyte class of insecticides. The primary route of entry into the target insects is through ingestion, although the product is also absorbed through the cuticle. SpinTor provides 7 - 14 days of residual control, depending on the target pest, but good coverage will increase consistency of crop protection. Spintor should be applied no more than four times per season. The use of a penetrating or silicone surfactant can enhance coverage and penetration of leaf surfaces. SpinTor applications should not be made with less than a 1 - 2 hour rain free period. SpinTor has shown good safety to many beneficials, but can be toxic to bees particularly if contacted before sprays are dried.

**24. Superior Oil** "Superior Oil" has been recommended as one of the preventive European red mite control programs in tree fruit. The 70-sec. oil provides better European red mite control than some of the lighter viscosity oils. The 70-sec. viscosity oil is not a dormant-type oil. It is lighter and more volatile than the original "superior oil" which was used as a dormant spray. The principal advantage of the lighter 70-sec. oil is the reduced possibility of plant injury. It is safer because it is more volatile, resulting in less persistence on the tree. It remains on the tree long enough to kill the mites but not so long as to interfere with vital plant processes or oil-incompatible pesticides which may be applied later. Because of this safety factor, the 70-sec. oil can be applied between Green-Tip and Pre-Pink stages of tree development. European red mite eggs are most susceptible to control by oil when they are about to hatch. Under Michigan conditions, the period of egg hatch starts about the Pre-Pink to Pink stage.

**53. SURROUND WP** (kaolin) is registered for use on apples, pears, blueberries and Wine grapes. The use of Kaolin for fruit insect pest management is based on a new concept called Particle Film Technology. Kaolin



is a common food additive already approved by the FDA as a generic filler and bulking agent. The objective of Particle Film Technology for insect pest management is to create a protective barrier between the plant and the pest that 1) reduces host recognition of the pest, and 2) prevents normal movement and damaging activity (i.e; egg laying, feeding, sheltering). In addition, if picked up onto body parts of the insect or mite, the abrasive nature of the material can cause significant irritation leading to repellency or even mortality of the pest. SURROUND WP can be applied to fruit crops through conventional orchard sprayer equipment. As a freshly applied spray it appears as a milky liquid, but with evaporation leaves a dry white film on the plant. Because it does not work like conventional contact poisons, complete coverage of the plant is critical. Adequate coverage is achieved primarily through use of proper rates of the product and sufficient gallons per acre of water carrier. Multiple applications are typically needed to attain initial coverage, as well as to compensate for actively growing plant tissue and to respond to wash-off from rain or excessive wind. Surround WP is listed by the Organic Materials Review Institute (OMRI) for use in organic production.

**26. Thiodan and Phaser** (endosulfan) are registered on most fruit crops for the control of aphids, plant bugs, tentiform leafminer adults, as well as greater and lesser peach tree borers. A 50% wettable powder and 3 lb/gal emulsifiable concentrate are available with no more than two applications after petal fall and during the fruiting season. Post-harvest sprays of endosulfan reduce late season infestations and there are no restrictions for post-harvest use of the product. Endosulfan may also be used as a pre-plant dip for nursery stock. Unlike Lorsban, endosulfan may be used for all stone fruits. Endosulfan is highly toxic and requires the same caution granted any chlorinated product similar to it.

**28. Vendex** is formulated as a 50 WP non-phosphate miticide with very good activity against a wide range of plant-feeding mites. Control is temperature dependent and is more effective in warm weather. It is registered for use on apples, pears, stone fruits, grapes and strawberries to control European red, two-spotted, and rust mites. This product mixes readily with water to form a suspension that can be applied with any conventional spray equipment. It is usable alone or in tank-mix combinations with those insecticides and fungicides generally employed in fruit crop sprays. No phytotoxicity or adverse effects on fruit finish have been reported. Apply when mites appear. It is of low toxicity to predaceous mites and can be utilized to adjust predator-prey ratios. It is toxic to fish and should be kept out of ponds and streams. It is non-toxic to honeybees and of low toxicity to humans.

**30. Vydate** is a systemic and contact carbamate insecticide-acaricide-nematicide. It is currently labeled as a nematicide and miticide on non-bearing fruit trees, and as an insecticide-miticide on bearing apples. It gives excellent control of aphids,

leafhoppers, mites and leafminer larvae; however, it is highly toxic to bees, insect and mite predators.

**WARNING:** Do not apply within 30 days after bloom at a rate greater than pt/100 gal or fruit thinning may occur. Outbreaks of wooly apple aphid may occur from a season-long program of Vydate.

**Warrior** (lambda cyhalothrin) is a synthetic pyrethroid insecticide that is expected to receive registration for the 2003 growing season on all pome and stone fruit crops. It will be labeled for control of a broad spectrum of sucking and chewing pests, including leafrollers, leafhoppers, plum curculio, and internal feeders like codling moth. Warrior has a unique microencapsulated formulation called "Zeon Technology", that protects the foliar residue from UV degradation so as to enhance the compound's residual activity. More specifics on Warrior rates and label recommendations will be available in the 2003 CAT Alerts as it becomes available.



# Monitoring Insects

Biological monitoring refers to checking a crop for the presence of pest species and following their development through time so that control decisions can be made.

Use biological monitoring to identify the pests present and design control programs specifically for them. By following the development of a pest through the season, the most vulnerable stage can be attacked very precisely. Biological monitoring of insects doesn't always mean reduced control costs, but this is certainly one of its goals. You may need as many, or more, sprays as in the past—but you spray only if the pest is present in numbers thought a threat to the crop.

All insects are "cold blooded" organisms and their seasonal development is tied primarily to the fluctuations of temperature. Temperature patterns vary from year-to-year, making it impossible to associate the presence of a pest with a particular date or even a stage in the development of the fruit tree. By following the development of a pest through the season, the vulnerable stage may be precisely determined and appropriate controls applied. This requires extra effort by the grower, scout, or professional fieldsperson. Following are the techniques and tools used for biological monitoring of tree fruit insect pests.

## Regular Inspections

Inspection of over wintering sites or sites where a pest is likely to be found during the growing season is perhaps an underrated monitoring method. This may require more effort and may not be as specialized or sensitive as other monitoring techniques, but is especially useful in detecting the presence of small, relatively immobile pests such as aphids, scales, mites, pear psylla nymphs, etc. Inspections are the only practical means of detecting the presence of some pests, such as climbing cutworms, before they cause damage. By simply marking sites where pests are located and returning at regular intervals, stage changes can be observed to aid in the timing of control applications.

## Traps

Different trapping techniques can be used to monitor the presence and seasonal activity of fruit insect pests. The bait trap is designed to monitor fruit flies, visual sticky traps can be used for leafhoppers and to monitor natural enemies, and pheromone traps are designed to attract moth species which are fruit pests.

**Visual trap** By using a color attractive to plant-feeding insects, scouts and growers can detect a pest early in its development, and monitor changes in its population. Most of these traps are yellow, though a white one may be used for tarnished plant bug. Traps are hung in the crop and checked weekly for insects trapped on its surface.

**Bait trap** The bait trap attracts adult fruit flies (cherry fruit flies, apple maggot, or blueberry maggot) through a combination of their attractive color and the odor given off by the bait (usually a mixture of protein hydrolysate and ammonium acetate). The flies are trapped in a sticky substance coating the trap. By inspecting them at regular intervals, their presence and relative activity, or abundance, can be judged. The attractive powers of these traps are not known, and if fly populations are low (as in most commercial fruit plantings) the ability of the trap to attract and therefore detect individuals, is questionable. However, traps placed in surrounding woods, abandoned fruit crops, or commercial sites with annual problems are useful for this purpose. Other designs of baited traps that attract Japanese beetles and rose chafers can be used to detect the start of their activity.

## Pheromone Trap

The other type of monitoring trap is the pheromone trap (sex-lure). Pheromones are synthetic, chemical substances, which imitate the natural hormones for sex attraction in the female of an insect species. Plastic wicks or capsules with minute quantities of these attractants lure the males of the insect involved. The interior of these specially-designed traps is pre-coated with adhesive. Since each insect species generally has its own sex hormone, only a pure culture of the specific insect monitored is collected. This feature makes insect detection and identification easier.

Pheromone traps offer new dimensions in insect detection, emergence timing and monitoring of red-banded leafroller, codling moth, fruit tree leafroller, tufted apple bud moth, and Oriental fruit moth. These traps may be used to determine insect presence or absence in a crop to assess insect populations, emergence trends, and economic damage thresholds. They eliminate much of the guesswork in spray timing for many of the more troublesome fruit insects. These traps are supplemental reinforcements and not replacements for other commonly used insect monitoring procedures.

**IPM Product Suppliers:** These two sources are distributors for Consep, Ecogen (formerly Scentry), Ladd, Phero-Tech, Trece, and other manufacturers.

Great Lakes IPM  
10220 Church Road  
Vestaburg, MI 48891  
(517) 268-5693 or 5911

Gempler's  
P.O. Box 270  
Mt. Horeb, WI 53572  
1(800) 272-7672

# Tree-Row Volume

J. W. Johnson

With the introduction of dwarf and semi-dwarf trees, it is no longer feasible to spray all trees at the same gallonage and dosage. The need is for a method of determining rates per acre for different sized trees. As early as 1972, researchers Lyons and Byers of the Winchester Fruit Research Laboratory recognized the necessity of determining rates per acre for different sized trees. An average sized mature tree was considered to be 19.5 feet tall, 23.5 feet across and spaced 35 X 35 feet.

Trees of this size were sprayed with 400 gpa. The amount of pesticide required to treat an acre of large trees is considerably greater than the amount required on an acre of trees planted at a higher density. Proper application required that adjustments be made to compensate for these differences. Concentrate spraying must be considered in terms of reducing the gallons of water per acre for the row-spacing and tree-size combination being sprayed.

As the gallonage of water is reduced errors become more critical. Sprays applied 3X or higher concentrate levels result in a 20 to 25% increase in deposit, thus allowing a similar reduction in rate of pesticide application without a reduction in pesticide deposit. From a practical viewpoint the acceptable concentrate level depends on several factors including the pest being controlled, density of foliage, weather conditions, and material being applied. Dilute sprays are preferred for applying growth regulators and control of pests such as scale and woody aphid. In most other cases concentrate sprays usually provide satisfactory results.

The key figure for Midwestern and Eastern orchards is to apply one gallon of spray solution per 1450 cubic feet of orchard foliage. Hence for each orchard we must know the number of cubic feet. Cubic feet in an orchard is obtained by multiplying the tree height X the tree width X lineal feet in an orchard.

**Example:** Rows are 35 ft apart, with a tree width of 23.3 and a tree height of 20. The lineal feet in this orchard is  $43,560 \div 35 = 1245$  lineal feet. The cubic feet =  $1245 \times 23.2 \times 20 = 580,180$ .  $580,180 \div 400 = 1450$  cubic feet. As stated previously, it takes 1 gallon of spray material for every 1450 cubic feet. To simplify tree-row-volume, a graph is presented on page 25 in which all factors in the formula are included. To use the graph, begin by drawing a line from 0 to the number on the chart that corresponds to the specific row width in the orchard. This gives the base line for all orchards of that row spacing. Once this is done, the height and width of the

trees for each planting are multiplied together to obtain a number for use on the vertical axis of the graph. Follow this line horizontally across the graph from the calculated height X width figure to the intersection with the row spacing base line. Directly below this point on the horizontal axis is the required gallons per acre figure for dilute spraying. Two examples are shown on the graph. Example 1 illustrates 25 foot row spacing with trees that are 16 feet high and 16 feet wide. Draw a base line from 0 to 25, multiply  $16 \times 16$  to get 256. Follow a horizontal line from 256 to the base line. Vertically below this is a base gallonage of 313 gpa dilute. Example 2 shows a need of 220 gpa dilute for 20 foot rows and trees that are 12 feet high and 12 feet wide.

Most growers are not using dilute sprays. Therefore, the lower row of numbers on the horizontal axis has been added to allow those using concentrate sprayers to compute the needed rate per acre. The base figure to use in this case is the rate of material per concentrate given on a product label. As with dilute spraying, the basis is that smaller, easier to spray trees need less material per acre than standard sized trees. This second row of numbers is used to compute the percentage of the full rate per acre needed. Example 1 in this case becomes 78% and Example 2, 55%. A product calling for 1 lb/acre would need 0.78 lb/acre in Example 1 and 0.55 lb/ acre in Example 2.

As with any other production procedure, grower judgment must be used with this method. Where tree size is quite variable, calibration should be done for the average of the largest trees. Since two-thirds of the spray is directed to the top of the trees, excess material should be blown over to the smaller trees. A well-pruned orchard may require only 85% of the base rate early in the season while a full foliated processing orchard would need the full rate. There can be no substitute for grower experience and judgment in making additional adjustments related to leaf density, pest pressure, or desired results from thinners and growth regulators.

Failure to apply the proper rates per acre can lead to disastrous results when dealing with thinners, growth regulators and other rate sensitive materials. At the very least, overestimating causes excess materials to be applied and underestimating could lead to lack of control.

It is also important to note that tree-row-volume or any other concept for determining rate per acre will not make up for poor application techniques or improper timing. This method should allow growers to more precisely calibrate their equipment for the various blocks they must spray and thereby reduce problems that arise from too

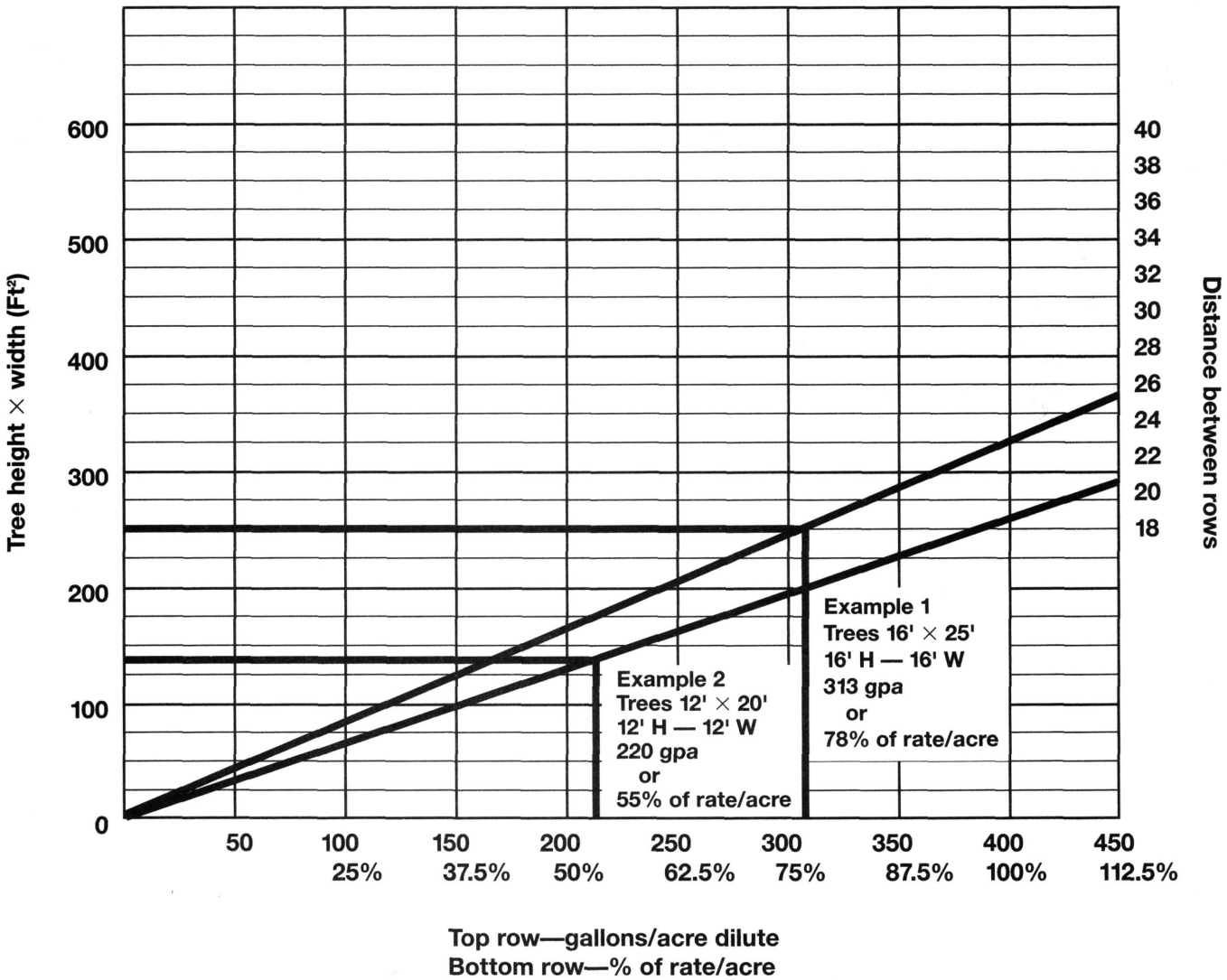
little or too much material per acre. But it will only be effective if the necessary adjustments of equipment are made before spraying blocks of different sized trees.

Until a grower gains experience with this method, it is suggested that a grower experiment with one or two blocks before committing the entire orchard to tree row

volume. A tree-row volume spraying rate calculator has been developed for apples. This slide rule calculator is available at Virginia Tech University, until a grower gains experience with this method, 595 Laurel Grove Rd., Winchester, VA 22602. The cost is \$3.00 each.

## Tree-Row Volume Graph

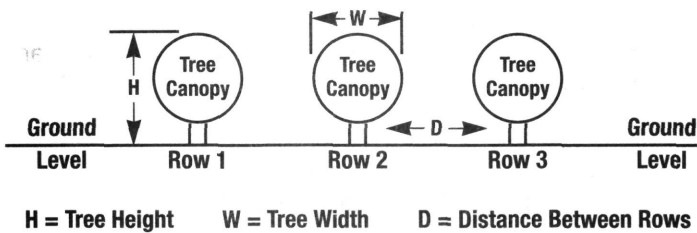
Courtesy of Lyons and Byers (V.P.I.)



# Percent of Standard Chart

(Standard is 400 gal/A)

## Calculating Percent of Standard



To determine your blocks PERCENT OF STANDARD, take the width and height line on the left and read across until you come to the correct width between rows. Example: Tree Height = 12 feet, Tree Width = 12 feet, Width Between Rows = 20 feet, then the Percent of Standard = 54%.

Height & Width	Square Feet	Distance Between Rows													
		14	16	18	20	22	24	26	28	30	32	34	36	38	40
6 8	48	26	23	20	18	16	15	.	.	.	.	.	.	.	.
6 10	60	32	28	25	23	20	19	.	.	.	.	.	.	.	.
6 12	72	39	34	30	27	25	23	.	.	.	.	.	.	.	.
6 14	84	45	39	35	32	29	26	.	.	.	.	.	.	.	.
8 10	80	43	38	33	30	27	25	23	.	.	.	.	.	.	.
8 12	96	51	45	40	36	33	30	28	.	.	.	.	.	.	.
8 14	112	60	53	47	42	38	35	32	.	.	.	.	.	.	.
8 16	128	69	60	53	48	44	40	37	.	.	.	.	.	.	.
10 12	120	64	56	50	45	41	38	35	32	.	.	.	.	.	.
10 14	140	75	66	58	53	48	44	40	38	.	.	.	.	.	.
10 16	160	86	75	67	60	55	50	46	43	.	.	.	.	.	.
10 18	180	97	84	75	68	61	56	52	48	.	.	.	.	.	.
12 12	144		68	60	54	49	45	42	39	36	.	.	.	.	.
12 14	168		79	70	63	57	53	49	45	42	.	.	.	.	.
12 16	192		90	80	72	66	60	55	51	48	.	.	.	.	.
12 18	216		101	90	81	74	68	62	58	54	.	.	.	.	.
14 14	196			82	74	67	61	57	53	49	46	.	.	.	.
14 16	224			93	84	76	70	65	60	56	53	.	.	.	.
14 18	252			105	95	86	79	73	68	63	59	.	.	.	.
14 20	280			117	105	96	88	81	75	70	66	.	.	.	.
16 16	256				96	87	80	74	69	64	60	57	.	.	.
16 18	288				108	98	90	83	77	72	68	64	.	.	.
16 20	320				120	109	100	92	86	80	75	71	.	.	.
16 22	352				132	120	110	102	94	88	83	78	.	.	.
18 18	324					111	101	94	87	81	76	72	68	.	.
18 20	360					123	113	104	97	90	84	79	75	.	.
18 22	396					135	124	114	106	99	93	87	83	.	.
18 24	432					147	135	125	116	108	101	95	90	.	.
20 20	400						125	116	107	100	94	88	83	79	.
20 22	440						138	127	118	110	103	97	92	87	.
20 24	480						150	139	129	120	113	106	100	95	.
20 26	520						163	150	139	130	122	115	108	103	.
22 22	484							140	130	121	114	107	101	96	91
22 24	528							152	142	132	124	117	110	104	99
22 26	572							165	153	143	134	126	119	113	107
22 28	616							178	165	154	145	136	128	122	116
24 24	576								154	144	135	127	120	114	108
24 26	624								167	156	146	138	130	123	117
24 28	672								180	168	158	148	140	133	126
24 30	720								193	180	169	159	150	142	135

# Tree-Row Volume Insecticide Chart

This table provides the DILUTE spray rate that you should use on apple trees after you calculate the Percent of Standard from the previous page. A dilute rate is that amount of spray it takes to treat a tree to runoff, and would normally be applied with a handgun sprayer or airblast sprayer set to apply a large amount of water. The DILUTE rate for a "standard tree" is 400 gal/acre, but no one applies this much spray to an acre of apples in full leaf. If you have large standard trees that are not well pruned, you will need more water than this to get adequate coverage. The spray is usually concentrated by reducing the amount of water used as a carrier, resulting in a much lower spray volume.

Concentrate sprays are designated by 1 x (dilute), 2X (1/2 water), 3x (1/3 water), etc. In a concentrate spray,

the amount of pesticide per acre does not change, just the water.

**Example:** To spray an orchard that is 60% of standard with Ambush 2 EC:

Dilute Spray:

Use 7.7 ounces of Ambush  
2 EC per acre in 240 gallons of water.

Concentrate Spray:

To spray a 2x concentrate spray, use 7.7 ounces of Ambush 2 EC in 120 gallons of water per acre;

To spray a 3x concentrate spray, use 7.7 ounces of Ambush 2 EC in 80 gallons of water per acre.

Percent of Standard Gallons of Water/Acre (Dilute)	Material	Formulation	20	30	40	50	60	70	80	90	100	110	
			80	120	160	200	240	280	320	360	400	440	
	Ambush	2 EC	2.6	3.8	5.1	6.4	7.7	9.0	10.2	11.5	12.8	14.1	ounce
		25 WP	2.4	3.6	4.8	6.0	7.2	8.4	9.6	10.8	12.0	13.2	ounce
	Apollo	SC	1.6	2.4	3.2	4.0	4.8	5.6	6.4	7.2	8.0	8.8	ounce
	Asana XL	0.66 EC	2.3	3.5	4.6	5.9	6.7	8.1	9.3	10.4	11.6	12.7	ounce
	Carzol	92 SP	0.3	0.4	0.5	0.6	0.8	0.9	1.0	1.1	1.3	1.4	pound
	Cygon, Defend	25 WP	1.6	2.4	3.2	4.0	4.8	5.6	6.4	7.2	8.0	8.8	pound
		2.67 EC	1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4	6.0	6.6	pint
	Diazinon	50 WP	0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0	4.4	pound
	Dimethoate	See Cygon and Defend											
	Guthion,												
	Azinphos-Methyl	50 WP	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	pound
	Imidan	70 WP	0.6	1.0	1.2	1.5	1.8	2.1	2.4	2.7	3.0		pound
	Lannate	90 SP	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	pound
	Lorsban	50 WP	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.3	pound
		4 EC	0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0	4.4	pint
	Methomyl	See Lannate											
	Superior Oil		1.6	2.4	3.2	4.0	4.8	5.6	6.4	7.2	8.0	8.8	gallon
	Pounce	3.2 EC	1.6	2.4	3.2	4.0	4.8	5.6	6.4	7.2	8.0	8.8	ounce
	Provado	1.6 F	1.6	2.4	3.2	4.0	4.8	5.6	6.4	7.2	8.0	8.8	ounce
	Sevin	50 WP	1.6	2.4	3.2	4.0	4.8	5.6	6.4	7.2	8.0	8.8	pound
		80 S	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	pound
	Thiodan	50 WP	0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0	4.4	pound
		3 EC	0.5	0.8	1.1	1.3	1.6	1.9	2.1	2.4	2.7	2.9	quart
	Vydate	2 L	0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0	4.4	pint

Equivalents 16 fluid oz = 1 pt, 4 oz = 0.25 lb, 2 pt = 1 qt, 8 oz = 0.5 lb, 4 qt = 1 gal, 16 oz = 1 lb

# **Apple Pest Guide**

## **Average Degree Days and Calendar Dates for Tree Growth Stages and Insect Development**

The Apple Pest Guide (on the following page) was developed by Phil Schwallier, MSU Extension, and Gil DeBruin, Reister's Grower Services and reviewed by James Johnson, former MSU fruit entomologist. This guide provides apple tree and apple insect growth stages, based on over 30 years of information compiled by the authors for the Peach Ridge area of Michigan. The growth stages are based on McIntosh apple, and degree days are based on starting accumulation on March 1st of each year using a Baskerville-Emin

calculation method. If you use this chart for areas other than the Grand Rapids, MI area, or for other varieties of apples, you need to adjust values for your orchard.

The degree day and average calendar data are included in the apple section of the Fruit Management Guide. Look for the information in the dark bar with the name of the growth stage. This information should help you better understand growth conditions in your orchard for better insect management decision-making.



# APPLE PEST GUIDE

## for the Peach Ridge Weather Station

APPROXIMATE DATE	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER																		
	7	14	21	27	1	8	10	12	18	24	31	7	14	21	28	4	11	18	25	1	8	15	22	29	5	12	19	26	
Overw. Stage	90	127	189	205	242	284	367	395	422	511	616	749	899	1061	1226	1405	1564	1759	1960	2167	2359	2552	2735	2916	3091	3261	3417	3545	3656
DD BASE 42° F	26	51	82	90	109	129	174	190	205	254	318	401	498	607	719	842	954	1094	1239	1390	1526	1663	1791	1917	2037	2153	2256	2345	2396
DD BASE 50° F																													
Growth Stage (McIntosh)	1st Green	1/4" Green	1/2" Green	Tight Green Cluster	Open Cluster	King Bloom	Pink Bloom	Full Bloom	Petal Fall	1st Fall	Peak	1st Cover	End	2nd Cover	3rd Cover	4th Cover	5th Cover	6th Cover	7th Cover	8th Cover	9th Cover	1st	Peak	1st	Peak	1st	Peak	1st	Peak
Scale	Apply Oil to control scales.																												
SAN JOSE SCALE	Adult																												
Hatch																													
EUROPEAN RED MITE	Adult																												
Hatch																													
OBLIQUE BANDED LEAFROLLER	Adult																												
Hatch																													
Larvae																													
Egg																													
APHIDS	Aphid																												
GREEN FRUITWORM	Adult																												
Egg & Pupae																													
Hatch																													
SPOTTED TENTIFORM LEAFMINER	Adult																												
Hatch																													
Pupae																													
Tissue																													
TARN PLANTBUG	Adult																												
Adult																													
RED BANDED LEAFROLLER	Adult																												
Adult																													
Pupae																													
PLUM CURCULIO	Adult																												
Adult																													
WHITE APPLE LEAFHOPPER	Adult																												
Adult																													
Egg																													
CODLING MOTH	Adult																												
Adult																													
Larvae																													
Pupae																													
APPLE MAGGOT	Adult																												
Adult																													
ORIENTAL FRUITMOTH	Adult																												
Adult																													
Larvae																													
DOGWOOD BORER	Adult																												
Adult																													
EUROPEAN CORN BORER	Adult																												
Adult																													
Hatch																													

This information was developed by Philip Schwallier, District Horticulture Agent, MSU Extension, and Gilbert DeBruine, Orchard Consultant, Reister's Grower Services Inc. Our thanks to Dr. James Johnson, Tree Fruit Entomologist, MSU, for reviewing this publication. It is a guide of "NORMAL" pest development in a typical year. Your actual situation during any year may be different. The dark shaded areas indicate critical control periods if the pest is present and the light shaded areas indicate possible control periods. The dates, growth stages and pest development were all correlated with the Peach Ridge Weather Station. The degree days were determined using the Baskerville-Emin method since March 1st, and are averages for a 28 year recording period.

Information provided by Kent County Extension, 836 Fuller NE, Grand Rapids, Michigan, Phone: 616-774-3265, Fax: 616-774-3836.

Critical control period  
 Possible control period

# APPLES

The rate of material is based on a standard dilute spray of 400 gallons per acre. If fewer gallons are used, refer to the rate-per-acre figure to insure the proper amount of pesticide is applied.

After each pest name appears a series of numbers and letters. These are provided to assist growers in choosing materials to use to control specific pests. The number

corresponds to the number of the pesticide in the column headed "Suggested Chemicals". The letters stand for effectiveness of control against specific pests: e = excellent, g = good, f = fair, and p = poor.

Products listed by the Organic Materials Review Institute (OMRI) for use in organic production will be marked with the following designation: ▲

## DORMANT

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASE</b>		<b>BACTERICIDES</b>
Phytophthora Collar Rot	See "Tree Fruit Fungicides," pages 32-36	Copper hydroxide (Champ, Champion, Kocide, many others) – see label.
Fire Blight	See "Tree Fruit Fungicides," pages 32-36	Copper oxychloride (COCS, others) – see label.
Copper Silvertip—¼" green tip.		Basic copper sulfate (Basicop, Blue Shield, many others) – see label.
		<b>Comments:</b> Use of copper at this stage does not eliminate the need for streptomycin during bloom. Adding spray oil at 1 qt/100 gal of spray solution (do not concentrate the oil) improves efficacy, but also increases the chance of phytotoxicity.

## Apple Scab Control

### SILVER TIP

Select scab fungicides from the following table. No single fungicide or class of fungicides can be used exclusively due to registration restrictions, differences in efficiency and control spectrum, anti-resistance strategies, and compatibility restrictions. Integrate at least two or three classes of fungicides into the scab control program each season. Individual applications may consist of a single product or a mixture, applied in no more than 2 or 3 consecutive applications. See page 24 for a possible use strategy.

Fungicide	Rate/acre	Timing and Comments	Restrictions*	
			PHI (days)	Maximum/acre/season
Captan 50% WP (other formulations such as Captan 80% W, Captec, etc. should be used at equivalent label rates)	6 - 8 lb	<i>Primary scab:</i> Begin applications at green tip and continue on a 5 to 7 day schedule through first cover.	14 days	64 lb
	4 - 8 lb	<i>Secondary scab:</i> Apply at 10 to 14 day intervals in second and later cover sprays.		
	3 - 4 lb	<i>Tank Mixtures:</i> Mix with Nova, Procure, Rubigan, Vanguard, etc. when needed for scab control. Begin applications at green tip and continue on a 7 to 10 day schedule depending on mixing partner.		

(Continued on next page)



# APPLES

## SILVER TIP (CONTINUED)

Fungicide	Rate/acre	Timing and Comments	Restrictions*	
			PHI (days)	Maximum/acre/season
EBDC Fungicides (other formulations may also be available)	6 lb	Use either the "Pre-Bloom" or "Extended Application" schedule. Do not combine or integrate the two treatment schedules.		
<i>Pre-Bloom schedule</i> Dithane 75 DF OR Manzate 200 DF OR Penncozeb 75 DF OR Polyram 80 WP	6 lb 6 lb 6 lb 6 lb 6 lb	<i>Pre-Bloom schedule:</i> Begin applications at green tip and continue on a 5 to 7 day schedule through bloom.	<i>Pre-Bloom schedule</i> Do not apply after bloom.	24 lb
Dithane 75% DF OR Manzate 200 DF OR Penncozeb 75 DF OR Polyram 80 WP	3 lb 3 lb 3 lb 3 lb	<i>Extended Application schedule:</i> Tank mix with a fungicide from a different chemical group. Begin applications at green tip and continue on a 7 to 10 day schedule through second cover.	<i>Extended Application schedule</i> 77 days or through second cover.	21 lb
Nova 40 W Tank mix with a protectant fungicide (Captan or EBDC fungicide).	5 - 8 oz	<i>Pre-Bloom, Bloom, Postbloom:</i> Begin applications at green tip or when conditions become favorable for primary scab development and continue on a 7 to 10 day schedule.	14 days	5 lb
Procur 50 WS Tank mix with a protectant fungicide (Captan or EBDC fungicide).	8 - 16 oz	<i>Pre-Bloom, Bloom, Postbloom:</i> Begin applications at green tip and continue on a 7 to 10 day interval through second cover.	14 days	4 lb
Rubigan 1 EC Tank mix with a protectant fungicide (Captan or EBDC fungicide).	8 - 12 oz	<i>Pre-Bloom, Bloom, Postbloom:</i> Begin applications at green tip or when conditions become favorable for primary scab and continue on a 7 to 10 day spray interval.	30 days	84 fl oz
Flint 50% W (trifloxystrobin)	2.0 - 2.5 oz	Begin at green tip and continue as needed on a 7 to 10 day schedule  <b>Maximum of 4 total applications of Flint or other strobilurin fungicide per acre per season and no more than 2-3 sequential applications of Flint or other strobilurin fungicide.</b>	14 days	11 oz
Sovran 50% W (kresoxim-methyl)	4.0 - 6.4 oz	Begin at green tip and repeat on a 10 day schedule.  <b>Maximum of 4 total applications of Sovran or other strobilurin fungicide per acre per season and no more than 2-3 sequential applications of Sovran or other strobilurin fungicide.</b>	30 days	25.6 oz
Syllit 65% W (dodine)		Not recommended in Michigan because of resistant apple scab.	7 days	
Vangard 75 WG (cyprodinil)	5 oz	<i>Pre-Bloom only.</i> Begin applications at green tip and continue on a 7-day interval. Use tank mix beginning at pink.	72 days	22 oz
Vanguard 75 WG Tank mix with a protectant fungicide (Captan or EBDC fungicide).	3 oz	<i>Pre-Bloom, Pink, Bloom.</i> Apply tank mixture on 7- to 10-day interval. A shorter interval is preferred during periods of wet weather.		
Topsin M 70 WSB (thiophanate-methyl)		Not recommended in Michigan because of resistant apple scab.	0 days	

\*Restricted Entry Intervals (REI) are listed on page 149 with all other fungicides. When using combinations base reentry on the fungicide with the longest interval.

# APPLES

## Approaches to scab control

Protective sprays are the best way to control apple scab. After-infection sprays can be used in an emergency, after unprotected infected periods. Post-symptom (eradication) approaches should be avoided; they are expensive, only moderately effective, may increase problems with fungicide resistance, and visible scab lesions will remain.

**Protectant spray program**—Protectant sprays are applied before infection occurs. They set up a chemical barrier between the susceptible plant tissue and the germinating spore. The apple fungicides listed below may be used as protectants, although some act in other ways as well.

### Efficiency and Control Spectrum Ratings for Apple Fungicides.

Class of fungicide/ Fungicide and rate per acre	Scab	Powdery mildew	Sooty blotch & flyspeck
<b>Classic Protectants</b>			
Captan 50 W 6-8 lb	5	1	4
EBDC 6 lb (full rate)	5	1	*
EBDC 3 lb (half rate)	3	1	2**
Carbamate 76 W 6 lb	4	1	4
Thiram 65 W 6 lb	4	1	4
Ziram 76 DF 6-8 lb	4	1	3
Sulfur 95 W 9 lb	1	3-4	1
<b>Sterol inhibitors/demethylation inhibitors plus protectant</b>			
Procure 50 WS (8-16 oz) plus Captan 50% W (3-4 lb) or EBDC (3 lb)	4-5	4	3***
Nova 40 W (5-8 oz) plus Captan 50% W (3-4 lb) or EBDC (3 lb)	5	5	3***
Rubigan 1 EC (9-12 oz) plus Captan 50% W (3-4 lb) or EBDC (3 lb)	5	5	3***
<b>Strobilurins</b>			
Flint 50% 2-2.5 oz	6	4	4-5
Sovran 50% 4-6.4 oz	6	4	4-5
<b>Anilinopyrimidines</b>			
Vanguard 75 WG 5 oz	4	1	*
Vanguard 75 WG 3 oz plus a protectant 3-4 lb	4-5	1	*
<b>Benzimidazoles</b>			
Topsin M 70% WSB 8 oz plus Captan 50% WP 6 lb OR Ziram 76 DF 6 lb	R	5	5

6 = excellent, 5 = very good, 4 = good, 3 = fair, 2 = poor, 1 = none

R = significant resistance problems

\* = not rated because of long interval between last application and harvest

\*\* = overall effectiveness reduced because of 77 day PHI

\*\*\* = assumes Captan as mixing partner because of the long PHI for EBDC fungicides

**After-infection spray program**—After-infection fungicides are effective for a few days after the beginning of an infection period. They are used against unprotected infection periods and in schedules with standard protectants. Accurate scab warning systems need to be available for identifying infection periods. Fungicides with after-infection activity should be used at their full recommended rate; at lower rates their ability to stop infection is reduced or lost.

Greenhouse studies indicate that in orchards with high populations of SI-resistant apple scab strains, Nova, Procure, and Rubigan will likely exhibit poor after-infection control activity. The timing of programs that exploit the after-infection, curative properties of SI fungicides, such as schedules involving 10- to 14-day intervals and the Integrated Reduced-Spray (IRS) Program, will need to be adjusted to favor protective control.

### After-infection or kick-back action of apple fungicides.

Class of fungicide/ Product Name	Rate/ acre	After infection activity (hr)	Comments
<b>Classic protectants</b>			
Captan, EBDC's	full rates	18-24	No after-infection activity when used at half-rate.
<b>Sterol inhibitors</b>			
Nova 40W	8 oz	96	Less after-infection activity at reduced rates. After-infection control will be more difficult in orchards with SI-resistant strains.
Procure 50 WS	12-16 oz	48-72	
Rubigan 1EC 1st spray 2nd spray	12 oz 8-12 oz	96	
<b>Strobilurins</b>			
Flint 50 W	2-2.5	48?	Neither fungicide has provided adequate scab control when applied a few hours before the 96 - 100 hr after-infection times listed on labels. Assume about 48 hr of after-infection control until data are available.
Sovran 50 W	6.4 oz	48?	
<b>Anilinopyrimidine</b>			
Vanguard 75 WG	5 oz	48	Repeat applications 7 days apart have not improved after-infection control.

# APPLES

Apple scab infections occur during wetting periods when moisture stimulates the pathogen spores to germinate and penetrate plant tissue. The scab prediction table given here can be used to determine whether or not conditions have been sufficient for infection so that appropriate spray decisions can be made. Listed are the Mills table as revised by Alan Jones, used by Michigan growers for many years, and a more recent revision of the table by MacHardy, Gadoury, and Stenvand.

Work by Jones and others have shown that, although the majority of primary scab spores (ascospores) are released during daylight hours, nighttime release can occur as well. Secondary spores (conidia) are available for infection during wetting periods anytime, once the pathogen has become established on foliage or fruit. The same table can be used for primary (ascospore) or secondary (conidia) infection.

**Table 1.** Approximate number of hours of wetting for primary apple scab infection at different air temperatures

Temperature Average (°F)	Mills revised by Jones	MacHardy & Gadoury (1989), as amended by Stenvand et al. (1997)
34	48	41
36	48	35
37	41	30
39	33	28
41	26	21
43	21	18
45	17	15
46	16	13
48	15	12
50	14	11
52	12	9
54	11.5	8
55	11	8
57	10	7
59	10	7
61-75	9	6
77	11	8

**Notes:** The infection period is considered to start at the beginning of the rain. Symptoms, if the infection is successful, will generally appear after 9 days incubation with average daily temperatures at 60° F and after 16 days or more with average daily temperatures below 50° F.

# APPLES

**Postsymptom control**—Postsymptom control is the ability of a fungicide, when applied to sporulating scab lesions, to suppress lesion development and sporulation. To inactivate sporulating scab lesions, use Syllit (dodine) 65% WP at 3 lb/acre and apply 2 applications one week apart. The first application should be made as soon as possible after infection occurs or, if necessary, as soon as possible after lesions appear. In orchards where dodine resistance is suspect, use Captan 50% WP at 6 lb/acre on a protectant program. The use of strobilurins for postsymptom control is not recommended to delay development of resistance.

**Resistance management**—The recent introduction of two new classes of fungicides, the anilinopyrimidines and strobilurins, offers new opportunities for more effective anti-resistance management strategies. The use of anti-resistance strategies will help to prolong the life of old classes of fungicides as well as the life of new fungicides. Resistance can be managed by reducing the total number of applications per season for each class of fungicides, alternating different classes of fungicide in blocks of 2 to 3 successive applications, and using unrelated fungicides in mixtures. An example of a resistance management program for apple scab is outlined below. Other scenarios are also possible.

## Anti-resistant scab management based on rotating different classes of fungicides.

### Approximate timing of protective scab sprays

Green tip	Pre-bloom	Pink and bloom	Petal fall, 1st cover	Summer
1 to 2 applications: EBDC or Captan (full rate) OR Vanguard	2 applications: Strobilurin (Flint or Sovran) OR EBDC or Captan (full rate) OR Vanguard + EBDC or Captan	2 applications: Sterol inhibitor mixed with EBDC or Captan (half rate) OR EBDC or Captan (full rate)	2 applications: Strobilurin (Flint or Sovran) OR Classic protectant except EBDC at full rate	Classic protectant except EBDC OR a benzimidazole mixed with Captan or Ziram

## TIGHT CLUSTER—PRE-PINK DD BASE 50 = 104 AVG CAL. DATE = APRIL 23

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		Sterol inhibitors and strobilurins control scab and powdery mildew. Captan, Vanguard, and EBDC fungicides do not control powdery mildew.
Apple Scab (Primary)	See Silver Tip and pages 30-31	
Powdery Mildew	See "Tree Fruit Fungicides" pages 41-45	<b>INSECTICIDES</b> 3. Carzol 92 SP (1 lb) 5. Diazinon 50 W (4 lb) 14. MPEDE (1% - 2% v/v)** 17. Apollo SC (4 - 8 fl oz) 24. Superior Oil (Biocover; Sunspray6F)(1% - 2% v/v) 26. Thiodan 50 WP (4 lb) 26. Thiodan 3 EC (2 2/3 qt) 32. Lorsban 4 EC (2 - 4 pt) 34. Ambush 2 EC (12.8 fl oz)* 34. Ambush 25 WP (12.8 oz)* 35. Pounce 3.2 EC (8 fl oz)* 35. Pounce 25 WP (12.8 oz*) 40. Asana XL 0.66 EC (4.8 - 14.5 fl oz)* 42. Savey 50 WP (3 - 6 oz) 42. Savey 50 DF (3 - 6 oz) 52. Esteem 35WP (5 oz) 59. Actara 25WG (4.5 oz) 56. Supracide 2E (3 - 12 pts) 60. Assail 70WP (1.1 oz)
<b>INSECTS/MITES</b>		
European Red Mite	17e, 24e, 42e	
San Jose Scale	5g, 24e, 32e, 52e	
Spotted Tentiform Leafminer (adult and eggs)	3g, 26f, 34e*, 35e*, 40e*, 52g, 59e, 60e	
Rosy Apple Aphid	5e, 14+24e**, 24e, 32e, 52g, 59e, 56, 60e	
<b>Comments:</b> *--Asana, Pounce, and Ambush are adulticides and ovicides and should be applied before the eggs hatch. **--MPEDE should be used at 1% - 2% v/v plus Superior Oil at 2% v/v		



# APPLES

## PINK DD BASE 50 = 174 AVG. CALENDAR DATE = MAY 8

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<i>Mildew control is critical at this time.</i>
Apple Scab (Primary)	See Silver Tip and pages 30-31	Sterol inhibitors and strobilurins control scab and powdery mildew.
Powdery Mildew	See "Tree Fruit Fungicides," pages 41-45	
<b>INSECTS/MITES</b>		<b>INSECTICIDES</b>
European Red Mite	3g, 30f, 42e, 44g	3. Carzol 92 SP (1 lb)
Aphids	6e, 11g, 26e, 30g, 32g	6. Dimethoate 2.67 EC (6 pt)
Tarnished Plantbug	3g, 6e, 11g, 26f, 34e, 35e, 40e, 44g	6. Dimethoate 25 WP (8 lb)
Green Fruitworm	11g, 26f, 32e, 34e, 35e, 40e, 44e	6. Dimethoate 400 (4 pt)
Obliquebanded Leafroller	8p/f, 9p/f, 11f/g, 32f/g, 34g, 35g, 40g, 44g	8. Guthion 50 WP (2 lb)*
<b>Comments:</b> The effectiveness of materials for control of OBLR varies depending upon levels of resistance that have developed in your growing area.		9. Imidan 70 WP (3 lb)*
		11. Lannate 90 SP (1 lb)
		26. Thiodan 50 WP (4 lb)
		26. Thiodan 3 EC (2 2/3 qt)
		30. Vydate 2 L (4 - 8 pt)
		32. Lorsban 50 WP (2 - 3 lb)
		34. Ambush 2 EC (12.8 fl oz)
		34. Ambush 25 WP (12.8 oz)
		35. Pounce 3.2 EC (8 fl oz)
		35. Pounce 25 WP (12.8 oz)
		40. Asana XL 0.66 EC (4.8 - 14.5 fl oz)
		42. Savey 50 WP (3 - 6 oz)
		42. Savey 50 DF (3 - 6 oz)
		44. Danitol 2.4 EC (10.6 - 21.3 oz)
		<b>Comments:</b> *-- Water soluble pouch formulations will not dissolve well if the spray water contains boron. It is recommended that the pouches be added, and fully dissolved, before the boron is added.

## BLOOM DD BASE 50=205 AVG. CALENDAR DATE = MAY 12

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Apple Scab (Primary)	See Silver Tip and pages 30-31	1. Agrimycin 17 WP (1.5 lb)*
Powdery Mildew	See "Tree Fruit Fungicides," pages 41-45	2. Mycoshield 17 WP (1.5 lb)*
Fire Blight	1e, see Fire Blight, page 43-45 2, see Fire Blight, page 43-45	<b>GROWTH REGULATOR</b>
		3. Apogee 27.5% (36 - 48 oz)** + Regulaid (see label)
<b>Comments:</b> Apply at full bloom to first petal fall on king blooms. Apogee should not be substituted for streptomycin (Agrimycin, etc.) for blossom blight control. If needed, streptomycin can be combined with Apogee. See Fire Blight, page 43-45.		<b>Comments:</b> *--Use Mycoshield (17% oxytetracycline) at 1.5 lb/150 gallons of water per acre (200 ppm solution) as part of an anti-resistance strategy for streptomycin. It can be combined with streptomycin for improved fire blight control and resistance management. Mycoshield can only be used on apples in 2002 if EPA grants a special Section 18 emergency registration. **Based on 300-400 gallons of dilute spray per acre, respectively.
<b>INSECTS/MITES</b>		<b>INSECTICIDES</b>
Codling Moth	44g	44. Codling moth mating disruption products*
<b>Comments:</b> *--Place pheromone dispensers in the top 2 feet of the canopy prior to moth emergence in the spring. Refer to the label to determine the application rate and number of treatments recommended for a particular product. Supplement the pheromone disruption product with insecticide sprays for larval control if pest pressure is too high for pheromone alone to provide control. Monitor the orchard with pheromone traps and by visual inspection of fruit.		

# APPLES

**PETAL FALL DD BASE 50 = 254    AVG. CALENDAR DATE = MAY 18**

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Apple Scab (Primary)	See Silver Tip and pages 30-31	1. Agrimycin 17 WP (1.5 lb)* 2. Mycoshield 17 WP (1.5 lb)*
Powdery Mildew	See "Tree Fruit Fungicides," pages 41-45	<b>Comments:</b> *--Use Mycoshield (17% oxytetracycline) at 1.5 lb/150 gallons of water per acre (200 ppm solution) as part of an anti-resistance strategy for streptomycin. It can be combined with streptomycin for improved fire blight control and resistance management. Mycoshield can only be used on apples in 2002 if EPA grants a special Section 18 emergency registration.
Fire Blight	1e, see Fire Blight, page 43-45	
<b>INSECTS/MITES</b>		<b>INSECTICIDES</b>
Aphids	11g, 19e**, 55g, 59e, 60e	3. Carzol 92 SP (1 lb)
White Apple Leafhopper	3e, 6f, 11e, 14g, 19e**, 41g, 45f, 55 59e, 60e	5. Diazinon 50 WP (4 lb)
Tarnished Plantbug	6e, 26g, 34e***, 35e***, 40e, 44e, 55g	6. Dimethoate 2.67 EC (6 pt)
Plum Curculio	5g, 8e, 9e, 34g***, 44g, 35g***, 40g, , 55e, 59g, 60g,	6. Dimethoate 25 WP (8 lb)
Spotted Tentiform Leafminer (Larvae)	11e, 19e**, 41e, 46e, 50g, 59e, 60e	6. Dimethoate 400 (4 pt)
Obliquebanded Leafroller	8p/f, 9p/f, 11f/g, 34g, 35g, 40g, 43g, 46e, 49g, 50g, 44g	8. Guthion 50 WP (2 lb)
Other Leafrollers	8e, 9e, 11e, 34e***, 35e***, 40e, 43g, 44g, 46e, 50g, 44e, 55g	9. Imidan 70 WP (3 lb)
European Red Mite	3g, 17e, 41e, 45e, 42e, 44g, 61g	11. Lannate 90 SP (1 lb)
Codling Moth	52f	14. MPEDE (1% - 2% v/v)
Oriental Fruit Moth	5g, 8e, 9e, 11e, 40e, 44e, 46f, 50g, 55f	17. Apollo SC (4 - 8 fl oz)
<b>Comments</b> **--Provado must be used at early petal fall to control Spotted Tentiform Leafminer larvae and Rosy Apple Aphids. For Leafhopper control, use 4 fl oz/A; use the 8 fl oz/A rate for Leafminer and Rosy Apple Aphids. ***** Actara for sprays targeting leafhoppers only, use 2-2.75 oz/acre.		19. Provado 1.6 EC (4 - 8 fl oz)**
		26. Thiodan 50 WP (4 lb)
		34. Ambush 25 WP (12.8 oz)***
		35. Pounce 25 WP (12.8 oz)***
		40. Asana XL 0.66 EC (4.8 - 14.5 fl oz)
		41. Agri-Mek 0.15 EC (10 - 20 oz)
		42. Savey 50 DF (3 - 6oz)
		42. Savey 50 WP (3 - 6 oz) plus paraffinic spray oil (1 gal)
		43. Bacillus thuringiensis (B.t.) Dipel DF 1 - 2 lb**** ▲
		44. Danitol 2.4 EC (10.6 - 21.3 oz)
		45. Pyramite 60 W (4.4 - 6.6 oz)
		46. Spintor 2 SC (6 - 10 oz)
		49. Confirm 2 F (20 oz)
		50. Intrepid 2 F (8 - 16 oz)
		52. Esteem 35WP (5 oz)
		59. Actara 25WG (4.5 - 5.5 oz) *****
		55. Avaunt 30WG (5-6 oz)
		60. Assail 70WP (1.1 oz)(3.4 oz for PC,OFM)
		61. Acramite 50W (0.75 - 1.0 lb)
		<b>Comments:</b> ***--Ambush and Pounce may not be applied after petal fall. ****--B.t.'s should be timed for early egg hatch and complete coverage is required for control. Two or three applications are generally required. B.t. is most effective under warm weather conditions.

