



# 2005 Crop Protection Guide for Tree Fruits in Washington



## Important Phone Numbers

|  |   |                       |
|--|---|-----------------------|
| <b>Poison Emergency</b>                      | National Poison Control Center                                | 1-800-222-1222        |
| <b>Toxic/Hazardous Waste Spills</b>          | Washington State Patrol                                       | 911                   |
| <b>WSU Extension, Tree Fruits</b>            | North Central Washington (Tim Smith)                          | 509-667-6540          |
|  | Columbia Basin (Karen Lewis)                                  | 509-754-2011 ext. 413 |
|  | Northeastern Washington (Tonie Fitzgerald)                    | 509-477-2164          |
|  | Yakima (Dana Faubion, Mike Bush)                              | 509-574-1600          |
|  | South Central Washington (Jack Watson)                        | 509-786-5609          |
|  | Tree Fruit Research & Extension Center—Wenatchee              | 509-663-8181          |
|  | WSU Irrigated Agriculture Research & Extension Center—Prosser | 509-786-2226          |
| <b>Pesticide Safety</b>                      | WSDA Pesticide Management Division, Olympia                   | 1-877-301-4555        |
|  | WSDA pesticide licensing and recertification                  | 360-902-2020          |
|  | WSDA pesticide product registration                           | 360-902-2030          |
|  | WSDA application accidents and compliance (Olympia)           | 360-902-2040          |
|  | WSDA, Pesticide Management Division, Yakima                   | 509-225-2647          |
|  | WSDA, Pesticide Management Division, Spokane                  | 509-533-2690          |
|  | WSDA, Pesticide Management Division, Wenatchee                | 509-664-9616          |
|  | WSDA, Pesticide Management Division, Moses Lake               | 509-766-2575          |
|  | Washington State Dept. of Health                              | 1-888-586-9427        |
|  | Washington Public Health Laboratory                           | 206-361-2898          |
| <b>Pesticide Disposal</b>                    | WSDA Pesticide Disposal Program                               | 360-902-2056          |
| <b>Pesticide Container Disposal</b>          | Northwest Ag Plastics Inc.<br>(container recycling)           | 509-956-6809          |
| <b>Worker Protection Standards</b>           | Department of Labor and Industries                            | 1-800-547-8367        |
| <b>Horticultural Pest and Disease Boards</b> | Adams County  | 509-488-2862          |
|  | Benton County   | 509-786-5609          |
|  | Franklin County   | 509-545-3580          |
|  | Chelan-Douglas Counties                                       | 509-667-6677          |
|  | Grant County  | 509-754-2011 ext. 411 |
|  | Kittitas County   | 509-962-7507          |
|  | Klickitat County  | 509-773-5817          |
|  | Okanogan County   | 509-32 2-1286         |
|  | Skagit County   | 360-428-4270          |
|  | Walla Walla County  | 509-527-3206          |
|  | Whatcom County  | 360-398-9187          |
|  | Yakima County   | 509-225-2609          |
| <b>Bee Registration</b>                      | Olympia   | 360-902-2070          |

**STOP**

This guide replaces earlier editions. Do not use after 2005.

**POISON EMERGENCY**

**National: 1-800-222-1222**

For further information, see Pesticide Safety.  
 Natl. Animal Poison Control Center 1-800-548-2423

**Pesticide Labels**

YOU ARE REQUIRED BY LAW TO FOLLOW THE LABEL. It is a legal document. Always read the label before using any pesticide. You, the grower, are responsible for safe pesticide use.

**Trade Names**

Trade (brand) names are provided for your reference only. No discrimination is intended, and other pesticides labeled for the crop having the same active ingredient may be suitable. No endorsement is implied.