# APPLES

## FIRST COVER DD BASE 50 = 401 AVG. CALENDAR DATE = MAY 31

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Apple Scab	See Silver Tip and pages 30-31	1. Agrimycin 17% (1.5 lb)*
Powdery Mildew	See "Tree Fruit Fungicides" pages 41-45	<b>Comments:</b>
Fire Blight	1e Following (within 24 hours) a hailstorm. See Fire Blight, page 43-45	*--The fewer streptomycin applications made in summer, the longer the product is likely to be effective.
Blister Spot on Mutsu	See "Tree Fruit Fungicides" pages 41-45	
<b>INSECTS/MITES</b>		<b>INSECTICIDES</b>
Plum Curculio	See Petal Fall	5. Diazinon 50 WP (4 lb)
Leafrollers	See Petal Fall	8. Guthion 50 WP (2 lb)
European Red Mite	See Petal Fall, 17e, 41e, 42e, 44g 45e, 61g	9. Imidan 70 WP (3 lb)
Spotted Tentiform Leafminer	41e	11. Lannate 90 SP (1 lb)
Codling Moth	5g, 8e, 9e, 11g, 23f, 40g, 44g, 46f, 49f, 50g, 52f, 55f, 60g	17. Apollo SC (4 - 8 fl oz)
White Apple Leafhopper	See Petal Fall	23. Sevin 50 WP (8 lb)
Apple Rust Mite	17f, 42f, 45e	23. Sevin 80 S (5 lb)
		23. Sevin XLR+ (2 - 3 qt)
		40. Asana XL 0.66 EC (4.8 - 14.5 fl oz)
		41. Agri-Mek 0.15 EC (10 - 20 oz) plus paraffinic spray oil (1 gal) (Sun Ultrafine or other summer oil)
		42. Savey 50 WP (3 - 6 oz)
		42. Savey 50 DF (3 - 6 oz)
		44. Danitol 2.4EC (10.6 - 21.3 oz)
		45. Pyramite 60 WP (4.4 - 6.6 oz)
		46. SpinTor 2SC (7.5-10 oz)
		49. Confirm 2 F (20 fl oz)
		50. Intrepid 2 F (12 - 16 oz)
		52. Esteem 35WP (5 oz)
		55. Avaunt 30WG (5 - 6 oz)
		60. Assail 70WP (3.4 oz)
		61. Acramite 50W (0.75 - 1.0 lb)

## SECOND COVER DD BASE 50 = 607 AVG. CALENDAR DATE = JUNE 14

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Apple Scab	See page 32 for ratings	16. Sovran 50 W(4.0 - 6.4oz)
Powdery Mildew	See "Tree Fruit Fungicides," pages 41-45	17. Flint 50 W (2.0 - 2.5 oz)
Blister Spot on Mutsu	See "Tree Fruit Fungicides," pages 41-45	50. Captan 50 WP (4 - 8 lb)
		51. Ziram 76 DF (6 - 8 lb)
		52. Nova 40 W (5 - 8 oz), Rubigan 1 EC (8 - 12 fl oz), or Procure 50 WS (8 - 16 oz) +
		Protectant scab fungicide

# APPLES

**SECOND COVER DD BASE 50 = 607    AVG. CALENDAR DATE = JUNE 14**

**Continued**

INSECTS/MITES		INSECTICIDES
Codling Moth	5g, 8e, 9e, 11g, 23f, 40g, 44g, 49f, 50g, 52f, 60g, 46f, 55f	5. Diazinon 50 WP (4 lb) 8. Guthion 50 WP (2 lb)
Potato Leafhopper	(See Comments) 3e, 8e, 9e 11e, 19e, 55g, 57, 58, 59e, 60e	9. Imidan 70 WP (3 lb) 11. Lannate 90SP (1 lb) 19. Provado 1.6 EC (4 fl oz)
Rose Chafer	8g, 9g, 11f, 19f, 23g, 59f, 55f See "Special Apple Insect Controls", page 46	17. Apollo SC (4.- 8 fl oz) 23. Sevin 50 WP (8 lb) 23. Sevin 80 S (5 lb)
San Jose Scale (crawlers)	5g, 52e	23. Sevin XLR+ (2 - 3 qt) 46. SpinTor 2SC (7.5 - 10 oz) 49. Confirm 2 F (20 fl oz)
Tufted Apple Budmoth	8g, 11g, 46g, 49e, 50e, 52g, 55g	50. Intrepid 2 F (12 - 16 oz) 52. Esteem 35WP (5 oz) 55. Avaunt 30WG (5 - 6 oz) 57. Pyganic EC 1.4 (16 - 32oz) ▲ 58. Evergreen EC 60-6 (8 - 16oz) 59. Actara 25WG (4.5 - 5.5 oz) 60. Assail 70WP (3.4 oz)

**Comments:**

\*--Potato leafhopper adults migrate to Michigan from Southern states, generally in May storm fronts. They feed on all fruit crops, and cause leaf margins to turn brown (called "hopperburn"). Populations build quickly in June and usually peak in early July.

**THIRD COVER DD BASE 50 = 842    AVG. CALENDAR DATE = JUNE 28**

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Apple Scab	See Second Cover and pages 37-38	
Powdery Mildew	See "Tree Fruit Fungicides," pages 41-45	
<b>INSECTS / MITES</b>		
Codling Moth	See First Cover	<b>INSECTICIDES</b>
Apple Rust Mite	28g, 45e, 54g	5. Diazinon 50 WP (3 - 4 lb) 6. Dimethoate 400 (4 pt)
Mites (adults)	10g, 14g**, 28g, 30g, 44g, 45e, 61g	6. Dimethoate 2.67 EC (6 pt) 6. Dimethoate 25 WP (8 lb)
Mites (immature)	10g, 14g**, 28g, 30g, 44g, 45e, 61g	8. Guthion 50 WP (2 lb) 10. Kelthane 35 WP (4 - 8 lb) 10. Kelthane 50 WP (3 - 5 lb)
Redbanded Leafroller	See Petal Fall	11. Lannate 90 SP (1 lb) 14. MPEDE (1% v/v)**
Green Apple Aphid	6f, 11g, 19e, 30g, 40f, 54g, 57, 58, 59e, 60e	19. Provado 1.6 F (8 fl oz) 23. Sevin XLR+ (2 - 3 qt) 26. Thiodan 50 WP (4 lb)
Tufted Apple Budmoth	See Second Cover	28. Vendex 50 WP (1 - 2 lb) 30. Vydate 2 L (4 pt)
Obliquebanded Leafroller	See Petal Fall	40. Asana XL 0.66 EC (4.8 - 14.5 fl oz) 44. Danitol 2.4 EC (10.6 - 21.3 oz)
Spotted Tentiform Leafminer	See Petal Fall	45. Pyramite 60 WP (4.4 - 6.6 oz) 54. Neem compounds [AzaDirect (32 fl oz), Ecozin (10 oz)] ▲
Potato Leafhopper	See Second Cover	55. Avaunt 30WG (5 - 6 oz) 57. Pyganic EC 1.4 (16 - 32oz) ▲
Tarnished Plantbug	26g, 40e, 44e, 54g, 55e	58. Evergreen EC 60-6 (8 - 16oz) 59. Actara 25WG (4.5 - 5.5 oz) 60. Assail 70WP (3.4 oz) 61. Acramite 50W (0.75 - 1.0 lb)
Woolly Apple Aphid *	5g, 23f, 26g, 54f	

**Comments:**

\* Neonicotinoid insecticides, like Provado and Actara, are active on this pest, but not currently labeled for use.

\*\*--Adding MPEDE to miticides such as Kelthane or Vendex will improve mite control. See label for use precautions. Use only as a tank-mix, it will not control mites alone.

For mites, see "Special Apple Insect and Mite Problems and Controls," page 46.



# APPLES

## FOURTH COVER DD BASE 50 = 1094 AVG. CALENDAR DATE = JULY 11

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Apple Scab (Secondary)	See Second Cover and pages 32-33	
Powdery Mildew	See "Tree Fruit Fungicides," pages 41-45	
Sooty Blotch, Fly Speck	See "Tree Fruit Fungicides," pages 41-45	
<b>INSECTS / MITES</b>		
Apple Maggot	5g, 6e, 8e, 9e, 11g, 23f, 40g, 44f, 46f, 53e*	
Codling Moth	See First Cover, Second Cover	
Oriental Fruit Moth	5g, 8e, 9e, 11g, 23g, 40e, 44e, 46f, 50g, 55f	
Japanese Beetle	8e, 9e, 23g, 40g, 44g, 54f, 57f, 58f	
<b>Comments:</b>		
Call the local pest management code-a-phone or determine from the Extension agent when sprays for apple maggots should be applied.		
*Apply as often as needed to maintain coverage.		
**-These are short-lived pyrethrums with strong initial knockdown activity.		
***--Primarily a repellent.		
		<b>INSECTICIDES</b>
		5. Diazinon 50 WP (4 lb)
		6. Dimethoate 400 (4 pt)
		6. Dimethoate 2.67 EC (6 pt)
		6. Dimethoate 25 WP (8 lb)
		8. Guthion 50 WP (2 lb)
		9. Imidan 70 WP (3 lb)
		11. Lannate 90 SP (1 lb)
		23. Sevin 50 WP (8 lb)
		23. Sevin 80 S (5 lb)
		23. Sevin XLR+ (2 - 3 qt)
		40. Asana XL 0.66 EC (8.0 - 14.5 fl oz)
		44. Danitol 2.4 EC (10.6 - 21.3 oz)
		46. Spintor 2 SC (6 - 10 oz)
		50. Intrepid 2 F (8 - 16 oz)
		53. Surround WP (25 - 50 lb)
		54. Neem compounds [AzaDirect (32 fl oz), Ecozin (10 oz)]*** ▲
		55. Avaunt 30WG (5-6 oz)
		57. Pyganic EC 1.4 (16-32oz)** ▲
		58. Evergreen EC 60-6 (8-16oz)**
		59. Actara 25WG (4.5-5.5 oz)

## FIFTH COVER DD BASE 50=1390 AVG. CALENDAR DATE = JULY 25

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Apple Scab	See Second Cover and pages 32-33	
Powdery Mildew	See "Tree Fruit Fungicides," pages 41-45	
Sooty Blotch, Fly Speck	See "Tree Fruit Fungicides," pages 41-45	
<b>INSECTS / MITES</b>		
Apple Maggots	See Fourth Cover	
Codling Moth	See First Cover	
Redbanded Leafroller	See Petal Fall	
Obliquebanded Leafroller	See Petal Fall	
Dogwood Borer	32e*, See "Special Apple Insect and Mite Problems and Controls," page 46	
Oriental Fruit Moth	See Fourth Cover	
		<b>INSECTICIDES</b>
		32. Lorsban 50 WP (3 lb/100gal)*
		32. Lorsban 4E (1.5 qt/100 gal)*
<b>Comments:</b>		
*Labeled for trunk spray only.		

# APPLES

## SIXTH, SEVENTH AND EIGHTH COVERS (IF NEEDED)

SIXTH COVER DD BASE 50=1663    AVG. CALENDAR DATE = AUGUST 8

SEVENTH COVER DD BASE 50=1917    AVG. CALENDAR DATE = AUGUST 22

EIGHTH COVER DD BASE 50=2153    AVG. CALENDAR DATE = SEPTEMBER 5

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Apple Scab	See Second Cover and pages 32-33	
Sooty Blotch, Fly Speck	See "Tree Fruit Fungicides," pages 41-45	
<b>INSECTS/MITES</b>		
Aphids	See Third Cover	
Apple Maggot	See Fourth Cover	
Codling Moth	See First Cover	
Red-banded Leafroller	See Petal Fall	
Spotted Tentiform Leafminer larvae	11e, 19e, 30e, 40e, 44e, 46e, 54e, 60e	
White Apple Leafhopper	11e, 19e, 23e, 44g, 54e, 55f, 60e	
Tufted Apple Budmoth	8g, 40e, 44e, 46g, 50e, 55g	
San Jose Scale	5g,	
Obliquebanded Leafroller	See Petal Fall	
Oriental Fruit Moth	See Fourth Cover	
<b>INSECTICIDES</b>		
5. Diazinon 50 WP (4 lb)		
8. Guthion 50 WP (2 lb)****		
9. Imidan 70 WP (3 lb)		
11. Lannate 90 SP (1 lb)**		
19. Provado 1.6 F (4 oz)		
23. Sevin 50 WP (4 lb)***		
23. Sevin 80 S (2 1/2 lb)***		
23. Sevin XLR+ (1 - 2 qt)***		
30. Vydate 2 L (4 pt)***		
40. Asana XL 0.66 EC (4.8 - 14.5 fl oz)		
44. Danitol 2.4 EC (10.6 - 21.3 oz)		
46. Spintor 2 SC (6 - 10 oz)		
50. Intrepid 2 F (12 - 16 oz)		
54. Actara 25WG (2.0 - 2.75 oz)		
55. Avaunt 30WG (5 - 6 oz)		
60. Assail 70WP (1.1 oz)		
<b>Comments:</b>		
**--No more than 5 applications may be made per year.		
***--No more than 2 applications may be made per year.		
****--No more than 9 lbs can be applied per year.		

## POST-HARVEST

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Phytophthora Collar Rot	See "Tree Fruit Fungicides," pages 41-45	

# Tree Fruit Fungicides

<b>Table 1.</b>	
<b>Background information on apple fungicides</b>	
<b>Fungicide Categories</b>	
<b>Inorganic</b>	
<b>Sulfur</b>	<ul style="list-style-type: none"> <li>• 2-3 days of protectant activity (forward action)</li> <li>• no after-infection activity (some say 9 hours—Mills Table)</li> <li>• poor retention and fair redistribution</li> <li>• high rates required for scab control, lower rates often used to suppress powdery mildew</li> </ul>
<b>Copper</b>	<ul style="list-style-type: none"> <li>• also used for fire blight control</li> <li>• 3-4 days of protection activity</li> <li>• little to no back action</li> <li>• can be phytotoxic to foliage and fruit</li> <li>• do not apply after 1/4" green stage</li> </ul>
<b>Anilinopyrimidine</b>	
<b>Vanguard (cyprodinil)</b>	<ul style="list-style-type: none"> <li>• a protectant fungicide</li> <li>• about 48 hours of after-infection at full rate</li> <li>• often combined with a protectant</li> <li>• does not control powdery mildew</li> </ul>
<b>Strobilurins</b>	
<b>Flint (trifloxystrobin)</b>	<ul style="list-style-type: none"> <li>• use a maximum of 2 - 3 consecutive (block) applications for resistance management</li> <li>• alternate block sprays with block sprays of unrelated fungicides</li> <li>• 5-6 days of protectant activity</li> <li>• hours of after-infection activity are less than the 100 hours listed on labels</li> <li>• back-to-back sprays do not increase after-infection control</li> <li>• also controls powdery mildew, sooty blotch, and fly speck</li> </ul>
<b>Sovran (kresoxim methyl)-</b>	<ul style="list-style-type: none"> <li>• use a maximum of 2 - 3 consecutive (block) applications for resistance management</li> <li>• alternate block sprays with block sprays of unrelated fungicides</li> <li>• 5-6 days of protectant activity</li> <li>• hours of after-infection activity at high rates are less than the 96 hours listed on labels</li> <li>• back-to-back sprays do not increase after-infection control</li> <li>• also controls powdery mildew, black rot, sooty blotch, and fly speck</li> </ul>
<b>Sterol Inhibitors</b>	
<b>Rubigan (fenarimol)</b>	<ul style="list-style-type: none"> <li>• 2-3 days of protection activity</li> <li>• 96 hours (4 days) of after-infection activity at high rates and no SI resistance</li> <li>• back-to-back sprays give increased after-infection control</li> <li>• also controls powdery mildew</li> </ul>
<b>Nova (myclobutanil)</b>	<ul style="list-style-type: none"> <li>• 3-4 days of protection activity</li> <li>• 96 hours (4 days) of after-infection activity at high rates and no SI resistance</li> <li>• back-to-back sprays give increased after-infection control</li> <li>• also controls powdery mildew</li> </ul>
<b>Procure (triflumizole)</b>	<ul style="list-style-type: none"> <li>• 2-3 days of protection activity</li> <li>• 48-72 hours (2-3 days) of after-infection activity at high rates and no SI resistance</li> <li>• back-to-back sprays give increased after-infection control</li> </ul>

<b>Table 1 (continued).</b>	
<b>Background information on apple fungicides</b>	
<b>Fungicide Categories</b>	
<b>Benzimidazoles</b>	
<b>Topsin-M (thiophanate-methyl)</b>	<ul style="list-style-type: none"> <li>• like Benlate</li> <li>• scab resistance is a problem in Michigan—Topsin-M is not recommended for scab control</li> <li>• OK for powdery mildew control and summer diseases</li> </ul>
<b>Dithiocarbamate (EBDC's)</b>	
<b>Polyram (metiram)</b>	<ul style="list-style-type: none"> <li>• an example of an EBDC fungicide</li> <li>• 5-6 days of protection when used at full rate</li> <li>• 18-24 hours of after-infection activity</li> <li>• very good retention and redistribution</li> </ul>
<b>Dithane DF</b>	<ul style="list-style-type: none"> <li>• examples of EBDC fungicides</li> </ul>
<b>Manzate 200</b>	<ul style="list-style-type: none"> <li>• 5-6 days of protection when used at full rate</li> </ul>
<b>Penncozeb (mancozeb)</b>	<ul style="list-style-type: none"> <li>• 18-24 hours of after-infection activity</li> <li>• very good retention and redistribution</li> </ul>
<b>Other EBDC's</b>	<ul style="list-style-type: none"> <li>• Manex, Maneb (see label for registration status on apple)</li> </ul>
<b>Relatives of EBDC's</b>	
<b>Carbamate (ferbam)</b>	<ul style="list-style-type: none"> <li>• a second cousin to EBDC's</li> <li>• weak as a protector—3-5 days</li> <li>• no after-infection activity</li> <li>• good retention and redistribution</li> <li>• unsightly residues on fruit if applied close to harvest</li> <li>• associated with enlargement of fruit lenticels and russetting of Golden Delicious</li> </ul>
<b>Ziram (ziram)</b>	<ul style="list-style-type: none"> <li>• Much like Ferbam—a weak protector</li> <li>• 3-5 days of protection activity</li> <li>• no after-infection activity</li> </ul>
<b>Thiram (thiram)</b>	<ul style="list-style-type: none"> <li>• Much like Ferbam—a weak protector</li> <li>• 3-4 days of protection activity</li> </ul>
<b>Guanidine</b>	
<b>Syllit (dodine)</b>	<ul style="list-style-type: none"> <li>• 24-36 hours of after-infection activity</li> <li>• will inactivate sporulating lesions—two applications at high rates one week apart are needed</li> <li>• scab resistance is a significant problem in Michigan—Syllit is not recommended for scab control</li> </ul>
<b>Phthalimides</b>	
<b>Captan (captan)</b>	<ul style="list-style-type: none"> <li>• 5-6 days of forward action (protectant activity)</li> <li>• generally one day (18-24 hours) of after-infection (back action or kick back) activity</li> <li>• very good retention and redistribution</li> <li>• incompatible with superior oil</li> </ul>

# APPLES

## Apple Powdery Mildew

Powdery mildew control should start at green tip although pink may be early enough if temperatures are generally below 50°F. Early sprays (pink to petal fall) are paramount to success in controlling powdery mildew. Applications should be continued until terminal growth stops. Mildew sprays should be applied every 5 to 7 days, particularly from pink to first cover, even though scab sprays may not be necessary. Because powdery mildew is most active when mild weather exists, failure to maintain protection from mildew infection during this period may allow infection to become established. Where mildew is controlled through first cover, spray intervals may be increased to about 10 days.

If oil is used for mite control, there is a danger of phytotoxicity where sulfur or Captan are applied too closely to the oil application.

### **TIMING: Green tip to petal fall, first cover to third cover (or cessation of terminal growth)**

Fungicides	Rate/acre
Scab fungicide plus Bayleton 50% DF <sup>1</sup>	2-6 oz
OR	
Nova 40W plus protectant fungicide	5-10 oz
OR	
Rubigan 1 EC plus protectant fungicide	8-12 fl oz
OR	
Procure 50 WS plus protectant fungicide	8-16 oz
OR	
Flint 50 W	2.0-2.5 oz
OR	
Sovran 50 W	4.0-6.4 oz
OR	
Scab fungicide plus wettable sulfur 95% WP <sup>2</sup>	8 lb

<sup>1</sup>Where mildew is a severe problem, use 4 to 6 oz/acre in two to three applications, then reduce 2 to 3 oz/acre. Where mildew is a minor problem, use 2 oz/acre. Short spray intervals (5 to 7 days) are preferred to long (10 to 14 days) intervals. Also controls rust.

<sup>2</sup>Other formulations of sulfur such as flowable sulfur, liquid sulfur, and less concentrated wettable sulfur should be used at rates that will give the same amount of sulfur as the 95% wettable powder formulation except where prohibited by the product label.

## Sooty Blotch, Fly Speck and Scab

### **TIMING: Cover sprays starting at third cover**

Fungicides	Rate/acre
Captan 50% WP	6-8 lb
OR	
Ziram 76 DF	6-8 lb
OR	
Flint 50 W	2.0-2.5 oz
OR	
Sovran 50 W	4.0-6.4 oz
OR	
Topsin M 70 WSB plus	8 oz
Captan 50% WP or Ziram 76 DF	6-8 lb

## Cedar-Apple Rust

### **TIMING: Pink to third cover**

Fungicides	Rate/acre
Bayleton 50% WP plus Scab fungicide	2-4 oz
OR	
Nova 40W plus protectant fungicide	5-8 oz
OR	
Rubigan 1 EC plus protectant fungicide	8-12 fl oz
OR	
Procure 50 WS plus protectant fungicide	8-16 oz

## Blister Spot on Mutsu, Cortland, Fuji

Blister spot is a bacterial disease of apple caused by a bacterium in the genus *Pseudomonas*. It is a common and serious problem on the cultivar Mutsu. New outbreaks of blister spot have been identified on Cortland and Fuji. Additional information on this disease may be found in Bulletin NCR-45, "Diseases of Tree Fruits," or in the "Compendium of Apple and Pear Diseases" published by the American Phytopathological Society.

Use of streptomycin to control blister spot is not recommended. Streptomycin-resistant *P. syringae* pv. *papulans* has been detected in Michigan and in other areas of North America where streptomycin was used to control blister spot. Resistance was confirmed in several Mutsu orchards in Michigan. Because of the loss of streptomycin for control due to resistance and the lack of alternative control procedures, establishing new plantings of Mutsu is not recommended.



# Fire Blight Management

With the probable future loss of streptomycin for fire blight control due to the development of resistance in the pathogen, nonchemical aspects of control take on increasing importance and must be considered as a top priority.

**Sanitation.** The first step in managing fire blight is to remove the overwintering cankers from dormant trees. Cut the branch 8 to 12 inches below the canker margin.

Pruning out infected shoots to limit the spread of shoot blight is recommended on young or small trees, particularly those on M.9 or M.26 rootstocks. Removing infected shoots resulting from the extension of dormant canker is recommended on large trees. If infection to spurs and shoots is severe, however, it is of doubtful benefit to remove blight from large trees. To be effective in limited spread, prune out strikes as soon as they appear.

**Orchard Risk Assessment.** At the beginning of each growing season, make a risk assessment of each orchard, categorizing its risk of infection by fire blight as low, medium, or high. This judgment should be based on such factors as the previous occurrence of fire blight in the orchard, the susceptibility of the varieties grown and their rootstocks, the age and vigor of the trees, and the number of overwintering cankers. The orchard risk assessment rating is used in combination with a "daily risk assessment," described below, to determine whether to apply antibiotic sprays.

In making orchard risk assessments, consider the relative susceptibility of the varieties to fire blight. A table listing the susceptibility of many new and common apple varieties is provided for your convenience. Trees propagated on M.26 rootstocks tend to be more susceptible than others, and the rootstock itself is very susceptible. Young, vigorously growing trees are generally more susceptible than mature ones. Most commercial pear varieties are susceptible.

**Chart for Assessing Orchard Risk**

Daily risk rating	Orchard risk rating		
	Low	Moderate	High
Low	None	None	Marginal
Moderate	None	Marginal	Worthwhile
High	Marginal	Worthwhile	Critical

**Chemical Control.** Two bactericides, Agrimycin (streptomycin) and Mycoshield (oxytetracycline), are effective against the blossom phase of fire blight. Mycoshield can only be used on apples in 2003 if a special Section 18 emergency registration is granted by EPA.

Streptomycin has been the standard for control of fire blight on apples since it was introduced in the 1950s. It is a more effective product than Mycoshield where bacteria are not resistant.

**Since being discovered in one orchard in Van Buren County in 1990, streptomycin-resistant strains of the fire blight bacterium (*Erwinia amylovora*) have been detected throughout Van Buren County and, beginning in 2000, in some areas of Berrien county adjacent to Van Buren County. Resistant strains also have been detected in Kent County and in Newaygo County.**

Mycoshield is useful as a replacement for streptomycin in areas where streptomycin resistance has been a problem or in combination with streptomycin as a part of an anti-resistance management program. Apply it as a protectant during bloom for blossom blight control. The product has no effect on fire blight unless applied to open flowers under weather conditions that are likely to lead to blight infection. It does not provide economic control of blight if applied even a few hours after infection has occurred, and it does not prevent infection of shoots or fruit during the summer.

**Timing Antibiotic Sprays.** Time antibiotic sprays carefully. With Agrimycin and Mycoshield, timing is everything. The best timing can be achieved using Paul Steiner's MARYBLYT model.

In the absence of information from the MARYBLYT model, reasonable control of fire blight should be achieved if the antibiotics are applied using the "daily risk system." These daily assessments are determined after the onset of bloom. On days with rain and days following a rain, note the maximum temperature and the amount of rainfall, then refer to the following chart to determine the daily risk rating.

**Chart for Assessing Daily Risks**

Maximum temperature	Rainfall	
	Less than 0.1 inch	More than 0.1 inch
	Daily risk rating	
Under 65° F	None	Low
65° F to 69° F	Low	Moderate
70° F to 80°	Moderate	High
Over 80° F	High	High

For example, on a day with a maximum temperature of 75° F and more than 0.1 inch of rain, the daily risk rating would be high. On a day following a rain with the same maximum temperature but no rainfall, the rating would be moderate.

When determining daily risk ratings, use the "Orchard Risk Chart" described earlier to determine whether it is worthwhile to apply an antibiotic spray to control fire blight. For example, if the daily risk rating is moderate and the orchard risk rating is low, a spray is

# APPLES

not needed. If both the daily and the overall orchard risk ratings are high, on the other hand, applying a spray would be critically important.

When using the "daily risk system," remember that a single day with rain occurring early in the bloom period is usually inconsequential; in low-risk orchards, a spray is probably not needed. During the early bloom stage after a spray has been applied, a second application is usually not needed until a significant number of new blooms have opened. After full bloom, an application is effective for about four days. If rainfall of 0.5 inch or more occurs, however, it will end the application's effective period.

**Shoot Fire Blight Management with Apogee.** Apogee (prohexadione calcium) inhibits gibberellin biosynthesis, this results in an early cessation of terminal growth. Shoots with inhibited growth are less susceptible to fire blight; therefore, the potential for the build up of fire blight during the summer is reduced significantly. Apogee only decreases host susceptibility; it does not affect the pathogen directly. Apogee is not a substitute for streptomycin during bloom for blossom blight control.

**Timing.** Apogee 27.5% W should be applied at full bloom to early petal fall on king blooms for maximum effectiveness. The decrease in susceptibility will not start to become effective until about 10 days to 2 weeks after application.

**Application rate and number.** The rate is 36 to 48 oz of Apogee 27.5% W per acre for trees that require 300 to 400 gallons of dilute spray per acre, respectively, or 12 oz per 100 gallons of dilute spray. The effectiveness of lower per acre rates for blight control drops off quickly. In Michigan, one application of Apogee should be sufficient for preventing fire blight spread in the summer but, overly vigorous trees may need a second application (see label).

**Additives.** The non-ionic surfactant, Regulaid, should be used with Apogee. Follow the manufacturer's rate recommendations. If Apogee is being applied in hard water (water that contains high levels of calcium carbonate), 1 lb of spray-grade ammonium sulfate (AMS) should be used for each pound of Apogee.

**Comments.** Growth control with Apogee is not concentration dependent. There is no difference in shoot growth control between dilute and concentrates sprays. Apogee as a concentrate spray is equally effective to a dilute spray provided the total amount of chemical per acre is the same.

The level of growth control with Apogee is rate dependent. The greatest and quickest reduction in growth is obtained at the recommended rate, and the effect on growth declines as the rate is reduced.

**Hailstorms.** Fire blight outbreaks can be severe after a hailstorm. If hail occurs and fire blight is either present in the orchard or has been a problem in previous years, spray streptomycin immediately regardless of the risk assessment ratings.

## Severity of fire blight on apple trees on M.7a or M.7 EMLA rootstocks at the Southwest Michigan Research and Extension Center following a severe epidemic in 2000.

Variety	Severity scores for	
	Cultivars <sup>y,z</sup>	
Lucky Rose		1.0
Valstar		1.3
Novamac		1.3
Williams Pride		1.5
Mollies Delicious		1.5
Runkel		1.5
Nova Spy		1.5
Red Delicious strains		1.5
Zestar!		1.7
Empire strains		2.0
Honeycrisp		2.0
Royal Court		2.0
Enterprise		2.0
Pinova		2.0
Acey Mac		2.5
Corodel		2.5
Winsap/Staymen strains		2.6
Braeburn strains		2.7
Jonamac		2.7
Pristine		2.8
Cameo		2.8
Jonagold strains		2.9
Macoun		3.0
Liberty		3.0
Mac strains		3.3
Golden Delicious strains		3.4
Spigold		3.7
Arlet		4.0
Melrouge		4.0
Rome strains		4.2
Gala strains		4.4
Suncrisp		4.5
Jonathan strains		5.0
Paulared		5.0
Fortune		5.8
York strains		6.0
Pink Lady		6.0
Gingergold		6.0

<sup>y</sup>Data adapted from W. W. Shane, 2000, Annual Report, SW Michigan Research & Extension Center, Michigan State University, Benton Harbor, MI.

<sup>z</sup>Scores were based on the scale: 1 = low to 6 = severe. Data are mean rating scores for a minimum of three trees.

## Phytophthora Collar Rot

This disease is caused by several species of fungi in the genus *Phytophthora*; these fungi cause a brown decay just below ground in the collar, crown, and roots. Collar rot should not be confused with fire blight in common dwarfing rootstocks such as M.26, M.9, and M.7 because controls for collar rot will not control fire blight.

Collar rot can be avoided by carefully selecting the type of soil and rootstocks for new apple orchards. Do not plant susceptible rootstocks in orchards (or areas of the orchard) with heavy, poorly drained soils. Tiling of wet areas in an otherwise well-drained location often improves internal soil drainage sufficiently to eliminate problems with this disease.

Two fungicides, Ridomil and Aliette, are registered for the control of phytophthora collar rot. Chemical control measures are not substitutes for good cultural practices. Rather, they are stop-gap measures for use in emergency situations.

### Ridomil for Collar Rot

**Bearing Apple Trees.** Ridomil Gold EC is applied as a soil drench consisting of 1/2 pt of Ridomil Gold EC per 100 gal of water. Apply 1 to 4 qt of the diluted mixture around the trunk of each tree. The exact amount of diluted mixture per tree depends on trunk diameter as indicated in the table below. Make two applications per year. One application is made in spring before growth

starts and another application in the fall after harvest. On new plantings delay the first application until 2 weeks after planting.

Tree trunk diameter	Diluted mixture/tree
Less than 1 inch	1 quart
1 – 3 inches	2 quarts
3 – 5 inches	3 quarts
More than 5 inches	4 quarts

**Nonbearing Apple Trees.** In nurseries and field plantings of nonbearing trees, make the first application of Ridomil Gold EC at two weeks after planting with additional applications made at three-month intervals throughout the growing season. Do not apply to plantings (except apple as noted above) that will bear harvestable fruit within 12 months of application. Apply 2 qts per treated acre (1.5 fl oz per 1000 sq ft) in sufficient water to obtain thorough coverage of the soil under the canopy of the trees. Sufficient surface area should be treated in nurseries to cover the root zone of the plants.

### Aliette for Collar Rot

Aliette 80 WSP is applied as a spray to the foliage at the rate of 2.5 to 5 lb/acre. Begin applications at the start of the growing season. Do not apply more than 100 gal/acre per application or 20 lb of Aliette WSP per acre per season. Repeat every 60 days; maximum of four applications per year. Aliette is particularly effective against *Phytophthora cactorum*.

# APPLES

## Special Apple Insect and Mite Problems and Controls

### Mites

Superior oil applied at the right time with good coverage at the full rate can provide control of mites until mid-summer, but can cause phytotoxicity if applied within 48 hours of freezing temperatures.

Apollo, Savey and Agri-Mek all provide extended control of European red mites, ranging from 10 weeks to full season depending on mite pressure, tree vegetative growth and predator mite populations. Savey and Apollo can be applied pre-bloom for over-wintering European red mite eggs, but now have in-season use with their respective 28-day and 45-day pre-harvest intervals. Agri-Mek is most effective when applied between petal fall and first cover (14 days past petal fall) with the addition of 1 gallon of paraffinic spray oil per acre. These compounds can be used in lieu of early season oil timings, but oils should remain as an important resistance management tool to reduce the selection pressure from consecutive use of Apollo and Savey, which have similar ovicidal modes of action.

Pyramite and Acramite are good contact miticides which when used early season can provide six or more weeks of control, or in mid-summer as a "clean up" application if early season products have lost control of mites. Carzol early in the season (cannot be applied after petal fall) provides control of adult mites (along with some insect pests), but is toxic to predator mites. Vendex provides good control during warm weather. Kelthane gives good control in all temperature conditions, but should be used only once or as a back-to-back application on the same generation of mites to prevent resistance from building. Vydate will kill some mites, but is very toxic to predators, and causes fruit drop if used within 30 days after petal fall.

### Dogwood Borer

The dogwood borer is a problem in some apple orchards in Michigan, mostly 4 to 9 years of age. Initially the dogwood borer larvae feed inside burr knots (adventitious roots) which can develop on the exposed above ground portion of clonal rootstocks. Feeding in the burr knot does little damage to the tree but feeding can continue below the bark where it is much more destructive and may eventually girdle the tree. Burr knots are aggregations of partially developed root initials that usually occur in clusters at or below the graft union. Reddish frass on the surface of a burr knot is a visible sign of infestation. Burr knots are fibrous and permit entry of some insecticides such that larvae are readily exposed to a lethal dose while still within the plant tissue. The larvae can be controlled with trunk applications of Lorsban 50 WP at the rate of 3 pounds per 100 gallons of water. Lorsban 4E is also labeled for use at a rate of 1.5 quarts per 100 gallons of water. These must be applied directly to the trunk from a distance of

no more than 4 ft using low volume handgun or shielded spray equipment. Do not allow spray to contact foliage or fruit. A single spray timed for the peak egg hatch in late June to mid-July will provide control.

### Japanese Beetle

This insect is a native pest to Japan and was first found in the U.S. in 1916. Since that time it has gradually dispersed across the eastern states and in the last ten years has become well established in southern parts of Michigan. The insect overwinters as a white grub, feeding on roots in the soil, then emerges as an adult in mid-summer to feed, mate and lay eggs. The adults can emerge in the thousands per acre and being strong flyers can move heavily into fruit crops, especially along the edges of plantings. Japanese beetles prefer grapes, peaches and plums but will readily feed on other fruits like blueberry and apple. Japanese beetle adults can be controlled with many of the conventional contact poisons (organophosphates, carbamates, pyrethroids), but high rates and good plant coverage (aerial applications often not sufficient) is essential to provide a lethal dose. There are several novel compounds like SURROUND WP (Kaolin), Pyrethrum-based products (i.e.; PyGanic and Evergreen), and NEEM-based products (i.e.; AzaDirect, Ecozen and Neemix) that provide significant repellency effects, but have limited lethal activity. These compounds have the advantage of short pre-harvest intervals compared to most conventional insecticides. Controlling larvae is not effective in commercial orchards, but the natural insecticide, *Bacillus popilliae*, marketed as DOOM, Japademic, and other names, will provide persistent but low levels of larval control.

### Dock Sawfly

Dock sawfly occurs in the Northern U.S., and has been found in increasing numbers in new dwarf orchards in Michigan. It is a pest in the larval stage, and primarily feeds on species of dock and lambsquarter. There are several (up to four) generations per year, and most of these occur without damaging apples. The larvae of the last generation of the year will "wander," looking for a site to pupate. Apples that are on limbs hanging in the groundcover, or on dwarf trees, are subject to attack. Larvae will often "probe" an apple, making several holes in the fruit before tunneling into fruit. New orchards with disturbed soil are often infested with dock plants and the dock sawfly. Late season varieties such as Rome seem to be more susceptible, but any apple can be attacked. Apples are just an accidental host, and the larvae will overwinter in the fruit. Control is linked to weed control. Keeping the tree rows and row middles free from dock and lambsquarter is important. Controlling larvae after they are on the apple is difficult if not impossible.



# CODLING MOTH INTEGRATED PEST MANAGEMENT

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## BIOLOGY

There are typically two generations of codling moth (CM) per year in Michigan, with a partial third generation in exceedingly warm years (Figure 1). The spring flight of CM adults generally begins when apples are in bloom. In Michigan, second and third flights generally begin in mid-July and toward the end of August, respectively.

Fruit injury caused by CM is of two types. A deep entry is where the larva enters into the center of the fruit and feeds on seeds. Brown frass can usually be seen extruding from the entry hole. A sting is a shallow entry where the larva does some feeding but does not gain entry into the fruit.

## MATING DISRUPTION

Mating disruption of CM entails placement of pheromone dispensers in trees in sufficient numbers to interfere with mate location. The best opportunity for control is where orchard topography, size and shape, wind, and canopy structure allows for uniform distribution of pheromone within the orchard. The best candidates are orchards that are relatively flat and even-canopied. Orchards with large numbers of missing trees or uneven canopies are considered poor candidates for CM mating disruption.

## Monitoring

Pheromone traps and visual inspection of fruit should be used to assess the effectiveness of CM control in a

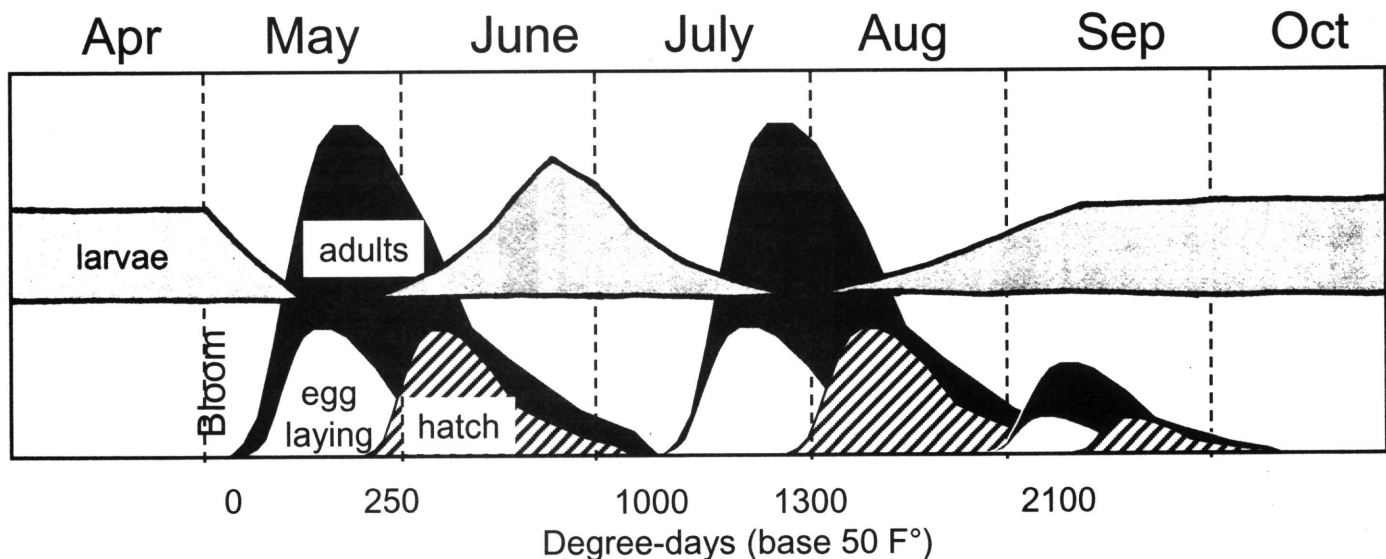
pheromone-treated orchard. Use of one trap for every 2 to 2.5 acres is optimal; 1 trap per 5-8 acres is acceptable in large, uniform blocks. Place traps baited with high-load lures in the upper third of the canopy. If using red septa lures (10 mg or 10X), replace them every 3 weeks for the first generation or every 2 weeks for second generation. Other high-load lure types are available, with some lasting an entire generation. Check with manufacturer's to determine replacement intervals. If a cumulative catch of 4 or more moths is recorded in any one trap, a supplemental control may be necessary.

Pheromone traps provide some measure of the effectiveness of mating disruption, however, fruit should always be visually inspected in conjunction with trapping. Examine 15 to 20 fruit on at least 10 trees per orchard. Concentrate fruit inspections in the upper canopy and along orchard borders. A supplemental treatment is advised if wormy fruit are observed. If damage is confined to an orchard border, treating three to six rows along the problem border may be adequate.

## Treatment

Isomate C Plus (Pacific Biocontrol Corp.) is currently the most widely used disruption product in Michigan. This polyethylene tube dispenser is commonly referred to as a rope or twist-tie. It is applied by hand at densities of 200-400 per acre and releases pheromone for approximately 5 months. Other CM disruption products are available; follow the manufacturer's guidelines for application rates and longevity under Michigan conditions.

Figure 1. Codling moth seasonal history.



## CODLING MOTH IPM (continued)

In orchards treated with low rates (<275/acre) plan on supplementing the pheromone with insecticides or other controls. Using pheromone in conjunction with insecticides is also suggested for orchards with a recent history of CM fruit injury or in the first year of a disruption program.

Mating disruption is most effective when the application is well timed and dispensers are properly positioned. Pheromone dispensers should be in place prior to the predicted start of the first flight period (before bloom on 'delicious'). Place dispensers within two feet of the top of the tree canopy and near foliage to protect them from UV radiation and high temperatures.

## INSECTICIDES

### Monitoring

Pheromone traps, in conjunction with degree-day (DD°) models, can be used to determine the need and timing for treatment. Place pheromone traps prior to bloom at a density of at least 1 trap per 5-8 acres. Check traps twice a week and begin accumulating degree-days (base 50°F) on the day at which the first moth is trapped, provided moths are captured on two successive trapping dates. The start of sustained moth capture is referred to as **biofix**. Inspect traps weekly for the remainder of the season; count and remove captured moths.

Many factors can influence trap performance. To optimize trapping efficiency, place them in areas of the orchard that are known hot spots. Position traps at mid-canopy (5-8 ft). If using red septa lures, replace them every 3 weeks first generation or every 2 weeks second generation. Other lure types are available, with some lasting an entire generation. Check with manufacturer's to determine replacement intervals. Larger traps, such as the Triangle, Wing, and some versions of the Diamond have proven to be most effective at trapping CM males. Change trap bottoms if dirty, or at least every 6 weeks.

### Treatment

Use of the DD° model rather than the calendar method should be used to time sprays. If the codling moth larva is the primary target of an insecticide, apply the first spray at 250 DD°, which coincides with the start of egg hatch. Apply the first spray against the second generation between 1250 and 1300 DD°. Timing of additional sprays will depend on the product used. Some insecticides provide 21 days of residual control, while others may only provide 10 days. Rainfall in excess of 1/2 inch will substantially reduce the residual of most materials. The egg hatch period lasts 30 to 45 days so several treatments may be required for control of each generation.

Thresholds based on cumulative moth catch can be used as a tool to determine the need to apply control treatments. A cumulative catch of 5-7 moths during the first generation or 3-5 moths during the second generation in any one trap may indicate the need for a spray. Do not total captures from more than one trap to attain the threshold (Table 1).

**Table 1. Example of determining CM cumulative moth catch.**

	Number of moths trapped			
	Week 1	Week 2	Week 3	Week 4
Trap 1	0	2	2	2
			4 cumulative	6 cumulative
Trap 2	1	1	1	0
		2 cumulative	3 cumulative	3 cumulative

Moth capture in a pheromone trap in conjunction with the DD° model can be used as a basis for codling moth management decisions. Sprays are only applied if catch is over threshold and are targeted for egg hatch as predicted by the model. Examples of the decision process are presented in Table 2.

**Table 2. Decision-making for codling moth management.**

Timing		Event	Management action		
1 <sup>st</sup> generation	2 <sup>nd</sup> generation		Orchard 1	Orchard 2	Orchard 3
0 DD°	1060 DD°	Start of flight	Begin accumulation		
250 DD°	1250-1300 DD°	First egg hatch	Over threshold TREAT Reset catch to zero New accumulation	Under threshold DO NOT TREAT Continue accumulation	Under threshold DO NOT TREAT Continue accumulation
350 DD°	1350-1400 DD°	20% egg hatch	Continue accumulation	Over threshold TREAT Reset catch to zero New accumulation	Still under threshold DO NOT TREAT Continue accumulation
10-21 days after treatment		Loss of residual	Over threshold TREAT Reset catch to zero New accumulation	Under threshold DO NOT TREAT Continue accumulation	Under threshold DO NOT TREAT Continue accumulation
10-21 days after treatment		Loss of residual	TREAT if over threshold and model indicates continued egg hatch		
1000 DD°	2100 DD°	End of flight	Visually inspect fruit for CM injury		

**CODLING MOTH IPM (continued)**

**Insecticides for codling moth management**

<b>Common Name</b> (Trade Name)	<b>Manufacturer</b>	<b>EPA Registration Number</b>	<b>Rate/A</b>	<b>PHI</b>	<b>REI</b>
<b>azinphosmethyl</b> (Guthion 50WP)	Bayer	3125-193	2 lb	14 d	48 hr
<i>Guthion provides excellent control of CM with a residual action of 10-14d under high pest pressure and 14-21d in low to moderate pressure situations. It is generally considered of low toxicity to predaceous mites. The maximum yearly amount of Guthion 50WP to be applied on apple and pear is 9 lb per acre.</i>					
<b>phosmet</b> (Imidan 50WP)	Gowan	10163-169	2.25-3.0 lb	7 d	24 hr
<i>Imidan provides excellent control of CM with a residual action of 10-14d. It is generally considered of low toxicity to predaceous mites.</i>					
<b>carbaryl</b> (Sevin 80S)	Rhone-Poulenc	264-316	5 lb	3 d	12 hr
(Sevin XLR Plus)	Rhone-Poulenc	264-333	2-3 qt	3 d	12 hr
<i>Sevin provides good control of CM with a residual action of 7d. This material is highly toxic to mite predators and should be used carefully to prevent mite population buildup. Sevin is a fruit thinning agent if used within 30 days after bloom.</i>					
<b>esfenvalerate</b> (Asana XL 0.66EC)	Dupont	352-515	4.8-14.5 oz	21-28 d	12 hr
<i>Asana provides good control of CM with a residual action of 7d. This material is highly toxic to mite predators and its use may cause severe outbreaks of phytophagous mites. The PHI's for apple and pear are 21 and 28 days, respectively.</i>					
<b>tebufenozide</b> (Confirm 2F)	DowAgrosciences	707-238	20 oz	14 d	4 hr
<i>Confirm provides fair to good control of CM with a residual action of 10-14d. Good control requires excellent timing and coverage. Confirm must be ingested by the larvae, and may take several days to cause mortality. The addition of an agricultural adjuvant is recommended to improve initial spray deposition. This material is an insect growth regulator that primarily effects lepidopteran larvae. It is not harmful to most beneficial insects. The maximum yearly amount of Confirm 2F to be applied on apple and pear is 120 oz per acre.</i>					

*(Continued on next page)*

## CODLING MOTH IPM (continued)

### Insecticides for codling moth management (continued)

Common Name (Trade Name)	EPA Registration				
	Manufacturer	Number	Rate/A	PHI	REI
<b>methoxyfenozide</b> (Intrepid 2F)	DowAgrosciences	707-277	16 oz	14 d	4 hr
<p><i>Intrepid provides good control of CM with a residual action of 10-14d. Excellent timing and coverage is required to achieve control. Intrepid must be ingested by the larvae, and may take several days to cause mortality. The addition of an agricultural adjuvant is recommended to improve initial spray deposition. This material is an insect growth regulator that primarily effects lepidopteran larvae, but is also active against adults and eggs. It is not harmful to most beneficial insects. The maximum yearly amount of Intrepid 2F to be applied on apple and pear is 64 oz per acre.</i></p>					
<b>spinosad</b> (SpinTor 2SC)	DowAgrosciences	62719-294	7.5 oz	7 d	4 hr
<p><i>SpinTor provides fair to good control of CM with a residual action of 7-10d. Good control requires excellent timing and coverage. SpinTor must be ingested by the larvae, and may take several days to cause mortality. The addition of an agricultural adjuvant is recommended to improve initial spray deposition. Avoid use when bees are actively foraging as this material is highly toxic to bees exposed to direct spray. Dried residues have minimal effects. The maximum yearly amount of SpinTor 2SC to be applied on apple and pear is 29 oz per acre.</i></p>					
<b>acetamiprid</b> (Assail 70WP)	Bayer		3.4 oz	d	hr
<p><i>Assail provides good control of CM with a residual action of 10-14 at the high rate. Excellent timing and coverage is required to achieve control. Assail must be ingested by the larvae, and may take several days to cause mortality. Field trials have indicated that use of Assail can cause outbreaks of phytophagous mites. The maximum yearly amount of Assail 70WP to be applied on apple and pear is 13.5 oz per acre.</i></p>					
<b>narrow range oil</b> (Sunspray Ultra-fine)	Sun	862-23	1-2 gal	1 d	4 hr
<p><i>Narrow range oils provide fair control of CM. Oils affect CM by smothering eggs. Applications should be repeated every 7-14 days during the egg laying period. The effectiveness of oil treatments may be enhanced with more dilute applications. Oils may be phytotoxic if used within a few weeks of a sulfur spray or if applied at higher rates during hot weather (90F+).</i></p>					



# Effectiveness of Insecticides and Miticides in Controlling Arthropod Pests of Apples

(Note that a product's effectiveness rating on a pest does not necessarily indicate that it is labeled for that use.)

Pests	Life Stage	Ratings of control are																																							
		Carzol	Diazinon	Dimethoate	Guthion	Imidan	Kelthane	Lannate	Malathion	MPEDF	Apollo	Provado	Sevin	Superior Oil <sup>1</sup>	Thiodan	Vendex	Vydate	Lorsban <sup>1</sup>	Pounce	Ambush	Asana	Agri-Mek	Savey	B.t.'s	Dantol	Pyramite	Spinlor	Confirm	Intrepid	Esteem	Surround	Neem compounds	Avant	Actara	Assail	Acramite					
Apple Maggot	Adult	3	5	6	8	9	10	11	13	14	17	19	23	24	26	28	30	32	34	35	40	41	42	43	44	45	46	49	50	52	53	54	55	59	60	61					
Codling Moth	Larva		G	F	E	E	G	G																																	
Cutworms	Larva					P		F										E	E	E	E																				
European Red Mite	Active	E		P			G			G				E	E	E																									
Fruit Tree Leafroller	Larva		G	E	E	E	E					F					P		E	E	E																				
Green Apple Aphid	Active		P	F	P	P	G	P				E	P	P	F	G	G	F	F	F	F																				
Green Fruitworm	Larva		F	P	P	P	G										P	E	E	E	E																				
Obliquebanded Leafroller	Larva		G	E	E	E	G																																		
Oriental Fruit Moth	Larva		G		E	E	G																																		
Plum Curculio	Adult			P	E	E	F	P				F	F			P	G	G	G	G																					
Redbanded Leafroller	Larva		G	P	E	E	E	P				F				P	E	E	E	E																					
Rose Chafer	Adult																																								
Rosy Apple Aphid	Active		P	E	P	P	G																																		
Rust Mite	Active	E	P	P	P	P	G					F	G	E	E	G	F	P	P	P	P																				
San Jose Scale	Adult																																								
San Jose Scale	Crawler																																								
Spotted Tentiform Leafminer	Adult	G				P																																			
Spotted Tentiform Leafminer	Larva		P	F																																					
Tarnished Plantbug	Active	G	P	E	P	P	G																																		
Two-spotted Spider Mite	Active	E		P																																					
White Apple Leafhopper	Active	E	P	F	P	P	E	P				E	E			G	F																								
Woolly Apple Aphid	Active		F	G																																					
Bees		M	T	T	T	N	T	T	N	S	M	T	S	M	T	S	S	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T		
Mite Predators		T	S	M	S	S	M	T	M	T	S	S	T	S	M	T	S	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	
Insect Predators		M	T	M	M	N	T	M	N	T	M	S	M	T	S	M	T	S	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	

<sup>1</sup> Use only before pre-pink!

# PEARS

The rates of materials are based on a standard of 300 gallons per acre dilute spray for mature trees. If less gallonage is used, refer to the rate-per-acre figure to insure that the proper amount of pesticide is applied.

After each pest appears a column of numbers and letters. These are provided to assist growers in choosing materials to use to control specific pests. The number

refers to the pesticide in the column headed "Suggested Chemicals" and the letter is a rating of efficiency: e = excellent, g = good, f = fair and p = poor for the pesticide controlling the pest.

Products listed by the Organic Materials Review Institute (OMRI) for use in organic production will be marked with the following designation: ▲

## LATE DORMANT OR DELAYED DORMANT

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>INSECTS/MITES</b>		<b>INSECTICIDES</b>
Pear Psylla	34e, 35e, 40e, 44e, 52g, 53g*	24. Superior Oil (6 gals)** 34. Ambush 2 EC (9.6 fl oz) 35. Pounce 3.2 EC (6 fl oz) 40. Asana XL 0.66 EC (4.8 - 14.5 fl oz) 44. Danitol 2.4 EC (16 - 21.3 oz) 52. Esteem 35WP (5 oz) 53. Surround WP (25 - 50 lb)* ▲ 56. Supracide 2E (3 - 12 pts)
San Jose Scale	24e**, 52e, 56g	
<b>Comments:</b> See page 56 for information on pear psylla resistance and insecticide options. *--Must maintain coverage for adequate performance. **--Unless applied dilute (300 gal/A) the use of oil is questionable.		

## Pear Scab Control

### GREEN TIP TO PRE-PINK

Fungicide	Rate/acre	Comments	Restrictions
Carbamate 76 WDG	3 - 4 ½ lb	Use 4.5 lb per acre in pink, calyx, first and second cover sprays, and 3 lb per acre in summer.	Do not apply within 7 days of harvest.
EBDC Fungicides (other formulations may also be available)		<b>Use either the "Pre-Bloom" (e.g. 6 lb) or "Extended Application" (e.g. 3 lb) schedule.</b>	<b>Do not combine or integrate the two treatment schedules.</b>
Dithane M-45 75% DF OR Manzate 200 DF OR Penncozeb 75 DF	6 lb	<i>Pre-Bloom Use:</i> Begin applications at 1/4 to 1/2 inch green tip and continue on a 7 to 10 day schedule through bloom.	Do not apply after bloom or more than 24 lb per acre per year.
Dithane M-45 75% DF OR Manzate 200 DF OR Penncozeb 75 D	3 lb	<i>Extended Application Schedule or for Use in Tank Mixtures:</i> Begin applications at 1/4 to 1/2 inch green tip and continue applications on a 7 to 10 day schedule through the second cover spray. Tank mix with non-EBDC fungicide when needed for primary scab control.	Do not apply more than 3 lb per acre per application or 21 lb per acre per season.  Do not apply within 77 days of harvest.
Procure 50 WS	8 - 16 oz  12 - 16 oz	<i>Standard Spray Schedule:</i> Begin applications at 1/2 inch green tip stage and continue on a 7 to 10 day interval through the second cover spray. Tank mix with an EBDC fungicide (see Extended Application Schedule above) for maximum fruit disease control.  <i>Postinfection:</i> Apply within 48 to 72 hr after the beginning of an infection period. Use the high rate under heavy disease pressure or when applied after 48 hr.	Do not apply more than 64 oz/A per season.  Do not apply within 14 days of harvest.
Flint 50% W (trifloxystrobin)	2.0 - 2.5 oz	Begin at green tip and continue as needed on a 7 to 10 day schedule.  <b>Maximum of 4 total applications of Flint or other strobilurin fungicide per acre per season and no more than 2-3 sequential applications of Flint or other strobilurin fungicide.</b>	Do not apply within 14 days of harvest.  Do not apply more than 11 oz per acre per season.

(Continued on next page)

## GREEN TIP TO PRE-PINK *continued*

Fungicide	Rate/acre	Comments	Restrictions
Sovran 50% W (kresoxim-methyl)	4 - 6.4 oz	Begin at green tip and repeat on a 10 day schedule. <b>Maximum of 4 total applications of Sovran or other strobilurin fungicide per acre per season and no more than 2-3 sequential applications of Sovran or other strobilurin fungicide.</b>	Do not apply within 30 days of harvest. Do not apply more than 25.6 oz per acre per season.
Vanguard 75 WG tank mixed with a protectant fungicide (generally an EBDC fungicide)	3 oz	Use tank mixtures beginning at pink. <i>Pre-Bloom, Pink, Bloom:</i> Begin applications at green tip and continue on a 7- to 10-day interval. A shorter interval is preferred during periods of wet weather favorable for disease.	Do not apply more than 22 oz of Vanguard WG per acre per season. Do not apply Vanguard WG alone on pears. Do not apply within 72 days of harvest.
Ziram 76 DF	6 - 8 lb	Begin applications at 1/4 to 1/2" green tip and continue through cover sprays as needed.	Do not apply within 14 days of harvest. Do not apply more than 56 lb/A per season.

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>INSECTS/MITES</b>		<b>INSECTICIDES</b>
European Red Mite	<b>24e</b>	<b>24.</b> Superior Oil (1%-2% v/v)
San Jose Scale	<b>24e, 32e, 52e</b>	<b>32.</b> Lorsban 4 EC (3 pt)
		<b>52.</b> Esteem 35WP (5 oz)
		<b>Comments:</b> <i>Addition of an organophosphorous insecticide to superior oil enhances the effectiveness of scale control.</i>

## WHITE BUD

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Pear Scab	Fungicides listed under Green Tip to Pre-Pink	
<b>INSECTS/MITES</b>		<b>INSECTICIDES</b>
European Red Mite	<b>3g, 10g</b>	<b>3.</b> Carzol 92 SP (1½ lb)
Leafrollers	<b>8e, 9e, 34e, 35e, 40e</b>	<b>8.</b> Guthion 3 F (2 pt)
Green Fruitworm	<b>26f, 34e, 35e, 40e</b>	<b>8.</b> Guthion 50 WP (2 lb)
Tarnished Plantbug	<b>3g, 34e, 35e, 40e</b>	<b>9.</b> Imidan 70 WP (2¼ lb)
Pear Psylla	<b>34e, 35e, 40e, 44e, 45g, 52g, 53g*</b>	<b>10.</b> Kelthane 35 WP (4 - 8 lb)
Pear Rust Mite	<b>3e, 10e, 30f, 45e</b>	<b>26.</b> Thiodan 50 WP (3 lb)
<b>Comments:</b> <i>Spraying at flower bud separation (green cluster) is the most effective pre-bloom timing for rust mite control.</i> <i>*--Apply as often as needed to maintain coverage.</i>		<b>30.</b> Vydate 2 E (6 pt)
		<b>34.</b> Ambush 2 E (9.6 fl oz)
		<b>35.</b> Pounce 3.2 EC (6 fl oz)
		<b>40.</b> Asana XL 0.66 EC (4.8 - 14.5 fl oz)
		<b>44.</b> Danitol 2.4 EC (16 - 21.3 oz)
		<b>45.</b> Pyramite 60 WP (8.8 - 13.2 oz)
		<b>52.</b> Esteem 35WP (5 oz)
		<b>53.</b> Surround WP (25 - 50 lb)* ▲

# PEARS

## BLOOM

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Fire Blight	1e, See Fire Blight, <i>page 43 &amp; 44</i>	1. Agrimycin 17 WP (1 1/2 lb)
Pear Scab	See Green Tip	
<b>INSECTS</b>		
Pear Sawfly	See "Special Pear Insect Problems and Controls," <i>page 56</i>	

## PETAL FALL

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Fire Blight	1e, See Fire Blight, <i>page 43 &amp; 44</i>	1. Agrimycin 17 WP (1 1/2 lb)
Pear Scab	See Green Tip	
<b>INSECTS/MITES</b>		<b>INSECTICIDES</b>
Plum Curculio	8e, 9e, 34g, 35g, 40g, 55e, 59g	3. Carzol 92 SP (1½ lb)
Green Fruitworm	26f, 34e, 35e, 40e, 55g	8. Guthion 50 WP (2 lb)
Tarnished Plantbug	26f, 34e, 35e, 40e, 54g, 55e	9. Imidan 70 WP (2 ¼ lb)
Pear Rust Mite	3e, 10e, 45e, 54g	10. Kelthane 35 WP (4 - 8 lb)
Pear Psylla	19g, 45g, 52g, 54g*, 59g	19. Provado 1.6 F (15 oz)
Codling Moth	52f	26. Thiodan 50 WP (3 lb)
<b>Comments:</b> <i>*To control Pear Psylla with Neem-based compounds requires multiple applications.</i>		26. Thiodan 3 EC (3 qt)
		34. Ambush 2 E (9.6 fl oz)
		35. Pounce 3.2 EC (6 fl oz)
		40. Asana XL 0.66 EC (4.8 - 14.5 fl oz)
		45. Pyramite 60 WP (8.8 - 13.2 oz)
		52. Esteem 35WP (5 oz)
		54. Neem compounds [AzaDirect (32 fl oz), Ecozin (10 oz)] ▲
		55. Avaunt 30WG (5 - 6 oz)
		59. Actara 25WG (4.5 - 5.5 oz)

## FIRST COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Fire Blight	1e, Following (within 24 hours) a hailstorm, <i>pages 43 &amp; 44</i>	1. Agrimycin 17 WP (1.5 lb)
Pear Scab	See Green Tip OR Rubigan 1 EC + 3 lb Dithane DF or Manzate 200 DF or Penncozeb 80 WP. Do not apply within 77 days of harvest.	
<b>Comments:</b> <i>Where Fabraea Leaf Spot or Septoria Leaf Spot are problems, continue with applications of Ziram until late July.</i>		
<b>INSECTS/MITES</b>		<b>INSECTICIDES</b>
Plum Curculio	See Petal Fall	41. Agri-Mek (20 oz) plus Paraffinic Spray Oil (1 gal)
Pear Psylla	41e, 45g, 53g*	45. Pyramite 60 WP (8.8 - 13.2 oz)
Pear Rust Mite	41e, 45e, 53g*	53. Surround WP (25 - 50 lb)* ▲
<b>Comments:</b> <i>*Apply as often as needed to maintain coverage.</i>		



## SUMMER COVERS

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Pear Scab		Flint 50 W (2.0 - 2.5 oz)
<b>Comments:</b> <i>Where Fabraea Leaf Spot or Septoria Leaf Spot are problems, continue with applications of Carbamate or Ziram until late July.</i>		Sovran 50 W (4.0 - 6.4 oz)
		Ziram 76 DF (6 - 8 lb)
		Carbamate 76 WDG (4 lb)
		Procure 50 WP (8 - 16 oz)
		+
		protectant scab fungicide
<b>INSECTS/MITES</b>		<b>INSECTICIDES</b>
Codling Moth	5g, 8e, 9e, 23g, 49f, 50g, 55f	5. Diazinon 50 WP (2 - 4 lb)
Oriental Fruit Moth	5g, 8e, 9e, 23g, 49f, 50g, 55f	8. Guthion 50 WP (2 lb)
San Jose Scale (crawlers)	5g, 52e	9. Imidan 70 WP (2 ¼ lb)
Pear Psylla	19g, 45g, 53g**, 54g*	10. Kelthane 35 WP (4 - 8 lb)
Apple Maggot	5g, 8e, 9e, 53e*	19. Provado 1.6 F (16 - 20 oz)
Mites (adults)	10g, 28g, 45e, 61g	23. Sevin 50 WP (6 lb)
Mites (immatures)	10g, 28g, 45e, 61g	23. Sevin 80 S (4 lb)
Pear Rust Mite	10e, 45e, 54g	28. Vendex 50 W (1 - 3 lb)
<b>Comments:</b> <i>*To control Pear Psylla with Neem-based compounds requires multiple applications.</i> <i>**Apply as often as needed to maintain coverage.</i>		45. Pyramite 60 WP (8.8 - 13.2 oz)
		49. Confirm 2 F (20 oz)
		50. Intrepid 2F (12 - 16 oz)
		52. Esteem 35WP (5 oz)
		53. Surround WP (25 - 50 lb)* ▲
		54. Neem compounds [AzaDirect (32 fl oz), Ecozin (10 oz)] ▲
		55. Avaunt 30WG (5 - 6 oz)
		59. Actara 25WG (4.5 - 5.5 oz)
		61. Acramite 50W (0.75 - 1.0 lb)

# Special Pear Insect Problems and Controls

## Pear Psylla

Pear psylla has become resistant to most conventional insecticides, but recent registrations have increased the tools available for control. Pyrethroid sprays (like Danitol, Asana, Brigade and Ambush) for psylla control are effective only against the overwintering generation and should not be used in the summer psylla sprays. Esteem is an insect growth regulator that can be sprayed at white-bud stage for eggs, then again at petal fall for remaining eggs and early nymphs. SURROUND WP (Kaolin) is effective in preventing adult psylla egg laying when applied starting at the green-cluster stage, but only if complete coverage is effectively maintained. It will also control nymphs in-season with good coverage of new foliage and sucker shoots. The summer treatment threshold for pear psylla is 1 psylla nymph/3 leaves. There are several products that should be considered for use in the summer. One application of Agri-Mek at 1st cover (14 days post-petal fall) will generally provide season-long control of pear psylla and pear rust mite. Agri-Mek users should be sure to use the 20 ounce rate of Agri-Mek + 1 gallon of a paraffinic spray oil (Sun Ultra Fine Oil or other summer oil) per acre. At least two applications of Provado, Actara or Pyramite are generally required for season-long control of pear psylla. These materials also have the flexibility to be used later in the summer if pear psylla populations do not exceed threshold earlier. Pyramite will also control pear rust mite. NEEM compounds like Aza-Direct and Ecozin 3% EC will control psylla nymphs (and rust mites), but require continued applications to suppress psylla populations.

## Pear Sawfly

This insect was reported in Michigan in 1992. Fruit damaged from this pest is found periodically in southern Michigan counties like Van Buren County. This insect is related to, and is similar in appearance to, the European apple sawfly, a pest in the Hudson Valley of New York. Pear sawfly females fly during pear bloom, and lay an egg directly into the developing flower pistil. The hatching larva feeds in the developing pear and exits the fruit to pupate in the soil. Control is difficult, but pear sawfly will not likely become a pest problem in commercial pear orchards. This insect is not the same as pear slug, which is an incidental defoliator.

# PEACHES AND NECTARINES

The rates of materials are based on a standard of 300 gallons per acre dilute spray for mature trees. If rates less than 300 gallons are applied per acre, refer to the rate-per-acre column to insure the proper amount of pesticide is applied.

After each pest appears a column of numbers and letters. These are provided to assist growers in choosing materials to use to control specific pests. The

number refers to the pesticide in the column headed "Suggested Chemicals" and the letter is a rating of efficiency: e = excellent, g = good, f = fair, p = poor for the pesticide in controlling the pest, and n = not labeled or no activity against this pest.

Products listed by the Organic Materials Review Institute (OMRI) for use in organic production will be marked with the following designation: ▲

## DORMANT

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Peach Leaf Curl	4e, 51e, 53e, 57e, 58e*	4. Bravo 720 (3 1/8 - 4 pt)
Bacterial Spot	4n, 51n, 53n, 57f, 58f*	51. Ziram 76 DF (3 3/4 - 6 lb)
Valsa Canker	See page 62	53. Carbamate 76 WDG (4 1/2 - 6 lb)
Crown Gall	See page 63	57. Bordeaux mixture (see page 62)
<b>Comments:</b>		58. Fixed coppers (Kocide, Champ, COCS, and others)*
*--Rates for fixed coppers should contain 4 to 8 lb of <b>metallic copper equivalent</b> . For example, use Kocide 101 or COCS at 12 lb/acre.		
The addition of lime to fixed copper sprays will increase the effectiveness of peach leaf curl sprays (see product label for instructions). Bordeaux (see page 62) is a persistent and economical copper/lime combination for peach leaf curl. Lime is not compatible with Tenn-cop or other copper salts of fatty and rosin acids.		
Apply leaf curl sprays in autumn after leaf drop or spring before bud swell. Kocide, Tennacop (Citcop), COCS can also be used against peach leaf curl (use before bud swell in the spring, or in the fall), and are less messy than Bordeaux. The coppers have some suppression of bacterial spot, which is a problem with some susceptible varieties (see page 62).		
<b>INSECTS</b>		<b>INSECTICIDES</b>
Peach Tree Borer (Pre-plant dip only)	See page 63 26e, 32e	26. Thiodan 3 EC
<b>Comments:</b>		32. Lorsban 4 F (3 qt)/100 gal
See Special Problems: Peach Tree Borer		

## DELAYED DORMANT

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>INSECTS</b>		<b>INSECTICIDES</b>
San Jose Scale	24e, 32e, 52e, 56	24. Superior Oil (6 gals)**
Peach Twig Borer	32e, 56	32. Lorsban 4 E (3 pt)
Climbing Cutworms	32e, 34e*, 35e*, 40e	34. Ambush 2 EC (9.6 fl oz)*
<b>Comments:</b>		35. Pounce 3.2 EC (6 fl oz)*
*--Peaches only.		40. Asana XL 0.66 EC (4.8 - 14.5 fl oz)
**--Unless applied dilute (300 gal/A) the use of oil is questionable.		52. Esteem 35WP (5 oz)
		56. Supracide 2E (3 - 12 pts)

# PEACHES AND NECTARINES

## PINK

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>Comments:</b>
Brown Rot	See Bloom*	*Sprays for American brown rot are initiated at bloom
Valsa Canker	See page 62	
<b>INSECTS/MITES</b>		<b>INSECTICIDES</b>
Tarnished Plant Bug	34e, 35e, 40e	34. Ambush 2 EC (9.6 fl oz)*
Green Fruitworm	34e, 35e, 40e, 46e	35. Pounce 3.2 EC (6 fl oz)
Oriental Fruit Moth	47g	40. Asana XL 0.66 EC (4.8 - 14.5 fl oz)
<b>Comments:</b>		46. Spintor 2 SC (4 - 8 oz)
*--Peaches only.		47. Oriental Fruit Moth mating disruption products**
**--Place pheromone dispensers in the orchard prior to moth emergence in the spring. Refer to the label to determine the application rate and number of treatments recommended for a particular product. Monitor the orchard with pheromone traps and by visual inspection of fruit.		

## BLOOM

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Brown Rot	2e, 4g, 5e, 6g, 7e, 8e, 14f, 50g	2. Indar 75 WSP (2 oz)
Valsa Canker	See page 62	4. Bravo 720 (3 ½ - 5½ pt)
<b>Comments:</b>		5. Nova 40 W (2.5 - 6.0 oz)
Where pink bud spray is omitted, or if weather is unusually favorable for brown rot, begin bloom sprays earlier and continue at 2- to 4-day intervals if wet, rainy weather prevails.		6. Vangard 75 WG (5 oz)**
		7. Orbit 3.6 EC (4 fl oz)
		8. Elite 45 DF (6 oz)
		14. Wettable Sulfur 95 WP (15 lb)
		50. Captan 50WP (8 lb)
		<b>Comments:</b>
		**--Do not use Vangard past bloom in peaches. Fungicide-resistant plant pathogens may develop where Topsin-M are used. Topsin-M will not control Benlate-resistant pathogens. Flowable sulfur, liquid sulfur, and less concentrated wettable sulfur should be used at rates that will give the same amount of sulfur as the 95% wettable powder formulation except where prohibited by the product label.



# PEACHES AND NECTARINES

## PETAL FALL

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Brown Rot	2e, 4g, 5e, 7e, 8e, 14f, 50g	2. Indar 75 WSP (2 oz)
Powdery Mildew	2g, 4n, 5g, 7g, 8g, 14g, 50n	4. Bravo 720 (3 1/8 - 5 1/2 pt)
<b>Comments:</b>		5. Nova 40 W (2.5 - 6.0 oz)
<i>Powdery mildew is sometimes an economic problem in southwest Michigan, particularly on Rio-Oso-Gem and Redskin.</i>		7. Orbit 3.6 EC (4 fl oz)
		8. Elite 45 DF (6 oz)
		14. Wettable sulfur 95 WP (15 lb)
		50. Captan 50 WP (8 lb)
<b>INSECTS</b>		<b>INSECTICIDES</b>
Plum Curculio	8e, 9e, 34e, 35e, 40e	5. Diazinon 50 WP (3 lb)
Oriental Fruit Moth	5g, 8e, 9e, 11f, 23f, 34g, 35g, 40g, 46g, 52f	8. Guthion 50 WP (1 ¼ - 2 1/4 lb)
Rose Chafer	11f, 23g, 54f, 57, 58	9. Imidan 70 WP (2 1/4 lb)
Tarnished Plant Bug	11g, 26f, 34e, 35e, 40e, 54g	11. Lannate 90SP (1 - 2 lb)*
Green Peach Aphid	5g, 11g, 26g, 54g, 57, 58	11. Lannate 2.4LV (3 - 6 pts)*
Thrips	11g, 46g, 57, 58	23. Sevin 50 WP (6 lb)
<b>Comments:</b>		23. Sevin 80 S (4 lb)
<i>* Use Lannate on peaches only.</i>		23. Sevin XLR+ (2 qt)
		26. Thiodan 3 EC (3 qt)
		26. Thiodan 50 WP (3 lb)
		34. Ambush 2 EC (9.6 fl oz)
		35. Pounce 3.2 EC (6 ft oz)
		40. Asana XL 0.66 EC (4.8 - 14.5 ft oz)
		46. SpinTor 2SC (6-8 oz)
		52. Esteem 35WP (5 oz)
		54. Neem compounds [AzaDirect (32 fl oz), Ecozin (10 oz)] ▲
		57. Pyganic EC 1.4 (16 - 32oz) ▲
		58. Evergreen EC 60-6 (8 - 16oz)

## SHUCK SPLIT

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Brown Rot	2e, 14f, 50g	2. Indar 75 WSP (2 oz)
Powdery Mildew	2g, 14g, 50n	14. Wettable sulfur 95 WP (15 lb)
Peach Scab	2e, 14g, 50e	50. Captan 50 WP (8 lb)
Bacterial Spot	See page 62	<b>Comments:</b>
		<i>Topsin-M is omitted on peaches and nectarines at shuck split through fourth cover in order to delay resistance problems.</i>
		<i>Flowable sulfur, liquid sulfur and less concentrated wettable sulfur should be used at rates that will give the same amount of sulfur as the 95% wettable powder formulation except where prohibited by the product label.</i>
<b>INSECTS</b>		<b>INSECTICIDES</b>
Plum Curculio	See Petal Fall	5. Diazinon 50 WP (3 lb)
Oriental Fruit Moth	See Petal Fall	23. Sevin 80 S (4 lb)
Rose Chafer	See Petal Fall	23. Sevin 50 WP (6 lb)
Lecanium Scale	5g, 23g, 52e	26. Thiodan 50 WP (3 lb)
Tarnished Plant Bug	26f, 40e	26. Thiodan 3 EC (3 qt)
		40. Asana XL 0.66 EC (4.8 - 14.5 fl oz)
		52. Esteem 35WP (5 oz)

# PEACHES AND NECTARINES

## FIRST COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Brown Rot	Fungicides listed under Shuck Split	
Peach Scab	Fungicides listed under Shuck Split	
Powdery Mildew	Fungicides listed under Shuck Split	
Bacterial Spot	See page 62	
X-Disease	See page 62	
<b>Comments:</b> <i>Peach scab is sometimes an economic problem in southwest Michigan. It is usually more severe on late maturing varieties, and fruits should be protected to at least 60 days of harvest.</i>		
<b>INSECTS</b>		
Oriental Fruit Moth	See Petal Fall	<b>INSECTICIDES</b> 23. Sevin 50 WP (1 - 2 lb/100 gal)
Tarnished Plant Bug	See Shuck Split	
Earwigs	23g	
Rose Chafer	See Petal Fall	
<b>Comments:</b> <i>Earwigs are slim brown insects 1 -inch long with pincers on the rear. They will sometimes feed on foliage or in peaches with split pits. Apply Sevin to trunk and soil around trees.</i>		

## SECOND COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Peach Scab	Fungicides listed under Shuck Split	
Powdery Mildew	Fungicides listed under Shuck Split	
Bacterial Spot	See page 62	
<b>INSECTS</b>		
Oriental Fruit Moth	See Petal Fall	<b>INSECTICIDES</b> 26. Thiodan 3 EC (1 qt/100 gal) 32. Lorsban 4 E (3 qt/100 gal)*
Lesser Peach Tree Borer	26g, 32e*	
<b>Comments:</b> <i>For lesser peach tree borer control: Apply sprays between June 3 to 10, and if using Thiodan, apply another 3 weeks later. Apply with a hydraulic gun as a coarse dilute spray, with concentration on scaffold limbs, crotches and trunk. Avoid contact with foliage and fruit.</i>		
<b>Comments</b> *--Limited to 1 application/season.		

## THIRD COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Peach Scab	Fungicides listed under Shuck Split	
Powdery Mildew	Fungicides listed under Shuck Split	
Bacterial Spot	See page 62	
<b>INSECTS</b>		
Oriental Fruit Moth	See Petal Fall	<b>INSECTICIDES</b> 17. Apollo SC (4 - 8 oz)* 26. Thiodan 3 EC (1 qt/100 gal) 32. Lorsban 4 E (3 qt/100 gal) ** 42. Savey 50 WP (3 - 6 oz)* 42. Savey 50 DF (3 - 6 oz)* 45. Pyramite 60 W (4.4 - 6.6 oz) 61. Acramite 50W (0.75-1.0 lb)
Lecanium Scale	See Shuck Split	
Peach Tree Borer	26g, 32e	
European Red Mite	17e*, 42e*, 45e, 61g	
Two-spotted Spider Mite	17e*, 42e*, 45g***, 61e	
Tarnished Plant Bug	See Petal Fall	
<b>Comments:</b> **--For peach borer control apply sprays the first week in July. Apply to the base of the tree as a coarse dilute spray. Use a hydraulic gun. Avoid contact with foliage and fruit. See "Peach Tree Borer," page 63. If Lorsban 4 E was used for Lesser Peach Tree Borer no additional spray for Peach Tree Borer is necessary.		
<b>Comments:</b> *--Limited to 1 application/season. ***Use 8.8 oz - 13.3 oz rate for Two-Spotted Spider Mites		

# PEACHES AND NECTARINES

## FOURTH COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Brown Rot	Fungicides listed under First Cover	
Bacterial Spot	See page 62	
<b>INSECTS</b>		<b>INSECTICIDES</b>
Oriental Fruit Moth	See Petal Fall ,9e, 11f, 23f, 46f	9. Imidan 70 W (2 - 3 lb)
Japanese Beetle	9g, 11f, 23g, 54f, 57g, 58g	11. Lannate 90SP (1 - 2 lb)*
Thrips	11g, 46g, 57, 58	11. Lannate 2.4LV (3 - 6 pts)*
		23. Sevin 80 S (4 lb)
		23. Sevin 50 WP (6 lb)
		23. Sevin XLR+ (2 qt)
		46. Spintor 2 SC (6 - 8 oz)
		54. Neem compounds [AzaDirect (32 fl oz), Ecozin (10 oz)]** ▲
		57. Pyganic EC 1.4 (32 - 64oz)*** ▲
		58. Evergreen EC 60-6 (8 - 16oz)***
		<b>Comments:</b>
		*--Use Lannate on Peaches only
		**--Primarily a repellent.
		***--These are short-lived pyrethrums with strong initial knockdown activity.

## PRE-HARVEST

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Brown Rot	2e, 7e, 8e, 14f*, 50g	2. Indar 74 WSP (2 oz)
<b>Comments:</b> Make first application 2 or 3 weeks before harvest and repeat in 5 to 10 days.		7. Orbit 3.6 EC (4 fl oz)
		8. Elite 45 DF (6 oz)
		14. Wettable sulfur 95 WP (15 lb) *
		50. Captan 50 WP (8 lb)
		<b>Comments:</b>
		<i>Fungicide-resistant plant pathogens may develop where Topsin-M are used. Topsin-M will not control Benlate-resistant pathogens.</i>
		<i>Flowable sulfur, liquid sulfur, and less concentrated wettable sulfur should be used at rates that will give the same amount of sulfur as the 95% wettable powder formulation except where prohibited by product label.</i>
		<i>*--Apply a maximum of two pre -harvest sprays during the period beginning 10-14 days before harvest through the day of harvest.</i>
<b>INSECTS</b>		
Oriental Fruit Moth	See Fourth Cover	
Japanese Beetle	See Fourth Cover	
Thrips	See Fourth Cover	

## POST-HARVEST

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
X-Disease	See page 62	

# PEACHES AND NECTARINES

## Special Peach Insect and Disease Problems and Controls

### Bacterial Spot

Bacterial spot is best controlled by planting resistant varieties. Some susceptible varieties to avoid include: Suncling, Babygold-5, Suncrest, Sunhigh, Autumn glo, and certain nectarine varieties. Bacterial spot is generally worse on sandy sites exposed to wind. The following spray schedule will help suppress the disease, but it will not provide outstanding control, particularly in severe years for infection.

**TIMING:** *In fall after leaf drop or spring before bud swell. This spray may reduce the amount of primary inoculum in spring, thus delaying the development of disease in summer. It also controls peach leaf curl.*

Bactericide	Rate/100 gal. dilute
Bordeaux mixture	
Copper sulfate	6 lb
Spray lime	6 lb

**TIMING:** *Shuck split and repeat application at 7-day intervals through the cover sprays. Shorter intervals may be needed during wet periods to maintain maximum protection.*

Bactericide	Rate/acre
Syllit (dodine) <sup>1</sup> 65 WP, plus	1 to 1 ½ lb
Captan 50 WP	4 lb
OR	
Mycoshield 17 WP <sup>2</sup>	150 ppm

<sup>1</sup>Caution: Phytotoxicity may result if combined with, or applied near, solvent formulations of insecticides or sulfur. Do not apply during periods of high temperatures, at spray concentrations above 3X, or within 15 days of harvest. Multiple applications can result in phytotoxicity if there has been no rain since last application and the residue level is high. It also controls brown rot and scab.

<sup>2</sup>Use dilute or 2X; higher concentrates are not effective and may be phytotoxic. Once a week spraying of the entire tree is essential. If only one side of the tree is sprayed (alternate middle row spraying), make certain the other side of tree is sprayed within three to four days. Treatment can be applied until three weeks of harvest.

### Valsa Canker (also called Cytospora or Leucostoma canker)

Delay pruning to pink or later to allow rapid healing. Recent studies indicate partial control of Valsa can be obtained as a benefit of using Benlate against brown rot. For best results, time the spray or sprays before rain occurs.

**Cultural Practices:** Cultural practices to harden-off the trees by the fall are important in reducing cold injury. These include late spring pruning, early cover cropping (by July 4) in clean, cultivated orchards. Do not leave stubs when pruning; remove and burn prunings as soon as possible. Develop trees with wide-angle crotches to reduce splitting.

Check trees for dead and diseased wood after growth starts and cut out and burn.

### X- Disease

Eradication of chokecherry bushes within at least a 500-foot radius of stone fruit orchards is important in the control of X-disease. Chokecherry bushes are commonly found in hedgerows, along property lines, in woods, and on other non-crop areas. Remove by bulldozing, deep plowing, burning, or pulling the individual bushes. Brush killers are effective in areas where cultivation is not possible or is too costly (see Table labeled "Brush Killers for Removal of X-Disease Hosts"). During the growing season following treatment or cultivation, check the treated area carefully for chokecherry sprouts. Any sprouts or new chokecherry seedlings should be marked for treatment in the fall or pulled out.

#### Other X-Disease Controls

1. Partial control of X-disease may be obtained as a benefit of using plum curculio, Oriental fruit moth, or plant bug insecticides that also have good activity against leafhoppers.

2. Remove infected cherry trees. X-diseased cherry on mazzard rootstock is an important source of the X-disease agent. Remove infected trees as soon as they are detected.



# PEACHES AND NECTARINES

## Brush Killers for Removal of X-Disease Hosts

Timing	Herbicide	Amount	Method of Application	Comments
Early spring	bromacil liquid (Hyvar X-L)	1 tablespoon/stump or brush clump	Hand-gun applicator	Caution: Bromacil is a soil sterilant. Growth of most vegetation will be halted in the treated area for an extended period of time (years). Do not apply Bromacil, Garlon or Weedone near ditches or where surface water may carry the material to desirable plants.
June or July	Garlon 3A plus a surfactant	2 to 3 gal/100 gal	Spray to actively growing plant	
June to September	Weedone 170	1 to 1 1/2 gal/100 gal	Spray to foliage and stems	
Any season	Weedone CB	1 to 5 gal CB/A	Spray basal bark or cut or frilled surface with knapsack sprayer	

## Biological Control of Crown Gall

Many materials and methods have been tested to control crown gall over the past 75 years, but the most successful to date has been a biological control based on the antagonistic bacterium *Agrobacterium radiobacter* strain 84. This natural bacterium has been approved as a pesticide for use on the seeds, roots, and stems of non-bearing apricot, cherry, nectarine, peach, plum, and prunes.

This pesticide, brand name "Galltrol-A," consists of a special culture plate (agar plate) containing concentrated amounts of a bacterial inoculant. Galltrol is used at the rate of 1 agar plate per gallon of water.

The bacterium is scraped from the agar plate into water (unchlorinated). Norbac is another brand of *A. radiobacter* strain 84 sold as a concentrated liquid suspension. Seeds, roots, and stems are then sprayed or dipped into the liquid. Plants should be treated soon after each handling which causes new wounds. Wash plant materials before treating. Prepare new Galltrol suspension whenever it becomes excessively dirty or after every 500 to 1000 seedlings. Discard prepared dip held more than two days.

Registered applications include treatment of seeds, seedlings, cuttings, and roots and stems of large bare-root stock. Possible breakdown in control may occur if insensitive or resistant strains of the crown gall pathogen are present. This treatment will not control latent or established infections.

## Peach Tree Borer

*Pre-Plant Treatment* to control peach tree borer: do not plant if infected with crown gall. If plants are not infested, dip trees in bundles or individually in Thiodan (3 lb/gal EC) used at the rate of 2 2/3 qt/40 gal water or Lorsban 4 E at the rate of 3 qt/100 gal water. Dip trees up to 12 inches above the grafting bud scar and plant immediately or allow to dry before returning to storage. Spray application of Thiodan as a preplant treatment is better than dip to avoid cross contamination with crown gall.

*Summer peach tree borer sprays* should be applied with a handgun sprayer and applied to the trunk and lower scaffold limbs. DO NOT apply materials to foliage and/or fruit. DO NOT apply more than one application of Lorsban 4 E per year. **Lorsban 4 E is not registered for borer control on prunes or plums.**

# PRUNES AND PLUMS

The rates of materials are based on a standard of 300 gallons per acre dilute spray for mature trees. If less than 300 gallons are applied per acre, use the rate per acre figures to insure the proper amount of chemical is applied.

After each insect and mite pest appears a column of numbers and letters. These are provided to assist growers in choosing materials to use to control specific

pests. The number refers to the pesticide in the column headed "Suggested Chemicals" and the letter is a rating of efficiency: e = excellent, g = good, f = fair, p = poor for the pesticide in controlling the pest, and n = not labeled or no activity against this pest.

Products listed by the Organic Materials Review Institute (OMRI) for use in organic production will be marked with the following designation: ▲

## DELAYED DORMANT

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Black Knot	See Comments	
<b>Comments:</b> Prune out and burn all knots in the dormant season and continue to remove knots whenever they are observed. Make pruning cuts at least 6 to 8 in. below visible swellings. Do not plant new plum orchards next to old plantings with black knot. Remove infected wild plums and cherry seedlings from fencerows and nearby wooded areas before planting.		
<b>INSECTS/MITES</b>		
European Red Mite	24e*	<b>INSECTICIDES</b> 24. Superior Oil (6 gal)* 32. Lorsban 4 EC (3 pt)** 52. Esteem 35WP (5 oz) 56. Supracide 2E (3-12 pts) <b>Comments:</b> *--Unless applied dilute (300 gal/A) the use of oil is questionable. If unable to spray dilute, consider using organic miticides applied at petal fall against motile stages of mites and control scale at the crawler stage. **--Delayed Dormant use only.
Lecanium Scale, San Jose Scale,	24e*, 32e**, 52e, 56	
Aphids	32e**, 52g, 56	
Peach Twig Borer,	32e**, 56	
Climbing Cutworms	32e**	

## GREEN TIP

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Black Knot	4g-e, 56g, 50f	<b>FUNGICIDES</b> 4. Bravo 82.5 WDG (2.8-3.8 lb) or Bravo 6F (3 1/8-4 1/8 pts) 50. Captan 50 WP (6 lb) 56. Topsin M 70 WP (1 1/2 lb) <b>Comments:</b> Fungicide-resistant plant pathogens may develop where Benlate or Topsin-M are used.

# PRUNES AND PLUMS

## BLOOM

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Brown Rot	4g, 6g, 7e, 14g*, 15f, 50g 56p,	4. Bravo 82.5 WDG (2.8 - 3.8 lb) or Bravo 6F (3 1/8 - 4 1/8 pts)
Black Knot	4g-e, 6n, 7n, 14n*, 15n, 56g, 50f	6. Vangard 75 WG (5 oz)
<b>Comments:</b> Where green tip spray is omitted, or if weather is unusually favorable for disease, begin bloom sprays earlier and continue at 2- to 4-day intervals if wet, rainy weather prevails.		7. Orbit 3.6 EC (4 fl oz, do not apply on "Stanley" type plums)
		14. Wettable sulfur 95 WP (15 lb) *
		15. Elevate 50 WDG (1 - 1.5 lb)
		50. Captan 50 WP (6 lb)
		56. Topsin-M 70 WP (1.5 lb)
		<b>Comments:</b> Fungicide-resistant plant pathogens may develop where Topsin-M is used. *--Flowable sulfur, liquid sulfur, and less concentrated wettable sulfur should be used at rates that will give the same amount of sulfur as the 95% wettable powder formulation except where prohibited by the product label.

## PETAL FALL

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Brown Rot	4g, 7e, 14g*, 15f, 50g, 56p	4. Bravo 82.5 WDG (2.8-3.8 lb) or Bravo 6F (3 1/8 - 4 1/8 pts)
Leaf Spot	7f, 14p*, 50g, 56p	7. Orbit 3.6 EC (4 fl oz, do not apply on "Stanley" type plums)
Black Knot	4g-e, 7n, 14n*, 50f, 56g	14. Wettable sulfur 95 WP (15 lb) *
<b>Comments:</b> The cherry leaf spot fungus <i>Blumeriella jaapii</i> sometimes is a problem on Stanley and related cultivars in wet years. This is not a bacterial disease.		15. Elevate 50 WDG (1 - 1.5 lb)
		50. Captan 50 WP (6 lb)
		56. Topsin-M 70 WP (1.5 lb)
		<b>Comments:</b> Fungicide-resistant plant pathogens may develop where Topsin-M is used. *--Flowable sulfur liquid sulfur and less concentrated wettable sulfur should be used at rates that will give the same amount of sulfur as the 95% wettable powder formulation except where prohibited by the product label.
<b>INSECTS</b>		<b>INSECTICIDES</b>
Plum Curculio	8e, 9e, 40e	5. Diazinon 50 WP (3 lb)
European Red Mite	42e, 45e, 61g	8. Guthion 50 WP (1 3/4 - 2 1/2 lb)
Two-spotted Spider Mite	42e, 45g**, 61e	9. Imidan 70 WP (2 1/4 lb)
Oriental fruit Moth	8e, 9e, 40g, 46g, 52f	40. Asana XL 0.66 EC (4.8 - 14.5 fl oz)
Aphids	5g	42. Savey 50 WP (3 - 6 oz)*
<b>Comments:</b> *--Limited to 1 application/season. ** Use 8.8 oz - 13.3 oz rate for Two-Spotted Spider Mites		42. Savey 50 DF (3 - 6 oz)*
		45. Pyramite 60 W (4.4 - 6.6 oz)**
		46. SpinTor 2SC (6 - 8 oz)
		52. Esteem 35WP (5 oz)
		61. Acramite 50W (0.75 - 1.0 lb)

# PRUNES AND PLUMS

## SHUCK SPLIT

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Brown Rot	4g, 14p, 50g, 56p	4. Bravo 82.5 WDG (2.8 - 3.8 lb) or Bravo 6F (3 1/8 - 4 1/8 pts)*
Leaf Spot	14g, 50g, 56p	14. Wettable sulfur 95 WP (15 lb)
Black Knot	4g-e, 14n, 50f, 56g	50. Captan 50 WP (6 lb)* 56. Topsin-M 70 WP (1 1/2 lb)
		<b>Comments:</b> *--Captan applied from shuck split through early July can cause shot-holing of leaves and spotting of fruit of Stanley and Japanese Plums. Do not apply Bravo after shuck split.
<b>INSECTS</b>		
Plum Curculio	See Petal Fall	

## FIRST COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Brown Rot	See Shuck Split	
Leaf Spot	See Shuck Split	
Black Knot	See Shuck Split	
<b>INSECTS</b>		<b>INSECTICIDES</b>
Scale*	5g, 52e	5. Diazinon 50 WP (3 lb)
Peach Tree Borers**	26g See page 63	26. Thiodan 3 EC (1 qt/100 gal) 52. Esteem 35WP (5 oz)
Plum Curculio	See Petal Fall	<b>Comments:</b> *Sprays for scale should be timed when crawlers become active. **Lorsban 4 EC is not registered for borer control on plums or prunes.

## SECOND COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Leaf Spot	See Shuck Split	
Black Knot	See Shuck Split	
<b>INSECTS</b>		<b>INSECTICIDES</b>
Apple Maggot	8e, 9e	8. Guthion 50 WP (1 3/4 - 2 1/2 lb) 9. Imidan 70 WP (2 1/4 lb)
<b>Comments:</b> Call the local pest management code-a-phone or determine from the Extension agent when sprays for apple maggot should be applied.		

# PRUNES AND PLUMS

## THIRD AND FOURTH COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Leaf Spot	See Shuck Split	
<b>INSECTS/MITES</b>		
Apple Maggot	See Second Cover	
Mites	28g, See Petal Fall	
Japanese Beetle	8e, 9e, 23e, 54g, 57g, 58g	
Leafhoppers	8g, 9g, 23g, 45f, 57, 58	
Aphids	5g, 54g, 57, 58	
*--Primarily a repellent.		
**--These are short-lived pyrethrums with strong initial knockdown activity.		
		<b>INSECTICIDES</b>
		5. Diazinon 50 WP (3 lb)
		8. Guthion 50 WP (1 3/4 - 2 1/2 lb)
		9. Imidan 70 WP (2 1/4 lb)
		23. Sevin 80 S (4 lb)
		23. Sevin 50 WP (6 lb)
		23. Sevin XLR+ (2 qt)
		28. Vendex 50 WP (1 - 2 lb)
		45. Pyramite 60 W (8.8 - 13.3 oz)
		54. Neem compounds [AzaDirect (32 fl oz), Ecozin (10 oz)]* ▲
		57. Pyganic EC 1.4 (32 - 64 oz)** ▲
		58. Evergreen EC 60-6 (8 - 16 oz)**

## PRE-HARVEST

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Brown Rot	7e**, 14f*, 15f, 50g	
Leaf Spot	7f**, 14f*, 15p, 50g	
<b>Comments:</b> Make first preharvest application for brown rot 2 to 3 weeks before harvest and repeat in 5 to 10 days.		
		<b>FUNGICIDES</b>
		7. Orbit 3.6 EC (4 fl oz, do not apply on "Stanley" type plums)**
		14. Wettable sulfur 95 WP (15 lb)*
		15. Elevate 50 WDG (1-1.5 lb)
		50. Captan 50 WP (6 lb)
<b>Comments:</b> Fungicide-resistant plant pathogens may develop where Topsin-M is used. *--Flowable sulfur, liquid sulfur and less concentrated wettable sulfur should be used at rates that will give the same amount of sulfur as the 95% wettable powder formulation except where prohibited by the product label. **--Apply a maximum of two pre-harvest sprays during the period beginning 10 - 14 days before harvest through the day of harvest.		



# TART CHERRIES

The rates of materials are based on a standard of 300 gallons per acre dilute spray for mature trees. If rates less than 300 gallons are applied per acre, refer to the rate-per-acre to insure the proper amount of chemical is applied.

After each pest appears a column of numbers and letters. These are provided to assist growers in choosing materials to use to control specific pests. The number

refers to the pesticide in the column headed "Suggested Chemicals" and the letter is a rating of efficiency: e = excellent, g = good, f = fair, p = poor for the pesticide in controlling the pest, and n = not labeled or no activity against this pest.

Products listed by the Organic Materials Review Institute (OMRI) for use in organic production will be marked with the following designation: ▲

## DORMANT

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Crown Gall	See page 63	
Phytophthora Root Rot	See "Special Tart Cherry Disease Problems and Controls," page 75	
<b>INSECTS/MITES</b>		
Mineola Moth	5g, 8e, 9e, 23g, 34e, 35e, 40e	<b>INSECTICIDES</b> 5. Diazinon 50 WP (3 lb) 8. Guthion 50 WP (1 ½ lb) 9. Imidan 70 WP (2 1/4 lb) 23. Sevin 50 WP (6 lb) 24. Superior Oil (6 gal)* 32. Lorsban 4 E (3 pt) 34. Ambush 2 EC (9.6 fl oz) 35. Pounce 3.2 EC (6 fl oz) 40. Asana XL 0.66 EC (4.8 - 14.5 fl oz) 52. Esteem 35WP (5 oz) 56. Supracide 2E (3 - 12 pts)
Eyespotted Bud Moth	5g, 8e, 9e, 23g, 34e, 35e, 40e	
Mites	24e*	
Scales	24e*, 32e, 52e, 56	
		<b>Comments:</b> *--Unless applied dilute (300 gal/A), the use of oil is questionable. Growers unable to spray dilute should consider using organic miticides applied at petal fall against motile stages of mites and to control scales at crawler stage.

## GREEN TIP

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Bacterial Canker	See "Special Tart Cherry Disease Controls," page 75	

# TART CHERRIES

## PRE-BLOOM (WHITE BUD STAGE)

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Bacterial Canker	See "Special Tart Cherry Disease Controls," page 75	2. Indar 75 WSP (2 oz)
European Brown Rot on Cultivar Meteor*	2e	<b>Comments:</b> European Brown Rot is primarily on Meteor but it is occasionally found on Montmorency. To date, European Brown Rot has only been detected in west central and northwest Michigan. It is a problem during bloom when the fungus attacks the flower parts and moves into the spurs. Indar has give significant control in a Michigan test; Rubigan, Nova, Rovral and Bravo gave poor control in the same tests.
Brown Rot (American)**	See Bloom	
<b>Comments:</b> *--Two sprays, at white bud and again at bloom, are needed to control European Brown Rot. **--In most years spray programs initiated when 10 - 20% of the flowers are open will give economic control of American brown rot. Infection at "white bud" is rare, but may occur where a large number of brown rot infected fruit are present from the previous season and a prolonged period of warm (above 60° F) wet weather occurs. If these conditions occur in unprotected orchards, use the maximum rate of Indar, 24 - 48 hr after the beginning of the wet weather.		
<b>INSECTS</b>		<b>INSECTICIDES</b>
Green Fruitworm	26f, 32e, 34e, 35e, 40e, 46e	26. Thiodan 50 WP (3 lb)
Plum Nursery Mite	28g	28. Vendex 50 WP (1 1/2 - 3 lb)
		32. Lorsban 50 W (2 - 3 lb)
		34. Ambush 25 WP (9.6 oz)
		35. Pounce 25 WP (9.6 oz)
		40. Asana XL 0.66 EC (4.8 - 14.5 fl oz)
		46. SpinTor 2 SC (6 - 8 oz)

## BLOOM

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Bacterial Canker	See "Special Tart Cherry Disease Controls," page 75	2. Indar 75 WSP (2 oz)
European Brown Rot on Cultivar Meteor	2e	4. Bravo 720 (3 1/8 - 51/2 pt)
Brown Rot (American)	2e, 4f-g, 5e, 6g*, 7e, 8e, 14f**	5. Nova 40 W (2.5 - 6.0 oz)
		6. Vangard 75 WG (5 oz)*
		7. Orbit 3.6 EC (4 fl oz)
		8. Elite 45 DF (6 oz)
		14. Wettable sulfur 95 WP (15 lb) **
		<b>Comments:</b> *--Do not apply Vangard past bloom in tart cherries. **--Flowable sulfur, liquid sulfur and less concentrated wettable sulfur should be used at rates that will give the same amount of sulfur as the 95% wettable powder formulation except where prohibited by the product label. Because Benlate/Topsin-M-resistant brown rot and leaf spot are widespread in Michigan, Topsin-M is not recommended for cherries.

# TART CHERRIES

## PETAL FALL

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Bacterial Canker	See "Special Tart Cherry Disease Controls," page 75	2. Indar 75 WSP (2 oz)
Brown Rot	2e, 4f-g, 5e, 7e, 8e, 10p/n	4. Bravo 720 (3 1/8 5 1/2 pt)
Leaf Spot	2g, 4e, 5g, 7f, 8g, 10f-g	5. Nova 40 W (2.5 - 6.0 oz)
<b>Comments:</b> The Elite/Captan tank mix may be applied as a resistance management strategy for sterol inhibitor fungicides. This use is permitted only in Michigan as a FIFRA Section 2(ee) recommendation.		7. Orbit 3.6 EC (4 fl oz)
		8. Elite 45 DF (6 oz) or Elite 45 DF (4 oz) plus Captan 50 WP (3 lb)
		10. Rubigan 1 EC (6 - 12 fl oz)
		<b>Comments:</b> Because Benlate-resistant brown rot and leaf spot are widespread in Michigan, Topsin-M is not recommended for cherries past bloom.
<b>INSECTS</b>		<b>INSECTICIDES</b>
Green Fruitworm	26f, 32e, 34e, 35e, 40e, 46e	5. Diazinon 50 WP (3 lb)
Leafrollers	8e, 9e, 32e, 40e, 46e	8. Guthion 50 WP (1 1/2 lb)
Plum Curculio	8e, 9e, 32g***, 34g, 35g, 40g	9. Imidan 70 WP (2 1/4 lb)
Rose Chafer	8g, 9g, 23g, 32g***, 40e, 54f	23. Sevin 50 WP (6 lb)
American Plum Borer	32e**. See "Special Tart Cherry Insect Problems and Controls" on page 76	23. Sevin 80 S (4 lb)
		26. Thiodan 50 WP (3 lb)
Black Cherry Aphid	5g, 54g, 57, 58	32. Lorsban 50 W (2 - 3 lb) ***
		32. Lorsban 4 E (3 qt/100 gal) **
		34. Ambush 25 WP (9.6 oz)
		35. Pounce 25 WP (9.6 oz)
		40. Asana XL 0.66 EC (4.8 - 14.5 fl oz)
		46. Spintor 2 SC (4 - 8 oz)
		54. Neem compounds [AzaDirect (32 fl oz), Ecozin (10 oz)] ▲
		57. Pyganic EC 1.4 (16 - 32oz) ▲
		58. Evergreen EC 60-6 (8 - 16oz)
		<b>Comments:</b> **--Lorsban 4E only ***--Use Lorsban 50 W only

## SHUCK FALL

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Bacterial Canker	See "Special Tart Cherry Disease Controls," page 75	2. Indar 75 WSP (2 oz)
Leaf Spot	2g, 4e, 5g, 8g, 10f-g, 11g	4. Bravo 720 (3 1/8 - 5 1/2 pt)
Brown Rot	2e, 4f-g, 5p/n, 8e, 10p/n, 11p/n	5. Nova 40W (5 - 6oz)
		8. Elite 45 DF (6 oz) or Elite 45 DF (4 oz) plus Captan 50 WP (3 - 4 lb)
		10. Rubigan 1 EC (6 - 12 fl oz)
		11. Syllit (dodine) 65 WP (1 - 2 lb)
		<b>Comments:</b> Do not use Bravo after shuck split; may resume use after harvest.

# TART CHERRIES

## FIRST COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Leaf Spot	2g, 5g, 8g, 10f-g, 11g	2. Indar 75 WSP (2 oz) 5. Nova 40 W (5 - 6 oz) 8. Elite 45 DF (6 oz) or Elite 45 DF (4 oz) plus Captan 50 WP (3 - 4 lb) 10. Rubigan 1 EC (6 - 12 fl oz) 11. Syllit (dodine) 65 WP (1 - 2 lb)
<b>INSECTS</b>		<b>INSECTICIDES</b>
Plum Curculio	See Petal Fall	26. Thiodan 3 EC (1 qt/100 gal)
Peach Tree Borer	26g, 32e. See "Special Tart Cherry Insect Problems and Controls" on page 76	32. Lorsban 4 E (3 qt/100 gal)
Lesser Peach Tree Borer		
<b>Comments:</b> For lesser peach tree borer control, apply sprays between June 3 and 10. Apply with a hydraulic gun as a coarse dilute spray concentrating on scaffold limbs, crotches and trunk		

## SECOND COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Leaf Spot	Fungicides listed under First Cover	
<b>INSECTS</b>		<b>INSECTICIDES</b>
Scale	5g, 32e	5. Diazinon 50 WP (3 lb)
Plum Curculio	See Petal Fall	32. Lorsban 50W (2 - 3 lbs)
<b>Comments:</b> Apply spray for scales when crawlers become active.		