**Pesticide Information**

National Pesticide Information Center  
 1-800-858-7378, 6:30 a.m. to 4:30 p.m. Pacific Time  
 EXTOWNET (EXTension TOXicology NETwork)  
<http://npic.orst.edu>  
 Washington State Department of Agriculture, Olympia,  
 Washington 1-877-301-4555.  
<http://agr.wa.gov/PestFert/Pesticides>  
 WSU's Washington State Pest Management Resource  
 Service (WSPRS) <http://wsprs.wsu.edu>

|  |   |  |
|--|---|--|
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|--|---|--|

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If you have questions about the content of this guide, please consult your area extension agent.

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**Cover photos clockwise from top left: pear flower, Fuji apples, fire blight on apples, cherry fruit fly, Golden Delicious apples, codling moth trap, and sweet cherries.**

## Tree Fruit Information on the Internet

**WSU Wenatchee Tree Fruit Research  
& Extension Center**  
www.tfrec.wsu.edu

**WSU Extension  
North Central Washington**  
www.ncw.wsu.edu/treefruit/index.html

**WSU Extension  
Yakima County**  
treefruit.yakima.wsu.edu

**WSU Tree Fruit Team**  
fruit.wsu.edu

**WSU Grant-Adams Extension**  
grant-adams.wsu.edu/agriculture/index.htm

**WSU Postharvest**  
postharvest.tfrec.wsu.edu

**WSU-Prosser**  
www.prosser.wsu.edu

**Caution:** The law requires that pesticides be used as the label directs. Uses against pests not named on the label and low application rates are permissible exceptions. Where a disparity exists between the rate suggested per 100 gallons and the rate per acre, do not exceed the rate listed on the label. If a conflict is apparent between label directions and the uses suggested in this publication, consult your extension agent.

New pesticide registrations and special labels often are made available after publication.

This guide could not have been prepared without the valuable contributions of numerous faculty in the departments of entomology, plant pathology, and horticulture and landscape architecture, tree fruit extension agents, WSDA and USDA personnel, and industry representatives.

**Remember to order your 2006 Crop Protection Guide for Tree Fruit in Washington in February 2006.** The next printed edition will be due out about February 15. We will post the latest edition on our web page as soon as all changes have been entered.

You are welcome to visit our College of Agriculture and Home Economics Information Department Web site anytime, and click on publications at <http://pubs.wsu.edu> **Happy browsing!**

Please contact the Cooperative Extension Bulletin office or your county office for order information. Most county offices in tree fruit growing areas carry this bulletin.

Bulletins: Phone: 1-800-723-1763  
Email: [bulletin@wsu.edu](mailto:bulletin@wsu.edu)

Bulletin Office  
Washington State University  
P.O. Box 645912  
Pullman, WA 99164-5912

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# CROP PROTECTION GUIDE FOR TREE FRUITS IN WASHINGTON

## NEW DEVELOPMENTS

### Spray Buffer Zones

In 2003, a lawsuit resulted in a significant increase in the number of pesticides that may not be applied near waterways that may support endangered fish species. Many of the restricted material issues have been resolved, but several tree fruit materials remain on this special list. These restrictions are not described on the product label. Until the specific “buffer zones” are negotiated for each pesticide product, there is a temporary 60 foot (ground applied) or 300 foot (aircraft applied) “buffer zone” near specific waterways where the listed products may not be applied. The specific products affected by this ruling, and the allowable spray buffer distances of many other products are changing rapidly. A list of tree fruit pesticides with special restrictions when applied near water may be found at the WSDA web site: <http://agr.wa.gov/PestFert/Pesticides/docs/OrchardUseRestrAsst.pdf>. Look for links for updated information on this subject starting on the WSDA web site: [www.wa.gov/agr/](http://www.wa.gov/agr/).

### Personal Protective Equipment

The labels of various pesticide products have relatively new emphasis on the type of protective equipment that must be worn by anyone applying or mixing that product. While employee safety has been especially emphasized, the orchard owner must understand that these protective equipment requirements apply equally to everyone, including the owner/operator. Use of a product without following label directions about personal protective equipment is considered a misuse of the pesticide, and is subject to action by regulatory agencies. Certain PPE must be worn when entering the orchard soon after spray application. Refer to the label for these restricted entry intervals and for PPE requirements. Often, these requirements depend on who is entering the orchard and what type of work duty they have there.