## THIRD COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Leaf Spot	See First Cover	
<b>INSECTS/MITES</b>		<b>INSECTICIDES</b>
Cherry Fruit Fly	5g, 8e, 9e, 23g, 34f, 35f, 40g	1. Omite-CR**
Plum Nursery Mite	28e	5. Diazinon 50 WP (3 lb)
Rose Chafer	See Petal Fall, 57, 58	8. Guthion 50 WP (1 1/2 lb)
Scale	See Second Cover	9. Imidan 70 WP (2 1/4 lb)
European Red Mite	1g**, 17e*, 28g, 42e*	17. Apollo SC (4 - 8 oz)*
Two-spotted Spider Mite	1g**, 17e*, 28g, 42e*	23. Sevin 50 WP (6 lb)
<b>Comments:</b> Call the local pest management code-a-phone or determine from the Extension agent when sprays for cherry fruit fly should be applied.		23. Sevin 80 S (4 lb)
		28. Vendex 50 WP (2 - 3 lb)
		34. Ambush 25 WP (9.6 oz)
		35. Pounce 25 WP (9.6 oz)
		40. Asana XL 0.66 EC (4.8 - 14.5 fl oz)
		42. Savey 50 WP (3 - 6 oz)*
		42. Savey 50 DF (3 - 6 oz)*
		57. Pyganic EC 1.4 (32 - 64 oz) ▲
		58. Evergreen EC 60-6 (8 - 16oz)
		<b>Comments:</b> *--Use is limited to 1 application per season. **--For use on non-bearing orchards only.

# TART CHERRIES

## CHERRY FRUIT FLY AERIAL CONTROL

### METHOD

Flat Fan Nozzles

13e

13. Malathion LV Concentrate (12 oz)

### PRE-HARVEST

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Leaf Spot	2g, 5g, 7f, 8g, 10f-g, 11g	2. Indar 75 WSP (2 oz)
Brown Rot	2e, 5p/n, 7e, 8e, 10p/n, 11f	5. Nova 40 W (5 - 6 oz)
<b>Comments:</b> Make first preharvest application for brown rot 2 or 3 weeks before harvest and repeat in 5 to 10 days.		7. Orbit 3.6 EC (4 fl oz)
		8. Elite 45 DF (6 oz) or Elite 45 DF (4 oz) plus Captan 50 WP (3 - 4 lb)
		10. Rubigan 1 EC (6 - 12 fl oz)
		11. Syllit (dodine) 65 WP (1 1/2 lb), plus Wettable sulfur 95 WP (9 lb)
		<b>Comments:</b> Flowable sulfur, liquid sulfur, and less concentrated wettable sulfur should be used at rates that will give the same amount of sulfur as the 95% wettable powder formulation except where prohibited by the product label. Because Benlate-resistant brown rot and leaf spot are widespread in Michigan, Topsin-M is not recommended for cherries.
<b>INSECTS</b>		
Cherry Fruit Fly	See Third Cover	

### POST-HARVEST

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Leaf Spot	2g, 4e, 5g, 8g, 10f-g, 11g	2. Indar 75 WSP (2 oz)
		4. Bravo 720 (4 1/8 pt)
		5. Nova 40 W (5 - 6 oz)
		8. Elite 45 DF (6 oz)
		10. Rubigan 1 EC (6 - 12 fl oz)
		11. Syllit (dodine) 65 W (2 lb)
<b>INSECTS</b>		<b>INSECTICIDES</b>
Peach Tree Borer	See page 76	28. Vendex 50 WP (1 - 3 lb)
Two-spotted Spider Mite	28g, 45g	45. Pyramite 60 WP (8.8 - 13.3 oz)
Plum Nursery Mite	28e, 45g	



# TART CHERRIES

## Special Tart Cherry Disease Problems and Controls

### Brown Rot, Leaf Spot and Powdery Mildew Control in Tart and Sweet Cherries

Protectant sprays are the backbone of effective control of common cherry diseases. They are typically applied on a 7- to 10-day spray schedule. It is no longer possible without Difolitan to control these diseases on a 14-day spray schedule. A protectant program should be strictly adhered to when controlling brown rot, particularly in sweet cherries. Brown rot develops too quickly to rely on after-infection control. With cherry leaf spot, after-infection spray programs are not generally recommended because they do not reduce fungicide usage adequately for the risk that's taken. Growers have, however, been successful with after-infection sprays following unanticipated infection periods during droughty periods.

An alternate row spray program where the interval does not exceed 7 days is an effective IPM strategy for reducing the total amount of fungicide used between petal fall and 3-4 weeks before harvest. Brown rot sprays in the last few weeks prior to harvest should be applied on an every middle basis, especially in sweet cherries.

With the increased reliance on the sterol inhibitors in recent years, resistance is a great concern. Whenever possible, growers should use 2-3 full cover sprays per year to control brown rot or leaf spot from another fungicide category, other than "sterol inhibitors," to postpone or prevent resistance within this valuable category of fungicides.

The relative strengths and weaknesses of currently available fungicides for cherry diseases are outlined below.

**Table 1.**  
Background information on cherry fungicides  
(compiled by Gary Thornton and Alan L. Jones)

#### Fungicide Categories

##### *Anilinopyrimidine*

- |                     |                                  |
|---------------------|----------------------------------|
| <b>Vanguard</b>     | • a protectant fungicide         |
| <b>(cyprodinil)</b> | • blossom brown rot control good |
|                     | • not effective for leaf spot    |
|                     | • do not use on sweet cherries   |

**Table 1 (continued)**  
Background information on cherry fungicide

#### *Sterol Inhibitors (SI fungicides)*

*These compounds are locally systemic in the foliage and blossoms. Once applied, they are absorbed within a few minutes into the leaves and blossoms: The absorbed fungicide cannot be washed off. Regular sprays will increase the overall effectiveness of the control program. Postsymptom control is not adequate to control infections after they are observed, and some defoliation will occur. Wetting agent is required when using Indar, and may improve activity.*

**Nova 40 W (myclobutanil)** Blossom Brown Rot—Excellent

- Protectant—3-5 days
- Back action—24-36 hours, dependent on temperature

Leaf Spot—Good; commonly used at 5 oz/acre

- Protectant—3-5 days
- Back action (no precise data available)
- Maximum interval between sprays for effective control is 10 days when used in a regular program of SI sprays

Powdery Mildew—Good

- Best control when used on a regular schedule
- Wetting agent should improve effectiveness

Fruit Brown Rot—Not labeled for this use; activity very poor

**Rubigan 1 EC (fenarimol)** Blossom Brown Rot—Not labeled for this use; activity very poor

Leaf Spot—6 oz/acre—Fair; 12 oz/acre—Good

- Protectant—3-5 days
- Back action (no precise data available)
- Maximum interval between sprays for effective control is 7-10 days when used in a regular program of SI sprays

Powdery Mildew—Good

Fruit Brown Rot—Not labeled for this use; activity very weak

**Elite 45 DF (tebuconazole)** Blossom Brown Rot—Excellent

- Protectant—4-5 days
- Back action—24-36 hours

Leaf Spot—Good

- Protectant—3-5 days
- Back action (no precise data available)
  - Maximum interval between sprays for effective control is 7-10 days when used in a regular program of SI sprays

Powdery Mildew—Good

Fruit Brown Rot—Excellent

# TART CHERRIES

**Table 1 (continued).**  
Background information on cherry fungicides

## Fungicide Categories

<b>Indar 75 WSP</b> (fenbuconazole)	<i>Blossom Brown Rot—Excellent</i> • Protectant—4-5 days • Back action—24-36 hours <i>European Brown Rot—Excellent control on Meteor in 1994</i> <i>Leaf Spot—Good</i> • Protectant—3-5 days • Back action (no precise data available) • Maximum interval between sprays for effective control is 7-10 days when used in a regular program of SI sprays <i>Powdery Mildew—Not labeled for this use; no data available</i> <i>Fruit Brown Rot—Excellent</i> • Wetting agent recommended
<b>Orbit 3.6 EC</b> (propiconazole)	<i>Blossom Brown Rot—Excellent</i> • Protectant—4-5 days • Back action—24-36 hours <i>Leaf Spot—activity fair</i> <i>Fruit Brown Rot—Excellent</i> • Maximum of two pre-harvest sprays
<b>Strobilurin</b>	
<b>Flint</b> (trifloxystrobin)	<i>Blossom Brown Rot—Not labeled for use before petal fall</i> <i>Leaf Spot—Good</i> • Protectant—7-10 days • Back action; no data available <i>Powdery Mildew—Good</i> • Protectant—7-10 days • Back action; no data available <i>Fruit Brown Rot—Weak</i> • Protectant—7-10 days • Back action; no data available
<b>Cabrio</b> (pyraclostrobin)	<i>Blossom Brown Rot—Weak</i> <i>Leaf Spot—Weak</i> <i>Fruit Brown Rot—Weak</i> <i>Powdery mildew—Good</i>
<b>Benzene Compounds</b>	
<b>Bravo 6F</b> (chlorothalonil)	<i>Blossom Brown Rot—Good</i> • Protectant—5-7 days • Back action—None <i>Leaf Spot—Excellent</i> • Protectant—7-10 days • Back action—None • Do not use after shuck split, except post-harvest <i>Fruit Brown Rot—Not labeled after shuck split</i>
<b>Guanidines</b>	
<b>Syllit 65</b> (dodine)	<i>Leaf Spot—Good (where dodine resistance does not occur)</i> • Protectant—5-7 days • Back action—36 hours <i>Fruit Brown Rot—Poor; Fair if tank mixed with sulfur or Captan</i> • Protectant—7-10 days • Back action—None

## Dimethyldithiocarbamates

<b>Carbamate</b> <b>76W (ferbam)</b> <b>+ sulfur 95 WP</b>	<i>Leaf Spot—Fair—sweets; Poor—tarts</i> • Protectant—4-6 days • Back action—None <i>Fruit Brown Rot—Fair—sweets; Fair—tarts</i> • Protectant—4-6 days • Back action—None
<b>Ziram 76 W</b> (ziram)	<i>Leaf Spot—Fair—sweets; Poor—tarts</i> <i>Fruit Brown Rot—Fair; best tank mixed with Sulfur 95 W or Captan 50 WP</i>

## Heterocyclic Compounds

<b>Captan 50 WP</b> (captan)	<i>Only use in combination with Topsin-M or Syllit due to the low maximum labeled rate of 4 lb/acre. IR-4 is attempting to increase the label rate.</i>
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## Dicarboximides

<b>Rovral 50 WP</b> (iprodione)	• Maximum of 2 applications per season. • Do not apply after petal fall <i>Blossom Brown Rot—Excellent</i> • Protectant—4-5 days • Back action—24 hours <i>Leaf Spot—Fair</i> • Protectant—5-7 days • Back action (no data available)
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## Benzimidazoles

<b>Benlate</b> (Benomyl) 50 WP + Captan 50 WP	<i>Blossom Brown Rot—Excellent</i> • Protectant—3-4 days • Back action—24-36 hours, depending on temperature • Resistance to Benlate in Brown Rot exists, but not of economic importance where non-related fungicides are used after petal fall • Locally systemic in bloom <i>European Brown Rot—Excellent control on Meteor in 1994. This disease is restricted to areas of Michigan from Hart-Shelby north.</i> <i>Leaf Spot—Resistance to Benlate is widespread—not recommended for use</i> <i>Fruit Brown Rot—Excellent</i> • Protectant—5-7 days • Back action—less than 12 hours • see resistance note above <i>Weaker than Benlate. See Benlate.</i>
<b>Topsin-M 70 WP</b> (thiophanate-methyl)	

## Inorganic

<b>Sulfur 95 WP</b>	<i>Blossom Brown Rot—Fair when used at 15-20 lb/A, Poor at lower rates</i> • Protectant—2-3 days • Back action—None <i>Leaf Spot—Poor</i> <i>Fruit Brown Rot—Fair</i> • Protectant—2-3 days • Back action—None <i>When used at 9 lb/acre in tank mixtures with Syllit or Topsin-M, it does not give adequate control of fruit brown rot when conditions are highly favorable for disease development.</i>
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# TART CHERRIES

## Bacterial Canker

Bacterial canker of tart cherries is caused by the bacterium *Pseudomonas syringae* pv. *morspunorum* and sometimes by *P. syringae* pv. *syringae*. It is a sporadic problem and has been most serious in southwest Michigan. Additional information on this disease can be found in bulletin NCR-45, "Diseases of Tree Fruits in the East."

To prevent blossom blight, leaf and fruit spot stages of bacterial canker, use 1 lb per 100 gallons of dilute spray or 3 lb per acre of Tennessee Brand Tri-Basic Copper Sulfate. Initiate sprays at bud burst stage and repeat applications at weekly intervals to late May. Later sprays may cause some leaf yellowing and defoliation. This and any other copper treatment will not be effective where copper-resistant *P. syringae* pv. *syringae* are present. Resistant strains are common in Michigan cherry orchards.

## Phytophthora Root Rot

Phytophthora root rot is a problem on heavy, poorly drained soils. It occurs in all areas of Michigan where tart cherries are grown on poor sites. Tiling of wet areas in otherwise well-drained locations often eliminates problems with this disease. Trees on mahaleb rootstock are more susceptible to Phytophthora root rot than trees on mazzard, MXM2, or MXM6O rootstock.

## Ridomil for Root Rot

**Nonbearing Cherry Trees:** In nurseries and field plantings of nonbearing trees, make the first application of Ridomil 2E at 2 weeks after planting with additional applications made at three-month intervals throughout the growing season. **Do not apply to plantings that will bear harvestable fruit within 12 months of application.** Apply 2-4 gal per treated acre (6-12 fl oz per 1000 sq ft) in sufficient water to obtain thorough coverage of the soil under the canopy of the trees. Sufficient surface area should be treated in nurseries to cover the root zone of the plants. Use of Ridomil is not a substitute for good cultural practices.

## Aliette for Root Rot

Apply Aliette as a spray to the foliage at the rate of 5 lb/100 gal of dilute spray. Begin applications at the start of the growing season. Up to 4 foliar sprays may be applied during the season at 60-day intervals. Do not apply more than 100 gal per acre. Aliette is only registered for nonbearing stone fruit trees. A nonbearing tree is a tree that will not produce marketable fruit for 12 months after the last application. Aliette is particularly effective against *Phytophthora cactorum*.

## Cherry Leaf Spot

*Approximate number of hours of wetting required for conidial infection by the leaf spot fungus at different air temperatures<sup>a</sup>*

Average temperature		Wetting Period (hr) <sup>b</sup>		
(°F)	(°C)	Light infection	Moderate infection	Heavy infection
81	27.2	28	43	--
80	26.7	21	35	--
79	26.1	18	30	--
78	25.5	16	27	42
77	25.0	14	24	36
76	24.4	12	21	32
75	23.8	11	19	29
74	23.3	9	18	27
73	22.7	8	16	25
72	22.2	7	15	23
71	21.6	7	14	22
70	21.1	6	13	21
69	20.5	6	13	20
63-68	17.2-20	5	12	19
62	16.6	6	12	19
61	16.1	6	13	20
60	15.5	7	13	20
59	15.0	7	14	21
58	14.4	8	15	22
57	13.8	9	16	23
56	13.3	10	17	24
55	12.7	11	18	25
54	12.2	12	19	27
53	11.6	14	21	29
52	11.1	15	23	31
51	10.5	17	25	33
50	10.0	19	27	35
49	9.4	20	29	38
48	8.8	23	32	42
47	8.3	25	34	46
46	7.7	28	38	51

<sup>a</sup> Adapted from Eisensmith and Jones, 1981. Plant Dis. 65:955-958 and Phytopathology 71:728-732.

<sup>b</sup> The infection period is considered to start when rain begins.

# CHERRIES

## Special Tart Cherry Insect Problems and Controls

### **American Plum Borer**

This is a serious problem on tart and sweet cherries especially in counties from Oceana to as far north as cherries are grown in Michigan. The female adults are attracted to injured bark tissue for egg laying. The larvae feed on inner bark at the cambium. There are two generations a year. The second generation adults begin to emerge at cherry harvest and continue to emerge until early September. Lorsban 4 E at 3 qt/100 applied with a hydraulic gun to the trunk at the petal fall stage when the first generation adults are emerging on tart and sweet cherries will give seasonal control. In addition, if the spray is directed at the base of the trunk and scaffold limbs, lesser peach tree borer will be controlled for the season.

### **Peach Tree Borer**

The peach tree borer can be a serious problem on cherries because it attacks and feeds on the root system. No evidence of frass or feeding is seen unless the soil is dug around the base of the tree. Cherry trees infested with peach tree borer show wilting and loss of vigor. Unlike the lesser peach tree borer, the peach tree borer does attack young, healthy trees. While cherry trees can survive many lesser peach tree borers infesting the scaffold limbs, a single peach tree borer can cause serious injury to the root and affect the vigor of the tree. Multiple infestations of peach tree borer in the root kills the tree. Applying Lorsban at petal fall for American plum borer does not control the peach tree borer. Applying Lorsban in late June for lesser peach tree borer, taking special care to spray the base of the trunk and the soil around the trunk, controls peach tree borer. Lorsban 4E will cause foliar and fruit injury on sweet cherry.

# SWEET CHERRIES

The rates of materials are based on a standard of 400 gallons per acre dilute spray for mature trees. If rates less than 400 gallons are applied per acre, refer to the rate-per-acre to insure the proper amount of chemical is applied.

After each pest appears a column of numbers and letters. These are provided to assist growers in choosing materials to use to control specific pests. The number

refers to the pesticide in the column headed "Suggested Chemicals" and the letter is a rating of efficiency: e = excellent, g = good, f = fair, p poor for the pesticide in controlling the pest, and n = not labeled or no activity against this pest.

Products listed by the Organic Materials Review Institute (OMRI) for use in organic production will be marked with the following designation: ▲

## PRE-BLOOM

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Crown Gall	See page 63	
<b>INSECTS/MITES</b>		
Black Cherry Aphid	5g, 26e	<b>INSECTICIDES</b> 5. Diazinon 50 WP (4 lb) 24. Superior Oil (1%-2% v/v) 26. Thiodan 50 WP (4 lb) 32. Lorsban 4 E (3 pt) 52. Esteem 35WP (5 oz) 56. Supracide 2E (3-12 pts)
Mites	24e	
Scales	24e, 32e, 52g, 56	

## WHITE BUD OR POPCORN

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Brown Rot (blossom blight)	2e, 4f-g, 5e, 7e, 8e, 14f, 15f, 17p	<b>FUNGICIDES</b> 2. Indar 75 WSP (2 oz) 4. Bravo 6F (3 1/8 - 5 1/2 pt)* 5. Nova 40 W (2.5 - 6.0 oz) 7. Orbit 3.6 EC (4 fl oz) 8. Elite 45 DF (8 oz) 14. Wettable sulfur 95 WP (20 lb) * 15. Elevate 50 WDG 1-1.5 lb 17. Flint 50 W  <b>Comments:</b> *--Bravo 82.5% WDG (Bravo Ultrex) formulation may cause phytotoxicity on some varieties such as Gold. Flowable sulfur, liquid sulfur; and less concentrated wettable sulfur should be used as rates that will give the same amount of sulfur as 95% the wettable powder formulation, except where prohibited by the product label.
<b>INSECTS</b>		
Green Fruitworm	26f, 34e, 35e, 40e, 46e	<b>INSECTICIDES</b> 26. Thiodan 50 WP (4 lb) 34. Ambush 25 WP (9.6 oz) 35. Pounce 25 WP (9.6 oz) 40. Asana XL 0.66 EC (4.8 - 14.5 fl oz) 46. Spintor 2 SC (6 - 8 oz)



# SWEET CHERRIES

## BLOOM

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Brown Rot (blossom blight)	See fungicides listed under White Bud	
<b>Comments:</b> Where popcorn spray is omitted, or if weather is unusually favorable for brown rot, begin bloom spray earlier and continue at 2- to 4-day intervals if wet, rainy weather prevails.		

## PETAL FALL

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Brown Rot	2e, 4f-g, 5e, 7e, 8e, 10p/n, 15f, 17p, 50p, 53f	<b>FUNGICIDES</b> 2. Indar 75 WSP (2 oz) 4. Bravo 6F (4 1/8 - 5 1/2 pt)* 5. Nova 40 W (2.5 - 6.0 oz) 7. Orbit 3.6 EC (4 fl oz) 8. Elite 45 OF (8 oz) 10. Rubigan 1 EC (6 - 12 fl oz) 15. Elevate 50 WDG (1-1.5 lb) 17. Flint 50 W (2 - 4 oz) 50. Captan 50 WP (4 lb) 53. Carbamate 76 WDG (4 lb), plus Wettable sulfur 95 WP (12 lb)*
Leaf Spot	2g, 4e, 5g, 7f, 8g, 10g, 15p, 17g, 50p, 53f	
<b>Comments:</b> *-- Bravo 82.5% WDG (Bravo Ultrex) formulation may cause phytotoxicity on some varieties such as Gold. Flowable sulfur, liquid sulfur and less concentrated wettable sulfur should be used at rates that will give the same amount of sulfur as the 95% WP formulation, except where prohibited by the product label. Because Benlate-resistant brown rot and leaf spot are widespread in Michigan, Topsin-M is not recommended in cherries past bloom.		
<b>INSECTS</b>		
Black Cherry Aphid	5g, 54g, 57, 58	<b>INSECTICIDES</b> 5. Diazinon 50 WP (3 lb) 8. Guthion 50 WP (1 1/2 lb) 32. Lorsban 4 E (3 qt/100 gal) 34. Ambush 25 WP (9.6 oz) 35. Pounce 25 WP (9.6 oz) 40. Asana XL 0.66 EC (4.8 - 14.5 fl oz) 46. Spintor 2 SC (6 - 8 oz) 54. Neem compounds [AzaDirect (32 fl oz), Ecozin (10 oz)] ▲ 57. Pyganic EC 1.4 (16-32oz) ▲ 58. Evergreen EC 60-6 (8-16oz)
Green Fruitworm	See White Bud	
Leafrollers	8e, 46e	
Plum Curculio	5g, 8e, 34e, 35e, 40e	
American Plum Borer	32e. See comments on page 76	
Oriental Fruit Moth	5g, 8e, 34g, 35g, 40g, 46f	
Leafhoppers	8e, 9e, 32g, 34g, 35g, 40g, 57, 58	

# SWEET CHERRIES

## SHUCK SPLIT

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b> 2. Indar 75 WSP (2 oz) 4. Bravo 6F (4 1/8 - 5 1/2 pt) 5. Nova 40 W (5 - 6 oz) 8. Elite 45 DF (8 oz) 10. Rubigan 1 EC (6 - 12 fl oz) 15. Elevate 50 WDG (1-1.5 lb) 17. Flint 50 W (2 - 4 oz) 50. Captan 50 WP (4 lb)* 53. Carbamate 76 WDG (4 b), plus Wettable sulfur 95 WP (12 lb)
Brown Rot	2e, 4f-g, 5p/n, 8e 10p/n, 15f, 17p, 50p, 53f	
Leaf Spot	2g, 4e, 5g, 8g, 10f-g, 15p, 17g, 50p, 53f	
		<b>Comments:</b> Do not apply Bravo after shuck split and before harvest. Bravo 82.5% WDG (Bravo Ultrex) formulation may cause phytotoxicity on some varieties such as Gold. *--Captan can build up and cause a bacterial spot-like symptom on sweet cherries if multiple applications are used with no rain.
<b>INSECTS</b>		
Plum Curculio	See Petal Fall	
Black Cherry Aphid	See Petal Fall	

## FIRST COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b> 2. Indar 75 WSP (2 oz) 5. Nova 40 W (5 - 6 oz) 8. Elite 45 DF (8 oz) 10. Rubigan 1 EC (6 - 12 fl oz) 17. Flint 50 W (2 - 4 oz) 50. Captan 50 WP (4 lb) 53. Carbamate 76 WDG (4 lb), plus Wettable sulfur 95 WP* (12 lb)
Brown Rot	2e, 5p/n, 8e, 10p/n, 17p, 50p, 53f	
Leaf Spot	2g, 5g, 8g, 10f-g, 17g, 50p, 53f	
		<b>Comments:</b> *---Flowable sulfur, liquid sulfur; and less concentrated wettable sulfur should be used at rates that will give the same amount of sulfur as the 95% wettable powder formulation except where prohibited by the product label.
<b>INSECTS</b>		
Black Cherry Aphid	See Petal Fall	
Leafrollers	See Petal Fall	
Plum Curculio	See Petal Fall	
Rose Chafer	See Third Cover	

## SECOND COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Brown Rot	Fungicides listed under First Cover	
Leaf Spot	See First Cover	
<b>INSECTS</b>		<b>Comments:</b> Lorsban 4 E trunk sprays for borer control will cause foliar and fruit injury on sweet cherry if chemical drifts to the tree canopy.
Black Cherry Aphid	See Petal Fall	
Leafrollers	See Petal Fall	
Rose Chafer	See Third Cover	
Peach Tree Borer	See "Special Tart Cherry Insect Problems and Controls" on page 76	

# SWEET CHERRIES

## THIRD COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Brown Rot	Fungicides listed under First Cover	
Leaf Spot	See First Cover	
<b>INSECTS/MITES</b>		<b>INSECTICIDES</b>
Cherry Fruit Fly	5g, 8e, 23g, 34f, 35f, 40g	5. Diazinon 50 WP (4 lb)
Rose Chafer	5g, 23g, 54f, 57, 58	8. Guthion 50 WP (1 1/2 Lb)
European Red Mite	28e, 17e**, 42e**	17. Apollo SC (4 - 8 oz)**
Two-spotted Spider Mite	28e, 17e**, 42e**	23. Sevin 50 WP (8 lb)
Plum Nursery Mite	28e	28. Vendex 50 WP (1 - 3 Lb)
<b>Comments:</b>		34. Ambush 25 WP (9.6 oz)
Call the local pest management code-a-phone or determine from the Extension agent when sprays for cherry fruit fly should be applied.		35. Pounce 25 WP (9.6 fl oz)
		40. Asana XL 0.66 EC (4.8 - 14.5 fl oz)
		42. Savey 50WP (3 - 6 oz)**
		42. Savey 50 DF (3 - 6 oz)**
		54. Neem compounds [AzaDirect (32 fl oz) Ecozin (10 oz)]*** ▲
		57. Pyganic EC 1.4 (32-64 oz)**** ▲
		58. Evergreen EC 60-6 (8-16oz)****
		<b>Comments:</b>
		WARNING:--Do not apply Imidan. It causes leaf spotting and defoliation of sweet cherry.
		**Use is limited to 1 application per season.
		***--Primarily a repellent.
		****--These are short-lived pyrethrums with strong initial knockdown activity.

## PRE-HARVEST

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Brown Rot	2e, 5p/n, 7e, 8e, 10p, 15f, 17p, 50p, 53f	<b>FUNGICIDES</b>
Leaf Spot	2g, 5g, 7f, 8g, 10f-g, 15p, 17g, 50p, 53f	2. Indar 75 WSP (2 oz)
		5. Nova 40 W (5 - 6 oz)
		7. Orbit 3.6 EC (4 fl oz)
		8. Elite 45 DF (8 oz)
		10. Rubigan 1 EC (6 - 12 fl oz)
		15. Elevate 50 WDG (1 - 1.5 lb)
		17. Flint 50 W (2 - 4 oz)
		50. Captan 50 WP (4 lb)
		53. Carbamate 76 WDG(4 lb), plus Wettable sulfur 95 WP (12 lb) *
		<b>Comments:</b>
		*--Flowable sulfur, liquid sulfur; and less concentrated wettable sulfur should be used at rates that will give the same amount of sulfur as the 95% wettable powder formulation except where prohibited by the product label Benlate and Topsin-M not recommended for cherries because Benlate-resistant brown rot and leaf spot are widespread in Michigan.
<b>INSECTS</b>		
Cherry Fruit Fly	See Third Cover	
<b>Comments:</b>		
Make first application 2 or 3 weeks before harvest and repeat in 5 to 10 days.		

# SWEET CHERRIES

## POST- HARVEST

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Leaf Spot	2g, 4e, 5g, 8g, 10f-g, 11g, 17g	2. Indar 75 WSP (2 oz) 4. Bravo 720 (4 1/8 pt) 5. Nova 40 W (5 - 6 oz) 8. Elite 45 DF (8 oz) 10. Rubigan 1 EC (6 - 12 fl oz) 11. Syllit (dodine) 65 WP (1 1/2 - 2 lb) 17. Flint 50 W (2 - 4 oz)
<b>INSECTS</b>		<b>INSECTICIDES</b>
Peach Tree Borers	See American Plum Borer under "Special Tart Cherry Insect Problems" on page 76	12. Vendex 50 WP (1 - 3 lb) 45. Pyramite 60 WP (8.8 - 13.3 oz)
Two-spotted Spider Mites	12e, 45g	

# Effectiveness of Insecticides and Miticides in Controlling Arthropod Pests of Stone Fruits

(Note that a product's effectiveness rating on a pest does not necessarily indicate that it is labeled for that use.)

Ratings of control are E = excellent, G = good, F = fair, P = poor Ratings against beneficials are T = highly toxic, M = moderately toxic, S = relatively safe			Diazinon	Guthion	Imidan	Lannate	Malathion	Apollo	Sevin	Superior Oil <sup>1</sup>	Thiodan	Vendex	Lorsban <sup>1</sup>	Pounce	Ambush	Asana	Savey	Pyramite	Spintor	Esteem	Surround	Neem compounds	Acramite	
Insect / Mite	Life Stage		5	8	9	11	13	17	23	24	26	28	32	34	35	40	42	45	46	52	53	54	61	
<b>Pests</b>	Cherry Fruit Fly	Adult	G	E	E		E		G					F	F	G			F		G			
	Thrips	Active				G	P												G					
	Cutworms	Larva											E	E	E	E								
	European Red Mite	Active						E		E		G					E	E			F		G	
	Leafrollers	Larva	G	E	E	G			F				E	E	E	E			E	G				
	Aphids	Active	G			G					E									G		G		
	Green Fruitworm	Larva									F		E	E	E	E			E	G				
	Oriental Fruit Moth	Larva	G	E	E	F			F						G	G	G			G	F			
	Plum Curculio	Adult	G	E	E	F			F						G	G	G					F	P	
	Eye-Spotted Bud Moth	Larva	G	E	E				G						E	E	E			G	G			
	Rose Chafer	Adult		G	G	F			G								G					F	F	
	Plum Nursery Mite	Active											E						G					
	Lecanium Scale	Adult								E			E								E			
	Lecanium Scale	Crawler	G																		E			
	Tarnished Plantbug	Active	P	P	P	G						F			E	E	E					G	G	
Two-spotted Spider Mite	Active							E				G					E	G					E	
White Apple Leafhopper	Active	P	P	P	E	P		E		F				P	P	G		F			G			
Borers	Larva										G		E											
<b>Beneficials</b>	Bees		T	T	T	T	T	S	T	S	M	S	T	T	T	T	S	M	M	S	S	S	M	
	Mite Predators		S	S	S	T	M	S	T	S	M	S	S	T	T	T	S	M	M	S	M	S	S	
	Insect Predators		T	M	M	T	M	S	T	S	M	S	S	T	T	T	S	M	M	S	M	S	S	

<sup>1</sup> Use only before pre-pink!



# GRAPES

The rate of materials for use on grape is based on a standard of 200 gal/acre dilute spray. If you are concentrate spraying—(less than 200 gal of water/acre), use the rate/acre figures, regardless of the amount of water you are spraying/acre. To get sufficient spray coverage of fruit clusters within the canopy, it is recommended to use 50-100 GPA after bloom. Effectiveness of materials listed below is based primarily on trials using concentrate sprays of 50 GPA (water) on mature grape vines. After each pest appears

a column of numbers and letters. These are provided to assist growers in choosing materials to use to control specific pests. The number refers to the pesticide in the column headed "Suggested Chemicals" and the letter is a rating of efficiency: e = excellent, g = good, f = fair and p = poor for the pesticide controlling the pest.

Products listed by the Organic Materials Review Institute (OMRI) for use in organic production will be marked with the following designation: ▲

## BUD SWELL

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>INSECTS</b>		<b>INSECTICIDES</b>
Grape Flea Beetle	44g	32. Lorsban 4 E (1 qt)*
Climbing Cutworms	32e*, 44e	44. Danitol 2.4EC (10.6 oz)
		<b>Comments:</b> *--This is a Special Local Needs (SLN) label, and growers must possess the SLN label at the time of application. Lorsban 4 E will not control flea beetles.

## 1- TO 5-INCH SHOOT

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Phomopsis (cane, leaf, and rachis infection)	50g, 51g, 59g-e	5. Nova 40 WP (3 - 5 oz)
Powdery Mildew	5e, 8e, 10e, 13e, 14g*, 54e	8. Elite 45 DF (4 oz)
<b>Comments:</b> <b>Phomopsis cane and leaf spot:</b> <i>Phomopsis viticola</i> overwinters in infected canes. <i>Phomopsis</i> usually releases most of its spores between bud break and bloom. The critical period for protection against shoot and leaf infection is during early shoot development, as young tissue is especially susceptible. Rachises appear to be susceptible from the time the flower clusters become visible until berry touch or even later, so protection is warranted from the moment the flowers clusters appear. Berries are most susceptible from bloom to pea-sized berry. See Table 2 for varietal susceptibility to this disease.		10. Rubigan 1 EC (4 oz)
<b>Powdery mildew:</b> A powdery mildew spray may only be needed for highly susceptible varieties or problem areas (see Table 2).		13. Bayleton 50 WP (3 - 6 oz)
<b>Black rot:</b> Sprays specifically for black rot at this time are not necessary. Instead, emphasize protection of the vines against black rot during the period of fruit susceptibility (immediately pre-bloom to 4-5 weeks after bloom for Concord and Niagara; <i>Vitis</i> , <i>vinifera</i> and certain hybrid varieties may retain some susceptibility until veraison. EBDC or SI fungicides applied at early shoot growth will be sufficient to suppress foliar black rot infections.		14. Sulfur [various formulations] (labeled rates)* ▲
		50. Captan 50 WP (4 lb) or Captec 4 L (2 qt)
		51. Ziram 76 DF or Ziram Granuflo (3 - 4 lb)
		54. Procure 50 WP (4 - 6 oz)
		59. Dithane DF or Penncozeb 75 DF or Manzate 200 DF (1½ lb)
		<b>Comments:</b> <i>Note: Review fungicide characteristics and restrictions in the section "Fungicides and Bactericides for Fruit Crops", pages 10-16. Also consider cultivar disease susceptibility and sulfur/copper sensitivity (Table 2, page 93) when making spray decisions.</i> *--Sulfur-sensitive grapes, such as Concord, may be injured by sulfur. Sulfur can provide good management of powdery mildew on sulfur-tolerant grapes (Table 2) but must be applied relatively frequently. Sulfur is much less active at temperatures below 65°F. Sulfur can cause injury even on tolerant varieties when temperatures are above 85°F. Do not apply within 14-21 days of a JMS Stylet Oil application. Sulfur has a detrimental effect on beneficial mites.
<b>INSECTS</b>		<b>INSECTICIDES</b>
Grape Flea Beetle	44g	44. Danitol 2.4 EC (10.6 oz)
Climbing Cutworms	See Bud Swell	

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## 8- TO 12-INCH SHOOT

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Downy Mildew	12e*, 16e*, 17g*, 50e**, 51g, 57e***, 58e***, 59e	5. Nova 40 WP (3-5 oz) 8. Elite 45 DF (4 oz) or Elite 45 WP (4 oz)
Powdery Mildew	5e, 8e, 10e, 12g-e*, 13e, 14g*, 16e*, 17e*, 54e	10. Rubigan 1 EC (4 oz) 12. Abound 2 F (11-15 oz)* 13. Bayleton 50 WP (3-6 oz) 14. Sulfur [various formulations] (labeled rates) ▲
Phomopsis (cane, leaf, and rachis infection)	5f, 8f, 12e*, 16e*, 17e*, 50g**, 54f, 59g-e	16. Sovran (3.2 - 5.6 oz)* 17. Flint (1.5 - 4 oz)* 50. Captan 50 WP (4 lb)** or Captec 4 L (2 qt)** 51. Ziram 76 DF or Ziram Granuflo (3 - 4 lb) 54. Procure 50 WP (4 - 6 oz) 57. Bordeaux mixture (6 lb copper sulfate and 6 lb hydrated lime per 100 gal water)*** ▲ 58. Fixed copper [various formulations] (labeled rates)*** ▲ 59. Dithane DF or Penncozeb 75 DF or Manzate 200 DF (2 lb)
<b>Comments:</b>		<b>Comments:</b>
<p><b>Downy mildew:</b> The downy mildew fungus becomes active at about 10-inch shoot growth and infective spores are released during rainy periods if temperatures are above 50°F. A spray at this time may be important for highly susceptible varieties or if the disease was severe the previous year.</p> <p><b>Phomopsis cane and leaf spot:</b> Rachis infections are possible once the flower clusters become exposed. Rachis lesions do not become visible until 3-4 weeks after infection.</p>		<p>*--To limit the risk of resistance development, do not apply more than two consecutive applications of Abound, Sovran or Flint before switching to a fungicide with a different mode of action, and don't exceed a total of three strobilurin fungicide applications per season</p> <p>**--Captan applied here will give control of Phomopsis leaf and cane spot disease and downy mildew, but is weak against black rot.</p> <p>***--Copper sensitive varieties (see table 2) can be injured by copper. Even non-sensitive varieties can be harmed under slow drying, cooling conditions. Add hydrated lime as a safener if formulation does not have lime in it. Fixed copper formulations should not be used with Bayleton, Nova, Guthion, Imidan, Sevin or Thiodan.</p>

## IMMEDIATE PRE-BLOOM

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Black Rot (fruit infection)	5e, 8e, 10g, 12e*, 13e, 16e*, 17g*, 51g, 53g, 54g, 64g**	5. Nova 40 WP (3 - 5 oz) 8. Elite 45 DF (4 oz) or Elite 45 WP (4 oz)
Downy Mildew	12e*, 16e*, 17g*, 50e, 51g, 57e, 58e, 59e	10. Rubigan 1 EC (4 oz) 12. Abound 2 F (11 - 15 oz)*
Powdery Mildew	5e, 8e, 10e, 12g*, 13e, 14g, 16e*, 17e*, 54e, 64f-g**, 66f-g***	13. Bayleton 50 WP (3 - 6 oz) 14. Sulfur [various formulations] (labeled rates) ▲
Phomopsis (rachis infection)	5f, 8f, 12e*, 16e*, 17e*, 50g, 54f, 59g-e	16. Sovran (3.2 - 5.6 oz)* 17. Flint (1.5 - 4 oz)*
<b>Comments:</b> <b>Black rot:</b> Control of the fruit infection stage of black rot should commence now and be continued until 4-5 weeks post-bloom, at which time the berries become naturally resistant to infection by the black rot pathogen. This means that after the second or third post-bloom spray, no more sprays are needed for black rot. Infection risk increases with increasing leaf wetness and temperature (see Grape Black Rot table on page 92). Nova or Elite applied for black rot will also be highly effective against powdery mildew. Rubigan does not provide adequate control of black rot under moderate to high disease pressure. Tank mix with a mancozeb product if black rot control is needed.		50. Captan 50 WP (4 lb) or Captec 4 L (2 qt) 51. Ziram 76 DF or Ziram Granuflo (3 - 4 lb) 53. Ferbam Granuflo (4 lb) 54. Procure 50 WP (4 - 6 oz) 57. Bordeaux mixture (6 lb copper sulfate and 6 lb hydrated lime per 100 gal water) ▲ 59. Dithane DF or Penncozeb 75 DF or Manzate 200 DF (2 lb) 64. Armicarb 100 (2.5 - 5 lb)** 66. JMS Stylet Oil (1-2% conc.)*** ▲
<b>Downy mildew:</b> It is important <u>not</u> to delay downy mildew sprays beyond this point, except for grape varieties that are resistant to downy mildew. This is an important time to manage primary infections. Vineyards should be scouted for the disease throughout the summer and the foliage should be protected based on weather conditions and presence of the disease.		<b>Comments</b> *--To limit the risk of resistance development, do not apply more than two consecutive applications of Abound, Sovran or Flint before switching to a fungicide with a different mode of action, and don't exceed a total of 3-4 strobilurin fungicide applications per season. **--Armicarb is a salt and considered an environmentally friendly material. Apply in at least 50 gpa of water to get adequate coverage. ***--JMS Stylet Oil will temporarily remove bloom on grapes. Stylet oil also helps to control mealybugs, mites, and leafhoppers. Do not tank mix Stylet Oil with spreaders-stickers, foliar fertilizers, or Captan. Do not apply sulfur with or following an oil application for 21 days. Do not apply oil for 14 days following a sulfur treatment.
<b>INSECTS</b>		<b>INSECTICIDES</b>
Grape Berry Moth	48f	48. Grape berry moth mating disruption products
<b>Comments:</b> The grape berry moth overwinters as a pupa and adult emergence begins at or before bloom. Pheromone traps are available to detect the presence and seasonal activity of these moths. Pheromone for mating disruption should be applied at the first adult emergence, according to the product label. Re-application may be necessary to cover all adult flights. Large acreage vineyards with relatively low populations are the most appropriate for mating disruption.		

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## BLOOM

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Black Rot (fruit infection)	5e, 8g, 10f-g, 12g, 13e***, 16g 17g, 50e, 51g, 53g, 59e, 64g	3. Rovral 50 WP (1½ - 2 lb)* 5. Nova 40 WP or DF (3 - 5 oz) 6. Vangard 75 WG (10 oz)** 8. Elite 45 DF (4 oz) or Elite 45 WP (4 oz) 10. Rubigan 1 EC (4 oz) 12. Abound (11 - 15 oz) 13. Bayleton 50 WP (3 - 6 oz)*** 14. Sulfur [various formulations] (labeled rates) ▲ 16. Sovran (3.2 - 5.6 oz) 17. Flint (1.5 - 4 oz) 50. Captan 50 WP (4 lb) or Captec 4 L (2 qt) 51. Ziram 76 DF or Ziram Granuflo (3 - 4 lb) 53. Ferbam Granuflo (4 lb) 54. Procure 50 WP (4 - 6 oz) 55. Ridomil Gold MZ (2.5 lb)***** 57. Bordeaux mixture (6 lb copper sulfate and 6 lb hydrated lime per 100 gal water)**** ▲ 58. Fixed copper [various formulations] (labeled rates)**** ▲ 59. Dithane DF or Penncozeb 75 DF or Manzate 200 DF (2 lb) 60. Ridomil Gold/Copper (2 lb)***** 64. Armicarb 100 (2.5 - 5 lb) 65. Elevate 50 WDG (1 lb)***** 66. JMS Stylet Oil (1 - 2% conc.) ▲
Phomopsis (rachis and fruit infection)	5f, 8f, 12e, 16e, 17e, 50g, 54f, 59g-e	
Powdery Mildew	5e, 8e, 10g, 12g, 13e***, 14g, 16e, 17e, 54e, 58f****, 64f-g, 65f*****, 66f-g	
Downy Mildew	12e, 16e, 17g, 50e, 51g, 53f, 55e****, 57e****, 58e****, 60e****, 59e	
Botrytis Bunch Rot	3g*, 6e**, 65e*****	
<b>Comments:</b>		<b>Comments:</b>
<p><b>Botrytis bunch rot:</b> A spray for <i>Botrytis bunch rot</i> at bloom is only warranted when conditions are extremely favorable for disease development. The most important times for control of <i>Botrytis bunch rot</i> are veraison and pre-harvest or when the disease is first spotted in the vineyard.</p> <p><b>Phomopsis:</b> Berries are susceptible to infection by <i>Phomopsis</i> from bloom to about pea-sized berry. These infections remain invisible until the berries start to ripen. It is therefore important to keep the developing fruit protected, particularly during wet weather. Rachis infections can continue at least until berry touch if inoculum is available. Remember that some processors will not accept fruit treated with Mancozeb after bloom.</p>		<p>*--Add a non-ionic surfactant, e.g. Triton B-1956 or Triton CS-7 at 0.05% or 6 fl oz/100 gal water. Where resistant strains of <i>Botrytis</i> occur, Rovral may not provide adequate control.</p> <p>**--Do not make more than 2 applications of Vangard per season.</p> <p>***--If black rot pressure is heavy, increase Bayleton rate to 6 oz/acre.</p> <p>****--Fixed copper and hydrated lime can be tank-mixed with other fungicides to enhance disease control. Copper can cause injury on sensitive varieties (see Table 2), especially under slow drying, cool conditions. Fixed copper formulations and lime should <b>not</b> be used with Bayleton, Nova, Guthion, Imidan, Sevin, or Thiodan.</p> <p>*****--Both of these products have a 66-day pre-harvest interval (PHI). Ridomil Gold MZ provides some black rot control but no powdery mildew control. Ridomil Gold/Copper will not control black rot but provides some control of powdery mildew</p> <p>*****--Do not apply Elevate more than 3 times per season.</p>

## BLOOM (CONTINUED)

INSECTS		INSECTICIDES
Grape Berry Moth	5g, 8e, 9e, 11g, 23e, 43g, 44e**, 50g	5. Diazinon 50 WP (2 lb)
Rose Chafer	8g, 9g, 11f, 23g, 44g**, 53f***	8. Guthion 50 WP (1½ - 2 lb)
Grape Phylloxera	26e*, 44	9. Imidan 70 WP (1½ lb)
		11. Lannate 90 SP (½ - 1 lb)
		23. Sevin 50 WP (4 lb)
		23. Sevin 80 S (2½ lb)
		23. Sevin XLR+ (2 qt)
		26. Thiodan 50 WP (2 lb)*
		26. Thiodan 3 EC (1½ - 2 qts)*
		43. B.t.'s [Dipel DF (1 lb)] ▲
		44. Danitol 2.4 EC (10.6 oz)**
		50. Intrepid 2F (8 oz)
		53. Surround WP (25 lb)***
		<b>Comments:</b>
		*--Do not use Thiodan 3 EC formulation on Concord grapes to prevent severe injury. Check labels for other variety restrictions.
		**-- Do not make more than one post-bloom application of Danitol.
		***--Must maintain coverage for adequate performance.

## FIRST COVER (PEA-SIZED BERRIES)

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Black Rot (fruit infection)	See Bloom	<b>Comments:</b> NOTE: Time interval between last spray and harvest for EBDC fungicides, Ridomil Gold MZ and Ridomil Gold/Copper is 66 days.
Downy Mildew	See Bloom	
Powdery Mildew	See Bloom	
Phomopsis (rachis and fruit infection)	See Bloom	
<b>INSECTS</b>		
Grape Berry Moth	See Bloom	<b>INSECTICIDES</b>
Grape Leafhopper	5f, 8f*, 9f, 11g, 19e**, 23g, 44e***, 45g, 53f****, 60g	
Potato Leafhopper	5e, 8e*, 9e, 11g, 19g**, 23g, 44e***	
Rose Chafer	8g*, 9g, 11f, 23e, 44e***	
<b>Comments:</b> Pheromone traps are available for monitoring berry moth abundance and helping to time insecticide applications in vineyards.		
		5. Diazinon 50 WP (2 lb)
		8. Guthion 50 WP (1½ - 2 lb)*
		9. Imidan 70 WP (1.5 lb)
		11. Lannate 90 SP (½ - 1 lb)
		19. Provado SoluPak (¾ - 1 oz)**
		23. Sevin 50 WP (4 lb)
		23. Sevin 80 S (2 lb)
		44. Danitol 2.4 EC (5.3 - 10.8 oz)***
		45. Pyramite 60 W (6.6 - 13.2 oz)
		53. Surround WP (25 lb)**** ▲
		60. Assail WSP (1.1 oz)
		<b>Comments:</b>
		*--Guthion is restricted to three applications per year.
		**--Do not apply more than 2.0 oz of Provado per acre per year.
		***--Do not make more than one post-bloom application of Danitol.
		****--Must maintain coverage for adequate performance.



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## SECOND COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>Comments:</b> NOTE: Time interval between last spray and harvest for EBDC fungicides, Ridomil Gold MZ and Ridomil Gold/Copper is 66 days.
Black Rot (fruit infection)	See Bloom	
Botrytis Bunch Rot	See Bloom	
Downy Mildew	See Bloom	
Powdery Mildew	See Bloom	
Phomopsis (rachis and fruit infection)	See Bloom	
<b>Comments:</b> The most important period for control of Botrytis bunch rot is between veraison and pre-harvest. When very wet conditions occur during bloom or bunch closing in susceptible varieties, a fungicide application at that time may aid control.		
<b>INSECTS</b>		<b>INSECTICIDES</b>
Grape Berry Moth	See Bloom	
Grape Phylloxera	See Bloom	
Grape Leafhopper	See First Cover	
Rose Chafer	See First Cover	

## THIRD COVER (BUNCH CLOSING)

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Black Rot (fruit infection)	See Bloom	
Downy Mildew	See Bloom	
Phomopsis (rachis and fruit infection)	See Bloom	
Powdery Mildew	See Bloom	
<b>INSECTS</b>		<b>INSECTICIDES</b> 9. Imidan 70 W (2 lb) 10. Kelthane 35 WP (1 1/2 - 3 1/2 lb) 23. Sevin 50 WP (4 lb) 23. Sevin 80 S (2 1/2 lb) 23. Sevin XLR+ (2 qt) 28. Vendex 50 WP (1 - 2 1/2 lb) 41. Agri-Mek 0.15 EC (16 oz) plus non-ionic surfactant 44. Danitol 2.4 EC (10.6 oz) 45. Pyramite 60W (8.8 - 13.2 oz) 53. Surround WP (25 lb)* ▲ 61. Acramite 50W (0.75 - 1.0lb)
Grape Berry Moth	See Bloom	<b>Comments:</b> *--Must maintain coverage for adequate performance
Grape Leafhopper	See First Cover	
Mites	10g, 28g, 41g, 44g, 45g, 61g	
Japanese Beetle	9g, 23g, 44g, 53f*	

## FOURTH COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Black Rot (fruit infection)	See Bloom	
Downy Mildew	See Bloom	
Powdery Mildew	See Bloom	
Botrytis Bunch Rot	See Bloom	
<p><b>Comments:</b>  <i>The berries of most grape cultivars, including Concord and Niagara, become naturally resistant to <b>black rot</b> at 3 and 5 weeks after bloom. Sprays for black rot may only be needed at this time for certain Vinifera varieties and hybrids that remain susceptible until veraison.</i></p>		
<b>INSECTS/MITES</b>		
Grape Berry Moth	See Bloom	
Japanese Beetle	See Third Cover	
Mites	See Third Cover	
<p><b>Comments:</b>  <i>The third week of July is a key time to scout high risk vineyards for <b>grape berry moth</b> and <b>grape leafhopper</b>, and to make decisions on their control.</i></p>		<p><b>Comments:</b>  <i>Lambrusca vines are naturally resistant to feeding by Japanese beetles, and can withstand some leaf area loss without affecting vine growth or fruit quality. Hybrid and Vinifera vines are at greater risk from Japanese beetle defoliation.</i></p>

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## FIFTH COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Black Rot (fruit infection)	5e, 8g, 10f-g, 12g, 13e**, 16g, 17g, 50e, 51g***, 64g	5. Nova 40 WP or DF (3 - 5 oz) 8. Elite 45 DF (4 oz) or Elite 45 WP (4 oz)
Powdery Mildew	5e, 8e, 10e, 12g, 13e**, 14g*, 51f***, 54e, 64f-g, 66f-g	10. Rubigan 1 EC (4 oz) 12. Abound (11 - 15 oz) 13. Bayleton 50 WP (3 - 6 oz)**
Downy Mildew	12e, 16e, 17g, 50e, 51g***, 57e, 58e	14. Sulfur [various formulations] (labeled rates)* ▲ 16. Sovran (3.2 - 5.6 oz) 17. Flint (1.5 - 4 oz) 50. Captan 50 WP (4 lb) or Captec 4 L (2 qt) 51. Ziram 76 DF or Ziram Granuflo (3 - 4 lb)*** 54. Procure 50 W (4 - 6 oz) 57. Bordeaux mixture (6 lb copper sulfate and 6 lb hydrated lime per 100 gal water) 58. Fixed copper [various formulations] (labeled rates) ▲ 64. Armicarb 100 (2.5 - 5 lb) 66. JMS Stylet Oil (1 - 2% conc.) ▲
<b>Comments:</b> <i>The berries of most grape cultivars, including Concord and Niagara, become naturally resistant to <b>black rot</b> at 3 - 5 weeks after bloom. Sprays for black rot may only be needed at this time for certain Vinifera varieties and hybrids that remain susceptible until veraison.</i>		<b>Comments:</b> *--Sulfur can cause severe injury to sensitive grape varieties (Table 2). Sulfur should not be sprayed less than a month from harvest, since it may interfere with the wine-making process. **--Bayleton may give superior control of powdery mildew on French hybrid grapes. ***--Do not apply Ziram later than 21 days to harvest.
<b>INSECTS</b>		
Japanese Beetle	See Third Cover	
Grape Berry Moth	See Bloom	

## SIXTH COVER (VERAISON)

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Black Rot (fruit infection)	5e, 8g, 10f-g, 12g, 13e, 16g, 17g, 50e, 51g <sup>***</sup> , 64g	3. Rovral 50 WP (1½ - 2 lb) 5. Nova 40 WP or DF (3 - 5 oz) 6. Vanguard 75 WG (10 oz)* 8. Elite 45 DF (4 oz) or Elite 45 WP (4 oz) 10. Rubigan 1 EC (4 oz) 12. Abound (11 - 15 oz) 13. Bayleton 50 WP (3 - 6 oz) 14. Sulfur [various formulations] (labeled rates)** ▲ 16. Sovran (3.2 - 5.6 oz) 17. Flint (1.5 - 4 oz) 50. Captan 50 WP (4 lb) or Captec 4 L (2 qt) 51. Ziram 76 DF or Ziram Granuflo (3 - 4 lb) <sup>***</sup> 54. Procure 50 W (4 - 6 oz) 57. Bordeaux mixture (6 lb copper sulfate and 6 lb hydrated lime per 100 gal water) ▲ 58. Fixed copper [various formulations] (labeled rates) ▲ 64. Armicarb 100 (2.5 - 5 lb) 65. Elevate 50 WDG (1 lb) <sup>****</sup> 66. JMS Stylet Oil (1 - 2% conc.) ▲
Powdery Mildew	5e, 8e, 10e, 12g, 13e, 14g <sup>**</sup> , 51f <sup>***</sup> , 54e, 64f-g, 66f-g	<p><b>Comments:</b></p> <p>*--Do not apply Vanguard more than 2 times per season.            **--Sulfur should not be sprayed less than a month from harvest, since it may interfere with the wine-making process.            ***--Do not apply Ziram later than 21 days to harvest            ****--Do not apply Elevate more than 3 times per season.</p>
Downy mildew	12e, 16e, 17g, 50e, 51g <sup>***</sup> , 57e, 58e	
Botrytis Bunch Rot	3g, 6e*, 65e <sup>****</sup>	
<p><b>Comments:</b></p> <p>The berries of most grape cultivars, including Concord and Niagara, become naturally resistant to <b>black rot</b> at 3 - 5 weeks after bloom. Sprays for black rot may only be needed at this time for certain Vinifera varieties and hybrids that remain susceptible until veraison.</p> <p><b>Powdery mildew:</b> On highly susceptible varieties, late-season powdery mildew development may need to be controlled.</p> <p><b>Downy mildew:</b> On susceptible varieties, downy mildew has the potential for explosive spread during mid- to late summer under the proper conditions (moderate temperatures and wet). The need for a spray here should be based on the weather conditions and the presence of the disease as determined by scouting.</p> <p><b>Botrytis bunch rot:</b> Veraison (early fruit ripening) is an important timing for Botrytis bunch rot control, especially in susceptible varieties.</p>		
<b>INSECTS</b>		
Grape Berry Moth	See Bloom	
<p><b>Comments:</b></p> <p>Required only if vineyard scouting indicates grape berry moth is present. High risk vineyards should be checked for infestation at this time. Increase spray volume to cover clusters for berry moth sprays.</p>		

## PRE-HARVEST

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Botrytis Bunch Rot	3g*, 6e, ** 65e <sup>***</sup>	3. Rovral 50 WP (1½ - 2 lb)* 6. Vanguard 75 WG (10 oz)** 65. Elevate 50 WDG (1 lb) <sup>***</sup>
<p><b>Comments:</b></p> <p>Pre-harvest is an important timing for Botrytis bunch rot control, especially in susceptible varieties.</p>		<p><b>Comment:</b></p> <p>*--Do not Rovral apply within 7 days of harvest.            **--Do not apply Vanguard more than 2 times per season and no later than 7 days to harvest            ***--Do not apply Elevate more than 3 times per season. Elevate has a 0-day PHI.</p>

# GRAPES

## Special Grape Disease Problems and Controls

### Eutypa Dieback

Eutypa dieback, formerly called "dead arm," is caused by the fungus *Eutypa lata*. The symptoms consist of dying arms and yellowed, cupped leaves on new growth in the spring. As canes and leaves grow out, the symptoms are easily masked by healthy growth. Symptoms are also variable from year to year and may not be noticed every year. This disease is a deep-seated systemic fungus disease of the woody part of the trunk and arms. It takes 3-4 years from the time of infection until symptoms become apparent. Infected vines have a blackish, corky fungal "stroma" on the surface of the trunk near large, old pruning wounds. In this stroma, ascospores are produced. Whenever it rains, these

ascospores are shot into the air. The main period of spore dispersal is from October through May. These spores can infect pruning wounds throughout the pruning season. Unfortunately, a change in pruning time is not feasible as a control strategy. Removing dead and dying grapevines from the vineyard helps reduce inoculum and thereby new infections. Trunk renewal using basal canes may help save infected vines as long as the discoloration of the wood does not extend below ground. When pruning out diseased wood, cut to ½ to 1 foot below discolored zone in the wood.

**Table 1. Relative Effectiveness of Fungicides for Grape Disease Control in Michigan.**

Fungicide	Black Rot	Downy Mildew	Powdery Mildew	Botrytis Rot	Phomopsis
Abound (azoxystrobin)	+++	+++	++	+	+++
Basic Copper Sulfate (copper)	+	+++	++	+	+
Bayleton (triadimefon)	+++	0	+++	0	+
Captan (captan)	++	+++	0	+	++
Ferbam (ferbam)	++	+	0	0	0
Copper Hydroxide (copper)	+	++	+	+	+
JMS Stylet Oil (mineral oil)	0	0	++	+	0
EBDCs (mancozeb)	+++	+++	0	0	++/+++
Elevate	0	0	0	+++	0
Elite (tebuconazole)	+++	0	+++	0	++
Flint (trifloxystrobin)	+++	++	+++	+	+++
Nova (myclobutanil)	+++	0	+++	0	++
Procure (triflumizole)	++	0	+++	+	++
Ridomil Gold MZ (mefenoxam + mancozeb)	++	+++*	0	0	++
Ridomil Gold/Copper (mefenoxam + copper)	+	+++	++	+	+
Rubigan (fenarimol)	++	0	+++	0	0
Rovral (iprodione)	+	0	0	++	?
Sulfur (elemental sulfur)	0	0	++	0	+
Sovran (kresoxim methyl)	+++	++	+++	+	+++
Topsin M (thiophanate methyl)	++	0	+++**	++	+
Vanguard (cyprodinil)	?	?	+	+++	+
Ziram (ziram)	++	++	+	+	++

0 = not effective, + = slightly effective, ++ = moderately effective, +++ = highly effective, ? = effectiveness not known.

Ratings are based on published information and modified based on observations in Michigan vineyards.

\*Ridomil also has eradicative properties.

\*\*If benzimidazole-resistant strains are present, efficacy will be reduced.



# GRAPES

**Table 2. Relative susceptibility to disease and sulfur and copper sensitivity of grape varieties.** (The ratings apply to an average growing season under conditions favorable for disease development. Any given cultivar may be more severely affected).

	Black Rot	Downy Mildew	Powdery Mildew	Phomopsis	Botrytis	Eutypa	Crown gall	Sulfur Sensitive <sup>3</sup>	Copper Sensitive <sup>4</sup>
Aurore	+++ <sup>1</sup>	++ <sup>2</sup>	+++	++	+++	+++	++	No	++
Baco Noir	+++	+	++	+	++	++	++	No	?
Cabernet Franc	+++	+++	+++	?	+	?	+++	No	+
Cabernet Sauvignon	+++	+++	+++	+++	+	+++	+++	No	+
Canadice	+++	++	+	?	++	?	++	No	?
Cascade	+	+	++	++	+	++	+	No	?
Catawba	+++	+++	++	+++	+	+	+	No	++
Cayuga White	+	++	+	+	+	+	++	No	+
Chambourcin	+++	++	+	?	++	?	++	Yes	?
Chancellor	+	+++	+++	+++	+	+	++	Yes	+++
Chardonnay	++	++	++	++	++	?	++	No	?
Chardonnay	+++	+++	+++	+++	+++	++	+++	No	+
Chelois	+	+	+++	+++	+++	+++	++	No	+
Concord	+++	+	++	+++	+	+++	+	Yes	+
DeChaunac	+	++	++	+++	+	+++	++	Yes	+
Delaware	++	+++ <sup>2</sup>	++	+++	+	+	+	No	+
Dutchess	+++	++	++	++	+	+	++	No	?
Elvira	+	++	++	+	+++	+	+	No	++
Einset Seedless	+++	+++	++	?	+	?	+	?	?
Foch	++	+	++	?	+	+++	+	Yes	?
Fredonia	++	+++	++	++	+	?	+	No	?
Gewürtztraminer	+++	+++	+++	?	+++	?	+++	No	+
Himrod	++	+	++	?	+	?	?	No	?
Ives	+	+++	+	?	+	++	+	Yes	?
Limberger	+++	+++	+++	?	+	+++	+++	No	?
Marechal Foch	++	+	++	?	+	+++	?	Yes	?
Melody	+++	++	+	?	+	?	+	No	?
Merlot	++	+++	+++	+	++	+++	+++	No	++
Moore's Diamond	+++	+	+++	?	++	++	?	No	?
Muscat Ottonel	+++	+++	+++	?	++	+++	+++	No	?
Niagara	+++	+++	++	+++	+	+	++	No	+
Pinot gris	+++	+++	+++	?	++	+++	+++	No	?
Pinot Meunier	+++	+++	+++	?	+++	+++	+++	No	?
Pinot blanc	+++	+++	+++	?	++	?	+++	No	+
Pinot noir	+++	+++	+++	?	+++	?	+++	No	+
Reliance	+++	+++	++	++	+	?	?	No	+
Riesling	+++	+++	+++	++	+++	++	+++	No	+
Rosette	++	++	+++	++	+	++	++	No	+++
Rougeon	++	+++	+++	+++	++	+	++	Yes	+++
Sauvignon blanc	+++	+++	+++	?	+++	?	+++	No	+
Seyval	++	++	+++	++	+++	+	++	No	+
Steuben	++	+	+	?	+	?	+	No	?
Vanessa	+++	++	++	+	+	?	+	?	?
Ventura	++	++	++	+	+	?	++	No	?
Verdelet	+	?	?	?	+	?	?	No	?
Vidal 256	+	++	+++	+	+	+	++	No	+
Vignoles	+	++	+++	+++	+++	++	++	No	?
Villard noir	?	+	+++	?	+	?	?	?	?

<sup>1</sup>+ = slightly susceptible or sensitive, ++ = moderately susceptible or sensitive, +++ = very susceptible or sensitive. ? = relative susceptibility not established.

<sup>2</sup>Berries are not susceptible.

<sup>3</sup>Sulfur injury can occur on tolerant varieties when temperatures of 85° or higher occur during or immediately after spray application.

<sup>4</sup>Copper applied under cool, slow-drying conditions is likely to cause injury.

Most of the data in this table were obtained from the New York Cooperative Extension Service.

# GRAPES

**Table 3. Approximate number of hours of wetting required for foliar and fruit infection by the grape black rot fungus at different temperatures.**

<b>Average Temperature (°F)</b>	<b>Hours of Wetness</b>
50	24
55	12
60	9
65	8
70	7
75	7
80	6
85	9
90	12

Source: R.A. Spotts, Ohio State University. Data represent a compilation from several experiments with Concord, Catawba, Aurora and Baco Noir.

# GRAPES

## Effectiveness of Insecticides and Miticides in Controlling Arthropod Pests of Grapes

(Note that a product's effectiveness rating on a pest does not necessarily indicate that it is labeled for that use.)

Ratings of control are E = excellent, G = good, F = fair, P = poor Ratings against beneficials are T = highly toxic, M = moderately toxic, S = relatively safe			Diazinon	Guthion	Imidan	Kelthane	Lannate	Provado	Sevin	Thiodan	Vendex	Lorsban	Agri-Mek	B.t.'s	Danitol	Pyramite	Mating disruption	Intrepid	Surround	Assail	
<b>Pests</b>	<b>Insect / Mite</b>	<b>Life Stage</b>	5	8	9	10	11	19	23	26	28	32	41	43	44	45	48	50	53	56	
	Grape flea beetle	Adult													G						
	Climbing cutworm	Larva										E			E						
	Grape berry moth	Egg/Larva	G	E	E		G		E					G	E		F	G		G	
	Rose chafer	Adult		G	G		F		E						E				F		
	Grape phylloxera	Aerial forms								E											
	Grape leafhopper	Larva/Adult	F	F	F		G	E	G						E	G			F	G	
	Potato leafhopper	Larva/Adult	E	E	E		G	G	G						E					G	
	Japanese beetle	Adult	F	G	G		F		G						G				F		
	Mites	Motiles				G						G		G		G	G				
<b>Beneficials</b>	Bees		T	T	T	N	T	M	T	M	S	T	T	S	T	M	S	S	S	M	
	Predator Mites		M	S	S	M	T	S	T	M	S	S	S	S	T	M	S	S	M	S	
	Insect Predators		T	M	M	N	T	M	T	M	S	S	S	S	T	M	S	S	M	M	

# STRAWBERRIES

The rates of materials for use on strawberry are based on a standard of 100 gal/acre dilute spray. If you are concentrate spraying (less than 100 gal of water/acre), use the rate/acre figures, regardless of the amount of water you are spraying/acre. After each pest appears a column of numbers and letters. These are provided to assist growers in choosing materials to use to control

specific pests. The number refers to the pesticide in the column headed "Suggested Chemicals" and the letter is a rating of efficiency: e = excellent, g = good, f = fair and p = poor for the pesticide controlling the pest.

Products listed by the Organic Materials Review Institute (OMRI) for use in organic production will be marked with the following designation: ▲.

## EARLY GROWTH

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Leaf Spot, Leaf Blight, Scorch, Stem End Rot (leaves)	1g*, 5g, 19g, 56g*	1. Benlate 50 WP (1 lb)* plus Captan 50 WP (5 - 6 lb) or Captec 4 L (2 - 2½ qt)
Angular Leaf Spot (bacterial)	57g***, 58g***	5. Nova 40 W (2.5 - 5 oz)
Red Stele	15g**, 61e****	15. Aliette WDG (2.5 - 5 lb)**
<b>Comments:</b>		19. Thiram Granuflo (4 lb)
<i>Leaf spot, leaf blight, and scorch stem end rot are common foliar diseases caused by rain-splash dispersed fungi. Unless severe, they are relatively harmless on the foliage. However, foliar lesions of leaf blight, and stem end rot provide inoculum for fruit rots, and the scorch fungus can also infect the calyx, leading to calyx browning and smaller fruit. Choosing a resistant variety (see Table 2) or at least avoiding highly susceptible varieties can greatly reduce the number of sprays needed.</i>		56. Topsin-M 70 WP or Topsin M WSB (¾ lb)* plus Captan 50 WP (5-6 lb) or Captec 4 L (2 - 2½ qt)
<i>Angular leaf spot is caused by a rain-splashed bacterium. Lesions are small and angular, and are translucent when viewed against the light (unlike fungal leaf spots). Foliar lesions themselves are not damaging to the plant, unless they become severe. However, bacteria from foliar lesions can cause calyx blackening and reduce marketability of the fruit. Angular leaf spot can enter the field on planting material and can spread rapidly under cool wet conditions.</i>		57. Bordeaux mixture (6 lb copper sulfate and 6 lb hydrated lime per 100 gal water)*** ▲
<i>Red stele is a root rot disease caused by a soilborne fungus and most often occurs on heavy, poorly drained soils. Most root rots in Michigan are black root rot and not red stele. Red stele is characterized by brick red to brown vascular bundles in an otherwise white root. In the case of black root rot, the entire root is brown to black. Red stele can be reduced by growing strawberries on raised beds and improving drainage. Choose a resistant variety (Table 2) if you've had a red stele problem. There is no variety which is resistant to all strains of the fungus, but some varieties have resistance to multiple strains.</i>		58. Fixed copper [various formulations] (labeled rates)*** ▲
		61. Ridomil Gold EC (1 pt)****
		<b>Comments:</b>
		*--Benlate has been withdrawn by the manufacturer, but remaining stocks can still be used. Topsin M may be substituted for Benlate. Repeated use of Benlate or Topsin-M may result in the build-up of fungicide-resistant pathogen strains. Use with Captan together as a tank mix. Benlate is not labeled for home plantings.
		**--Apply Aliette as a foliar spray in spring when active foliage growth occurs. If disease persists make additional applications at 30 to 60-day intervals. Do not tank mix with copper compounds.
		***--Cool wet conditions can enhance phytotoxicity. Discontinue copper applications if signs of crop injury occur. Add hydrated lime as a safener if formulation does not have lime in it.
		****--Make one application of Ridomil Gold EC in spring after ground thaws and before bloom. A second application may be made in autumn after harvest.

# STRAWBERRIES

## EARLY GROWTH (CONTINUED)

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>INSECTS</b>		<b>INSECTICIDES</b>
Spittlebug	8g, 23e, 26e, 44	8. Guthion 50 WP (1 lb)
Mites*	10g*, 20g*, 28g, 41g****, 42g, 44g*, 59g	10. Kelthane 35 WP (1 - 3 lb)*
Strawberry Clipper	32e	10. Kelthane 50 WP (¾ - 2 lb)*
Slugs	36g**, 58g	20. Brigade 10 WP (18 - 32 oz)*
		23. Sevin 80 WSP (2 lb)
		23. Sevin XLR+ (1½ - 2 qt)
		26. Thiodan 50 WP (2 lb)
		26. Thiodan 3 EC (1½ qt)
		28. Vendex 50 WP (1 - 2 lb)*
		32. Lorsban 4 E (2 pt)***
		36. Deadline (Metaldehyde) (10 - 40 lb)**
		41. Agri-Mek 0.15 EC (1 pt)****
		42. Savey 50 WP (3 - 6 oz)*
		42. Savey 50 DF (3 - 6 oz)*
		44. Danitol 2.4 EC (16 oz)*
		58. Sluggo (40 lbs)
		59. Acramite 50 W (0.75 - 1 lb)
		<b>Comments:</b>
		*--Apply as two-spotted spider mites begin to increase.
		**--Various formulations of Metaldehyde and Metaldehyde-Sevin baits have a label for slugs on strawberries.
		***--For strawberry clipper apply first spray when first buds become visible followed by a second spray 10 days later.
		****--Do not add oil to Agri-Mek applied to strawberry. May need back-to-back applications for satisfactory mite control.

## PRE-BLOOM

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Leaf Spot, Leaf Blight, Scorch, Stem End Rot (leaves)	1g, 5g, 19g, 56g	1. Benlate 50 WP (1 lb) plus Captan 50 WP (5 - 6 lb) or Captec 4 L (2 - 2½ qt)
Angular Leaf Spot (bacterial)	57g, 58g**	5. Nova 40 W (2.5 - 5 oz)
Red Stele	15g*, 61e***	15. Aliette WDG (2.5 - 5 lb)*
		19. Thiram Granuflo (4 lb)
		56. Topsin-M 70 WP or Topsin M WSB (¾ lb) plus Captan 50 WP (5-6 lb) or Captec 4 L (2 - 2½ qt)
		57. Bordeaux mixture (6 lb copper sulfate and 6 lb hydrated lime per 100 gal water) ▲
		58. Fixed copper [various formulations] (labeled rates)** ▲
		61. Ridomil Gold EC (1 pt)***
		<b>Comments:</b>
		*--Apply Aliette as a foliar spray in spring when active foliage growth occurs. If disease persists make additional applications at 30 to 60-day intervals. On susceptible cultivars use shorter intervals and higher rates. Do not tank mix with copper compounds.
		**--Cool wet weather may enhance phytotoxicity. Discontinue applications if signs of crop injury occur.
		***--Make one application of Ridomil Gold EC in spring after ground thaws and before bloom. A second application may be made in autumn after harvest.
<b>INSECTS</b>		<b>INSECTICIDES</b>
Tarnished Plant Bug	20, 23, 26e*, 44e	8. Guthion 50 WP (1 lb)
Spittlebug	See Early Growth	20. Brigade 10 WP (16 - 32 oz)
Strawberry Leafroller	8e, 23e, 44, 46g	23. Sevin 80 WSP (2 lb)
Strawberry Clipper	See Early Growth	23. Sevin XLR+ (1½ - 2 qts)
Mites	See Early Growth	26. Thiodan 50 WP (2 lb)*
		26. Thiodan 3 EC (1½ qt)*
		44. Danitol 2.4 EC (10 - 21.3 oz)
		46. SpinTor 2 SC (4 - 6 oz)
		<b>Comments:</b> Tarnished plant bug control is critical at this time. Best results are obtained with a specific Thiodan application at or before 10% king bloom.



# STRAWBERRIES

## BLOOM

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Leaf Spot, Leaf Blight, Scorch, Stem End Rot (leaves/fruit)	1g*, 5g, 19g, 20g****, 56g, 62g****	1. Benlate 50 WP (½ lb)* plus Captan 50 WP (5 - 6 lb) or Captec 4 L (2 - 2½ qt)
Angular Leaf Spot (bacterial)	57g, 58g	3. Rovral 50 WP (1 - 2 lb)** plus Captan 50 WP (5-6 lb) or Captec 4 L (2 - 2½ qt)
Powdery mildew	1g*, 5e, 14g, 20e****, 62e****	5. Nova 40 W (2.5 - 5 oz)
Anthracnose	1g*, 20e****, 56g, 62e****, 67f	14. Sulfur [various formulations] (labeled rates) ▲
Gray Mold	1g*, 3g**, 19g, 20f****, 56g, 65e*****, 67e*****	15. Aliette WDG (2.5 - 5 lb)***
Leather Rot	15g***, 61e*****	19. Thiram Granuflo (4 lb)
<b>Comments:</b> Do not apply insecticides during bloom to avoid bee poisoning.		20. Cabrio EG (14 oz)****
<p><b>Powdery mildew</b> is caused by a windborne fungus and is characterized by upward curling of the leaves and a white powdery growth on the upper or lower sides of the leaf. Severe infections can reduce fruit yields and also lead to blossom and fruit infection. Powdery mildew is favored by warm humid conditions. While these conditions also favor powdery mildew fungi on other plants in the vicinity of your field, these do not infect strawberry. To reduce the number of sprays needed, avoid susceptible varieties and dense canopies resulting from overfertilization.</p>		56. Topsin-M 70 WP or Topsin M WSB (¾ lb) plus Captan 50 WP (5 - 6 lb) or Captec 4 L (2 - 2½ qt)
<p><b>Anthracnose</b> is caused by several Colletotrichum fungi which infect different parts of the plant. Anthracnose can occur in the crown, on the leaves and runners, as well as on the fruit. The fruit rot is most common in Michigan and crown is not common. Anthracnose can be brought in on planting material. Plants collapsing soon after planting may be indicative of anthracnose crown rot and should be sent in for diagnosis. Anthracnose fruit rot is characterized by dark sunken areas on the fruit. Under humid conditions, orange spore masses can be seen in the lesions. These can be splashed by rain to healthy fruit. Anthracnose fruit rot is favored by hot humid weather and typically becomes more common later in the harvest period.</p>		57. Bordeaux mixture (6 lb copper sulfate and 6 lb hydrated lime per 100 gal water) ▲
<p><b>Gray mold</b> is caused by the fungus Botrytis cinerea and is characterized by a gray fuzzy growth on the berries. The fungus overwinters on mummified fruit and old leaves. Symptoms are usually first seen on ripening or ripe berries. The fungus can also incite blossom blight. Flowers are the main pathway by which the fungus infects the fruit. The fungus then remains latent until the fruit ripens. Fruit rot is favored by moderate temperatures and long periods of high relative humidity or wetness during the flowering period. Cultivars with partial resistance are available. To reduce post-harvest fruit rot, minimize injury to the fruit, avoid contact with infected fruit, and ensure rapid cooling of picked fruit to near 32 F.</p>		58. Fixed copper [various formulations] (labeled rates) ▲
<p><b>Leather rot</b> is caused by a soilborne fungus and characterized by brown leathery berries. Whole clusters can be affected. When older berries get infected they become light brown in color and have a pungent, chemical-like odor. Under wet conditions, a white fuzzy growth (mycelium and spores) may be present on these berries. Leather rot is most common in poorly drained fields and where standing water is present. The best way to control leather rot is to mulch the strawberries with straw to prevent direct contact of the berries with soil and to keep soil from splashing onto the berries.</p>		61. Ridomil Gold EC (1 pt)*****
		62. Quadris FL (6.2-15.4 oz)****
		65. Elevate 50 WDG (1.5 lb)*****
		67. Switch 62.5WG (11 - 14 oz)*****
		<b>Comments:</b> *--After fruit formation, the maximum allowable rate of Benlate is 1/2 lb/acre. The addition of Captan will also aid in the control of leather rot. **--If resistant Botrytis strains are present, efficacy of Rovral will be reduced. Only one application of Rovral is allowed per season. Do not apply Rovral after first fruiting flower. ***--Begin applications of Aliette between 10% bloom and early fruit set and continue on a 7-14-day interval as long as conditions are favorable to disease development. When disease pressure is heavy, use shorter intervals and higher rates. Do not tank mix with copper compounds. ****--Do not apply strobilurins more than two times consecutively, and not more than four times (Quadris) or five times (Cabrio) per season. *****--In addition to applications of Ridomil for control of red stele, one additional application may be made for leather rot control at fruit set. Do not apply more than 1.5 qt per acre per year. *****--Do not make more than 2 consecutive applications of Elevate. Do not apply more than 6 lbs of product per acre per season. *****-- Alternate Switch with other effective fungicides, like Elevate or Captan. Do not exceed 56 oz product per acre per year.

# STRAWBERRIES

## THIMBLE-SIZED BERRIES

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Leaf Spot, Leaf Blight, Scorch, Stem End Rot (fruit)	1g*, 5g, 19g, 20g**, 56g, 62g**	1. Benlate 50 WP (½ lb) plus Captan 50 WP (5 - 6 lb) or Captec 4 L (2 - 2½ qt)
Angular Leaf Spot (bacterial)	57g, 58g**	5. Nova 40 W (2.5 - 5 oz)
Powdery mildew	1g*, 5e, 14g, 20e**, 62e**	14. Sulfur [various formulations] (labeled rates) ▲
Anthracnose	1g*, 20e**, 56g, 62e**, 67f****	15. Aliette WDG (2.5 - 5 lb)*
Gray Mold	1g*, 19g, 20f**, 56g, 65e***, 67e****	19. Thiram Granuflo (4 lb)
Leather Rot	15g*	20. Cabrio EG (14 oz)**
<b>Comments:</b>		56. Topsin-M 70 WP or Topsin M WSB (¾ lb) plus Captan 50 WP (5 - 6 lb) or Captec 4 L (2 - 2½ qt)
*--Do not tank mix Aliette with copper compounds.		57. Bordeaux mixture (6 lb copper sulfate and 6 lb hydrated lime per 100 gal water) ▲
**--Do not apply strobilurins more than two times consecutively, and not more than four times (Quadris) or five times (Cabrio) per season.		58. Fixed copper [various formulations] (labeled rates) ▲
***--Do not make more than 2 consecutive applications of Elevate. Do not apply more than 6 lbs of product per acre per season.		62. Quadris FL (6.2 - 15.4 oz)**
****--Alternate Switch with fungicides with a different mode of action, like Elevate or Captan. Do not exceed 56 oz product per acre per year.		65. Elevate 50 WDG (1.5 lb)**
		67. Switch 62.5WG (11 - 14 oz)****
<b>INSECTS</b>		
Tarnished Plant Bug	See Pre-Bloom	
Mites	See Early Growth	

## PRE-HARVEST

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Leaf Spot, Leaf Blight, Scorch, Stem End Rot (fruit)	1g*, 5g**, 19g***, 20g**, 56g*, 62g**	1. Benlate 50 WP (½ lb)* plus Captan 50 WP (5 - 6 lb) or Captec 4 L (2 - 2½ qt)*
Powdery mildew	1g*, 5e**, 20e**, 62e**	5. Nova 40 W (2.5 - 5 oz)**
Anthracnose	1g*, 20e**, 56g*, 62e**, 67f**	15. Aliette WDG (2½ - 5 lb)**
Gray Mold	1g*, 19g***, 20f**, 56g*, 65e**, 67e**	19. Thiram Granuflo (4 lb)***
Leather Rot	15g**	20. Cabrio EG (14 oz)**
<b>Comments:</b>		56. Topsin-M70 WP or Topsin M WSB (¾lb)*plus Captan 50 WP (5-6 lb) or Captec 4 L (2 - 2½ qt)*
*--Benlate and Topsin-M have a 1-day PHI, while Captan has a 0-day PHI.		62. Quadris FL (6.2 - 15.4 oz)**
**--Nova, Alliette, Cabrio, Quadris, Elevate, and Switch have a 0-day PHI.		65. Elevate 50 WDG (1.5 lb)**
***--Thiram has a 3-day PHI.		67. Switch 62.5 WG (11 - 14 oz)**
<b>INSECTS</b>		<b>INSECTICIDES</b>
Strawberry Sap Beetle	20g, 44g	20. Brigade 10 WP (16 - 32 oz)
		44. Danitol 2.4 EC (16 - 21.3 oz)

# STRAWBERRIES

## HARVEST

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>Comments:</b>
Leaf Spot, Leaf Blight, Scorch, Stem End Rot (fruit)	See Pre-Harvest	Benlate cannot be used after "U-pick" operations have started.
Anthraxnose	See Pre-Harvest	Do not plant rotational crops other than strawberries or onions for 12 months following the last application of Switch 62.5WG.
Gray Mold	See Pre-Harvest	
Leather Rot	See Pre-Harvest	
<b>Comments:</b>		
<p>At harvest, various <b>fruit rots</b> may be noticed, e.g., leather rot, <i>Botrytis</i>, anthracnose fruit rot, <i>Phomopsis</i> soft rot, stem end rot, and <i>Rhizopus</i> rot. Most of these rots can be prevented by fungicide applications earlier in the season. Fungicide sprays just prior to harvest can help reduce post-harvest losses to <i>Botrytis</i> and other rots.</p> <p><b>Rhizopus rot</b> is difficult to control with pre-harvest sprays. Broad-spectrum fungicides can help reduce disease pressure to some extent. The <i>Rhizopus</i> fungus causes a leaky soft rot causing the berries to literally melt away. The berries become covered in a white to blueish grey fuzz containing spores which spread rapidly through the air. <i>Rhizopus</i> is particularly severe on overripe fruit in hot summers. Timely harvesting and rapid cooling may help reduce post-harvest losses.</p>		
<b>INSECTS/MITES</b>		<b>INSECTICIDES</b>
Cyclamen Mites	10g, 26g	10. Kelthane 35 WP (4 - 6¾ lb) 10. Kelthane 50 WP (¾ - 2 lb) 26. Thiodan 3 EC (2¾ qt) 26. Thiodan 50 WP (4 lb)
<b>Comments:</b>		
<p>Under certain circumstances cyclamen mites may become established in a planting. Usually the infestation is limited to small areas in the field. These can be spot treated with the suggested chemical. The material should be applied with up to 400 gallons of water per acre, so the plants are thoroughly drenched. The addition of a wetting agent will improve control. NOTE: Be aware of days between final sprays and harvest (Thiodan 4 days).</p>		

## POST-HARVEST AND NEW PLANTING

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Leaf Spot, Leaf Blight, Scorch*	1g, 5g, 56g,	1. Benlate 50 WP (1 lb) plus Captan 50 WP (4 lb) or Captec 4 L (2qt)
Powdery mildew*	1g, 5e, 14g	5. Nova 40 W (2.5 - 5 oz)
Red Stele	61e	14. Sulfur [various formulations] (labeled rates) ▲ 56. Topsin-M 70 WP or Topsin M WSB (¼ lb) plus Captan 50 WP (4 lb) or Captec 4 L (2qt)
<b>Comments:</b>		61. Ridomil Gold EC (1 pt)
<p>*--These treatments are especially for new plantings, starting 10 days to 2 weeks after harvest and repeated 2 weeks later. They will keep new plants relatively disease free and allow maximum growth to occur in the fall.</p>		
<b>INSECTS</b>		<b>INSECTICIDES</b>
Strawberry Leafroller	5g, 8e, 20, 23e, 46g	5. Diazinon 50 WP (2 lb)
Leafhoppers	23g	8. Guthion 50 WP (1 lb)
Strawberry Aphids	5e, 26e*	20. Brigade 10 WP (8 - 32 oz)
Slugs	36g**, 58g**	23. Sevin 50 WP (4 lb)
Grubs	32g***	23. Sevin 80 S (2½ lb)
		26. Thiodan 3 EC (1½ qt) *
		32. Lorsban 4 E (2 qt)***
		36. Deadline (Metaldehyde bait) (10 - 40 lb) **
		46. SpinTor 2 SC (4 - 6 oz)
		58. Sluggo (40 lb)**
<b>Comments:</b>		
*--See label for restriction of Thiodan use.		
**--Fall application can ease slug problems the following spring. Bait should be applied during a period of clear and dry weather for best results.		
***--Preplant only for grub control in sufficient water for incorporation.		

# STRAWBERRIES

## Special Strawberries Disease Problems and Controls

**Table 1.** Effectiveness of Fungicides for Strawberry Disease Control

Fungicide	Anthraco nose	Botrytis gray mold	Angular leaf spot	Common leaf spot	Phomopsis leaf blight and fruit rot	Powdery mildew	Leather rot	Mucor fruit rot	Rhizopus rot	Red stele	Phytophthora crown rot
Aliette	0	0	0	0	0	0	+++	0	0	+++	+++
Benlate	+R	+++R	0	+++	++	++R	0	0	0	0	0
Cabrio	+++	++	?	+++	+++	+++	?	?	?	?	?
Captan	+++	+++	0	+++	++	0	+	+	+++	0	0
Copper*	+	+	+	+	+	+	+	+	+	+	+
Elevate	?	++++	?	?	?	?	0	?	?	0	0
Nova	0	0	0	+++	+++	+++	0	?	?	0	0
Quadris	++++	+	?	+++	++	+++	?	?	?	?	?
Ridomil	0	0	0	0	0	0	+++R	0	0	++++	++++
Rovral	0	+++R	0	0	0	0	0	0	0	0	0
Sulfur*	0	0	0	0	0	+++	0	0	0	0	0
Switch	++	++++	?	?	?	?	0	?	?	0	0
Thiram	+++	+++	0	+	++	0	+	+	0	0	0
Topsin-M	+R	+++R	0	+++	+++	++R	0	0	0	0	0

0 = not effective, + = poor, ++ = moderate, +++ = good, ++++ = excellent, ? = not known. Ratings are based on published information and observations in Michigan and other states.

\*Phytotoxicity may occur.

R = Efficacy reduced if fungicide-resistant strains present.

**Table 2.** Disease resistance of strawberry cultivars commonly grown in the Midwest.

Variety	Red stele	Verticillium wilt	Botrytis gray mold	Common leaf spot	Leaf scorch	Phomopsis leaf blight	Powdery mildew	Angular leaf spot	Black root rot
Allstar	VR	R	S-I	R	R		R	S	S
Annapolis	S	I	S	S	S		VS		
Bounty	S	VS	I	I	I				
Cavendish	R	I-R	S	R	R		S-I		
Chandler			I						
Delmarvel	R	R		S-R	T-R	I	T	R	
Earliglow	R	T-R	R	S	R	R	S		R
Glooscap	S	S	S	S-I	S-I	I	S-I	S	
Gov. Simcoe	S	I	I		I		VS		
Guardian	R	I-R		S	R				
Honeoye	S	S	I	R	R	S	S-R	I	S
Idea	I-R			S	S			I	
Jewel	S	S	I	R	R		I		
Kent	S	S	S	S-I	S-I	S	I	S	
Lateglow	R	R	I	T	T	S	T	S	
Latestar	R	R	S	S-R	S-R	S	T		
Lester	R	R		R	R	I	R	S	
Midway	R	S-I	I	VS	S		I		R
Mira								I	
Mohawk	R	R		I	I	I	I		
Northeaster	R	R	I	S-R	S-R		S		
Oka				S	I		T		
Primetime	R	R		T	T		T		
Redchief	R	R	S	S-R	S-R	I	S-R	S	
Scotland		I		T	R		S		
Scott	R	I-R		S-R	R		R		
Selkirk		S		I	S		VS		
Seneca	S	S		R	R			S	VS
Settler	S	I			I		I		
St. Williams		I		R	R		I-R		
Startyme	S	S		I	I	I			
Winona	R		S	I	I	I			I

VR=very resistant, R=resistant, I=intermediate, T=Tolerant, S=susceptible, and VS=very susceptible

Table prepared by J. Hancock, E. Hanson, M. Ellis, and A.M.C. Schilder.

Resistant to several races of the red stele fungus.

# BRAMBLES

## (Red Raspberries, Black Raspberries, Dewberries, and Blackberries)

The rate of materials for use on brambles is based on a standard of 200 gal/acre dilute spray. If you are concentrate spraying (less than 200 gal of water/acre), use the rate/acre figures, regardless of the amount of water you are spraying/acre. To get sufficient spray coverage of fruit clusters and foliage, it is recommended to use 50-100 GPA. Effectiveness of materials listed below is based primarily on trials using concentrate sprays of 50 GPA (water). After each pest appears a

column of numbers and letters. These are provided to assist growers in choosing materials to use to control specific pests. The number refers to the pesticide in the column headed "Suggested Chemicals" and the letter is a rating of efficiency: e = excellent, g = good, f = fair and p = poor for the pesticide controlling the pest.

Products listed by the Organic Materials Review Institute (OMRI) for use in organic production will be marked with the following designation: ▲.

### DELAYED DORMANT (BUD BREAK)

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Anthracnose	64g*	61. Ridomil Gold EC (¼ pt)** or Ridomil Gold GR (5 lb)**
Spur blight	64g*	64. Lime sulfur solution (10 or 20 gal/100 gal water)* ▲
Cane blight	64g*	
Phytophthora Root Rot	61e** See Post-Harvest	
<p><b>Comments:</b>  <i>Phytophthora root rot symptoms appear in summer and spring. Whole canes suddenly wilt. The disease is associated with heavy soils and poorly drained areas in the field. Good drainage and raised beds help in the management of this disease.</i></p> <p><i>Anthracnose, spur blight, and cane blight are cane diseases caused by fungal pathogens which overwinter in infected canes. These fungi become active during rainy periods in the spring. Lime sulfur can help reduce disease pressure by inactivating overwintering inoculum. Anthracnose looks like whitish spots on the green canes, whereas spur blight looks like purple blotches around the nodes. Cane blight can look purple initially but then becomes brown to grey.</i></p>		<p><b>Comments:</b>            *--When new leaves are exposed ¼ to ¾ in., use the 20 gal rate; when a few leaves have unfolded, use the 10 gal rate. There is a greater risk of lime-sulfur burn by spraying at the later time.            **--Ridomil may be applied once in the spring and once in the fall. Apply between bud break and pre-blossom. Do not apply within 45 days of harvest. Application rate is per 1,000 ft of row. Ridomil Gold is registered for raspberries only.</p>



# BRAMBLES

## PRE-BLOSSOM

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Anthracnose	50g <sup>***</sup> , 57g	5. Nova 40 W (1.25 - 2.5 oz)*
Spur Blight	50g <sup>***</sup> , 57g	15. Aliette 80 WDG (5 lb)**
Cane Blight	50g <sup>***</sup> , 57g	50. Captan 50 WP (4 lb)***
Phytophthora Root Rot	15g <sup>**</sup> , 61e <sup>****</sup>	57. Bordeaux mixture (6 lb copper sulfate and 6 lb hydrated lime per 100 gal water) ▲
Raspberry Leaf Spot	5g*	61. Ridomil Gold EC (¼ pt) or Ridomil Gold GR (5 lb)****
Powdery Mildew	5e*	
Rusts	5e*	
<b>Comments:</b> The <b>cane blight</b> fungus can infect the plant only through wounds. Avoid wounding by trellising the canes, protecting the canes from insect damage, and not topping the canes in wet weather during the growing season. Apply fungicides right after topping to protect the pruning wounds from infection.  <b>Rusts</b> include orange rust, yellow rust, and cane and leaf rust. Orange rust is particularly insidious since it becomes systemic inside the plant. Even a systemic fungicide cannot save a plant once it is severely infected, but new infections from occurring.		<b>Comments:</b> *-- Do not apply more than 10 oz of Nova per acre per season. **--Apply Aliette at 1-3" new growth and continue spraying on a 45-60 day schedule, up to a maximum of 4 sprays per season. Do not apply within 60 days of harvest. Do not tank mix with copper compounds, surfactants or foliar fertilizers. ***--Captan may be used in Michigan under a Special Local Need label. Apply first when blossoms are in bud (young canes 8-10" long) and make the second application 2 weeks later. Apply in 45-100 gal water. Do not apply more than 20 lb Captan per acre per season. ****--Ridomil may only be applied once in the spring. If already applied at bud break, do not apply now. Special Local Need label. Apply first when blossoms are in bud (young canes 8-10" long) and make the second application 2 weeks later. Apply in 45-100 gal water. Do not apply more than 20 lb Captan per acre per season. ****--Ridomil may only be applied once in the spring. If already applied at bud break, do not apply now.

# BRAMBLES

## PRE-BLOSSOM *continued*

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>INSECTS</b>		<b>INSECTICIDES</b>
Spittlebug	23g	5. Diazinon 50 WP (2 lb)
Leafrollers	5g, 8g, 43g*, 49g	8. Guthion 50 WP (½ lb)
Raspberry Sawfly	13g	13. Malathion 50 WP (4 lb)
Raspberry Fruit Worm	13g	23. Sevin 50W (2-4 lb)
Raspberry Cane Borer*	See Comments	23. Sevin 80 S (2-2½ lb)
Red-necked cane borer**	See Comments	23. Sevin XLT (1-2 qt)
		43. B.t.'s [Dipel DF (1 lb)]* ▲
		49. Confirm 2 F (16 oz)
<p><b>Comments:</b>            To control the <b>raspberry cane borer</b>; cut off and destroy injured canes below the two rings made by the beetles. Do this as soon as wilted tips are noticed, usually in July.</p> <p>To control the <b>red-necked cane borer</b>; cut and burn in the fall or early spring any wild raspberries in the vicinity since this insect develops on wild raspberries. At pruning time remove and burn all canes showing any swellings.</p>		<p><b>Comments:</b>            *--B.t.'s should be timed for early egg hatch and complete coverage is required for control. Two or three applications may be required. B.t. is most effective under warm weather conditions</p>

## EARLY BLOOM

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Anthracnose	1e*, **, 20e****, 50g**	1. Benlate (¾ lb)* plus Captan 50 WP (4 lb)**
Spur Blight	1e*, **, 20g****, 50g**	3. Rovral 4 F (1-2 pt)***
Cane Blight	1g*, **, 20e****, 50g**	5. Nova 40 W (1.25-2.5 oz)
Raspberry Leaf Spot	1g*, **, 5g, 20e****	20. Cabrio EG (14 oz)****
Gray Mold (Botrytis rot)	1g*, **, 3e***, 5g, 50f-g**, 65e*****	50. Captan 50 WP (4 lb)**
Powdery Mildew	5e, 20g****	65. Elevate (1.5 lb)*****
Rusts	5e, 20g****	
<p><b>Comments:</b>            The <b>gray mold</b> fungus can cause latent infections of fruit by invading the blossoms. These infections will become active when the fruit ripens. Fruit rots are most severe when rainy, wet conditions prevail. Fungicide sprays at bloom can help reduce the incidence of pre-harvest fruit rot.</p>		<p><b>Comments:</b>            *--Benlate has been withdrawn by the manufacturer, but can still be used. Benlate may not be used on home plantings or after "U-pick" operations have started.            **--Captan 50 WP can be used under a Special Local Need label in Michigan. For control of fruit rot, apply at 5-10% bloom and then again at full bloom. Additional applications can be made at 10-14 day intervals as needed. Apply Captan in 45-100 gal water. Do not apply more than 20 lb Captan per acre per season. Captan has a 3-day PHI.            ***--If resistant Botrytis strains are present, efficacy of Rovral may be reduced. Do not make more than 4 applications of Rovral per season.            ****--Do not apply Cabrio more than four times during the growing season, and not more than two times consecutively.            *****--Do not apply Elevate more than four times during the growing season, and not more than three times consecutively.</p>

# BRAMBLES

## FULL BLOOM

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Anthracnose	See Early Bloom	
Gray mold (Botrytis rot)		
Spur blight		
Cane blight		
Raspberry Leaf Spot		
Powdery Mildew		
Rusts		

## FIRST COVER (PETAL FALL)

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Anthracnose	See Early Bloom	
Gray mold (Botrytis rot)		
Spur blight		
Cane blight		
Raspberry Leaf Spot		
Powdery Mildew		
Rusts		
<b>INSECTS</b>		<b>INSECTICIDES</b>
Leafrollers	See Pre-Blossom	5. Diazinon 50 WP (2 lb)
Cane Borers	See Pre-Blossom	8. Guthion 50 WP (½ lb)
Aphids	See Pre Harvest	23. Sevin 50 WP (4 lb)
Leafhoppers	5g, 8g, 23g	23. Sevin 80 S (2½ lb)
Tarnished plantbug	23g	23. Sevin XLR+ (2 qt)

# BRAMBLES

## PRE-HARVEST

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Gray mold (Botrytis Rot)	3e*, 20f***, 50f-g****, 65e*****	3. Rovral 4F (1-2 pt)*
Penicillium Rot	5g**, 20g***, 50f****	5. Nova 40 W (1.25-2.5 oz)**
Cladosporium Rot	5g**, 20g***, 50f****	20. Cabrio EG (14 oz)***
<b>Comments:</b>		50. Captan 50 WP (4lb)****
<p><b>Gray mold</b> of harvested fruit can be reduced by preventing bruising of the fruit and by rapid cooling after harvest. Also, avoiding handling of infected fruit will reduce the spread of the disease to healthy fruit. A fungicide spray right before harvest can help minimize post-harvest rot.</p> <p><b>Penicillium rot and Cladosporium rot</b> appear on fruit as a green fuzzy growth. These are primarily post-harvest rots and can be reduced by fungicide sprays prior to harvest.</p>		65. Elevate (1.5 lb)*****
<b>INSECTS/MITES</b>		<b>Comments:</b>
Aphids	5g, 13e	*--Rovral has a 0-day PHI
Japanese Beetle**	13g, 23g, 54f*, 57g***, 58g***	**--Nova has a 0-day PHI
Two-spotted spider mite	13g, 23g, 54f*	***--Cabrio has a 0-day PHI
<b>Comments:</b>		****--Captan has a 3-day PHI.
*--Primarily a repellent.		*****--Elevate has a 0-day PHI.
**--Insecticide application for beetle control when fall bearing varieties are in bloom risks mortality for pollinators.		
***--These are short-lived pyrethrums with strong initial knockdown activity.		
<b>INSECTICIDES</b>		
		5. Diazinon 50 WP (2 lb)
		13. Aqua Malathion 8 E (1 pt)
		13. Malathion 25 WP (8 lb)
		23. Sevin 50 WP (4 lb)
		23. Sevin 80 S (2½ lb)
		23. Sevin XLR+ (2 qt)
		54. Neem [Ecozin (10 oz)]*
		54. Neem [Neemix (1 pt)]* ▲
		54. Neem [AzaDirect (32 oz)]* ▲
		57. Pyganic EC 1.4 (32-64oz)*** ▲
		58. Evergreen EC 60-6 (8-16oz)***

## POST-HARVEST

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Phytophthora Root Rot	15g*, 61e***	15. Aliette WDG (5 lb)*
Anthracoise	50g**	50. Captan (4 lb)**
Spur Blight	50g**	61. Ridomil Gold EC (¼ pt)*** or Ridomil Gold GR (5 lb)***
<b>Comments:</b>		*--The last fall application of Aliette should be made at least 30 days prior to leaf drop.
		**--Apply fall spray of Captan after old canes are removed.
		***--The rate of Ridomil is per 1,000 row ft in a band 3 ft wide centered over the row. Only one application is allowed in the fall.
<b>INSECTS</b>		<b>INSECTICIDES</b>
Aphids	5g*	5. Diazinon 50 WP (2 lb)*
Raspberry Crown Borer	5e*	<b>Comments:</b>
		*--Where raspberry crown borers are a major problem, apply a drenching crown spray using Diazinon at 100 to 200 gal of spray/acre. Apply the spray any time from mid-October to mid-November or as a drench to the crown area in early April to kill the overwintering stage.

# Special Brambles Disease Problems and Control

## Virus Diseases in Raspberries

There are at least five severe virus diseases in Michigan. Two of these diseases are raspberry mosaic and raspberry leaf curl. Both are vectored (spread) by raspberry aphids, which live on diseased wild raspberries and on diseased cultivated raspberries. A third virus disease, tomato ringspot virus, is soil-borne and vectored by the dagger nematode, *Xiphinema americanum*. Two other viruses causing disease in Michigan raspberries are raspberry bushy dwarf virus and tobacco streak virus. All of these virus diseases are devastating to raspberry production. *Follow these principles to keep raspberries free from virus diseases for as long as possible:*

1) Prior to planting, sample the planting site thoroughly for nematodes at 6- to 8-inch and 18-inch depths. Send the sample to the MSU Nematology Laboratory (see Extension Bulletin E-800, "Nematode Detection"). If there are dagger

nematodes (*Xiphinema americanum*) or root lesion nematodes (*Pratylenchus* spp.), fumigate the soil thoroughly the fall before spring planting (see section on soil fumigation for nematode control).

2) Buy registered virus-free or virus-tested raspberry stock. Do not plant stock grown by your neighbor or from any nursery source that does not grow them as part of a regulated virus-tested program. The quickest way to lose money growing raspberries is to plant virus-infected stock.

3) Plant the field 500 to 1,200 ft away from existing wild raspberries or existing old cultivated raspberries. If this cannot be done, attempt to eradicate wild raspberries within a radius of 500 to 1,200 ft with herbicides.

4) Spray the new planting with aphicides regularly throughout the first and succeeding growing seasons. This should be done from first growth in the spring through leaf drop in the fall on a regular basis.



**Table 1.** Susceptibility of raspberries to various diseases (VR=very resistant, R=resistant, MR=moderately resistant, I=intermediate, MS=moderately susceptible, S=susceptible, and VS=very susceptible; RMV= Raspberry mosaic virus; RBDV= Raspberry bushy dwarf virus; RLCV= Raspberry leaf curl virus).

Variety	Phytophthora root rot	Verticillium wilt	Anthrax- nose	Spur blight	Cane blight	Cane spot	Crown gall	Fire blight	Leaf spot	Powdery mildew	Late leaf rust	Gray Mold	Viruses
<b>Summer Red Raspberries</b>													
Algonquin	R			R								MR	R (aphid) R (RBDV)
Boyne	MR	S	S	R	I				R			MR	
Canby			S	R	S				I			I	VR (aphid) R (virus)
Carnival													
Chilcotin	VS			MS								R	R (aphid) S (RMV) R (RBDV)
Chilliwack	MR			MR	S	S						S	R (aphid) R (RBDV)
Comet			MR	MR									
Comox													
Encore	I			S				MS					
Festival	I		I	I						I	VS		I (RMV)
Gatineau													
Haida	VS			R								MR	R (aphid)
Hilton													
K81-6	MR			I	S	S		S	S	S		S	S (RLCV)
Killarney	MR		S	R					MR	S			
Latham	MR		MR	R	I				R			I	MR (virus)
Lauren	MS			R					R				
Liberty													R (aphid)
Madawaska										S			
Newburgh	MR		MR	MR	MR								
Nordic	MR		I										
Prelude				R					R				
Nova	S		MS	R				S	VR	MS	R		S (RLCV)
Regency													
Qualicum	S		S	R		S		I				S	R (aphid) R (RMV) MR (RBDV)
Reveille												I	
Sentry	I			R					R				
Summer													
Taylor	I								VS				VS
Titan	VS			MS	S				MR			I	R (aphid)
Trent										S			
Tulameen				I			R		MS			I	MR (RMV) MR (aphid) MR (RBDV)

**Table 1 (continued).** Susceptibility of raspberries to various diseases (VR=very resistant, R=moderately resistant, I=intermediate, MS=moderately susceptible, S=susceptible, and VS=very susceptible; RMV= Raspberry mosaic virus; RBDV= Raspberry bushy dwarf virus; RLCV=Raspberries leaf curl virus).