### Carzol Use

Check to find out whether a Special Local Needs label exists for Carzol use on pears (for control of pear rust mite) and apple (for sucking bugs) after petal fall using the Pesticide Notification Network web site (<http://ext.wsu.edu/pnn/user/searchTables.php>), or call your local county extension office.

## PESTICIDE SAFETY

The Pesticide Management Division of the Washington State Department of Agriculture (WSDA) is responsible for ensuring that pesticides are used safely and legally. To accomplish this responsibility, WSDA performs a number of activities including

registering the pesticidal products in the state, licensing of pesticide users, consultants and dealers, investigating complaints of possible misuse, maintaining a registry of pesticide sensitive individuals, and administering a waste pesticide collection program. These duties are performed under the authority of the Washington Pesticide Control Act (15.58 RCW), the Washington Pesticide Application Act (17.21 RCW), the General Pesticide Rules (WAC 16-228), the Worker Protection Standard (WAC 16-233) and a number of pesticide- or county-specific regulations.

The Washington State Department of Agriculture, Pesticide Management Division now has five offices in Washington. Complete state laws and regulations are available on the internet at <http://www.wa.gov/agr/> or can be obtained from one of the locations below:

WSDA Pesticide Management Division —Olympia  
1111 Washington Street S.E.  
P.O. Box 42560  
Olympia, WA 98504-2560  
fax 360-902-2092

WSDA Pesticide Management Division —Spokane Branch  
222 North Havana, Suite 203  
Spokane, WA 99204  
fax 509-533-2621

WSDA Pesticide Management Division—Moses Lake Branch  
821 E. Broadway, Suite 4  
Moses Lake, WA 98837  
fax 509-766-2576

WSDA Pesticide Management Division —Wenatchee Branch  
1505 North Miller Street, Suite 140  
Wenatchee, WA 98801-1569  
fax 509-664-3170

WSDA Pesticide Management Division—Yakima Branch  
21 North 1st Avenue, Suite 236  
Yakima, WA 98902  
Fax 509-575-2210

### Symptoms of Pesticide Poisoning

*Organophosphorus pesticides.* The first sign of poisoning is one or more of the following symptoms: giddiness, headache, nausea, vomiting, excessive sweating, and tightness of the chest. These symptoms may be followed or accompanied by blurring of vision, diarrhea, excessive salivation, watering of the eyes, twitching of eyelids and other muscles, and mental confusion. One of the most typical signs is narrowing of the pupils, after an initial widening. Late signs are fluid in the chest, convulsions, unconsciousness, loss of urinary or bowel control, and respiratory failure. Symptoms start within 12 hours of the last exposure to the pesticide.

*Carbamate pesticides.* Cause symptoms similar to organophosphorus poisoning.

*Chlorinated organic pesticides.* Poisoning causes hyperexcitability, tremors, and convulsions. General symptoms, which may also indicate other illnesses, include malaise, headache, fatigue, lack of appetite, and weight loss. Symptoms start as soon as 30 minutes after massive exposure, but generally develop more slowly. Maximum symptoms usually occur within a few hours after heavy exposure.

*Other:* There are many new classes of pesticides. Read the label and MSDS for specific hazards, symptoms, and first aid.

## What To Do for Poisoning

1. If breathing stops, artificial respiration is the most important first aid.
2. Call a physician or a poison control center immediately for instructions on first-aid measures. Get the victim to the physician or a hospital as soon as possible. If you know which pesticide may be involved, take the container along so the doctor can read the label. If this is not practical, remove the label and take it with you.
3. Decontamination is extremely important. If the pesticide has come in contact with skin or clothing, immediately remove contaminated clothing and bathe the area with generous amounts of detergent and water, rinsing thoroughly. Those who give first aid should avoid direct contact with contaminated clothing and body areas. Use protective clothing such as rubber gloves and rubber aprons.
4. If the eyes have been contaminated, hold the eyelids open and flush with a gentle stream of water for at least 15 minutes.
5. Never try to give anything by mouth to an unconscious person.