Variety	Phytophthora root rot	Verticillium wilt	Anthracnose	Spur blight	Cane blight	Cane spot	Crown gall	Fire blight	Leaf spot	Powdery mildew	Late		Viruses
											leaf rust	Gray mold	
<b>Summer Yellow Raspberries</b>													
Honey Queen	I												
<b>Fall Red Raspberries</b>													
Amity	MR		MR	MR	MR								MR (aphid) S (RMV)
August Red				R				R					S (RBDV) R (RMV)
Autumn Bliss				R				R				S	S (RBDV) R (RMV)
Autumn Britten				R				R					R (RMV)
Autumn Cascade	S			MR				R				R	R (RMV)
Caroline				VS				R				I	S (RBDV)
Dinkum	S							R					
Double Delight													
Fall Red													
Heritage	I		MR	MR	I			R	R	R	S	MR	I (RBDV) I (RMV)
Polana				I				R				I	
Redwing													
Ruby	S			R			S	R				S	S
Summit													
<b>Fall Yellow Raspberries</b>													
Anne													S
Fall Gold													S
Golden Harvest							R						R (RBDV)
<b>Purple Raspberries</b>													
Amethyst									I				
Brandywine	S?	S					S						S (aphid)
Clyde													
Estate													
Royalty							S						VR (aphid)
Success													
<b>Black Raspberries</b>													
Allegheny												MR	
Allen												MR	
Black Hawk						R					S		I
Bristol						S							I
Cumberland						S							
Dundee											S		MR (RMV)
Early Sweet													
Haut													
Huron												MR	
Jewel													

# BLUEBERRIES

The rate of materials for use blueberries is based on a standard of 200 gal/acre dilute spray. If you are concentrate spraying—(less than 200 gal of water/acre), use the rate/acre figures, regardless of the amount of water you are spraying/acre. To get sufficient spray coverage of fruit clusters within the canopy, it is recommended to use at least 50-100 GPA after bloom. Effectiveness of materials listed below is based primarily on trials using concentrate sprays of 50 GPA (water). After each pest appears a column of numbers

and letters. These are provided to assist growers in choosing materials to use to control specific pests. The number refers to the pesticide in the column headed "Suggested Chemicals" and the letter is a rating of efficiency: e = excellent, g = good, f = fair and p = poor for the pesticide controlling the pest.

Products listed by the Organic Materials Review Institute (OMRI) for use in organic production will be marked with the following designation: ▲.

## GREEN TIP (1/16")

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Fusicoccum Canker	1g*, 4g, 9g***	1. Benlate 50WP (1 lb)* plus: Captan 50 WP (5 lb) or Captec 4 L (2½ qt)
Phomopsis Twig Blight and Canker	1g-e*, 2g-e**, 4g, 9g-e***, 15f-g, 51g****	2. Indar 75 WSP (2 oz)**
Mummy Berry (shoot strike phase)	2g-e**, 4f-g, 9g***	4. Bravo WeatherStik (3 - 4¼ pt)
Phytophthora Root Rot	61e****	9. Topsin M WSB (1 lb)*** plus: Captan 50 WP (5 lb) or Captec 4 L (2½ qt) or Ziram 76 DF (3 - 4 lb) or Ziram Granuflo (3 lb)
<b>Comments:</b>		15. Aliette WDG (5 lb)
<b>Mummy berry:</b> The mummy berry fungus ( <i>Monilinia vaccinii-corymbosi</i> ) overwinters in mummified fruit on the ground. In the spring, the mummies form little trumpet-shaped mushrooms that shoot ascospores into the air. These ascospores are spread by wind and infect young shoots causing rapid wilting. Frost may enhance susceptibility of the shoots. Under humid conditions, a grayish layer of conidia can be seen on the wilted shoots. The conidia are spread by rain, wind, and bees to blossoms, which then become infected. As the fungus colonizes the developing berry, the berry becomes pink to gray, mummifies, and falls to the ground. In spring, after the fruit skin has weathered away, the mummies often look like small black pumpkins. Removing or covering mummies with soil or mulch helps reduce inoculum levels. Start fungicide applications at green tip.		51. Ziram 76 DF (3 - 4 lb) or Ziram Granuflo (3 lb)****
<b>Phomopsis twig blight and canker:</b> The fungus ( <i>Phomopsis vaccinii</i> ) overwinters in old cankers and infected twigs. Spores are released under wet conditions throughout the spring and summer, but mostly from bud swell to petal fall. The spores are dispersed by rain and infect young twigs and green canes, causing reddish brown lesions, wilting, and dieback. Infections can spread from the twigs into stems and may eventually kill entire canes. Drought stress, frost, and wounds can predispose plants to infection. Selective pruning of diseased canes is a good cultural control method. Remove and destroy prunings. Indar applied on the same schedule as for mummy berry will help control <i>Phomopsis</i> twig blight.		61. Ridomil Gold EC (1/4 pt)*****
<b>Fusicoccum canker:</b> <i>Fusicoccum putrefaciens</i> is a fungus which infects blueberry stems causing cankers, dieback and plant decline. The fungus overwinters in existing cankers and spores are released during wet weather from March to July, causing new infections. Lesions are reddish brown with a sharp margin, resembling a bull's eye pattern, and are centered around a leaf scar. The disease is more prevalent in northern than in southern Michigan.		<b>Comments:</b> <b>Review fungicide characteristics and restrictions in the section "Fungicides for Small Fruit Crops", pages 10-17.</b>
<b>Phytophthora root rot:</b> This disease, caused by the fungus <i>Phytophthora cinnamomi</i> is usually associated with heavy soils and poorly drained areas within fields. The fungus infects fine roots, causing them to turn brown or black; larger-diameter roots may also be discolored. Above-ground symptoms include chlorosis and reddening of the leaves, small leaves, defoliation, branch dieback, death of entire canes, stunting and death of the entire bush. Site selection and good drainage are important management tools. Raised beds may help also. 'Bluecrop' and 'Weymouth' are more tolerant than other cultivars.		*--Benlate has been withdrawn by the manufacturer, but is still allowed. Not for container-grown blueberries, home plantings or once "U-pick" operations have started. **--Indar is expected to be available under Section 18 (emergency exemption) in 2003. Apply in at least 20 gal water/acre by ground sprayer or in 10 gal water/acre by airplane. Make no more than 5 applications (10 oz) per acre per season. When disease pressure is high, applications on a 7-day schedule are advised. ***--Topsin M WSB is a substitute for Benlate and is expected to have a Section 18 (emergency exemption) label in 2003. Do not make more than three applications per season. ****--Ziram 76 DF can be applied at a higher rate under a Special Local Need label. The 4-lb rate is generally more effective than the 3-lb rate. *****--For established plantings, apply Ridomil at 1/4 pint/1,000 linear ft of row (3.6 pints/acre -broadcast basis). The chemical should be banded 3 ft wide centered on the row, but applied to the soil. One additional application may be made to coincide with periods favorable for root rot development. For new plantings do not apply more than 0.9 gals/acre (broadcast basis) during the 12 months prior to harvestable fruit or illegal residues may result. Ridomil will not revitalize plants showing moderate to severe root rot symptoms.

# BLUEBERRIES

## GREEN TIP (1/4 - 1/2")

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Mummy Berry (shoot strike phase)	2g-e, 4f-g	1. Benlate 50WP (1 lb) <b>plus:</b> Captan 50 WP (5 lb) or Captec 4 L (2½ qt)
Phomopsis Twig Blight and Canker	1g-e, 2g-e, 4g, 9g-e, 15f-g, 51g	2. Indar 75 WSP (2 oz) 4. Bravo WeatherStik (3 - 4 pt) 9. Topsin M WSB (1 lb) <b>plus:</b> Captan 50 WP (5 lb) or Captec 4 L (2½ qt) or Ziram 76 DF (3 - 4 lb) or Ziram Granuflo (3 lb) 15. Aliette WDG (5 lb) 51. Ziram 76 DF (3 - 4 lb) or Ziram Granuflo (3 lb)

## PINK BUD

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Mummy Berry (blossom infection phase)	1g*, 2g-e, 4f-g, 9g**	1. Benlate 50WP (1 lb)* <b>plus:</b> Captan 50 WP (5 lb) or Captec 4 L (2½ qt)
Fusicoccum Canker	1g*, 4g, 9g**	2. Indar 75 WSP (2 oz) 4. Bravo WeatherStik (3 - 4 pt) 9. Topsin M WSB (1 lb)** <b>plus:</b> Captan 50 WP (5 lb) or Captec 4 L (2½ qt) or Ziram 76 DF (3 - 4 lb) or Ziram Granuflo (3 lb) 15. Aliette WDG (5 lb) 51. Ziram 76 DF (3 - 4 lb) or Ziram Granuflo (3 lb) 65. Elevate 50WDG (1.5 lb)***
Phomopsis Twig Blight and Canker	1g-e*, 2g-e, 4g, 9g-e**, 15f-g, 51g	
Anthracnose	1g-e*, 4g, 9g-e**, 15g, 51g	
Botrytis leaf and blossom blight	1g*, 9g**, 51f, 65e***	
<b>Comments:</b>		<b>Comments:</b>
<p><b>Anthracnose:</b> This fruit rot is caused by the fungus <i>Colletotrichum acutatum</i>, which forms orange to pink spore masses on rotten berries. The fungus overwinters in infected twigs and starts sporulating in early spring. Spores are dispersed by rain and wind and can infect blossoms, fruit, and succulent tissue. Spores can also spread from diseased fruit to good fruit at harvest, resulting in post-harvest losses. The disease is enhanced by hot and humid weather. Cultivar Elliott has some resistance to the disease. Pruning to remove diseased twigs and increase air circulation, and timely harvesting help control the disease. Proper timing of irrigation to overlap with dew events will help reduce fruit wetness and infection. The most important periods to protect against anthracnose are from pink bud through early green fruit, and then again at late green fruit/early blue fruit.</p>		<p>*--Benlate has been withdrawn by the manufacturer, but is still allowed. Not for container-grown blueberries, home plantings or once "U-pick" operations have started. **--Topsin M WSB is expected to have a Section 18 (Emergency exemption) label in 2003. Do not make more than three applications per season. ***--Avoid making more than 2 consecutive applications of Elevate. Do not apply more than 6 lbs of product per season.</p>
<b>INSECTS</b>		<b>INSECTICIDES</b>
Obliquebanded Leafroller	11g, 40e, 43g, 46e, 49g	11. Lannate 90 SP (1 lb) 11. Lannate LV (3 pt) 40. Asana XL 0.66 EC (4.8 - 9.6 fl oz) 43. B.t.'s [Dipel] (1.5 lb) ▲ 46. SpinTor 2 SC (4 - 6 oz) 49. Confirm 2 F (16 oz)
Spring Canker Worm	11e, 40g, 46g	

## 25% BLOOM

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Mummy Berry (blossom infection phase)	1g, 2g-e	1. Benlate 50WP (1 lb) <b>plus:</b> Captan 50 WP (5 lb) or Captec 4 L (2½ qt) or
Fusicoccum Canker	1g	2. Indar 75 WSP (2 oz) 4. Bravo WeatherStik (3 - 4 pt) 9. Topsin M WSB (1 lb) <b>plus:</b> Captan 50 WP (5 lb) or Captec 4 L (2½ qt) or Ziram 76 DF (3 - 4 lb) or Ziram Granuflo (3 lb) 15. Aliette WDG (5 lb) 51. Ziram 76 DF (3 - 4 lb) or Ziram Granuflo (3 lb) 61. Ridomil Gold EC (¼ pt) 65. Elevate 50WDG (1.5 lb)
Phomopsis Twig Blight and Canker	1g-e, 2g-e, 4g, 15f-g, 51g	
Anthracnose	1g-e, 4g, 15g, 51g	
Phytophthora Root Rot	61e	
Botrytis leaf and blossom blight	1g, 51f, 65e	

# BLUEBERRIES

## FULL BLOOM (EARLY PETAL FALL)

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Mummy Berry (blossom infection phase)	1g, 2g-e*, 12f***, 20f****	1. Benlate 50WP (1 lb) plus: Captan 50 WP (5 lb) or Captec 4 L (2½ qt)
Fusicoccum Canker	1g, 4g**, 15g	2. Indar 75 WSP (2 oz)*
Phomopsis Twig Blight and Canker	1g-e, 2g-e*, 4g**, 12g***, 20g****, 15f-g, 51g	4. Bravo WeatherStik (3 - 4 pt)**
Anthrachnose	1g-e, 4g**, 12e***, 15g, 20e****, , 51g	9. Topsin M WSB (1 lb) plus: Captan 50 WP (5 lb) or Captec 4 L (2½ qt) or Ziram 76 DF (3 - 4 lb) or Ziram Granuflo (3 lb)
Alternaria Fruit Rot	15f-g	12. Abound FL (6.2 - 15.4 oz)****
Botrytis leaf and blossom blight	1g, 51f, 65e*****	15. Aliette WDG (5 lb)
<b>Comments:</b>		20. Cabrio EG (14 oz)****
*--Do not apply Indar within 30 days of harvest.		51. Ziram 76 DF (3 - 4 lb) or Ziram Granuflo (3 lb)
**--Do not apply Bravo WeatherStik after early petal fall or fruit spotting may occur. Bravo has a 42-day PHI.		65. Elevate 50WDG (1.5 lb)*****
***--A rate of 10-12 oz of Abound per acre is recommended. Abound is most efficiently used against anthracnose close to harvest. Do not make more than 2 consecutive applications of Abound before alternating to a non-strobilurin fungicide, and no more than 3 applications per season.		<b>Comments:</b>
****--Cabrio is most efficiently used against anthracnose close to harvest. Do not make more than 2 consecutive applications of Cabrio before alternating to a non-strobilurin fungicide, and no more than 4 applications of Cabrio or other strobilurin fungicides per season.		<b>Alternaria fruit rot</b> is characterized by dark green fuzzy growth on infected fruit and is caused mostly by the fungus <i>Alternaria tenuissima</i> . This fungus overwinters in twigs and debris on the ground. Spores are wind-dispersed and are not usually abundant until early to mid-June. Conditions required for infection are not well understood. Good control of anthracnose sometimes results in an increase in <i>Alternaria</i> fruit rot, presumably by taking away the competition. Removal of plant debris should help to reduce the spore supply.
*****--Avoid making more than 2 consecutive applications of Elevate. Do not apply more than 6 lbs of product per season.		
<b>INSECTS</b>		<b>INSECTICIDES</b>
Obliquebanded Leafroller	43g*, 49g**	43. B.t.'s [Dipel (1.5 lb)] * ▲
Cranberry Fruitworm	43g*, 49g**, 52g**	49. Confirm 2F (16 fl oz)** , ***
Cherry Fruitworm	43g*, 49g**, 52g**	52. Esteem 35WP (5oz)**
Gypsy Moth	43g*, 49g**, ***	<b>Comments:</b>
		*--Time these insecticides for early egg hatch. B.t. is most effective under warm weather conditions. B.t.'s may need to be reapplied every 4-7 days to maintain control.
		**--Time sprays for start of egg laying.
		***--Apply Confirm at 4-8 fl. oz for gypsy moth.

## FIRST COVER (100% PETAL FALL)

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Fusicoccum Canker	1g*, 15g	1. Benlate 50WP (1 lb)* plus: Captan 50 WP (5 lb) or Captec 4 L (2½ qt)
Phomopsis Twig Blight and Canker	1g-e*, 2g-e**, 9g-e***, 12g****, 15f-g, 20g****, 51g***	2. Indar 75 WSP (2 oz)**
Anthrachnose	1g-e*, 4g**, 9g-e***, 12e****, 15g, 20e****, 51g***	9. Topsin M WSB (1 lb) plus: Captan 50 WP (5 lb) or Captec 4 L (2½ qt) or Ziram 76 DF (3 - 4 lb) or Ziram Granuflo (3 lb)***
Alternaria Fruit Rot	15f-g	12. Abound FL (6.2 - 15.4 oz)****
<b>Comments:</b>		15. Aliette WDG (5 lb)
*--Benlate has a 21-day PHI.		20. Cabrio EG (14 oz)*****
**--Indar has a 30-day PHI.		51. Ziram 76 DF (3 - 4 lb) or Ziram Granuflo (3 lb)***
***--Do not apply Ziram Granuflo later than 3 weeks after bloom. Ziram 76 DF has a 14-day PHI.		
****--A rate of 10-12 oz of Abound per acre is recommended. Abound is most efficiently used against anthracnose close to harvest. Do not make more than 2 consecutive applications of Abound before alternating to a non-strobilurin fungicide, and no more than 3 applications per season.		
*****--Cabrio is most efficiently used against anthracnose close to harvest. Do not make more than 2 consecutive applications of Cabrio before alternating to a non-strobilurin fungicide, and no more than 4 applications of Cabrio or other strobilurin fungicides per season.		



# BLUEBERRIES

## FIRST COVER (100% PETAL FALL) (CONTINUED)

INSECTS		INSECTICIDES	
Plum Curculio	5g, 8e, 9e, 23g	5. Diazinon 50 WP (2 lb)	
Blueberry Tip Borer	5g, 8e, 9e, 23g	8. Guthion 50 WP (1 - 1¼ lb)	
Obliquebanded Leafroller	5g, 8e, 9e, 11g* 23g, 43g, 46g, 49g	9. Imidan 70 WP (1 1/3 lb)	
Cranberry Fruitworm	5g, 8e, 9e, 11g*, 23e, 40e, 43g, 46g, 49g, 52g**	11. Lannate 90 SP (1 lb)*	
Cherry Fruitworm	8e, 9e, 23e, 40e, 43f-g, 46g, 49g, 52g**	11. Lannate 2.4 LV (3 pt)*	
Aphids	5g, 11g*, 40f	23. Sevin 80 WSP (1¼ - 2½ lb)	
Thrips	5g, 8g, 46g	23. Sevin 50 WP (3 - 4 lb)	
<b>Comments:</b> For aphid control, sprays should be applied with a ground sprayer to achieve sufficient cover.		23. Sevin XLR+ (1½ - 2 qt)	
		40. Asana XL 0.66EC (8 oz)	
		43. B.t.'s [Dipel (1.5 lb)] ▲	
		46. SpinTor 2 SC (4 - 6 oz)	
		49. Confirm 2 F (16 oz)	
		52. Esteem 35WP (5 oz)**	
		<b>Comments:</b> *--Lannate cannot be used in "U-pick" fields. **--Esteem shows greatest activity against fruitworm eggs.	

## SECOND COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Fusicoccum Canker	1g*	<b>FUNGICIDES</b>
Phomopsis Canker	1g*, 9**, 15f-g, 51g**	1. Benlate 50WP (1 lb)* plus: Captan 50 WP (5 lb) or Captec 4 L (2½ qt) or Ziram 76 DF (3 - 4 lb) or Ziram Granuflo (3 lb)**
Anthracnose	1g-e*, 9g-e**, 12e***, 15g, 20e****, 51g**	9. Topsin M WSB (1 lb) plus: Captan 50 WP (5 lb) or Captec 4 L (2½ qt)
Alternaria Fruit Rot	15f-g	12. Abound FL (6.2 - 15.4 oz)***
***--A rate of 10-12 oz of Abound per acre is recommended. Abound is most efficiently used against anthracnose close to harvest. Do not make more than 2 consecutive applications of Abound before alternating to a non-strobilurin fungicide, and no more than 3 applications per season.		
****--Cabrio is most efficiently used against anthracnose close to harvest. Do not make more than 2 consecutive applications of Cabrio before alternating to a non-strobilurin fungicide, and no more than 4 applications of Cabrio or other strobilurin fungicides per season.		
INSECTS See First Cover		
*--Benlate has a 21-day PHI. **--Do not apply Ziram Granuflo later than 3 weeks after bloom. Ziram 76 DF has a 14-day PHI.		

## THIRD COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Fusicoccum Canker	1g*	<b>FUNGICIDES</b>
Phomopsis Canker	1g*, 9g**, 15f-g, 51g*	1. Benlate 50WP* (1 lb) plus: Captan 50 WP (5 lb) or Captec 4 L (2½ qt) or Ziram 76 DF (3 - 4 lb) or Ziram Granuflo (3 lb)
Anthracnose	1g-e*, 9g-e**, 12e***, 15g, 20e****, 51g*	9. Topsin M WSB (1 lb)** plus: Captan 50 WP (5 lb) or Captec 4 L (2½ qt)
Alternaria Fruit Rot	15f-g	12. Abound FL (6.2-15.4 oz)***
<b>Comments:</b> ***--A rate of 10-12 oz of Abound per acre is recommended. Abound is most efficiently used against anthracnose close to harvest. Do not make more than 2 consecutive applications of Abound before alternating to a non-strobilurin fungicide, and no more than 3 applications per season. Abound has a 0-day PHI. ****--Cabrio is most efficiently used against anthracnose close to harvest. Do not make more than 2 consecutive applications of Cabrio before alternating to a non-strobilurin fungicide, and no more than 4 applications of Cabrio or other strobilurin fungicides per season. Cabrio has a 0-day PHI.		
INSECTS See First Cover		
*--Benlate has a 21-day PHI and Ziram 76 DF has a 14-day PHI. **--Topsin M WSB has a 7-day PHI and Ziram 76 DF has a 14-day PHI.		



# BLUEBERRIES

## FOURTH COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		
Fusicoccum Canker	See Third Cover	
Phomopsis Canker	See Third Cover	
Anthracnose	See Third Cover	
Alternaria Fruit Rot	See Third Cover	
<b>INSECTS</b>		<b>INSECTICIDES</b>
Blueberry Maggot	5g, 8e, 9e, 11g, 13g, 23g, 40g, 46f, 53e*, 54f**	5. Diazinon 50 WP (2 lb) 8. Guthion 50 WP (1 - 1 1/2 lb) 9. Imidan 70 WP (1 1/3 lb) 11. Lannate 90 SP (1 lb) 11. Lannate 2.4 LV (3 pt) 13. Malathion LV Concentrate (10 fl oz) 13. Aqua Malathion 8 EC (1 1/2 - 2 1/2 pt) 23. Sevin XLR+ (1 1/2 - 2 qt) 40. Asana XL 0.66 EC (4.8 - 9.6 fl oz) 46. SpinTor 2 SC (6 oz) 53. Surround WP (25 lb)* 54. Neem [Ecozin 3% (10 oz)]** 54. Neem [Neemix (1 pt)] ** ▲ 54. Neem [AzaDirect (32 oz)]** ▲
Aphids	5g, 11g, 13g, 40f	
Japanese Beetle	8g, 9g, 11f, 13g, 23f, 40g, 53f*, 54f**	
<b>Comments:</b> *--Must maintain coverage for adequate performance. **--Primarily a repellent. Some formulations may affect fruit finish.		

## FIFTH COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>INSECTS</b>	See Fourth Cover	

## SIXTH COVER

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>INSECTS</b>	See Fourth Cover	

# BLUEBERRIES

## PRE-HARVEST

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Fusicoccum Canker	50g****	12. Abound FL (6.2 - 15.4 oz)*
Phomopsis Canker	15f-g***, 50f-g****	15. Aliette WDG (5 lb)****
Anthracoze	12e*, 15g***, 20e**, 50g****	20. Cabrio EG (14 oz)**
Alternaria Fruit Rot	15f-g***	50. Captan 50 WP (5 lb)****
<b>Comments:</b>		<b>Comments:</b>
**-- Do not make more than 2 consecutive and a total of 4 applications per season. Cabrio has a 0-day PHI.		*--A rate of 10 or 12 oz of Abound per acre is recommended. Do not make more than 2 consecutive and a total of 3 applications per season. Abound has a 0-day PHI.
***--Aliette has a 0-day PHI		
****--Captan has a 0-day PHI. If canker is a serious problem, and it has been 3 to 4 weeks since the last canker spray, apply a spray at this time.		
<b>INSECTS</b>		<b>INSECTICIDES</b>
White Marked Tussock Moth	11e, 23e*	5. Diazinon 50 WP (2 lb)
Obliquebanded Leafroller	11g, 23g*, 40e, 43g, 49g	8. Guthion 50 WP (1-1 1/2 lb)
Canker Worms	11e, 23e*	9. Imidan 70 WP (1 1/3 lb)
Japanese Beetle	8g, 9g, 11f, 13g, 23g*, 40g, 53f**, 54f***, 57g****, 58g****	11. Lannate 90 SP (1/2 - 1 lb)
Blueberry Maggot	5g, 8e, 9e, 13g, 23g*, 40f, 46f, 53e**, 54f****	11. Lannate LV (3 pt)
<b>Comments:</b>		13. Aqua Malathion 8 EC (2 - 2.5 pt)
*--Addition of non-ionic surfactant to ground sprays increases knockdown of Japanese beetle.		23. Sevin 80 S (1 7/8 lb)*
**--Must maintain coverage for adequate performance.		23. Sevin XLR+ (1 1/2 - 2 qt)*
***--Primarily a repellent. Some formulations may affect fruit finish.		40. Asana XL 0.66 EC (9.6 fl oz)
****--These are short-lived pyrethrums with strong initial knockdown activity.		43. B.t.'s [Dipel (1.5 lb)] ▲
		46. SpinTor 2SC (6 oz)
		49. Confirm 2 F (16 fl oz)
		53. Surround WP (25 lb)**
		54. Neem [Ecozin 3% (10 oz)]***
		54. Neem (Neemix 1pt)*** ▲
		54. Neem [AzaDirect (32 oz)]*** ▲
		57. Pyganic EC 1.4 (32 - 64oz)**** ▲
		58. Evergreen EC 60-6 (8 - 16oz)****

## POST-HARVEST

Pest	Efficiency	Suggested Chemicals (Rate/acre)
<b>DISEASES</b>		<b>FUNGICIDES</b>
Fusicoccum Canker	50f	50. Captan 50 WP (5 lb)
Phomopsis Canker	50f	<b>Comments:</b>
		Apply a spray if canker is a serious problem, and if it has been 3 to 4 weeks since the previous canker spray. Continue spray applications at 3 to 4-week intervals through leaf drop in the fall.
<b>INSECTS</b>		<b>INSECTICIDES</b>
Blueberry Bud Mite	26g	26. Thiodan 3 EC (2 qt)*
		<b>Comments:</b>
		*--Apply immediately post harvest with sufficient water to achieve thorough penetration of buds scales, followed by a second application 2 weeks later.

# BLUEBERRIES

## Special Blueberry Disease Problems and Controls

Table 1. Effectiveness of Fungicides for Blueberry Disease Control.

Fungicide	Mummy berry		Phomopsis twig blight and canker	Fusicoccum canker	Alternaria fruit rot	Anthracnose fruit rot	Botrytis blight and fruit rot	Phytophthora Root Rot
	Primary	Secondary						
Abound	+ / ++	+ / ++	++	?	+	++++	+	?
Aliette	0	0	++ / +++	?	++ / +++	+++	?	+++
Benlate or Topsin M + Captan	++	+++	+++ / ++++	+++ / ++++	+	+++	+++	0
Bravo	++	+	+++	+++	+	+++	++	0
Cabrio	+ / ++	+ / ++	+++	?	+	++++	+	?
Captan	+	+ / ++	+++	+	+	++ / +++	+	0
Elevate	+	++	+	?	0	0	++++	0
Indar	+++	+++	+++ / ++++	?	+	0	?	0
Lime sulfur	?	?	++*	?	?	?	?	0
Rovral	0	0	0	0	0	0	++++	0
Ridomil	0	0	0	0	0	0	0	++++
Ziram (3 lb)	++	+	++	++	+	++	+	0
Ziram (4 lb)	++	++	+++	++ / +++	++*	+++	++	0

0 = not effective, + = poor, ++ = fair, +++ = good, ++++ = excellent, ? = not known. Ratings are based on published information and observations in Michigan.

\* Based on data from New Jersey and Michigan. Fall and spring dormant application used.

### Dormant Applications:

Dormant or delayed-dormant applications of lime sulfur can help reduce overwintering inoculum of *Phomopsis* and *Fusicoccum*. Applications may be made in the fall after the leaves are off or in the spring before bud break. Lime sulfur is not a stand-alone treatment. A fall application was shown to be as effective or slightly more effective than a spring application in reducing twig blight in New Jersey and Michigan trials. About 50% reduction in twig blight can be expected using a fall or "fall + spring" application

# BLUEBERRIES

**Table 2.** Disease resistance in blueberry cultivars commonly grown in the Midwest.

Variety	Mummy berry	Phomopsis twig blight and canker	Fusicoccum canker	Powdery mildew	Anthraxnose fruit rot	Red ringspot virus	Shoestring virus
Berkeley	S	VS		R			
Bonus							
Bluecrop	MR			MR	VS	MR	VR
Bluegold	S						
Bluehaven	S	S					
Bluejay	R						R
Blueray	S				S		
Bluetta	S	R					
Burlington	R						S
Chippewa							
Collins	S						
Coville	MR		MR	MR			
Darrow	R						R
Duke	R						
Earliblue	S	S		R			S
Elliott	R	R			R		S
Jersey	MR	VS		S	S	MR	S
Lateblue	R						
Little Giant					R		
Nelson							
Northblue	R						
Northcountry							
Northland	S						R
Northsky	R						
Patriot							
Polaris							
Rancocas	MS		R	R			MS
Rubel	S	MR	MR		MS		S
Sierra	S						
St. Cloud							
Spartan	MR						S
Sunrise							
Toro							
Weymouth	S						S

VR=very resistant, R=resistant, MR=moderately resistant, MS=moderately susceptible, and S=susceptible and VS=very susceptible  
 Table prepared by J. Hancock, E. Hanson, D. Trinka, and A.M.C. Schilder.

# BLUEBERRIES

## Effectiveness of Insecticides and Miticides in Controlling Arthropod Pests of Blueberries

(Note that a product's effectiveness rating on a pest does not necessarily indicate that it is labeled for that use.)

Ratings of control are E = excellent, G = good, F = fair, P = poor Ratings against beneficials are T = highly toxic, M = moderately toxic, S = relatively safe			Diazinon	Guthion	Imidan	Lannate	Malathion	Sevin	Superior Oil	Thiodan	Asana	B.t.'s	Spintor	Conform	Esteem	Surround	Neem compounds	Pyganic	Evergreen	
Insect / Mite	Life Stage		5	8	9	11	13	23	24	26	40	43	46	49	52	53	54	57	58	
<b>Pests</b>	Blueberry Aphid	Active	G			G					F									
	Blueberry Bud Mite	Egg/Active							G	G										
	Blueberry Maggot	Adult	G	E	E	G	G	G			G		F			E	F			
	Blueberry Tip Borer	Adult	G	E	E			G												
	Canker Worms	Larva				E		E			G		G							
	Cherry Fruitworm	Larva/Egg	G	E	E			E			E	F/G	G	G	G					
	Cranberry Fruitworm	Larva/Egg	G	E	E	G		E			E	G	G	G	G					
	Gypsy Moth	Larva										G		G						
	Japanese Beetle	Adult		G	G	F	G	G			G						F	F	G	G
	Obliquebanded leafroller	Larva/Egg				G					E	G	E	G						
	Plum Curculio	Adult	G	E	E			G												
	Redbanded leafroller	Larva																		
	Thrips	Active	G	G									G							
	Tussock Moth	Larva				E		E												
<b>Beneficials</b>	Bees		T	T	T	T	T	T	S	M	T	S	M	S	S	S	S	S	M	
	Predator Mites		M	S	S	T	M	T	S	M	T	S	M	S	S	M	S	S	S	
	Insect Predators		T	M	M	T	M	T	S	M	T	S	M	S	S	M	S	S	S	



# Plant Growth Regulators

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Plant growth regulators (PGRs) are a class of natural and synthetic organic compounds, other than nutrients, that affect growth, development, and maturation of vegetative and reproductive plant structures. The type and degree of plant response varies with the type and concentration of PGR, the crop, and the stage of plant development when applied. Since PGRs subtly or dramatically alter plant growth, it is important to understand their intended and possible side effects, and how to apply them for optimum results.

PGRs must be absorbed into the plant to be effective. Leaves and fruits are the primary sites of absorption, and any factor that influences their wetting and contact time with the PGR may markedly influence plant response. The environment before, during, and/or after application can influence PGR performance by increasing or decreasing absorption, as well as plant activity once the PGR has been absorbed. Use of PGRs on plants low in vigor or under stress requires caution, since such plants may over-respond.

A major challenge with PGR use is results often vary considerably between years and locations, even when apparent climatic and growth conditions are seemingly the same. To minimize variation and improve consistency, consider these application factors:

**1. Dosage:** PGRs must be applied within a narrow dose range, often given as "parts per million" (ppm), PGR quantity (in oz, lbs, or grams) per 100 gal of spray solution, or PGR quantity applied per acre, to produce a desired response. Since absorption, and hence activity, of most PGRs is affected by drying time, the actual dose to which the plant can respond will depend on climate, the total volume of water applied, and spray particle size and distribution through the canopy.

**2. Time of Application:** For optimal growth-regulating activity, most PGRs must be applied within a narrow time interval, often only a few days, at a specific stage of plant growth. Missing the window may result in no response or possibly an unintended response.

**3. Variety:** Varieties often differ in degree of response. Read the product label for specific instructions concerning timing and concentration, and contact your local extension agent for area-specific experiences.

**4. Coverage:** In general, responses to PGRs are localized, thus all PGRs must be applied with precision. Ensure that the proper amount, with recommended surfactant (if any), is applied uniformly and thoroughly. Calibrate sprayers accurately. When spraying large trees from a non-tower sprayer, direct 2/3 of the spray volume into the upper 1/3 of the tree.

**5. Environment:** Since weather conditions before, during, and after application may affect PGR performance by influencing absorption and activity, avoid applications whenever weather conditions may approach extremes.

**6. Tree Age, Vigor, and Stress:** Young trees tend to be easy to thin until they reach full cropping maturity. High-density orchards respond as "young" trees until they are about 5 years old. Low-density orchards tend to respond as "young" trees until they are about 7 to 8 years old. Treatment of such "young" trees with PGRs should be conservative to prevent excessive responses, such as overthinning, until they become mature trees bearing full crops. Similarly, trees low in vigor or under stress often respond excessively to PGRs, so special adjustments in dose or application delay may be necessary.

**7. Evaluation:** There is no substitute for keen observation and routine recording of all PGR application conditions and responses across each orchard block. Always leave several non-treated trees, preferably within the block rather than at the edge, so that the effectiveness of each treatment [application] can be evaluated objectively. With time, future PGR treatments can then be adjusted for site-specific variations based on a record of past experiences.

## Apples

### Chemical Thinning

Chemical thinning of blossoms and fruitlets can reduce the crop load on the tree, promote return bloom and consistent annual production, eliminate small fruitlets, improve fruit size, and improve uniformity of ripening. Chemicals available for apple thinning include: naphthaleneacetic acid (NAA), naphthaleneacetamide (NAD), benzyladenine (BA) and carbaryl (Sevin).

#### Thinning With NAA

Varieties differ greatly in their response to NAA thinning sprays and on this basis are divided into three groups: 1) easy to thin; 2) intermediate to thin; and 3) difficult to thin.

Listed below are varieties and suggested NAA concentrations to apply 5 to 7 days after petal fall, as a guide when first starting a thinning program. The time of application, relative to bloom or fruit development, influences the response to the thinning application. Applications promote fruitlet abscission most effectively when developing king fruit are approximately 9 to 12 millimeters (mm) in diameter.

If the first application of NAA does not result in enough thinning, increase the concentration 2 to 5 ppm and follow with a second application 7 to 10 days after the first. Very late applications can cause very small sized fruit.

**1. Varieties Easy to Thin:** Delicious (non-spur type), Empire, Honeycrisp, Idared, Jersey mac, Jonagold, Jonathan, McIntosh, Northern Spy, and Rhode Island Greening: 4 grams of actual NAA per 100 gallons (10 ppm).

**2. Varieties Intermediate to Thin:** Cortland, Delicious (spur type), Gala, and Paulared: 6 grams of actual NAA per 100 gallons (15 ppm). Spur type Delicious are harder to thin than regular Delicious and require 3 to 5 more ppm. Note: NAA applied to spur type Delicious after application of Promalin or Accel can result in formation of pygmy fruit.

**3. Varieties Hard to Thin:** Fuji, Golden Delicious, Rome Beauty, and Wealthy: 8 grams of actual NAA per 100 gallons (20 ppm).

### Thinning with NAD

Amid-Thin (NAD) is suggested for use on apples at 50 ppm applied at petal fall. Concentrations lower than this have not given adequate thinning. Applying NAD after petal fall has resulted in poor thinning, as well as causing the fruit to stick fast to the tree so that no "June drop" occurred, resulting in a large crop of valueless, small apples.

NAD is suggested especially for early varieties that ripen before McIntosh, and for varieties likely to be injured by NAA applications. These include Early McIntosh, Northern Spy, Oldenburg (Duchess), Yellow Transparent, and Wealthy. NAD can also be used on most other varieties. While it may not adequately thin some of these other varieties, it seems to make follow-up thinning easier with a subsequent application of another thinning agent. However, NAD sometimes has not thinned Delicious, but instead resulted in a crop with many undersized, distorted apples. *Do not apply* NAD after petal fall on the Delicious variety. Do not combine with Accel.

### Thinning with Carbaryl

Carbaryl (Sevin) applied between petal fall and second cover can reduce yield. Applications at other times in the growing season have no adverse effect on crop yield.

Sevin is a mild thinning agent, but it has not always produced consistent and adequate results. Unlike most PGRs, thinning with Sevin does not appear to be concentration-dependent and rates of 1/2 to 2 lb Sevin (50 WP)/100 gal will result in similar thinning responses. Apply Sevin at first cover for fruit thinning. Warm temperatures following application (>70°F) are required for thinning activity. Sevin used at second cover following NAA applications can cause overthinning and increase mite problems. Sevin XLR Plus and Sevin 80S can also be used for thinning. Note: Sevin is toxic to bees, so extreme care must be used to prevent exposure to native or commercial bees.

### Thinning with Benzyladenine

Benzyladenine (BA, marketed for thinning with the addition of GA<sub>4+7</sub> as Accel) has not satisfactorily thinned most varieties, but has been somewhat effective on Empire, Jonathan and McIntosh. BA can thin over a two-week period but developing fruits appear most susceptible to BA applied at the 10-mm stage of fruit development. Good uniform spray coverage is important. To achieve thinning, BA must come in direct contact with the spur leaves of the target fruit cluster. Warm temperatures at and following application are necessary for effective thinning. A concentration of at least 25 ppm (dilute basis) is necessary for minimum thinning response and 50 ppm is more effective.

BA is not satisfactory for thinning spur type Delicious, and if combined with, or followed by, NAA applications, can result in pygmy fruit and seedless apples.

### Thinning Combinations

Combinations of NAA and Carbaryl provide thinning with lower rates of NAA. Combine NAA at 1/3 to 1/2 the rate used when applied alone with 1/2 to 1 lb Carbaryl. Apply when fruitlets are 10-12 mm in diameter. Carbaryl may be combined with BA for thinning using the usual rate of Carbaryl with 1/2 to 2/3 rate of BA. This may be helpful on smaller fruited varieties such as Empire and Jonathan. Combination applications are generally dependent on temperatures greater than 70°F for effective thinning.

### Guide for Chemical Thinning of Apples in Michigan<sup>1</sup>

	Chemical Method	
	NAA 5-15 days after petal fall (ppm)	NAD at petal fall (ppm)
Cortland	15	50
Delicious, non-spur type	10	—
Delicious, spur type	15	—
Empire	10	50
Gala	15	50
Golden Delicious <sup>2</sup>	20	—
Honeycrisp	10	—
Idared	10	50
Jersey mac	10	50
Jonathan	10	50
McIntosh	10	50
Northern Spy	10	50
Paulared	15	50
Rhode Island Greening	10	50
Rome Beauty	20	—
Wealthy	20	50
Winesap	10	50
Other summer varieties <sup>3</sup>	—	50

<sup>1</sup>This table should be used as a guide only. Specific chemical methods, and chemical concentrations may vary depending upon tree vigor, fruit set, environmental conditions, and application techniques (see text).

<sup>2</sup>Sevin may cause fruit russetting of Golden Delicious.

<sup>3</sup>Varieties that mature before McIntosh.

## Evaluating Results

The results of NAA or NAD thinning sprays may be determined 7 to 10 days after application, as the growth of affected fruits slows and eventually stops; fruits not affected will continue to grow and enlarge. This makes it possible to follow with an additional application of NAA, if the early application did not thin sufficiently.

Record the following information to aid in evaluating response: air temperature and relative humidity at time of applications, wind speed and direction, time of day, drying time, stage of tree growth, fruit development and orchard vigor, amount of formulated material added to the sprayer tank, gallons of water applied per acre, previous year's production, and tree response.

## Cautions

- As a general rule, apply NAA under fast-drying conditions, when the temperature is between 70° and 75°F. On the other hand, NAD gives best results when applied under slow-drying conditions. NAD is often applied in the evening.
- Weak trees are thinned more readily than vigorous ones. Weak wood in the lower portion of the tree thins more readily than vigorous wood in the top.
- Trees thinned annually have a more predictable response to NAA thinning sprays.
- Thinning with NAA and NAD is greater when weather conditions during bloom do not favor good pollination and fruit set. However, when fruit set is questionable, but chemical thinning is essential, use NAD at 50 ppm at petal fall.
- If the weather during the week preceding bloom or the week after bloom is cloudy, wet, and humid, thinning is accomplished more readily than if the weather during these periods has been fair and sunny. Light rain just before or after NAA application may increase uptake and thinning action. Cloudy weather and warm night temperatures (+70°F) 2 to 3 weeks after bloom may cause heavy fruit drop.
- When freezing temperatures (32°F and lower) occur after pink and before applying the thinning sprays, NAA may cause excessive thinning. Reduce the concentration by 2-3 ppm if frost, wind, chemical or insect damage to foliage has occurred.
- Each grower must work out the concentrations of NAA best suited for individual orchard conditions. Sprays of NAA will remove all the fruit and severely damage the leaves if rates are too high. When conditions exist that might result in injury or loss of crop from over-thinning with NAA, NAD applied at petal fall using 50 ppm is safer for widespread use. However, these decisions must be made by the grower.
- Uniform coverage is important to avoid over- or under-thinning different parts of the tree.
- Thinning is accomplished most effectively with NAA applied 5-15 days after petal fall. The earlier applications permit evaluation and a second application, if necessary.

- If daytime temperature does not rise above 70°F within 5 days after Sevin application, poor thinning and small seedless fruit may result.

Surfactants increase the effectiveness of NAA. Decrease NAA concentration 50% when including a surfactant such as Tween 20, X-77 or Regulaid in the thinning spray.

## Thinning with Concentrated Mixtures

Fruit-thinning sprays can be applied in concentrate form with airblast equipment. A 2x concentration is suggested in the beginning, using one-half the spray volume that would be used in conventional spraying.

If higher concentrations are tried, a good starting point is a 3x concentration, but apply only one-fourth the volume of spray solution per tree or per acre that would be used in conventional spraying.

To obtain the amount of thinning desired, each grower must work out the concentration and gallons per tree or per acre that are best suited to their specific orchard conditions.

## Defruiting Young Apple Trees

Removing fruit on small trees before they are large enough to produce a commercial crop is often desirable. On some varieties, these fruit reduce tree growth and may contribute to a buildup of insects and diseases if the orchard is not on a full spray schedule. NAA at 15 ppm plus Sevin 50 WP at 2 lb/100 gal, applied at petal fall, has proven effective on Jonathan, Red Delicious and McIntosh. The use of this combination results in much more thinning than generally would be expected, but may not completely defruit the tree. For other varieties, try the recommended rate of NAA plus 2 lb of Sevin 50 WP/100 gal. Higher concentrations may cause some leaf damage and should not be used.

## Promalin Use on Apples

Promalin (N-[phenylmethyl]-IH-purine-6-amine plus GA<sub>4+7</sub>) is a PGR applied to Red Delicious apples to improve fruit shape by promoting fruit elongation. Apply 16-24 oz/acre in 50 to 200 gallons of spray. Time of application is critical for satisfactory results. Apply from when king flower is in full bloom to early stages of petal fall of side blossoms. Promalin may cause excessive thinning on young trees. Apply when temperature is 70°F or warmer.

Promalin also can be applied to non-bearing apple trees to improve lateral branching. Apply 4-16 oz per 5 gallons using a pressurized hand sprayer and treat the new terminal growth of the leader when it is 1 to 3 inches (generally 1 to 2 weeks after full bloom). Thoroughly wet bark and foliage surfaces. Include a good non-ionic surfactant. Do not spray trees under stress or after terminal growth ceases. NAA applied for thinning following Promalin application can produce pygmy fruit.

## **Pro-vide Use on Apples**

Pro-vide (GA<sub>4+7</sub>) is used for suppression of fruit russeting of Golden Delicious apples. Apply 15 ppm (10 oz in 100 gallons) beginning at petal fall and continuing at 7-10 day intervals for a total of 4 applications. Do not exceed 100 gallons of spray per acre. The first two applications are most important and should be no more than 7 days apart. Apply under fast drying conditions. Do not utilize any wetting agent. Multiple applications may reduce flowering the next year.

## **Pre-Harvest Drop Control of Apples**

NAA (naphthaleneacetic acid) may be used to control pre-harvest drop. Apply NAA 7-10 days before anticipated harvest. It becomes effective in about 2 days and controls drop for 6-10 days. A repeat application may be necessary if harvest is delayed. Apply NAA at 10 ppm on McIntosh and earlier ripening varieties, and at 20 ppm on varieties maturing after McIntosh. NAA may stimulate ripening, so treated fruit should be harvested before it becomes overmature.

ReTain (aminoethoxy-vinylglycine, AVG) may be applied to control pre-harvest drop. Apply 4 weeks before anticipated harvest at 50 grams per acre with a nonionic surfactant. Applications of ReTain delay fruit maturity, coloring and softening.

## **Ethephon Use on Apples**

Pre-harvest applications of ethephon favor red color development, *hasten fruit maturity and ripening*, and promote abscission of apples. The type and degree of response depends on the concentration, time of application, and the variety of apple. Ethephon will not completely overcome conditions unfavorable for development of red color. Conditions that are normally associated with poor fruit color, such as high temperatures, excessive vigor, or dense tree canopies, may limit red color development to the point that applying ethephon still will not bring color up to a satisfactory level. Use ethephon only on apples intended for early sale since its ripening effect may shorten the storage life of the fruit.

For early season varieties that mature before McIntosh, use 75 ppm (4 oz/100 gal) applied 7-10 days prior to normal harvest. On McIntosh and later season varieties, use 150 to 300 ppm (8-16 oz/100 gal) applied 7-21 days before normal harvest. Tree response is influenced by temperature at, and immediately after, application. Cool weather delays response, and warm weather accelerates it. Responses are usually noticeable within 7 days. The timing and rate of application depend upon the apple variety and target market objectives.

Ethephon also promotes fruit abscission. NAA must be used to counteract the abscission effect or excessive fruit drop will occur.

## **Apogee Use to Control Shoot Growth and Fireblight Susceptibility on Apples**

Apogee (prohexadione-calcium), a gibberellin biosynthesis inhibitor, reduces shoot growth on apple trees, which tends to reduce susceptibility to fireblight (see Fireblight Management section). Shoots treated with Apogee slow shoot extension and some shoots develop early bud set. Factors that increase the vigor of trees, such as heavy pruning, additional nitrogen fertilization, or low crop load, will require additional Apogee applications per acre as will factors such as questionable spray coverage or greater fireblight concerns.

Apogee has a local systemic effect. It needs to be applied with thorough coverage. Therefore, if tops of trees are sprayed, Apogee will only have an effect on the top. This allows growers to use Apogee in problematic areas of trees that need localized control. For example, if the bottoms of trees had frost damage, resulting in a low crop load, an application of Apogee to the bottoms of trees will control excessive growth. Tree vigor, variety (see Table 2), crop load, and application timing impact the efficacy of Apogee and thus the rate needed.

Apogee (27.5% W) should be applied when shoot growth is 1 to 3 inches long, usually at king bloom petal fall on most varieties. Split applications have been shown to provide longer shoot suppression during the summer. When fireblight is a concern, the first application of Apogee should be increased to help control vigor early and reduce fireblight potential. Table 1 lists suggested application rates for fully bearing apple trees at different tree row volume levels. If trees have a light crop load or have high vigor, use a higher rate of Apogee per acre.

The decreased shoot lengthening will become evident about 14 days after the first application. Apogee has been shown to increase fruit set in some years and on some varieties; thus, increased thinning agent rates may be needed to compensate for increased fruit set, as experience dictates.

Apogee requires the addition of non-ionic surfactant such as Regulaid, SS 700 or LI 700. Also, an equal weight of spray grade Ammonium Sulfate (AMS) should be applied with an equal weight of Apogee. Ammonium Sulfate substitutes can be used; follow manufacturer rate recommendations for surfactant and AMS substitutes.



**Table 1. Suggested Apogee rates and timing (oz/acre).**

Tree Size	1st	2nd	3rd	4 <sup>th</sup> *Optional	Seasonal Total
Small <200 TRV	5	4	4	4*	17 oz
Medium <200 to 300 TRV	6	5	5	5*	21 oz
Large >300 TRV	7	6	6	6*	25 oz
Timing	King Bloom Petal Fall	2 weeks after King Bloom Petal Fall	3 weeks later	3 weeks later	

**Table 2. Sensitivity of Apogee response by apple variety.**

Sensitivity to Apogee	Variety	Recommendation
Very Sensitive	Cortland, Gala, Gingergold, Northern Spy, Paulared, Rome	Consider reducing rates of later sprays (spray 3 and 4)
Sensitive	Fuji, Golden Delicious, Jonamac, Spartan	
Less Sensitive	Empire, Golden Supreme, Jonagold, Jonathan, Idared, McIntosh	Consider using an additional 1 oz/acre
Special	Red Delicious, Spur Mac	Spur type, Use 4+3+2 for Medium-size trees

### **Water Sprout and Sucker Control on Apples and Pears**

Application of 1% NAA (naphthaleneacetic acid) paint or spray can aid in water sprout control around large pruning cuts and help control suckers at the base of the tree. Follow label directions for preparation of 1% NAA solution (Tre-Hold Sprout Inhibitor A112).

To control water sprouts in the vicinity of large pruning cuts, apply 1% NAA to bark in the immediate vicinity of the cut and 2-3 inches below the cut. To control re-growth of sprouts after removal, treat the area where existing sprouts were removed. To control root suckers, remove existing suckers during the dormant season and spray new suckers when 6-8 inches high with 1% NAA solution. To avoid the potential for excessive fruit thinning, do not treat suckers on bearing trees until one month after bloom. Repeat spray treatments may be required in successive seasons, particularly if root suckering has been excessive or a problem for many years. Glyphosate applied to root suckers when 6-10 inches high provides early season control.

## **Pears**

### **Chemical Thinning**

NAD (naphthaleneacetamide) thins Bartlett pears when applied at petal fall. The following rates are given as guides: (1) trees of low vigor, 25 ppm; (b) trees of medium vigor, 35 ppm; (c) trees of high vigor, 45 ppm. When the thinning spray is applied after petal fall, leaves are more subject to epinasty or twisting. Bosc pears may be completely defruited with NAD at 25 ppm. No suggestions are available for using NAD for thinning of varieties other than Bartlett.

## **Peaches**

### **Chemical Thinning**

No reliable chemicals are available for thinning peaches.

## **Cherries**

### **Ethephon Use on Cherries**

Ethephon may be used to promote the loosening of fruit from their stems to facilitate mechanical harvest of tart and sweet cherries, but proper application is important to avoid excessive activity and tree injury. Research and grower experience has shown that lower rates can be used than was first established, in part because of higher activity resulting from higher concentrations in low volume applications (the original research was conducted on a dilute spray basis). Lower rates reduce the likelihood for tree injury. Response varies not only with rate, but also variety, time of application, tree vigor, and the environmental conditions that occur during, and up to 3 days after, application. This creates a challenge to achieve the desired results without experiencing tree injury.

The following points should be considered when preparing to apply ethephon to cherries:

**Time of Application:** This important factor has two considerations. First, adequate and comparable loosening can be achieved by using either a lower rate if given adequate time for action (10 to 14 days) or a higher rate that will loosen fruit more rapidly over a short timeframe. Therefore, it is possible to substitute time for rate and obtain the same effect, with less potential for tree injury. Second, the chemical should not be applied too early in the season, as the fruit may fail to enlarge further and drop from the tree with the stems attached. Fruit should be in Stage III of growth (enlarging rapidly), with the grass-green color beginning to turn yellow or develop a tinge of red. Consequently, ethephon is generally applied about 7 to 14 days before anticipated harvest.

**Temperature:** During the 72-hour period following ethephon application, higher temperatures will increase the magnitude of response and lower temperatures will

decrease response. Thus, when temperatures are expected to exceed 85°F (30°C) or remain below 60°F (15°F) for up to 72 hours, applications should be avoided. Within this temperature range, when high temperatures are expected to be only in the 60's, higher than normal rates should be used and when highs are expected in the lower 80's, lower than normal rates should be used.

**Tree Size, Vigor, and Stress:** Suggested rates/acre are based on full-sized trees. Rates should be reduced when treating blocks having smaller trees. Trees low in vigor or under stress respond to a greater extent, often resulting in gumming and leaf abscission; consequently, such trees should not be treated with ethephon. Trees that exhibited serious gumming the previous year should not be treated.

**Concentrate spraying:** Applying ethephon with concentrate sprayers (i.e., 80 gal water/acre or less) achieves the same level of loosening at lower rates per acre as dilute applications. Uniform coverage is important.

**Tank-mixing:** There is little or no research data regarding tank-mixing ethephon. Do **not** tank mix with foliar nutrients or compounds such as fruit-cracking inhibitors, bird repellents, etc. While no problems have been reported by growers for tank-mixing ethephon with the fungicides and insecticides commonly used at this time, it is possible that these materials may act as a buffer to the ethephon, thereby altering activity. This can be overcome by acidifying the tank mixture prior to adding the ethephon.

**Re-entry interval (REI) and Pre-harvest interval (PHI):** Ethephon has a 48-hour worker protection REI and a 7 day PHI (thus, do not harvest within 7 days of application).

### **Tart Cherry Applications**

When applied in a concentrate spray (80 gal water/acre or less), use 8-16 oz/acre, applied 8 to 14 days prior to anticipated harvest. When applied dilute, apply no more than 5 oz/100 gal or 1 pt/acre.

### **Sweet Cherry Applications – Light Varieties**

With light sweet cherries, do not apply until fruit on the interior of tree is developing yellow ground color. Ethephon applied prior to this stage of development may cause fruit to drop prematurely with stems attached. When applied in a concentrate spray, use 16-32 oz/acre, applied about 14 days before anticipated harvest. Vary the rates depending on temperatures, days before harvest, tree stress and past experience. Rates up to 2.5 pts/acre may be necessary for promoting harvest in less than 10 days. The full rate of 48 oz/acre will result in tree damage some years. When applied dilute, use no more than 12 oz/100 gallons or 3 pts/acre.

### **Sweet Cherry Applications – Dark Varieties**

When applied in a concentrate spray, use 24-40 oz/acre, applied 12-14 days prior to anticipated harvest. Rates as low as 16 oz/acre have been used successfully by growers, but results have been less consistent. Rates up to 3 pts/acre may be necessary for promoting harvest in less than 10 days. The full rate of 64 oz/acre is generally not necessary and will result in tree damage some years. When applied dilute, use no more than 16 oz/100 gallons or 4 pts/acre.

### **Gibberellic Acid Use on Cherries**

Gibberellic acid (GA) may be used to reduce flowering and fruiting of young tart and sweet cherry trees to maximize vegetative growth. GA is used in mature tart cherries to increase fruiting capacity by stimulating the development of lateral shoots and spurs. Application of GA must be made the year prior to the desired result. Applications should be made when temperatures are expected to be above 70°F (21°C) for several days, if possible.

For non-bearing young tart and sweet cherry trees, do not treat the year of planting in the orchard. Apply during the second year to prevent flowering the third season and repeat the third year to prevent flowering the fourth year. Apply a single application of 100 ppm (40 oz/100 gal using 4% ProGibb) at three to four weeks after normal bloom time, when trees have about 5-7 leaves (3-5 fully-expanded leaves) on terminal growth. If tree vigor is low, two applications at 50 ppm (20 oz/100 gal) about 2.5 to 3 weeks apart are more effective than a single application at 100 ppm. Do not treat more than twice in one year.

Following these early year applications of high GA rates, it is very important to bring trees into bearing gradually and not discontinue GA all at once (which may result in oversetting of fruit and stunting of growth). In the fourth year, apply GA at 30-40 ppm if dilute (12-16 oz ProGibb/100 gal) or 20-24 oz/acre if applied as a concentrate spray. In the fifth year, decrease the GA rate to 15-20 ppm if dilute (6-8 oz/100 gal) or 10-12 oz/acre if applied as a concentrate spray. This will allow flowering in years five and six at reasonable levels and avoid the extremely heavy bloom and production that often occurs, and significantly reduces growth, in future years. GA use may then be discontinued or, for weak orchards, repeated annually at 10-15 ppm to promote a more moderate crop level.

In mature tart cherry trees, GA can help maintain and extend high fruiting capacity and reduce the occurrence of blind nodes by stimulating lateral shoots and spurs. Apply about three weeks after full bloom at rates of 10 to 20 ppm (6-12 oz/acre of 4% ProGibb), with lower rates used typically on more vigorous orchards or those with previous successful use of GA. For dilute application, use 4 oz/100 gal for a 10 ppm solution. For concentrate



application to full sized tart cherries, use 6 oz/acre for a 10 ppm response. Surfactants and wetting agents are not suggested until more research is completed, as responses have varied from phytotoxicity to no effect.

### ***Promalin Use on Cherries***

Promalin can be applied to non-bearing cherry trees to improve lateral branching. Apply one part Promalin per 3 parts dark-colored latex paint by hand to previous-season terminal or scaffold growth where lateral

branches are desired. Apply directly to dormant buds that have swollen and begin to show emergence of a green tip. Activity is generally best if temperatures at and following application reach 60°F and higher.

# Herbicides 2003

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## Weed Control in Fruit Crops

Ground cover management affects both fruit tree vigor and yield. Use a ground cover system that facilitates management of the fruit planting for improved tree growth and productivity.

Maintaining young trees, especially those on less vigorous rootstocks, free of competition from weeds and sod results in larger trees. Trees maintained in weed-free conditions produce more total yield, a result of increased tree size, fruit set, and fruit size. Thus, orchardists tend to maintain a weed-free area in the tree row and a sod or cover crop alleyway to support vehicle travel and control erosion.

Weeds compete directly with trees and vines for soil moisture and nutrients and often serve as hosts for insects, nematodes, and diseases. Weeds may also provide cover for rodents that attack tree trunks during the winter months. Certain noxious weeds, such as poison ivy or Canada thistle, may make harvesting of fruit an unpleasant task.

It is necessary to provide optimum growing conditions the first few seasons to produce a healthy tree with a strong trunk and scaffold branches. Control perennial weeds such as quackgrass, nutsedge, or Canada thistle with repeated tillage or herbicides prior to planting a new orchard or they may seriously reduce the growth of newly planted trees. Annual weeds may also inhibit the growth of young trees, particularly stone fruits, and should be controlled when trees are actively growing. Control of weeds in an area 3 feet from the trunk is adequate in the first 2 years. As the tree becomes larger and its root system spreads over large areas, control weeds in the area 4 feet from the trunk or at least to the drip-line of the tree.

Commercial fruit growers can select from a number of herbicides that can provide weed control with economical advantages over other cultural weed control methods. Fruit trees are not completely immune to herbicide injury, but will often tolerate dosages much higher than that required to kill weeds. Generally, trees gain herbicide tolerance with age. Newly planted trees may be susceptible to herbicide injury, gain some tolerance when 2 to 3 years old, and become very tolerant when older. Trees growing on sandy soils which are low in organic matter are more susceptible to soil-applied herbicides than trees growing on heavier, loam soils. Because a margin of tolerance is involved, apply herbicides as accurately as possible.

Continuously using a herbicide for many years can result in weed problems through resistance to the particular herbicide, or through infestations of weed species resistant to a particular herbicide. It is important to know the weed species that have been a problem in the fruit planting. Select herbicides that are effective against such species. Combining two soil-active herbicides such

as simazine plus oryzalin or terbacil plus diuron provides a wider spectrum of weed control. For example, where simazine-resistant lambsquarters, rough pigweed, and yellow foxtail occur, adding terbacil, diuron, or oryzalin improves the degree of weed control. Terbacil does not control rough pigweed but can be combined with diuron if rough pigweed is a major orchard weed problem. Apply napropamide if common groundsel is a major problem.

Early season applications of simazine, diuron, or terbacil may provide only fair to poor grass control in late season. Combining with oryzalin or napropamide provides control of late summer germinating grasses.

Selecting herbicides for orchard weed control is influenced by type of fruit trees involved, tree age, season of year when application is to be made and weed species to be controlled.

Oryzalin, napropamide or dichlobenil can be used in new orchard plantings to control grasses and some broadleaved weeds.

Preemergence herbicides usually are applied in established orchards after some weeds have emerged in the spring. Include glyphosate or paraquat to kill emerged weeds. A combination of two residual herbicides with different modes of action gives the best weed control.

## Herbicides for Fruit Crops

**2,4-D amine (several products)** These nonvolatile forms of 2,4-D may be utilized safely on the orchard floor if care is taken to avoid drift onto the foliage of trees. The primary use is to control perennial broadleaved weeds such as dandelions, field bindweed and common milkweed. Primary herbicide for perennial weed control in sodded alleyways,

2,4-D is absorbed through the foliage of these weeds and translocated to the root system. Apply the chemical at low pressure using 1 to 1.5 lbs of active chemical per acre on perennials that are growing actively. At this rate of application, the chemical disappears from the soil in 2 to 3 weeks. Two applications are permitted per year with at least 75-day interval between applications. Several spot applications are often needed to completely eradicate these deep-rooted perennials. It may be combined with other herbicides. Never use in sprayers that will later be used for foliar applications on fruit and vegetable crops. If possible, apply after harvest and before frost. Do not apply during bloom.

**Dichlobenil (Casoron)** This chemical effectively controls quackgrass in established fruit plantings. The granular formulation is superior to the wettable powder for controlling quackgrass. Proper timing of application is critical for obtaining optimum results. The most consistent

results have been obtained with application in November prior to snowfall. Six pounds of chemical (150 lbs of 4 percent granules) per acre will control quackgrass and annual weeds until late summer of the following year. Some other perennial weeds such as field bindweed and Canada thistle are also suppressed by this chemical.

Tractor mounted granular spreaders are available to apply Casoron accurately in bands along the rows. Application with hand spreaders has been less satisfactory. Do not apply granules when it is windy.

**Diuron (Karmex)** Diuron is particularly effective on annual grasses and broadleaved weeds. At higher rates of application, it may also suppress quackgrass. Applied at 2 to 3 lbs/acre prior to the emergence of weeds, it will provide acceptable weed control for the growing season. There is no buildup of chemical in the soil from annual applications of this rate. Diuron is utilized successfully with paraquat or glyphosate to obtain season-long control of most weeds. It can also be tank-mixed with other soil-active herbicides for improved control of a wider range of weed species.

**Fluazifop-P (Fusilade DX)** is a systemic herbicide only effective on grasses. Add 1 qt of crop oil or 1 pt of non-ionic surfactant for every 25 gal of dilute spray. Apply to actively growing grasses before they exceed growth stage specified on product label (annual grasses less than 8 inches tall and actively growing perennial grasses with 4 to 6 inches new growth). See label for rates to apply to different grass species. Avoid spray contact with fruit tree foliage.

**Glufosinate (Rely)** is a foliar-active, nonselective herbicide that controls a broad spectrum of emerged annual and perennial grasses and broadleaf weeds. Best results obtained when applied to actively growing weeds. Apply 1 lb/acre when weeds are less than 8 inches tall and 1.5 lb/acre when weeds are 8 inches or taller. Does not provide residual weed control but can be tank mixed with residual herbicides for broad-spectrum control. Avoid contact with green on uncalled bark on young trees and vines. Do not apply within 14 days of harvest.

**Glyphosate (Roundup or Touchdown)** Glyphosate controls both annual and perennial weeds. It is translocated in perennial plants and kills the underground parts. This characteristic makes it an excellent herbicide for control of quackgrass, Canada thistle, field bindweed, common milkweed, and many other perennial weeds. Since glyphosate is absorbed by the foliage, apply after perennial weeds have a large amount of foliage for best results. For example, quackgrass should be at least 8 inches tall and field bindweed should be in the bud or flower stage. Glyphosate is inactivated by soil and will not prevent annual weeds from emerging. This herbicide can seriously damage fruit trees if contact occurs on green tissues (leaves or shoots), but contact on occasional suckers does not cause problems. Direct sprays toward the base of the tree. Glyphosate may be combined with

other soil-active herbicides to provide season-long weed control. Apply in a maximum of 20 gal of water per acre. Apply only near trees established for 2 or more years.

Ammonium sulfate increases Roundup efficacy on a broad spectrum of weeds when spraying with hard water. Add 17 lb of ammonium sulfate per 100 gal of spray solution prior to adding the glyphosate.

**Hexazinone (Velpar)** This chemical is labeled only for blueberry to control many herbaceous and woody plants. Use Velpar primarily for woody perennials, as it controls or suppresses briars, brambles and wild cherry. Apply 1 to 2 lbs in the spring before blueberry plants begin active bud development. Do not apply on soils that are 85 percent or more sand. Do not apply to blueberry plants less than 5 years old and do not repeat applications in successive years.

**Isoxaben (Gallery)** is labeled for non-bearing tree fruit crops and grape. It controls broadleaf weeds when applied as preemergence treatment. Apply at 2/3 to 1 1/3 lbs/acre depending upon weeds to be controlled. Combine with Surflan to control annual grasses.

**Napropamide (Devrinol)** Napropamide can be applied at 4 lbs/acre in newly planted or established orchards, blueberry, grape and bramble plantings. Apply to weed-free ground. This chemical is readily inactivated by light and is most effective if incorporated into soil by tillage, irrigation or rainfall following application. Does not control established weeds. Most effective for control of annual grasses. Performance has been poor in established Michigan orchards for the usual spectrum of weeds present.

**Norflurazon (Solicam)** This chemical is labeled for apple, pear, peach, plum and blueberry, and can be applied to newly planted apple and peach trees after trees are established. Apply before weeds emerge or combine with paraquat or glyphosate for control of existing vegetation. Apply 2 to 4 lbs/acre, using the lower rate on coarse soils (sandy loam). Rainfall is necessary to move Solicam into the weed root zone for the chemical to be effective. Solicam is more effective on grasses than broadleaf weeds and does not control established weeds. Combinations with diuron or simazine provide broad-spectrum weed control. More effective when applied in the fall. Do not treat cherry on coarse soils.

**Oryzalin (Surflan)** can be used safely on newly planted fruit trees and vines after the soil has settled and no cracks are present. It is a preemergence herbicide, effective in controlling annual grasses and many annual broadleaved weeds. It has little effect on established weeds and grasses but may be combined with paraquat or glyphosate to kill established weeds and prevent regrowth. Combine with Princep, Karmex, Sinbar or Goal for broad spectrum, season-long control. Observe restrictions for these herbicides when applying in combination with Surflan. One-half to one inch of rain or sprinkler irrigation is needed to activate the herbicide.

**Oxyfluorfen (Goal)** can be applied to dormant, non-bearing or bearing tree fruit plantings and to established grapes at least 3 years old that are trellised. It can be applied for preemergence and postemergence control of susceptible weed species at 0.5 to 2.0 lbs/acre as a directed spray to the base of the trees. It can be applied in combination with paraquat, glyphosate and oryzalin. Include 2 pt/100 gal spray nonionic surfactant.

**Paraquat (Gramoxone)** Paraquat provides very rapid knockdown of annual and perennial weeds and may be utilized in all fruit plantings. Apply when weeds and grasses are succulent and new growth is 1 to 6 inches high. It has no action through the soil to prevent further weed growth and usually new weeds will be evident 30 to 40 days after application. Do not allow paraquat to contact foliage or areas of the trunk where bark has not formed. Painting trunks of young trees with latex paint before applying paraquat reduces possibility of injury. If weed growth is severe, apply at a rate of 1 lb of active ingredient per acre. On lighter infestations, 1/2 lb/acre is adequate.

Always add nonionic surfactant (NIS) at 1 to 2 pts/100 gal of water. Two or three applications are necessary to maintain weed control through out the season. Paraquat is extremely toxic and should never be allowed to touch skin or eyes. Avoid inhaling mist of this chemical. Paraquat may be combined with other soil-active herbicides to provide season-long weed control.

**Pendimethalin (Prowl)** is labeled for use on non-bearing fruit trees and grapes for preemergence weed control. Adequate rainfall (at least 1/2 inch) within 7 days after application is important for adequate weed control. Prowl 3.3 E controls seeds as they germinate but has no effect on established weeds. It can be used in the same manner as oryzalin but has been much less effective in MSU trials.

**Pronamide (Kerb)** Pronamide acts through the soil to kill quackgrass rhizomes and germinating annual weeds. It is most effective on grasses and controls few broadleaves. Apply in fall after fruit harvest but prior to leaf drop. On sandy loam soils, apply at rates of 1 to 2 lbs/acre of active ingredient. It is not effective on soils with a high organic matter content.

**Sethoxydim (Poast)** is applied postemergence to actively growing grasses. Rate varies with grass species and stage of growth. It does not control broadleaves. Add crop oil concentrate (COC) or nonionic surfactant (NIS) to the spray solution.

**Simazine (Princep)** Simazine is effective primarily on germinating, annual weeds but does provide some quackgrass suppression when applied in the spring in combination with paraquat or glyphosate. The use rate (2 to 4 lbs/acre) varies with soil type. Injury may occur on stone fruit on extremely sandy soils when the rate of application exceeds 2 lbs/acre. Simazine does not build up in the soil from annual application of the above rates.

**Snapshot** is a premix combination of isoxaben and oryzalin that provides control of a broader spectrum of weeds than either chemical by itself.

**Terbacil (Sinbar).** This chemical is registered for use only on peaches, pears and apples that have been established at least 3 years and blueberries established at least 1 year. It controls most annual weeds and also will suppress the growth of some other perennial weeds.

In tree fruits, spring applications (April 15 to May 1) of Sinbar at 1 lb of active ingredient per acre control annual weeds. Two or 3 lbs/acre are needed to control quackgrass, the lower rate being adequate on lighter soils. Sinbar may move quite readily in very sandy soils, and tree injury, manifested as venal chlorosis of leaves, results from applying too much chemical on these soils. Do not apply Sinbar on sandy or gravelly knobs or bulldozed areas where there is essentially no organic matter in the soil.

**Herbicide Combinations** The continuous use of a herbicide for many years can result in weed problems through the development of resistance to the particular herbicide or through heavy infestations of weed species resistant to a particular herbicide. Thus the combination of two soil-active herbicides such as simazine plus terbacil, or terbacil plus diuron, provides for a wider spectrum of weed control. Where simazine-resistant lambsquarters, pigweed, or foxtails are present, the addition of terbacil or diuron improves weed control. Terbacil does not control redroot pigweed and should be combined with diuron if pigweed is a major orchard weed problem. Simazine does not control horseweed (marestail). Terbacil controls this weed. Combinations with terbacil require caution. Generally, about 1 lb/acre of terbacil is necessary for an effective herbicide combination but this rate may be too high for light-textured sandy soils or soils with very little organic matter.

Early spring simazine applications tend to provide fair to poor grass control late in the season. Combination with oryzalin will provide control of later summer germinating grasses. Combination of oryzalin or napropamide with simazine, diuron or terbacil results in control of a broader spectrum of weeds and a longer period of control.

Oryzalin or napropamide can be utilized in new plantings to control grasses and some broadleaved annual weeds.

**Integrated Management.** Integrated pest management programs that utilize predator mites and insects as part of the pest control strategy often encourage some plant growth under the tree as habitat for predators. Broadleaf weeds appear to be favored by some predator mites.

Allelopathy is chemical interference that occurs when one plant interferes or influences the growth of other plants through release of chemicals into the environment. It involves introducing cover crop residue into crop management. Compounds in the decaying residue inhibit seeds from germinating.

Allelopathy weed control in orchards has involved seeding a cover crop in the fall of rye, wheat, barley or oats. In Michigan, Wheeler rye has produced the most



biomass, although Yorkstar wheat has also been utilized. The cover crop is sprayed with glyphosate or paraquat when it is about two feet high or just beginning to bloom the following spring. The residue controls germinating weed seeds. Low gallonage glyphosate application (15 gal of solution/A at 3/4 lb a.i./A) knocks down the cover crop effectively.

## Herbicides for Strawberries

**DCPA (Dacthal)** Dacthal provides good control of annual grasses such as crabgrass and foxtail when used at 8 lb active ingredient per acre on sandy soils. It is less effective on heavier soils and does not control most broadleaved weeds consistently. Apply Dacthal for grass control in new and established plantings before emergence of the weeds.

**2,4-D Amine (Formula 40, Amine)** 2,4-D (amine formulation only) has been used effectively in the renovation program for established strawberry plantings. Apply immediately after harvest, at 1 lb/acre, to control annual broadleaf weeds. It also provides some control of perennials. Do not apply 2,4-D at other times during the growth of the strawberry plant or injury and yield reduction may occur.

**Napropamide (Devrinol)** Napropamide is extremely effective on annual grasses and some broadleaf weeds when applied preemergence in strawberries at 1 to 2 lb active ingredient per acre. It is sensitive to light and should be either incorporated 2 inches into the soil before planting, or irrigated in on new or established plantings. It may be applied in spring or fall or at other times of the year after cultivation. It has the potential for inhibition of runner rooting on extremely light sandy soils. Do not apply from bloom through harvest. Fall application will not control weeds the next spring.

**Paraquat (Gramoxone)** Use paraquat for rapid knockdown of annual and perennial weeds between strawberry rows. Use a shielded sprayer to prevent spray from contacting strawberry plants. Apply when weeds are less than 8 inches tall.

**Sethoxydim (Poast)** is applied postemergence for grass control when grasses are actively growing. Several applications are needed for quackgrass control. Include COC or NIS in spray solution. Do not apply within 7 days of harvest.

**Terbacil (Sinbar)** Terbacil is used for pre- and post-emergence weed control in established strawberries. The safety margin on strawberries is extremely narrow. Use only on plants established in the field for at least 6 months. Apply 2 to 6 oz. of product per acre per application. Do not apply more than 8 oz. of Sinbar 8OWP per acre per growing season. Do not apply terbacil on newly planted berries. Avoid application during periods of the year when

the plants are making active growth. The safest times to apply are after mowing the plants at renovation time or late fall after growth stops, or late winter-early spring on light sandy soils in areas with heavy snowfall.

## Weed Sprayers

Many types of sprayers are suitable for chemical weed control. A complete weed-control sprayer should have the following features:

**1. A low pressure pump.** It should be easily replaced, not subject to damage by wettable powders, and have minimum capacity of 9 gal/minute. It should be able to maintain 50 psi at the nozzles.

**2. Solution agitation (stirring).** It can be either mechanical or a bypass from the pump. If a power takeoff sprayer does not provide agitation, add a bypass to a galvanized tee between the pump and pressure gauge. To increase agitation in the tank, place an agitator nozzle on the end of the overflow hose. In this case, a separate valve on the bypass line will regulate pressure. If the pump does not have enough capacity for agitation under specific spraying conditions, provide it by using both the next lower tractor gear and nozzle tips with a smaller orifice.

**3. 50-mesh screens for suction line and nozzles.** Wettable powders will not go through the 100-mesh screens that are sometimes provided.

**4. A spray boom.** It should have nozzles adjustable for distance between nozzles on the boom and for height above the ground. This is especially important for band spraying.

**5. A gauge** to measure pressure accurately up to 100 lb per square inch.

**6. Flat fan nozzles.** The best nozzle size for general use is equivalent to an 8004 Teejet. For most work, a moderate-angle nozzle 80 - 95 degrees—is best because the boom can be held close to the ground to reduce drift.

**7. For tree fruit and nurseries, 110-degree angle nozzles.** A rigid boom with three 110-degree angle nozzles located 2 feet apart and 14 inches above the ground will spray a strip 6 feet wide. The sprayed area can be reduced to 4 feet by plugging the inside nozzle or extended to 8 or more feet by making the boom proportionately longer and adding more nozzles. Although these booms are useful on level terrain, they cannot be used on steep slopes unless a wheel or other device is placed at the end of the boom to keep it parallel with the ground.



# Sprayer Calibration

One of the most important factors in effective weed spraying is accurate calibration—determining the amount of spray material applied per acre. A range of 20 to 30 gal/acre, at a pressure of 20 to 60 lbs per square inch, is satisfactory.

Adjust the boom height so that the spray overlaps about a third at ground level. For overall spraying, using 80-degree nozzles, this places the nozzles about 18 to 20 inches apart on the boom and 18 to 20 inches from the sprayed surface.

A good way to calibrate a sprayer is to:

1. Fill the spray tank with water only.
2. Spray a measured area, in a field if possible, at a fixed tractor speed and pressure gauge setting. Be sure to allow for partial coverage if bands are used.
3. Measure the amount of water needed to refill the tank.
4. Divide this amount by the fraction of an acre sprayed to get the gallons applied per acre.
5. Mix the amount of chemical desired per acre with water to give this much spray material.

For example, if 10 gallons were applied on one-fourth acre, the volume of spray material applied would be 40 gal/acre.

If you change the tractor speed or gear, pressure setting, nozzle size, or number of nozzles, the amount of liquid applied per acre will be different and recalibration will be necessary.

# Band Application

Drive down the row in one direction; never go in a circle around the trees, since this concentrates the spray at the base of the tree.

Apply the spray as a complete row treatment or as squares under the orchard trees. It is usually best to spray a strip on one side of a row going in one direction and on the other side coming back. In vineyards, the entire band (under a row) may be sprayed with a 45-degree angle TOC nozzle on a gun or boom. The width of the band will be determined by the age of the plants and desires of the grower. Most orchard trees should have weeds controlled under the full spread of the branches. For young trees, vineyards and nurseries, a 4-foot band in the row may be sufficient.

## Names, Sources and Formulations of Herbicides for Fruit Crops<sup>1,2</sup>

Table 1

Common Name	Trade Name and Manufacturer	Concentration and Commercial Formulations <sup>3</sup>
clethodim	SELECT (Valent)	2E
clopyralid	STINGER (DowAgro)	3L
DCPA	DACTHAL (Amvac)	75 WP
dichlobenil	CASORON (Uniroyal Chemical)	4G
diuron	KARMEX (Griffin)	80 DF
fluazifop-butyl	FUSILADE DX (Syngenta)	2 lb/gal L
glufosinate	RELY (Bayer)	1 lb/gal L
glyphosate	ROUNDUP ULTRA (Monsanto), Touchdown (Syngenta)	4 lb/gal L
hexazinone	VELPAR (DuPont)	2 lb/gal L; 90 SP
isoxaben	GALLERY (DowAgro)	75 DF
napropamide	DEVINOL (United Phosphorus)	50 DF
norflurazon	SOLICAM (Syngenta)	80 OF
oryzalin	SURFLAN (DowAgro)	4 lb/gal L
oxyfluorfen	GOAL (DowAgro)	1.6 lb/gal L
paraquat	GRAMOXONE MAX (Syngenta)	3 lb/gal L
pendimethalin	PROWL (BASF)	3.3 lb/gal L
pronamide	KERB (DowAgro)	50 WP
sethoxydim	POAST (BASF)	1.5 lb/gal L
simazine	PRINCEP (Syngenta)	80 WP; 90 WG, 4L
terbacil	SINBAR (DuPont)	80 WP
2,4-D	FORMULA 40 (Riverdale)	3.7 lb/gal L
	WEEDAR 64 (NuFarm)	3.8 lb/gal L

<sup>1</sup> Trade names and formulations are given for user convenience. Other formulations of the same herbicides, or other herbicides with the same active ingredients also may be labeled for use on certain crops.

<sup>2</sup> See table in back of bulletin for reentry interval and other information concerning herbicides.

<sup>3</sup> EC = emulsifiable concentrate; DF = dry flowable; G = granular; L = liquid; SP = soluble powder; WG = wettable granule; WP = wettable powder.

# Herbicide Registration for Bearing (B) and Nonbearing (N) Fruit Crops

Table 2

Common Name	Trade Name	Time of Application	Apple	Cherry	Peach	Pear	Plum	Grape	Blue-berry	Brambles	Strawberry	Cran-berry
clethodim	Select	Post	N	N	N	N	N	N	N	N	B	B
DCPA	Dacthal	Pre									B, N	
2,4-D	several	Post	B	B	B	B	B				B	B
dichlobenil	Casoron, Evital	Pre	B, N	B, N		B, N		B, N	B, N	B		B
diuron	Karmex	Pre	B		B	B		B	B	B		
fluazifop-P	Fusilade	Post	B, N	B, N	B, N	N	B, N	N	N	B	N	
glufosinate	Rely	Post	B					B				
glyphosate	Roundup Touchdown	Post	B, N	B, N	B, N	B, N	B, N	B, N	B, N	B, N		B, N
hexazinone	Velpar	Pre							B			
isoxaben	Gallery	Pre	N	N	N	N	N	N	N	N		
napropamide	Devrinol	Pre	B, N	B, N	B, N	B, N	B, N	B, N	B, N	B, N	B, N	B, N
norflurazon	Solicam	Pre	B, N	B	B	B	B	B	B	B		B
oryzalin	Surflan	Pre	B, N	B, N	B, N	B, N	B, N	B, N	B, N	B, N		
oxyfluorfen	Goal	Pre	B	B	B	B	B	B				
paraquat	Gramoxone	Post	B, N	B, N	B, N	B, N	B, N	B	B	B	B	
pendimethalin	Prowl	Pre	N	N	N	N	N	N				
pronamide	Kerb	Post	B, N	B	B	B, N	B	B	B			
sethoxydim	Poast	Post	B, N	N, N	B, N	N, B	N	B	B, N	B, N	B, N	B, N
simazine	Princep	Pre	B	B	B	B	B	B	B	B		B
terbacil	Sinbar	Pre	B		B				B	B	B	



# Weed Control Recommendations for Tree Fruit, Grape, and Small Fruit

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Herbicide rates given are for amount of commercial product per acre of land actually sprayed.

COC=crop oil concentrate

NIS=nonionic surfactant

## TREE FRUIT

### APPLE, PEAR (Year of planting)

Weed Problem	Chemical	Product per acre	Remarks
Preemergence annuals	oryzalin (Surflan 4 AS)	2 - 4 qt	Apply to weed-free soil after planting. Delay application until ground has settled. Use lower rate on light soil.
	pendimethalin (Prowl 3.3 E)	2.4 - 4.8	Apply after soil has settled in new plantings. Avoid contact with leaves or buds. Use high rate for longer control.
	napropamide (Devrinol 50 DF)	8 lb	Apply to weed-free ground after planting. May be used around newly planted trees. Incorporate or water in after application.
	pronamide (Kerb 50 W)	2 - 4 lb	Apply in November after harvest before soil freezes. Do not apply to trees transplanted less than 6 months.
	norflurazon (Solicam 80 DF)	2.5 - 5 lb	<b>Apples only.</b> Apply in fall or early spring to weed-free soil after soil settles. Use low rate on sandy soils. 60 day PHI.
	isoxaben (Gallery 75 DF)	0.7 - 1.3 lb	<b>Nonbearing only.</b> Apply in fall or spring before weeds emerge.
Postemergence emerged weeds	paraquat (Gramoxone Max 3L)	1.7 - 2.7 pt	Apply before or after planting trees and again during season as needed to kill emerged weeds. Do not allow spray to touch foliage or green stems of trees.
	glyphosate (Roundup Ultra 4L) (Touchdown 4L)	1 - 4 qt	Apply to actively growing weeds. See label for rate and optimum weed size. Use adjuvants as required by label.
Postemergence grasses	fluazifop-P (Fusilade DX 2E)	1 - 1.5 pt	Apply to actively growing grass 4 to 8 inches tall. Add non-ionic surfactant (NIS) or crop oil concentrate (COC).
	sethoxydim (Poast 1.5E)	1.5 - 2.5 pt	Apply to actively growing grass. Maximum of 7.5 pt/a/yr. Add NIS or COC. 14 day PHI.

## APPLE, PEAR (Established One Year or More)

Weed Problem	Chemical	Product per acre	Remarks
Preemergence annuals	simazine (Princep 90 WG)	2.2 - 4.4 lb	Apply in fall after frost or in spring before weeds emerge. Controls many annual broadleaves and grasses.
	diuron (Karmex 80 DF)	2.5 - 3.8 lb	Apply in spring before weeds emerge. Controls many broadleaves and grasses.
	norflurazon (Solicam 80 DF)	2.5 - 5 lb	Apply in late fall or in spring before weeds emerge. Use lower rates on sandy soils.
	oryzalin (Surflan 4 AS)	2 - 4 qt	Apply in early spring to weed-free soil. Use lower rate on lighter soil. Controls annual grasses.
	oxyfluorfen (Goal XL 2E)	3 - 4 qt	Apply to soil when trees are dormant in the spring. Do not apply after bud swell.
	pronamide (Kerb 50 W)	2 - 4 lb	Apply in November before soil freezes. Suppresses quackgrass.
	terbacil (Sinbar 80 W)	0.6 - 1.2 lb	<b>Apples three years or older only.</b> Apply in late April. Do not use on light, sandy soils.
Postemergence grasses	fluazifop-P (Fusilade DX 2 E)	1 - 2 pt	<b>Non-bearing only.</b> Apply to actively growing grasses. Add NIS or COC. 14 day PHI.
	sethoxydim (Poast 1.5 E)	2 - 4 pt	Apply to actively growing grasses. Include NIS or COC. 14 day PHI.
Postemergence annual and perennial weeds	paraquat (Gramoxone Max 3L)	1.7 - 2.5 pt	Kills annuals on contact. Apply to small weeds.
	glyphosate (Roundup Ultra 4 L) (Touchdown 4L)	2 - 4 qt	Kills annual and perennial weeds. Do not allow the spray to contact leaves or green shoots of trees. 1 day PHI.
	2,4-D (Weedar 64 3.8 L)	1qt	Apply when weeds are growing rapidly. Controls most broadleaves. Spray at low pressure to avoid drift to trees. Do not apply when trees are in bloom. 40 day PHI.
	glufosinate (Rely 1 L)	1 - 1.5 gal	<b>Apples only.</b> Apply to actively growing weeds. Avoid contact with apple foliage. 14 day PHI.



## APRICOT, CHERRY (TART, SWEET), PEACH, PLUM (Year of planting)

Weed Problem	Chemical	Product per acre	Remarks
Preemergence annual weeds	oryzalin (Surflan 4 AS)	2 - 4 qt	Apply in early spring before weeds germinate. Apply to weed-free soil after planting. Use lower rate on light soil. Controls most annual grasses.
	pendimethalin (Prowl 3.3 E)	2.4 - 4.8	Apply after soil has settled in new plantings. Avoid contact with leaves or buds. Use high rate for longer control.
	napropamide (Devrinol 50 DF)	8 lb	Apply to weed-free soil after planting. Safe for use on new plantings. Short residual life.
	isoxaben (Gallery 75 WG)	0.7 - 1.4 lb	<b>Non-bearing only.</b> Apply in fall or spring before weeds emerge. Controls many annual weeds.
Postemergence annuals and perennials	glyphosate (Roundup Ultra 4 L) (Touchdown 4L)	2 - 4 qt	Apply to emerged weeds. <b>Use only wiper applicator in peach and plum orchards.</b> Do not allow the spray to contact leaves or green shoots of trees. Peaches are very sensitive to glyphosate. 17 day PHI.
	paraquat (Gramoxone Max 3L)	1.7 - 2.7 pt	Apply when weeds are small. Kills annuals. Maximum 3 applications/year. Do not allow herbicide to contact green stems or leaves of cherries. 28 day PHI.
Postemergence grasses	fluazifop-P (Fusilade DX 2 E)	1 - 2 pt	Apply to actively growing grasses. Add NIS or COC. 14 day PHI.
	sethoxydim (Poast1.5 E)	2 - 4 pt	Apricot, cherry, peach, nonbearing plum. Apply to actively growing grasses. Include NIS or COC. 25 day PHI.

## APRICOT, CHERRY, etc. (Established One Year or More)

Preemergence	oryzalin (Surflan 4 AS)	2-4 qt	Apply in early spring before weeds emerge. Use low rate on light soil. Controls annual grasses.
	simazine (Princep 90 WG)	2.2 - 4.4 lb	Apply in late fall or early spring. Do not use on light sandy soil. Use lowest rate of simazine on peach and plum.
	norflurazon (Solicam 80 DF)	2.5 - 5 lb	Apply in late fall or spring before weeds emerge. Do not use for cherry on sandy soils. Wait 18 months after planting for use on cherry. 60 day PHI.
	oxyfluorfen (Goal XL 2 E)	3 - 4 qt	Apply in spring to dormant trees. Do not apply after bud swell. Controls many annual weeds.
	dichlobenil (Casoron 4 G)	150 lb	Apply in November before soil freezes. Controls many annual and perennial broadleaves and nutsedge.
	pronamide (Kerb 50 W)	2 - 4 lb	<b>Quackgrass suppression.</b> Apply in fall before soil freezes.
	terbacil (Sinbar 80 W)	2 - 3 lb	<b>PEACHES ESTABLISHED 3 YEARS OR MORE.</b> Apply in April or early May. Use lowest rate on sandy soils. May be tank mixed with Karmex at ½ rate of each. 60 day PHI.
	diuron (Karmex 80 DF)	2 - 4 lb	<b>PEACHES ESTABLISHED 3 YEARS OR MORE.</b> Apply in spring before weeds emerge. May be tank mixed with Sinbar at ½ rate of each. 90 day PHI.

## APRICOT, CHERRY PEACH, PLUM (CONTINUED)

Weed Problem	Chemical	Product per acre	Remarks
Postemergence	paraquat (Gramaxone Max 3L)	1.7 - 2.7 pt	Kills annuals on contact. Do not allow herbicide to contact green stems or leaves. 28 day PHI.
	glyphosate (Roundup Ultra 4L) (Touchdown 4L)	2 - 4 qt	Kills annuals and perennials. Do not allow spray to contact green leaves or stems of trees. Use only wiper applicator in peaches and plums. 17 day PHI.
	2,4-D (Weedar 64 3.8 L)	1 - 1.5 qt	Apply when weeds are small. Do not apply during bloom. Controls most broadleaves. Trees must be at least 1 yr. old. Avoid contact with green stems or leaves of trees. 40 day PHI.
Postemergence grasses	fluazifop-P (Fusilade DX 2 E)	1 - 2 pt	Apply to actively growing grasses. Add NIS or COC. 14 day PHI.
	sethoxydim (Poast 1.5 E)	2 - 4 pt	Apricot, cherry, peach, nonbearing plum. Apply to actively growing grasses. Include NIS or COC. 25 day PHI.

## SMALL FRUIT

### BLUEBERRY, BRAMBLES (Year of Planting)

Weed Problem	Chemical	Product per acre	Remarks
Preemergence	oryzalin (Surflan 4 AS)	2 - 4 qt	Apply to weed-free soil after planting. Use lower rate on lighter soil. Must be watered in to be effective.
	isoxaben (Gallery 75 DF)	0.7 - 1.3 lb	<b>Non-bearing only.</b> Apply in fall or spring before weeds emerge. Apply after soil has settled after transplanting. Wait 60 days between applications. Max 4 lb product/a/yr.
	napropamide (Devrinol 50 DF)	8 lb	Apply to weed free soil in the spring. Controls seedling grasses. 4-5 weeks residual life.
Postemergence grasses	fluazifop-P (Fusilade DX 2 E)	1 - 2 pt	<b>Non-bearing only.</b> Apply to actively growing grasses 4 to 8 inches tall. Add NIS or COC.
	sethoxydim (Poast 1.5 E)	1 - 2 pt	Apply to actively growing grasses. Include NIS or COC.
Postemergence annual and perennial weeds	glyphosate (Roundup Ultra 4 L) (Touchdown 4L)	1 - 2 qt	Apply to actively growing weeds. See label for best rate and timing. Avoid contact with green stems or leaves of blueberry and brambles. 14 day PHI.

### BLUEBERRY, BRAMBLES (Established One Year or More)

Preemergence annual weeds	diuron (Karmex 80 DF)	2 - 4 lb	Apply In spring before weeds emerge. Use low rate on young plantings. Less effective on organic soils. Maximum 3 lb product per acre on raspberries. 60 day PHI.
	simazine (Princep 90 WG)	2.2 - 4.4 lb	Apply in late fall or spring before growth starts. Use low rate on young plantings. Do not apply when fruit is present.
	napropamide (Devrinol 50 DF)	8 lb	Apply before weeds emerge in spring. Short residual life. Controls seedling grasses.
	dichlobenil (Casoron 4 G)	100 - 150 lb	Apply in November. Do not exceed 100 lb/acre on brambles. Suppresses broadleaves and nutsedge.
	pronamide (Kerb 50 W)	2 - 4 lb	<b>Blueberry only.</b> Apply in November or in early spring before weeds emerge. Not effective on high-organic soils. Suppresses quackgrass.
	terbacil (Sinbar 80 W)	1 - 2 lb	Apply in late fall or early spring. Use only in plantings that have been established at least one year. Apply the low rate on sands and sandy loams and the higher rate on clay loams.
	norflurazon (Solicam 80 DF)	2.5 - 5 lb	Apply in late fall or early spring before weeds emerge. Suppresses many annual weeds and nutsedge. 60 day PHI.
Postemergence annual and perennial weeds	glyphosate (Roundup Ultra 4 L) (Touchdown 4L)	1 - 2 qt	Apply to actively growing weeds. See label for best rate and timing. Avoid contact with green stems or leaves of blueberry and brambles. 14 day PHI.
Postemergence annual weeds	paraquat (Gramoxone Max 3L)	1.7 - 2.7 pt	Apply as a directed spray to emerged weeds. Avoid contact with new canes or shoots of brambles or blueberries.
Postemergence grasses	fluazifop-P (Fusilade DX 2 E)	1 - 2 pt	<b>Non-bearing only.</b> Apply to actively growing grasses 4 to 8 inches tall. Add NIS or COC.
	sethoxydim (Poast 1.5 E)	1 - 2 pt	Apply to actively growing grasses. Include NIS or COC. PHI: Blueberry - 30 days. Raspberry - 45 days.
Woody perennials	hexazinone (Velpar 2L)	2 - 4 qt	<b>Blueberry established 3 years or more only.</b> Apply in early spring before bud break. Do not apply on light sandy soils or in successive years. Can injure blueberry. 90 day PHI.

# CRANBERRIES

Weed Problem	Chemical	Product per acre	Remarks
Preemergence	simazine (Princep Caliber 90)	2.2 lb	Apply before growth begins in spring.
	norflurazon (Evital 5G)	80 - 160 lb	Make one application per year. Apply in early spring before weeds emerge, or late fall 2 weeks before winter flood. Use low rate on open, young, sandy bogs, or where sprinkler irrigation is used.
	napropamide (Devrinol 50 DF or 10G)	3 - 15 lb 30 - 150 lb	Apply in late fall or early spring before weeds emerge.
Postemergence	Riverdale 2,4-D granules	10 - 20 lb	Apply in spring after removal of winter flood. Do not use on light sandy soil.
	clethodim (Select 2E)	8 fl oz	Apply to actively growing grasses. Include COC. Do not exceed 32 fl oz/a/yr. 30 day PHI.
	sethoxydim (Poast 1.5 L)	1.5 - 2.5 pt	Apply to actively growing grasses. Add NIS or COC. 60 day PHI.

## GRAPES (Year of Planting)

Weed Problem	Chemical	Product per acre	Remarks
Preemergence	oryzalin (Surflan 4 AS)	2 - 4 qt	Apply after soil has settled after planting. Apply to established plantings in spring before weeds emerge. Use the lower rate on sandy soils. Must be watered in for optimum weed control. Suppresses annual grasses.
	pendimethalin (Prowl 3.3 E)	2.4 - 4.8 qt	<b>Nonbearing grapes only.</b> Apply after planting after soil settles. Apply to established plantings before buds swell. Do not apply over plants. Controls annual grasses.
	napropamide (Devrinol 50 DF)	8 lb	Apply to weed-free soil. Apply in early spring. Short residual life. Controls annual grasses and some broadleaves.
Postemergence annual and perennial weeds	glyphosate (Roundup Ultra 4 L) (Touchdown 4L)	1 - 3 qt	See label for appropriate rate and weed size. Do not allow the spray to contact leaves or green shoots. Avoid applications after bloom stage.
	paraquat (Gramoxone Max 3L)	1.7 - 2.7 pt	Apply when sucker growth is less than 8 inch long. Avoid contact with grape leaves or green foliage. Kills emerged annual weeds.
Postemergence Grasses	fluazifop-P (Fusilade DX 2 E)	1 - 2 pt	<b>Nonbearing grapes only.</b> Apply to actively growing grass 4 to 8 inches tall. Add NIS or COC.
	sethoxydim (Poast 1.5 L)	1.5 - 3 pt	Apply to actively growing grasses. Add NIS or COC. 50 day PHI.

## GRAPES (Established one year or more)

Preemergence	oryzalin (Surflan 4 AS)	2 - 4 qt	Apply after soil has settled after planting. Apply to established plantings in spring before weeds emerge. Use the lower rate on sandy soils. Must be watered in for optimum weed control. Suppresses annual grasses.
	diuron (Karmex 80 DF)	2 - 5 lb	<b>Grapes established 3 or more years.</b> Apply In spring before weed growth starts. Use lower rate on sandy soils.
	simazine (Princep 90 WG)	2.2 - 5 lb	<b>Grapes established 3 or more years.</b> Apply In spring before weed growth begins. Use low rates on sandy soils.
	norflurazon (Solicam 80 DF)	1.5 - 4 lb	<b>Grapes established 2 or more years.</b> Apply in fall or early spring before weeds emerge. Use lower rate on sandy soil. Suppresses annual grasses and nutsedge.
	dichlobenil (Casoron 4 G)	150 lb	Apply in November before soil freezes. Suppresses annual and perennial weeds.
	pronamide (Kerb 50 W)	2 - 4 lb	<b>Grapes established 1 or more years.</b> Apply in November before soil freezes or early spring. Suppresses quackgrass.
	oxyfluorfen (Goal XL 2 E)	3 - 4 qt	<b>Grapes established 3 or more years and trellised.</b> Apply to soil when grapes are dormant. Avoid plant contact.
	Postemergence annual and perennial weeds	glyphosate (Roundup Ultra 4 L) (Touchdown 4L)	1 - 3 qt
glufosinate (Rely 1 L)		3 - 6 qt	<b>Grapes established 1 year or more.</b> Apply to actively growing weeds directed to avoid contact with grapes. Use high rate on large weeds. 14 day PHI.
paraquat (Gramoxone Max 3L)		1.7 - 2.7 pt	Apply when sucker growth is less than 8 inches long. Avoid contact with grape leaves or green foliage. Kills emerged annual weeds.
Postemergence grasses	fluazifop-P (Fusilade DX 2 E)	1 - 2 pt	<b>Nonbearing grapes only.</b> Apply to actively growing grass 4 to 8 inches tall. Add NIS or COC.
	sethoxydim (Poast 1.5 L)	1.5 - 3 pt	Apply to actively growing grasses. Add NIS or COC. 50 day PHI.



# Weed Control

## STRAWBERRY (New Plantings)

Weed Problem	Chemical	Product per acre	Remarks
Preemergence grasses and broadleaves	DCPA (Dacthal 75 W)	8 - 11 lb	Apply about 5 days after planting and before weeds emerge. Do not apply after first bloom.
	napropamide (Devrinol 50 DF)	4 - 8 lb	Apply before weeds emerge in the spring or in fall following cultivation. May inhibit runner rooting on sandy soils. Must be irrigated or incorporated into the soil 2 inches prior to transplanting new plants.
Postemergence grasses	sethoxydim (Poast 1.5 L)	1 - 2 pt	Apply to actively growing grasses. Add NIS or COC. 7 day PHI.
	clethodim (Select 2E)	8 fl oz	Apply to actively growing grasses. Add 1% COC to spray mix. Max. 32 fl oz/a/yr in 4 applications. 4 day PHI.

## STRAWBERRY (Established Plantings)

Preemergence grasses and broadleaves	DCPA (Dacthal 75 W)	8 - 11 lb	Apply in spring to established fields before weeds germinate. Do not apply after first bloom.
	napropamide (Devrinol 50 DF)	4 - 8 lb	Apply before weeds emerge in the spring or in fall following cultivation. May inhibit runner rooting on sandy soils. Must be irrigated or incorporated into the soil 2 inches prior to transplanting new plants.
Postemergence broadleaves	2,4-D amine (Amine, Formula 40 3.7 L)	1 qt	Apply after harvest at renovation time. Do not apply after August 1 or misshapen fruit may be produced the next season. Controls most broadleaves.
	terbacil (Sinbar 80 W)	2 - 6 oz	Apply at renovation (after mowing) or in late fall. Use the lowest rate on sandy soils. Do not use on new plantings. Do not use on the 'Guardian,' 'Earliglow' and 'Kent' varieties. Do not exceed 8 oz Sinbar 80W per season.
	paraquat (Gramoxone Max 3L)	1.5 pt	Apply to emerged weeds as a directed, shielded spray between rows to prevent contact with strawberry plants. Maximum of 3 applications per season. 21 day PHI.
Postemergence grasses	sethoxydim (Poast 1.5 L)	1 - 2 pt	Apply to actively growing grasses. Add NIS or COC. 7 day PHI.
	clethodim (Select 2E)	8 fl oz	Apply to actively growing grasses. Add 1% COC to spray mix. Max. 32 fl oz/a/yr in 4 applications. 4 day PHI.

# Post-Harvest Disorder Control

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Fruit treated post-harvest must be labeled properly when marketed. The shipping container or master carton containing the treated fruit, but not the consumer package, must be marked "Treated with (name of chemical) to retard spoilage." The lettering of this statement must be as large as the other lettering on the container. Furthermore, before treating fruit or shipping previously treated fruit, check to see if importing countries will allow entry for sale. This is especially important given the relatively lengthy storage period of apples. Information on the tolerance level of a number of pre- and postharvest chemicals on apples, pears and cherries for countries around the world is available. The Northwest Horticultural Council (P.O. Box 570, Yakima, WA 98907) sells a publication containing this information.

## Scald on Apples

Scald is a physiological (non-parasitic) disorder that develops on susceptible varieties of apples during storage and marketing. The most common symptom is a brown discoloration of the skin, which results from reactions involving a volatile oxidizing substance produced naturally by the fruit. Antioxidant chemicals which are effective against scald are available for use on apple fruit. Treat susceptible varieties of McIntosh, Cortland, Delicious, Greening, Stayman Winesap, Turley Winesap and Rome Beauty (Red Rome) with a scald inhibitor whenever storage of several months or longer is anticipated. The occasional development of scald on Jonathan, Idared and Golden Delicious is not always severe enough to justify fruit treatment for its control, yet these varieties are sometimes treated.

## Control

Storage of fruit in atmospheres having 1.5% oxygen or less reduces the incidence and severity of superficial scald, but may not offer complete control. For chemical control, dip or drench the fruit shortly after harvest with a scald inhibitor. A delay of 2 weeks in storage considerably reduces scald control with chemicals. It should also be noted that there are some restrictions for the export of fruit treated with scald inhibitors, so knowledge of the destination of stored fruit may be an important consideration in the choice of which scald inhibitor to apply. Inclusion of a fungicide in the drench water may be necessitated to reduce the incidence of decay.

## SUGGESTED CHEMICAL

**Diphenylamine (DPA)**, from Atochem and Shield Brite, is a wettable powder or liquid at 1,000 or 2,000 ppm for warm fruit (50° F or higher) or 2,000 ppm for cold fruit.

Apply at least 1,000 ppm to control scald on susceptible varieties including Cortland, Delicious, McIntosh, Mutsu, Rome Beauty, Stayman Winesap and Turley Winesap. An exception is that 2,000 ppm is required for control on early-picked Delicious. Frequent renewal of DPA in the dip tank or drench and good agitation are essential to offset the DPA removed by the fruit, bins and debris or that which has settled out (DPA is a suspension, not a solution). Treatment with 2,000 ppm is frequently employed to assure an effective concentration of DPA. Test kits for quickly measuring the DPA solution concentration are available from several suppliers and are useful in efficiently maintaining an adequate level of the scald inhibitor. Avoid levels above 2,000 ppm because of injury and residue hazards. Rome Beauty and Golden Delicious may be damaged at lower levels, i.e. 1,500 ppm. If scald control seems necessary for Jonathan, Idared or Golden Delicious, use 1,000 ppm. It is important to note that DPA tends to "fix" the green color (chlorophyll) in the skin of apples.

DPA use is not permitted for fruit in many export markets.

## Internal Breakdown and Bitter Pit of Apples

Internal breakdown is an "old-age" disorder which is retarded in development by good fruit handling and storage practices and by post-harvest treatment of the fruit with calcium chloride. The disorder is characterized by browning of the flesh followed by excessive softening and finally skin discoloration.

Bitter pit appears as dry, brown spots of tissue before and after harvest. Its development can be retarded during storage by treatment with calcium chloride. It may be used on Delicious and Northern Spy.

## Control

Dip or drench the harvested apples in a 2.5% solution of calcium chloride containing 20 pounds of actual calcium chloride per 100 gallons of water. The calcium chloride should be either Food Grade or Technical Grade that meets Food Chemical Codex specifications. It may be combined with DPA applied for scald control (see above). The treated fruit should be stored immediately or put under cover to avoid loss of the material (i.e., by rainfall) which must remain on the fruit during the storage period to be effective. The apples must be washed when prepared for use or marketing. Apples with enlarged, poorly corked lenticels, poor finish due to russetting, or mite injury in the calyx cavity may be damaged by calcium chloride. Include fungicide in the treatment solution to minimize the occurrence of fruit rots.

# Nematode Management

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Plant-parasitic nematodes cause significant economic losses in fruit systems as plant pathogens, virus vectors and predisposition agents. The purpose of this information is to provide fruit producers with nematicide recommendations for nematode management. All other

aspects of nematode control in fruit production are covered in MSU Extension Bulletin E2419, "Avoidance and Management of Nematode Problems in Tree Fruit Production in Michigan".

## APPLE, CHERRY AND PEACH ORCHARDS

### PREPLANT APPLICATION

Nematicide	Application rate/acre	Directions and/or Limitations
1,3-D (Telone II)	Broadcast: 30 gal	Apply as a preplant treatment at least 21 days prior to planting into well prepared soil. Soil temperatures should be between 50° and 80° F. Inject to an 8-inch soil depth with shanks spaced 12-24 inches apart. Seal soil immediately after application. Allow additional time before planting if temperatures are below 60° F or if soil is very wet.
1,3-D and Chloropicrin (Telone C-17)	Broadcast: 35 gal	See information for 1,3-D.
1,3-D and Chloropicrin (Telone C-35)	Broadcast: 39-50 gal	See information for 1,3-D.
Metham (Busan 1020 and Vapam)	Broadcast: 50-100 gal	Apply as a preplant treatment at least 21 days prior to planting into moist soil. Soil temperatures should be between 40° and 70° F. Inject to a soil depth of 4 inches with blades placed 5 inches apart. Follow immediately with a roller to smooth and compact surface. Light watering or a tarp after rolling helps prevent gas escape. Fumigant should be applied with equal parts water or in a 2 to 1, water to fumigant ratio.
Oxamyl (Vydate L)	Broadcast: 3-4 gal	Apply in a minimum of 20 gallons of water per acre. Thoroughly incorporate with a rotary tiller to a depth of 48 inches immediately after application. READ LABEL WARNINGS CAREFULLY.

### POST-PLANT TREATMENT

Nematicide	Application rate/acre	Directions and/or Limitations
Fenamiphos (Nemacur 3)	Band: 1.67-2.5 gal	Apply in not less than 10 gallons of water per acre and incorporate immediately either mechanically or with sufficient irrigation. Center the treated band over the tree row with width of 4-6 feet. Do not apply within 72 days of harvest of apples or within 45 days of harvest of cherries or peaches. Do not apply more than 2.5 gallons per acre per site per year. <b>Do not feed cover crops grown in treated orchards to livestock. Avoid contacting tree foliage with the spray mixture.</b>
Oxamyl (Vydate L)	Foliar Spray: 2-4 pt	Mix in 100 gallons of water and apply as a dilute spray to foliage. Apply on a 2-3 week schedule for 4 applications. <b>Do not apply to trees that will bear fruit within 12 months of the last application. For non-bearing orchards only.</b>

# NEMATODE MANAGEMENT

## VINEYARDS AND SMALL FRUIT PLANTINGS

### PREPLANT APPLICATION

Nematicide	Application rate/acre	Directions and/or Limitations
1,3-D (Telone II)	Broadcast: 30 gal	Apply as a preplant treatment at least 21 days prior to planting into well prepared soil. Soil temperatures should be between 50° and 80° F. Inject to an 8-inch depth with shanks spaced 12-24 inches apart. Seal soil immediately after application. Allow additional time before planting if temperatures are below 60° F or if the soil is very wet.
1,3-D and Chloropicrin (Telone C-17)	Broadcast: 35 gal	See information for 1,3-D.
1,3-D and Chloropicrin (Telone C-35)	Broadcast: 39-50 gal	See information for 1,3-D.
Metham (Busan 1020 and Vapam)	Broadcast: 50-100 gal	Apply as a preplant treatment at least 21 days prior to planting into moist soil. Soil temperatures should be between 40° and 70° F. Inject to a soil depth of 4 inches with blades spaced 5 inches apart. Follow immediately with a roller to smooth and compact surface. Light watering or a tarp after rolling helps prevent gas escape. Fumigant should be applied with equal parts water or in a 2 to 1, water to fumigant, ratio.
Fenamiphos (Nemacur 3)	<b>Strawberries</b> —Band: 0.5-1 gal on 40-in, rows	Apply in 20-40 gallons of water to the soil in a 12-18-inch band over the row and incorporate immediately by cultivation or by sprinkler irrigation prior to transplanting. Do not apply more than 1 application. Do not apply within 110 days of harvest.
Fenamiphos (Nemacur 15G)	<b>Strawberries</b> —Band: 12-18 lb on 40-in, rows	Apply in 12-18-inch band over the row and incorporate immediately by cultivation or by sprinkler irrigation prior to transplanting. Do not apply more than 1 application. Do not apply within 110 days of harvest.
Oxamyl (Vydate L)	<b>Strawberries</b> —Broadcast: 3-4 gal	Apply in a minimum of 20 gallons of water per acre. Thoroughly incorporate with a rotary tiller to a depth of 4-8 inches immediately after application. READ LABEL WARNINGS CAREFULLY. Many varieties of strawberries are sensitive to Vydate L.

### POST-PLANT TREATMENT

Nematicide	Application rate/acre	Directions and/or Limitations
Fenamiphos (Nemacur 3)	<b>Grapes</b> —Band: 1-2 gal <b>Brambles</b> —Band: 1-2 gal	Apply in not less than 10 gallons of water per acre and incorporate immediately either mechanically or with sufficient irrigation. Band width should be 50% of the total area. On bearing grapes, the last application may be made up to 2 days of harvest. On raspberry, do not apply within 180 days of harvest. Do not apply more than once per year. <b>Do not use site for feed or grazing.</b>





# Days Between Final Spray and Harvest

Listed below are some of the commonly used pesticides and the intervals from last application to

harvest for each crop. See spray schedules for recommended materials. Consult product label.

## FUNGICIDES/BACTERICIDES

Chemical	Plums and									
	Apples	Pears	Peaches	Prunes	Cherries	Grapes	Strawberries	Brambles	Blueberries	
Abound			0	0	0	14			0	
Agri-mycin	50	30								
Aliette	14	14	365	365	365		0	60	0	
AQ10	0	0	0	0	0	0	0	0	0	
Armcarb	0	0	0	0	0	0	0	0	0	
Bayleton	45	45				14				
Benlate	14	14	3	3	3	50	1	3	21	
Benlate + Captan	14		3	3	3	50	1	3	21	
Bravo/Echo			d	d	d				42f	
Cabrio					0		0	0	0	
Captan	0		0c	0	0c	0	0	3	0	
Carbamate/Ferbam	7	7	21		0	7				
Copper (copper-lime mixtures)	b	b	b		b	b	b	b		
EBDC's	77	77				66				
Elevate			0	0	0	0	0	0	0	
Elite			0		0	14				
Flint	14	14	1	1	1	14				
Folpet						0			0	
Indar			0		0				30	
JMS Stylet Oil	0	0	0	0	0	0j	0	0	0	
Kaligreen	1	1	1	1	1	1	1	1	1	
Messenger	0	0	0	0	0	0	0	0	0	
Mycoshield		60	21							
Nova	14		7		7	14	0	0		
Orbit			0	0	0					
Oxidate	0	0	0	0	0	0	0	0	0	
Procure	14	14				7				
Quadris							0			

### Legend:

a = No residue if used according to recommendations.

b = Sulfurs and copper plus lime mixtures are exempt if used as recommended, however, the REI is 12-24 hr for Sulfur, 24 hr for Copper, and 48 hr for Lime sulfur.

c = May be used as post-harvest treatment—See label.

d = Do not apply after shuck split and before harvest.

e = Foliar application allowed on strawberry.

f = Do not apply after petal fall.

g = Do not apply after first fruiting flower

h = Do not apply past bloom

i = Do not apply later than 3 weeks past full bloom.

J = Do not apply later than 14 days to harvest on table grapes.

k = REI is 48 hr

m = Non-bearing only

n = Bearing and non-bearing.

**Days Between Final Spray and Harvest, continued.**

**FUNGICIDES/BACTERICIDES (continued)**

Chemical	Plums and					Grapes	Straw-berries	Brambles	Blue-berries
	Apples	Pears	Peaches	Prunes	Cherries				
Ridomil Gold MZ/Cu						66			
Ridomil GoldEC	n	m	n	n	n		0ek	45	0k
Ridomil Gold GR	m	m	m	m	m			45	
Rovral			f	f	f	7	g	0	0
Rubigan	30	30			0	30			
Serenade					0	0			
Sovran	30	30				14			
Sulfur/Lime Sulfur	b		b	b	b				
Switch							0		
Syllit	7		15		0		14		
Thiram	0		7				3a		
Topsin-M	0		1	1	1	14	1		7
Vanguard	72	72	h	h	h(tart)	7			
Ziram 76 DF	14	14	14		14	21			14
Ziram Granuflo	14	14	14		14	21			i

**Legend:**

- a = No residue if used according to recommendations.
- b = Sulfurs and copper plus lime mixtures are exempt if used as recommended, however, the REI is 12-24 hr for Sulfur, 24 hr for Copper, and 48 hr for Lime sulfur.
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- n = Bearing and non-bearing.

# Days Between Final Spray and Harvest, continued.

## INSECTICIDES/MITICIDES

Chemical	Plums and					Grapes	Straw-berries	Brambles	Blue-berries
	Apples	Pears	Peaches	Prunes	Cherries				
Acramite	7	7	3	3		14	1		
Actara	14j	14j							
Agri-Mek	28	21				28	3		
Ambush	a	14i	14		3				
Apollo	45		21	21	21				
Asana	21	28	14	14	14				14
Assail	7	7			7				
Avaunt	28	28							
Aza-Direct	0	0	0	0	0	0	0	0	0
Biobit	0	0	0	0	0	0	0	0	0
Brigade							0		
Carzol	a	a	a						
Confirm	14	14						14	14
Crymax	0	0	0	0	0	0	0	0	0
Cythion ULV					1	7			0
Danitol	14	14				21	2		
Diazinon	21	21	21	21	21	28	5	7	7
Dimethoate (Cygon)	28	28							
Dipel	0	0	0	0	0	0	0	0	0
Ecozin	0	0				0	0	0	0
Esteem	45	45	14	14	14			7	7
Evergreen	12hrs	12hrs	12hrs	12hrs	12hrs	12hrs	12hrs	12hrs	12hrs
Guthion	14f	14	21	15	15	21	5	14	7
Imidan	7b	7b	14b	7	7	7			3
Intrepid	14	14							
Javelin	0	0	0	0	0	0	0	0	0
Kelthane	7	7				7	2		
Lannate	14b		4			14e	3h		3
Lorsban (foliar)	i	i	i	i	i,14g	35	21i		
Lorsban (trunk)	28		14		6				
Malathion	3	1	7	3	3	3	3	1	0-1b
Methoxychlor	7	7	21	7	7	14		3	14
Mitac		7							
Neemix	0	0				0	0	0	0

### Legend:

- a = Do not apply after petal fall
- b = See label restrictions on use.
- c = No residue if used according to recommendations.
- d = 21 days if only 2 sprays are applied.
- e = Lannate PHI is 1 day for fresh grapes.
- f = 21 day PHI on apple if last application > 2 lb/acre.
- g = Lorsban 50 W on tart cherry only
- h = 10 day PHI for processed strawberries
- i = pre-bloom only
- j = 35 day PHI if use rates exceed 2.75 oz/A

**Days Between Final Spray and Harvest, continued.**

**INSECTICIDES/MITICIDES (continued)**

Chemical	Plums and								
	Apples	Pears	Peaches	Prunes	Cherries	Grapes	Straw-berries	Brambles	Blue-berries
Phosphamidon	30				b				
Pounce	a	b	14		3				
Provado	7	7				0			
PyGanic	12hrs	12hrs	12hrs	12hrs	12hrs	12hrs	12hrs	12hrs	12hrs
Pyramite	25	7	7	7	300	7			
Savey	28	28	28	28	28		3		
Sevin	3	3	3	3	3	7	7	7	7
SpinTor	7		14	7	7		1		3
Superior Oil	c	c	c	c	c	c	c	c	c
Supracide	i	i							
Surround	0	0				0			
Thiodan	21b	7d	30b	7b	21b	7	4b		b
Vendex	14b	14b	14	14	14	28	1		
Vydate L	14	14							

**Legend:**

- a = Do not apply after petal fall
- b= See label restrictions on use.
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- g= Lorsban 50 W on tart cherry only
- h= 10 day PHI for processed strawberries
- i= pre-bloom only
- j= 35 day PHI if use rates exceed 2.75 oz/A

# Record Keeping Requirements for Production Chemicals

The following list contains trade name, common name, manufacturer, EPA registration number, restricted entry interval, runoff potential and leaching potential. The list was prepared to provide growers a convenient place to find information for pesticide recordkeeping requirements. This is a partial list of the commonly used pesticides on fruit crops in Michigan and is not intended to be a complete list. It is the grower's responsibility to confirm the registration number and Restricted Entry Interval (REI) for the specific pesticide used by checking the label attached to the package.

## FUNGICIDES

Trade Name	Common Name	Manufacturer	EPA Reg #	REI <sup>1</sup>	Runoff/ Leach Potential <sup>2</sup>	Oral LD50	Dermal LD50	Class <sup>3</sup>
Bound	azoxystrobin	Syngenta	10182-415	4 hrs	-/-	>5000	>4000	strobilin
Agri-Mycin 17 Ag	streptomycin	Syngenta	100-899	12 hrs	-/-	>5000	>2000	antibiotic
Allette 80 WDG	fosetyl-Al	Aventis	264-516	12 hrs	3/3	2860	>2000	organophosphate
Q10	Ampeleomyces quisqualis	Ecogen	55638-16	4 hrs	-/-	-	-	-
Armicarb 100	potassium bicarbonate	Church & Dwight	10772-4	4 hrs	-/-	2700	>5000	-
Bayleton 50 DF	triadimefon	Bayer	3125-320	12 hrs	2/2	812-1470	>2000	conazole
Benlate	benomyl	DuPont	352-354	24 hrs	1/3	>10000	>10000	benzimidazole
Botran 75 W	dicloran	Gowan	10163-189	12 hrs	2/3	>4640	>6320	aromatic
Bravo WeatherStik	chlorothalonil	Zeneca	50534-188-10182	48 hrs	1/3	9000	>2000	aromatic
Bravon	pyraclostrobin	BASF	7969-187	12 hrs	-/-	>2000	>2000	strobilin
Captan 50 WP	captan	Micro-Flo	51036-166	24 hrs-4 days	2/3	>5000	>2000	dicarboximide
Captan 80 WP	captan	Micro-Flo	51036-168	24 hrs-4 days	2/3	>5000	>2000	dicarboximide
Captec 4 FL	captan	Micro-Flo	51036-181	24 hrs-4 days	2/3	>5000	>2000	dicarboximide
Camp Formula 2	copper hydroxide	Agrotol	55146-64	24 hrs	-/-	1630	>5000	copper
Camp DP	copper hydroxide	Agrotol	55146-57	24 hrs	-/-	1346	>5000	copper
Copper Sulfate	copper sulfate	Griffin	1812-313	24 hrs	-/-	472	-	copper
Disulfide M-45	mancozeb	Rohm & Haas	707-78	24 hrs	1/3	>5000	>5000	dithiocarbamate
Evate	fenhexamid	Tomen Agro	66330-35	12 hrs	-/-	>2000	>2000	unclassified
Fite 45 DF	tebuconazole	Bayer	3125-388	12 hrs	-/-	2593-8465	>2000	conazole
Ferbam Granuflo	ferbam	UCB Chemical	45728-7	24 hrs	2/2	>5000	>4000	dithiocarbamate
Flint	trifloxystrobin	Bayer	3125-559	12 hrs	-/-	>5050	>2000	strobilin
Flintar	fenbuconazole	DowAgro	707-239	12 hrs	-/-	4000	>2000	conazole
Flint AS Stylet Oil	paraffinic oil	JMS Flower Farms	65564-1	4 hrs	-/-	10000	-	unclassified
Flinticide 101	copper hydroxide	Griffin	1812-288	24 hrs	-/-	833	>5000	copper
Flintulus DF	sulfur	BASF	7969-61	24 hrs	-/-	>2200	>2000	inorganic
Flintaneb 75 DF	maneb	Cerexagri	4581-371	24 hrs	1/3	>5000	>2000	dithiocarbamate
Flintaneb 80 W	maneb	Cerexagri	4581-255	24 hrs	1/3	>5000	>2000	dithiocarbamate
Flintect 340-F	thiabendazole	Syngenta	100-889	12 hrs	1/3	3100	-	benzimidazole
Flintessenger	harpin protein	Eden Bioscience	69834-2	4 hrs	-/-	>5000	>6000	-
Flintcrothiol Dispers	sulfur	Cerexagri	4581-373	24 hrs	-/-	>2000	>2000	inorganic
Flintcoshield Ag Terramycin	oxytetracycline	Syngenta	100-900	12 hrs	-/-	>5000	>2000	-
Flintova 40 W	myclobutanil	DowAgrosiences	707-221	24 hrs	1/2	1870-2090	>5000	conazole
Flintbit	propiconazole	Syngenta	100-702	24 hrs	1/2	1310	>5000	conazole
Flintidate	hydrogen dioxide	Biosafe Systems	70299-2	0 hrs	-/-	330	1410	-
Flintmancozeb 80 WP	mancozeb	Cerexagri	4581-358	24 hrs	1/3	>5000	>2000	dithiocarbamate
Flintmancozeb 75 DF	mancozeb	Cerexagri	4581-370	24 hrs	1/3	>4470	>2000	dithiocarbamate
Flintplyram 80 DF	metiram	UAP Platte	7969-105-34704	24 hrs	1/3	>5000	>2000	dithiocarbamate
Flintpocure 50 WS	triflumizole	Uniroyal	400-431	24 hrs	2/2	2230	>2000	conazole
Flintdomil Gold GR	mefenoxam	Syngenta	100-798	48 hrs	2/1	>5000	>2000	xylylanine
Flintdomil Gold EC	mefenoxam	Syngenta	100-801	48 hrs	2/1	1172	>2020	xylylanine
Flintdomil Gold MZ	mefenoxam/mancozeb	Syngenta	100-803	48 hrs	2/1	>5000	>2000	xylylanine/dithiocarbamate
Flintdomil Gold/Copper	mefenoxam/copper	Syngenta	100-804	48 hrs	2/1	550	>2020	xylylanine/copper
Flintdral 50 WP	iprodione	Aventis	264-453	24-48 hrs	2/3	>5000	>2000	dicarboximide /imidazole
Flintdral 4 F	iprodione	Aventis	264-482	24-48 hrs	2/3	1170	>2000	dicarboximide /imidazole
Flintbigan 1 EC	fenarimol	DowAgrosiences	62719-134	12 hrs	1/1	1057-1270	>2000	pyridimine
Flintrenade	Bacillus subtilis	Agraquest	69592-4	4 hrs	-/-	>5000	<2000	-
Flintran	kresoxim-methyl	BASF	7969-154	12 hrs	-/-	>5000	>2000	strobilin
Flintrich	cyprodinil+fludioxinil	Syngenta	100-953	12 hrs	-/-	>5000	>2000	pyrimidine/pyrole
Flintthlit 65 W	dodine	Platte	264-508-34704	48 hrs	1/3	2330	>5000	aliphatic N
Flintthiram Granuflo	thiram	UCB Chemicals	45728-21	24 hrs	2/3	2400	>2000	dithiocarbamate
Flintthipsin-M 70 WP	thiophanate-methyl	Cerexagri	4581-322	12 hrs	2/3	>5000	>2000	benzimidazole
Flintthingard WG	cyprodinil	Syngenta	100-828	12 hrs	-/-	>5000	>2000	pyridimine
Flintthtable Sulfur 90 WP	sulfur	Micro-Flo	51036-14	24 hrs	-/-	>5000	>2000	inorganic
Flinttham 76 DF	ziram	Cerexagri	4581-140	48 hrs	2/2	1889	>5000	dithiocarbamate
Flinttham Granuflo	ziram	UCB Chemicals	45728-12	48 hrs	2/2	2700	>2000	dithiocarbamate

Restricted Use Pesticide

REI = Restricted Entry Interval, SL = See Label. Some REIs vary by crop, always check the label.

Runoff/leaching potential ratings are from the NRCS Field Office Technical Guide-Section II, "Water Quality and Quantity Interpretations."

1 = large, 2 = medium, 3 = small.

AM = carbamate, FA = fatty acid, IGR = insect growth regulator, K = clay, NA = naturalyte, NM = neem extract, NI = neonicotinoids, OP = organophosphate, OX = oxadiazine, SP = synthetic pyrethroid.



**Record Keeping Requirements for Production Chemicals (continued).**

**HERBICIDES**

Trade Name	Common Name	Manufacturer	EPA Registration #	REI <sup>1</sup>	Runoff /Leach Potential <sup>2</sup>	Oral LD50	Dermal LD50	Class
Casoron 4 G	dichlobenil	Uniroyal	400-168	12 hrs	1/2	>5000	>2000	Nitrile
Dacthal W-75	DCPA	Amvac	5481-490	12 hrs	1/3	10000	>10000	-
Devrinol 50 DF	napropamide	United Phosphorus	10182-258-70506	12 hrs	1/2	>5000	>2000	amide
Evital 5G	norflurazon	Syngenta	100-840	12 hrs	1/2	>5000	>2000	pyridazinone
Formula 40	2,4-D	Riverdale	62719-1-228	48 hrs	3/2	375-699	>2000	phenoxy
Fusilade DX	fluzafop-P	Syngenta	100-1070	12 hrs	1/3	>5000	>2000	phenoxy
Gallery 75 DF	isoxaben	DowAgrosciences	62719-145	12 hrs	1/3	>5000	>5000	amide
Goal XL 2E	oxyfluorfen	DowAgrosciences	707-243	24 hrs	1/3	>2000	>2999	nitrophenyl ether
*Gramoxone Extra	paraquat	Zeneca	10182-280	12-24 hrs	1/3	283	>2000	quaternary ammonia
Karmex 80 DF	diuron	Griffin	1812-362	12 hrs	1/2	2900	>2000	phenylurea
*Kerb 50 WP	pronamide	DowAgrosciences	707-159	24 hrs	2/1	>5000	>2000	-
Poast	sethoxydim	BASF	7969-58	12 hrs	2/3	4100	>5000	cyclohexine oxime
Princep 90 WDG	simazine	Syngenta	100-603	12 hrs	2/1	>5000	>2000	triazine
Princep 4 L	simazine	Syngenta	100-526	12 hrs	2/1	>5000	>2500	triazine
Prowl 3.3 EC	pendimethalin	BASF	241-337	24 hrs	1/3	3956	>2200	dinitroaniline
Rely	glufosinate	Bayer	45639-187	12 hrs	2/3	3570	>2000	organophosphate
Roundup	glyphosate	Monsanto	524-445	12 hrs	1/3	>5000	>5000	organophosphate
Roundup Ultra	glyphosate	Monsanto	524-475	4 hrs	1/3	5108	>5000	organophosphate
Select 2EC	clethodim	Valent	59639-3	24 hrs	3/3	2920-3610	>5000	Cyclohexene oxime
Sinbar 80 WP	terbacil	DuPont	352-317	12 hrs	2/1	5000-7500	>5000	uracil
Snapshot 80 OF	isoxaben + oryzalin	DowAgrosciences	62719-174	12 hrs	1/3	>5000	-	amide+ dinitroaniline
Solicam 80 DF	norflurazon	Syngenta	100-849	12 hrs	1/2	1140	>2000	pyridazinone
Surflan AS	oryzalin	DowAgrosciences	627 19-112	24 hrs	2/3	5000	>5000	dinitroaniline
Touchdown 6 F	sulfosate	Syngenta	100-1117	12 hrs	1/3	750	>5000	organophosphate
Velpar 90 SP	hexazinone	DuPont	352-378	24 hrs	2/1	1100	>5000	triazinone
Weedar 64	2,4-D	Nufarm	71368-1	48 hrs	3/1	1161	1544	phenoxy

**INSECTICIDES/MITICIDES**

Acramite 50WS	bifenazate	UniRoyal	400-503	12 hrs				
Actara 25WG	thiamethoxam	Syngenta	100-938	12 hrs	-/-	>5000	>2000	nicotinoid
*Agri-Mek 0.15 EC	avermectin B1	Syngenta	100-898	12 hrs	1/3	300	>1800	antibiotic
*Ambush 2 EC	permethrin	Syngenta	100-985	12 hrs	1/3	2305-3070	>2000	pyrethroid
*Ambush 25 WP	permethrin	Syngenta	100-1008	12 hrs	1/3	>5000	>2000	pyrethroid
Apollo SC	clofentezine	Aventis	264-623	12 hrs	1/3	>5000	>2400	-
*Asana XL	esfenvalerate	DuPont	352-515	12 hrs	1/3	458	>2000	pyrethroid
Assail 70WP	acetamiprid	Aventis	264-609	12 hrs				
Avaunt 30WG	indoxacarb	DuPont	352-597	12 hrs	-/-	687-1867	>5000	oxadiazine
Aza-Direct	azadirachtin	Gowan	71908-1-10163	4 hrs	-/-	>5000	>2000	botanical
Azinphos-Methyl 50	azinphos-methyl	Micro-Flo	51036-1 64	2-21days	2/3	14	>2000	organophosphate
Biobit HPWP	Bt var kurstaki	Valent	73049-54	4 hrs	-/-	>5000	>2500	-
*Brigade WSB	bifenthrin	FMC	279-3108	24 hrs	1/3	335	>2000	pyrethroid
Carbaryl 4 L	carbaryl	Platte	34704-447	12 hrs	2/3	590	2000	carbamate
Carbaryl 80	carbaryl	Drexel	19713-50	12 hrs	2/3	281	>2000	carbamate
Carzol 92 SP	formetanate	Aventis	264-635	4-16days	1/3	15-26	>10000	formamidine
Confirm 2F	benzoic acid	DowAgro	707-238	4 hrs	-/-	>5000	>5000	-
*Danitol 2.4 EC	fenpropathrin	Valent	59639-35	24 hrs	-/-	66	>2000	pyrethroid
*Diazinon 50 WP	diazinon	Platte	100-460-34704	24 hrs	1/3	1960	>2020	organophosphate
*Diazinon AG 600	diazinon	Platte	100-784-34704	24 hrs	1/3	1600	>2020	organophosphate
*Diazinon 50 W	diazinon	Micro-Flo	51036-108	24 hrs	1/3	>2000	>2000	organophosphate
Dimethoate 400	dimethoate	Platte	34704-207	48 hrs	3/2	425	2020	organophosphate
Dimethoate 267 EC	dimethoate	Micro-Flo	51036-198	48 hrs	3/2	750	>2000	organophosphate
Dipel	Bt var kurstaki	Valent	73049-17	4 hrs	-/-	8100	7200	-
Ecozin	azadirachtin	Amvac	5481-476	12 hrs	-/-	>5050	>5050	botanical
Endosulfan 50 WSB	endosulfan	Gowan	10163-130	24 hrs	1/3	-	-	organochloride
Esteem 35 WP	pyriproxyfen	Valent	59639-115	12 hrs	-/-	>5000	>5000	IGR
*Guthion 2 L	azinphos-methyl	Bayer	3125-102	2-21days	2/3	55-75	350	organophosphate
GuthionSolupak50WP	azinphos-methyl	Bayer	3125-301	2-21days	2/3	12.3-24.7	>2000	organophosphate
Imidan 70 WP	phosmet	Gowan	10163-169	24 hrs	2/3	126-681	>4.64	organophosphate
Intrepid 2F	Benzoic acid	DowAgrosciences	707-277	4 hrs	-/-	>5000	>2000	-
Javelin WG	Bt	Certis	70051-66	4 hrs	-/-	>5100	>5000	-
Kelthane MF	dicofol	DowAgrosciences	707-202	12 hrs	1/3	1835-5022	>5000	-
*Lannate 90 SP	methomyl	DuPont	352-342	2-7 days	2/1	30-34	>2000	carbamate
*Lannate 2.4 LV	methomyl	DuPont	352-384	2-7 days	2/1	160	>2016	carbamate
Lorsban 50 WP	chlorpyrifos	Gowan	62719-221-10163	1-4 days	1/3	382	>2000	organophosphate
Lorsban 4 EC	chlorpyrifos	DowAgrosciences	62719-220	1-4 days	1/3	300-776	>5000	organophosphate
Malathion 8 Flowable	malathion	Gowan	10163-21	12-24 hrs	3/3	370	4100	organophosphate
Malathion 57EC	malathion	UAP Platte	34704-108	12 hrs	3/3	3946	>2000	organophosphate
Malathion ULV	malathion	UAP Platte	34704-565	12 hrs	3/3	290	4100	organophosphate
M-Pede	fatty acids	DowAgrosciences	53219-6	12 hrs	-/-	>5000	>2000	-
Methoxychlor 2 EC	methoxychlor	Platte	34704-102	12 hrs	1/3	5000-6000	>2820	organochlorine
Neemix 4.5	azadirachtin	Certis	70051-9	12 hrs	-/-	>5000	-	botanical
Neemix	azadirachtin	Certis	70051-5	4 hrs	-/-	>5000	-	botanical
*Pounce 25 WP	permethrin	FMC	279-3051	12 hrs	1/3	1100	>2000	pyrethroid
*Pounce 3.2 EC	permethrin	FMC	279-3014	12 hrs	1/3	1030	>2000	pyrethroid
Provado	imidacloprid	Bayer	3125-457	12 hrs	-/-	4143-4870	>2000	nicotinoid
Pyramite 60 WP	pyridazinone	BASF	7969-125	12 hrs	-/-	1930	>2000	-

\* = Restricted Use Pesticide

(continued on next page)

<sup>1</sup>REI = Restricted Entry Interval, SL = See Label. Some REIs vary by crop, always check the label.

<sup>2</sup>The Runoff/leaching potential ratings are from the NRCS Field Office Technical Guide-Section II, "Water Quality and Quantity Interpretations." 1 = large, 2= medium, 3 = small.

<sup>3</sup> C = carbamate, FA = fatty acid, IGR = insect growth regulator, K = clay, NA = naturalyte, NM = neem extract, NI = neonicotinoids, OP = organophosphate, OX = oxadiazine, SP = synthetic pyrethroid.

**INSECTICIDES/MITICIDES (continued)**

Trade Name	Common Name	Manufacturer	EPA Registration #	REI <sup>1</sup>	Runoff /Leach Potential <sup>2</sup>	Oral LD50	Dermal LD50	Class
Savey 50 DF	hexythiazox	Gowan	10163-250	12 hrs	1/3	>5000	>5000	-
Sevin 80 S	carbaryl	Aventis	264-316	12 hrs	2/3	281	>2000	carbamate
Sevin XLR Plus	carbaryl	Aventis	264-333	12 hrs	2/3	649	>2000	carbamate
Sevin 4 F	carbaryl	Aventis	264-349	12 hrs	2/3	590	>2000	carbamate
Spintor 2 SC	spinosad	DowAgrosciences	62719-294	4 hrs	-/-	>5000	>5000	antibiotic
Sunspray Ultra-fine	superior oil	Security	862-28-270	4 hrs	-/-	>15000	-	-
Supracide 25 WP	methidathion	Gowan	10163-244	2-14	2/3	53	>2020	organophosphate
Surround WP	kaolin	Engelhard	70060-14	4 hrs	-/-	-	-	clay
Thiodan 3 EC	endosulfan	FMC	279-2924	24 hrs	1/3	45	256	organophosphate
Thiodan 50 WP	endosulfan	FMC	279-1380	24 hrs	1/3	41	>2000	organophosphate
Vendex 50 WP	fenbutatin-oxide	Griffin	1812-413	48 hrs	1/3	>5000	>2000	-
Vydate L	oxamyl	DuPont	352-372	48 hrs	3/3	37	2960	carbamate

**PLANT GROWTH REGULATORS**

Trade Name	Common Name	Manufacturer	EPA Registration #	REI <sup>1</sup>	Runoff /Leach Potential <sup>2</sup>	Oral LD50	Dermal LD50	Class
Accel	6BA + GA4+7	Valent	73049-29	12 hrs	-/-	4900	2900	cytokinin+gibberellin
Apogee	Prohexadione-Ca	BASF	7969-188	12 hrs	-/-	>5000	>2000	gibberellin inhibitor
Amid-Thin-W	NAD	Amvac	5481-426	48 hrs	2/2	>10000	>5000	auxin
Chlorthal	ethephon	Aventis	264-267	48 hrs	1/3	>5000	>2000	ethylene releaser
Chlorthal N	NAD	Amvac	5481-427	48 hrs	2/3	>10000	>5000	auxin
Chlorthal-Salt Fruit Fix 800	NAD	Amvac	5481-413	24 hrs	2/3	>5050	>2020	auxin
Chlorthal-Salt Fruit Fix 200	NAD	Amvac	5481-414	24 hrs	2/3	>5050	>2020	auxin
Chlorthal-Gibb	gibberellic acid (GA3)	Valent	73049-15	12 hrs	-/-	>5000	>2000	gibberellin
Chlorthal-Vide	gibberellic acid	Valent	73049-3	12 hrs	-/-	2100	>2000	gibberellin
Chlorthal-romalin	6BA+GA4+7	Valent	73049-41	4 hrs	-/-	3160-4900	>2000	cytokinin+gibberellin
Chlorthal-eTain	AVG	Valent	73049-45	12 hrs	-/-	>7000	>5000	ethylene inhibitor
Chlorthal-re-Hold	NAD	Amvac	548 1-429	12 hrs	2/3	5585	>5000	auxin

**NEMATOCIDES**

Nemacur 3 S	fenamiphos	Bayer	3 125-283	48 hrs	2/1	10.6-24.8	71.5-75.7	organophosphate
Nemacur 15G	fenamiphos	Bayer	3125-236	48 hrs	2/1	10-14	>2000	organophosphate
Telone II	dichloropropene	DowAgrosciences	627 19-32	5 days	3/2	200-300	300-500	unclassified
Telone C-17	dichloropropene and chloropicrin	DowAgrosciences	62719-12	5 days	3/2	300-500	200-500	unclassified
Metam	metam-sodium	Amvac	5481-466	48 hrs	3/2	812	>2020	unclassified
Vydate L	oxamyl	DuPont	352-372	48 hrs	3/3	37	2960	carbamate

**Restricted Use Pesticide**

REI = Restricted Entry Interval, SL = See Label. Some REIs vary by crop, *always check the label.*

Runoff/leaching potential ratings are from the NRCS Field Office Technical Guide-Section II, "Water Quality and Quantity Interpretations."

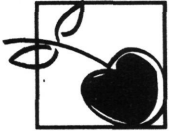
1 = large, 2 = medium, 3 = small.

OP = carbamate, FA = fatty acid, IGR = insect growth regulator, K = clay, NA = naturalyte, NM = neem extract, NI = neonicotinoids, OP = organophosphate, OX = oxadiazine, SP = synthetic pyrethroid.

# Restricted Use Pesticide Recordkeeping Form

Month/ Day/ Year	Commodity, stored product or crop	Pesticide trade name, EPA registration number	Total amount applied	Location of application	Applicator's name and certification number	Size of area treated
Notes*						
Month/ Day/ Year	Commodity, stored product or crop	Pesticide trade name, EPA registration number	Total amount applied	Location of application	Applicator's name and certification number	Size of area treated
Notes*						
Month/ Day/ Year	Commodity, stored product or crop	Pesticide trade name, EPA registration number	Total amount applied	Location of application	Applicator's name and certification number	Size of area treated
Notes*						
Month/ Day/ Year	Commodity, stored product or crop	Pesticide trade name, EPA registration number	Total amount applied	Location of application	Applicator's name and certification number	Size of area treated
Notes*						

\*Notes are optional and could include information such as wind speed and direction, weather, crop status, pest development stage and population density, soil type, equipment used, etc.



# The Fruit Crop Advisory Team Alert Newsletter

## Dependable pest management information from MSU Extension

**We send updates about growing tree and small fruit under current weather and pest conditions.**

No one knows what the weather or pest situation will be this spring and summer. The Fruit Crop Advisory Team (CAT) is structured to respond to the conditions with timely advice for growers and consultants. Members of the team are Extension field staff and campus faculty who meet weekly through conference phone calls to discuss current pest and crop conditions. Team members write newsletter articles and regional reports on crop development and pest management tactics for local conditions.

**Timing matters, so we offer prompt delivery to you by mail or Internet**

Our newsletters are written, formatted, printed and mailed within 48 hours. With Internet access, you can view the newsletter even faster -- within 8 hours of the start of production. We look at conditions in surrounding states, data on trends from past years, insects trap catches, forecasting tools and the reports of our agricultural meteorologist to predict what your pest management needs will be.

**Both immediate and long-term pest management tactics are provided**

The newsletter articles respond to current outbreaks and recommend long-term preventative actions. Our recommendations include resistance management and protecting beneficial organisms. The following subjects are covered:

- ♦ Managing insects, nematodes, and diseases on tree and small fruit
- ♦ Tree and plant health as well as orchard and vineyard management
- ♦ Pesticide regulations and registration changes including emergency registrations
- ♦ Weather conditions, growing degree days, precipitation totals, and production implications
- ♦ Insect trap catches and other scouting advice

**How to read us on the Internet**

See issues and archives of the *CAT Alert* at our IPM Web site: <http://www.msue.msu.edu/ipm/fruitCAT.htm>

The *CAT Alert* program is coordinated by the MSU IPM Program. With grant funding, we are able to offer this free Internet service and keep subscription costs down for our mail recipients.



### Subscribe for 18 issues throughout 2003

Our season begins March 2003. Most issues arrive during the growing season, but pre- and post- season issues address preventative measures and harvest or storage concerns. Send your subscription in any time during the year. We'll send back issues from the current publishing year, if you subscribe before July 1. **After July 1, the price is \$15 and does not include back issues.** Editions of the *CAT Alert* are also available for vegetables, landscape, greenhouse, and field crops.

Name \_\_\_\_\_ County \_\_\_\_\_

Company \_\_\_\_\_ Phone (\_\_\_\_) \_\_\_\_\_

Address \_\_\_\_\_ Check the edition(s) you would like to receive:

City/State \_\_\_\_\_ Fruit  Vegetable  Field Crop  Landscape

Zip Code (9-digit if available) \_\_\_\_\_ Enclose \$35 for each edition.

**The total amount you have enclosed is: \$ \_\_\_\_\_**  
 Make your check payable to: **Michigan State University**. Send your check and this form to: CAT Alerts, B18 Food Safety & Toxicology Building, Michigan State University, East Lansing, MI 48824 (Phone: 517-353-4703)



## ORDERING MATERIALS FROM THE MSU BULLETIN OFFICE

This guide, and other Michigan State University Extension resources, may be ordered by mail. A complete listing of available publications is available on the web at: <http://ceenet.msue.msu.edu/bulletin/>. An order form is printed on the back of this page. To contact the Bulletin Office by phone dial 517-355-0240.

When ordering from the Bulletin Office by mail, you will need each item's complete identification code and title and its price (if any). Please be sure

to give your complete address, including ZIP code. Using an order form will help to ensure your accuracy and to expedite the response.

Michigan residents may receive without charge single copies of up to 10 different publications priced 50 cents or less, except those identified as "for sale only." Additional copies of the same publication, requests for single publications over the first 10 titles, and all "for sale only" items can be purchased at the prices shown next to the titles.

## PAYMENT POLICIES AT THE BULLETIN OFFICE

Please do not send cash. Cash is accepted only when visiting the Bulletin Office in Room 10 Agriculture Hall.

Make checks payable to MICHIGAN STATE UNIVERSITY.

Charges against credit cards (VISA or MasterCard) must be accompanied by the full card number and expiration date and the cardholder's signature and daytime business/home phone number.

For United States residents, postage and handling charges are included in price.

Orders totaling less than \$100 must be accompanied by full payment.

Orders totaling \$100 or more can be billed by MSU.

Institutions and firms should use their official purchase orders.

**Non-Michigan residents and institutions** should check with their state's Cooperative Extension Service for items similar to those in this listing. Home state materials may have information better adapted to their needs. Out-of-state orders must include full payment, using the listed prices.



# How to submit a sample to the MSU Diagnostics Center for diagnosis

## SAMPLE SUBMISSION

Accurate diagnosis depends on the rapid receipt of fresh and representative samples along with pertinent information relating to the problem and client objectives. Diagnostic Services forms are available at the MSU Center for Integrated Plant Systems, at your local Extension office, or can be downloaded from <http://www.cips.msu.edu/diagnostics/services/form.html>.

### Plant Samples:

**Herbaceous Plants:** Send whole plants, including roots and soil. Roots and soil should be in a plastic bag to prevent soil from touching foliage. **Be sure to check out Jan's graphic guide (internet instructions) for submitting whole plants. Its packed full of handy tips that will help us get the most out of your sample.**

**Tree Decline / Wilt:** Send 6 to 12 branch sections 1/2 inch to 1 inch diameter and 8 inches long. Branches 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.

**Leaf Spot and Fruit Rot:** Send several affected samples representing the early and moderate stages of the symptom progression.

### Insects/Arthropod Samples:

Precise identification of insects or other arthropods requires specimens to be undamaged upon arrival to the laboratory. It is very important to kill and ship the specimens in a manner that will not damage the delicate structures that facilitate their identification. Peeling a squashed bug from a flyswatter or from the bottom of your shoe and putting it in an envelope for mailing is not recommended. Dried and unprotected insects are easily crumbled during mail processing. Attaching the specimen to scotch tape is not recommended. Killing and shipping specimens in a small, leak proof vial filled with rubbing alcohol is usually best.

**Moths / Butterflies:** Wing coloration is the most important characteristic in identifying these insects and precautions need to be taken to reduce the loss of the tiny scales that give moths and butterflies their distinctive wing patterns. Place them in the freezer for half an hour to kill them and then gently pack them in a small box or vial with tissue paper.

**Ants:** Specimens should only include worker ants (i.e. those without wings.) It is very difficult and in many cases, impossible to identify winged ants. Please submit these 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. Boiling helps prevent the specimens from shriveling and becoming discolored, however, this only works if the larvae are alive when dropped into boiling water.

### 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 and 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 zig-zag or w-shaped pattern. The more sub-samples (soil, cores, probes, etc.) collected, the "better" the sample.

**Soil & Plant Nutrient Samples:** Mail or deliver to A-81 Plant & Soil Science Building (PSSB) or drop off at Diagnostic Services, 101 Center for Integrated Plant Systems.

# Services and Fees for MSU Diagnostics Services

## Plant Health Analysis

Plant health analysis: visual inspection for infectious and non-infectious diseases, pathogen culturing, insect injury, pH and soluble salts	\$15.00
INSV/TSWV ELISA test	\$15.00
Bacterial identification (Biology)	\$20.00
Special laboratory analysis	Variable costs requiring client approval.

Diagnostic fees for out of state samples are double.

## Insects/Arthropods

Common Insect ID	No charge
Keyout Insect ID	\$10.00
Special identification/diagnosis	\$50.00 per hour

Diagnostic fees for out of state samples are double.

## Weeds / Plants

Common Plant ID	No charge
Keyout Plant ID	\$10.00
Herbicide Resistance in Weeds	
Standard Test	\$20.00
Extensive Test	\$30.00
Special identification/diagnosis	\$50.00 per hour

Diagnostic fees for out of state samples are double.

## Nematodes

Basic nematode analysis:	\$15.00
Total nematode community analysis:	\$50.00
Verticillium analysis	
Wet sieving	\$15.00
Dilution plating	\$10.00

## Soil & Plant Nutrient Lab Fees

Contact the Soil & Plant Nutrient Lab at: Ph. 517-355-0218  
Fax 517-355-1732

**DIAGNOSTIC SERVICES**  
 101 Center for Integrated Plant Systems  
 East Lansing, MI 48824-1311  
 Office: 517-355-4536 FAX: 517-432-0899  
 www.cips.msu.edu/diagnostics



Case No.: \_\_\_\_\_  
 Date Received: \_\_\_\_\_  
 Amount Paid: \_\_\_\_\_  
 Check/Receipt No.: \_\_\_\_\_  
 Send Bill To:  Client  County

Name (client): \_\_\_\_\_  
 Business Name: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 City/State/Zip: \_\_\_\_\_  
 Work: ( ) FAX: ( ) Home: ( )  
 Email: \_\_\_\_\_ Sample Reference: \_\_\_\_\_

**Plant Disease Diagnosis Fees**  
 Plant health analysis: \$15  
 INSV / TSWV ELISA tests: \$15  
 Bacterial ID (BIOLOG™): \$20  
**Insect / Plant Identification Fees**  
 Common ID: N/C  
 Keyout ID: \$10  
 Special ID/diagnosis (Per hour charge): \$50  
**Nematode Sample Fees** (see below)

**SEND RESULTS TO:**  CLIENT  COUNTY AGENT  KEEP RESULTS CONFIDENTIAL Fax: ( )  
 MSU Extension Agent: \_\_\_\_\_ County: \_\_\_\_\_ Email: \_\_\_\_\_

**SAMPLE TYPE** (plant type and variety, if known): \_\_\_\_\_

**GENERAL INFORMATION** (indicate all that apply)

<b>PLANT PARTS AFFECTED</b>		<b>TYPE OF PLANTING</b>		<b>PROBLEM DISTRIBUTION</b>		<b>HERBICIDE HISTORY</b>
Entire Plant	Stems	Field	Garden	Upland	Near Drive/Road	This year: _____
Leaves/Needles	Twigs/Limbs	Nursery	House Plant	Slopes	Edge of Field	_____
Roots	Trunk	Greenhouse	Pasture	Low Areas	Near a Residence	Last year: _____
Fruit	Flowers	Orchard	Natural Area	<b>OTHER BACKGROUND</b>		_____
		Turf/Lawn	City/Recreation	How long at site?		
<b>NATURE OF THE INJURY</b>		<b>PREVALENCE</b>		Height of plant?	<b>INSECTICIDE HISTORY</b>	
Poor or Abnormal Growth		Entire Planting		How many plants affected?	This year: _____	
Spots		Single Localized Area		How often watered?	_____	
Wilting	Yellowing	Several Localized Areas		How fertilized?	<b>FUNGICIDE HISTORY</b>	
Plant Death	Boring	Few Scattered Plants		Sunny or Shaded?	This year: _____	
Leaf/Needle Drop	Cupping	<b>EXTENT OF THE DAMAGE</b>			_____	
Chewing	Dieback	Light	Moderate		<b>CROP HISTORY</b>	
Rot	Galls/Cankers				Last year: _____	
<b>SOIL TYPE</b>		<b>DRAINAGE</b>			This year: _____	
Sandy	Clay	Good	Fair		Next year: _____	
Muck	Silt Loam		Poor			

**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 for root-feeding nematodes (\$15/sample)
  - Foliar nematode analysis (\$15/sample)
  - Total nematode community structure analysis (\$50/sample)
  - Verticillium dahliae* analysis
  - Dilution (\$10/sample)
  - Wet-sieving (\$15/sample)
  - Both (\$25/sample)
- No. of samples: \_\_\_\_\_  
 Sample/Field ID: \_\_\_\_\_

**USE REVERSE SIDE FOR ADDITIONAL INFORMATION REGARDING 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 February 2002



## 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 Health Diagnostic Laboratory (Toxicology) Michigan State University: **(517) 355-0281**

Phone No.

**and**

Fire Marshal Division, Michigan State Police: M - F: 8 - 12, 1 - 5 **(517) 322-1924**

**\* Telephone Number Operated 24 Hours**

### Pesticide Fire

Local fire department:

### Traffic Accident

Local police department or sheriff's department:

### 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

### Pesticide Disposal Information

Michigan Clean Sweep, Michigan Department of Agriculture Environmental Stewardship Division.

Monday - Friday: 8 a.m.-5 p.m.

**(517) 335-6529**

### 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**

## 2003 Calendar

<b>January</b>							<b>July</b>						
S	M	T	W	T	F	S	S	M	T	W	T	F	S
			1	2	3	4			1	2	3	4	5
5	6	7	8	9	10	11	6	7	8	9	10	11	12
12	13	14	15	16	17	18	13	14	15	16	17	18	19
19	20	21	22	23	24	25	20	21	22	23	24	25	26
26	27	28	29	30	31		27	28	29	30	31		
<b>February</b>							<b>August</b>						
S	M	T	W	T	F	S	S	M	T	W	T	F	S
						1						1	2
2	3	4	5	6	7	8	3	4	5	6	7	8	9
9	10	11	12	13	14	15	10	11	12	13	14	15	16
16	17	18	19	20	21	22	17	18	19	20	21	22	23
23	24	25	26	27	28		24	25	26	27	28	29	30
							31						
<b>March</b>							<b>September</b>						
S	M	T	W	T	F	S	S	M	T	W	T	F	S
						1		1	2	3	4	5	6
2	3	4	5	6	7	8	7	8	9	10	11	12	13
9	10	11	12	13	14	15	14	15	16	17	18	19	20
16	17	18	19	20	21	22	21	22	23	24	25	26	27
23	24	25	26	27	28	29	28	29	30				
30	31												
<b>April</b>							<b>October</b>						
S	M	T	W	T	F	S	S	M	T	W	T	F	F
		1	2	3	4	5				1	2	3	4
6	7	8	9	10	11	12	5	6	7	8	9	10	11
13	14	15	16	17	18	19	12	13	14	15	16	17	18
20	21	22	23	24	25	26	19	20	21	22	23	24	25
27	28	29	30				26	27	28	29	30	31	
<b>May</b>							<b>November</b>						
S	M	T	W	T	F	S	S	M	T	W	T	F	S
				1	2	3							1
4	5	6	7	8	9	10	2	3	4	5	6	7	8
11	12	13	14	15	16	17	9	10	11	12	13	14	15
18	19	20	21	22	23	24	16	17	18	19	20	21	22
25	26	27	28	29	30	31	23	24	25	26	27	28	29
							30						
<b>June</b>							<b>December</b>						
S	M	T	W	T	F	S	S	M	T	W	T	F	S
1	2	3	4	5	6	7		1	2	3	4	5	6
8	9	10	11	12	13	14	7	8	9	10	11	12	13
15	16	17	18	19	20	21	14	15	16	17	18	19	20
22	23	24	25	26	27	28	21	22	23	24	25	26	27
29	30						28	29	30	31			



**Fungicides–Bactericides**

**Insecticides–Miticides**

## **Tree Fruit**

**Apples**

**Pears**

**Peaches–Nectarines**

**Prunes–Plums**

**Red Tart Cherries**

**Sweet Cherries**

## **Small Fruit**

**Grapes**

**Strawberries**

**Brambles**

**Blueberries**

## **Growth Regulators**

**Herbicides**

**Weed Control**

**Nematicides**

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