## Where To Report Pesticide Accidents

Report accidents promptly to the appropriate state agency. The agency will investigate the problem and take immediate steps to reduce harmful effects, determine causes and responsibilities, and prevent recurrence.

*Human poisonings.* As soon as the victim is under a physician's care, caregivers should inform the Washington State Dept. of Health, Pesticide Section, P.O. Box 47825, Olympia, WA 98504, phone 1-877-539-4344. Reports from growers, while not required, are helpful.

*Application accidents.* In the event of misuse of a pesticide (i.e., drift problems, animal poisoning, plant damage, fish kill), notify the Washington State Department of Agriculture at any of the numbers located inside the front cover of this bulletin. When you speak with an individual, please be prepared to provide as much information as possible concerning the incident. It is also advised that you prepare a written statement concerning the incident as soon as possible. Staff will arrange a meeting with you as soon as possible. If your call is an emergency, please call the Olympia office. For more on how WSDA will respond to your complaint please review the Pesticide Investigation and Enforcement Brochure, available in English or Spanish at <http://www.wa.gov/agr/>.

*Storage or transportation accidents.* In the event of significant pesticide contamination due to leaks spills, floods, fires, and the like, notify the Department of Ecology at regional numbers under Pesticide Disposal.

## Transportation of Hazardous Materials

For information on regulations concerning transportation of hazardous materials, contact John Nicholas (360-753-0281), Washington State Patrol, P.O. Box 42614, Olympia, WA 98504-2614.

## Posting Displays and Notification Requirements

The federal Worker Protection Standard requires the following:

1. A Central Posting Display that includes: product name, active ingredient, EPA registration number, Restricted Entry Interval, time and date of application, area treated, and a safety poster and emergency medical information. This information must remain posted for 30 days.
2. Workers and handlers receive application notification as required on the specific product label. The label requirements determine if notification is to be oral, by posting the "warning—do not enter sign," or both. Most, but not all, agrichemical products used in tree fruit production do not require the posting of "warning—do not enter" signs. If the required timing of posting the sign is difficult for your operation to follow, then use these signs only when required by the label.
3. If "warning—do not enter" signs are required, they must not be displayed longer than 24 hours before application and must be removed or covered within 3 days after the end of the restricted entry interval.

For further information on WPS posting and notification requirements, contact WSDA or Department of Labor and Industries.

## Pesticide Toxicity and Cholinesterase Testing Information

For nonemergency information on pesticide toxicity, hazards, and treatment for poisonings refer to the pesticide product Material Safety Data Sheets (MSDS). For additional toxicology information contact the Washington State Department of Health, Office of Environmental Health, P.O. Box 47825, Olympia WA 98504, 1-888-586-9427 or Dr. Allan Felsot, WSU Tri-Cities, Food and Environmental Quality Laboratory, 509-372-7365 or the National Pesticide Information Center. (EXTOXNET [EXTension TOXicology NETwork] at <http://ace.orst.edu/info/extoxnet/>). For information on testing for human exposure to pesticides, contact the Washington Department of Health at 1-888-586-9427. For information on cholinesterase testing and monitoring, contact Labor and Industries Safety and Health Assessment and Research Program at 1-800-423-7233. Laboratory services for cholinesterase tests may be obtained from Washington Public Health Laboratories, 1610 N.E. 150th St. Shoreline, WA 98155. Contact Harold Ruark at 206-361-2800.

## Restricted Entry Intervals (REI) and Preharvest Interval Standards (PHI)

The restricted entry intervals (REI) and preharvest intervals (PHI) for a given material are listed on the product label. These restrictions change frequently and growers are advised to know the latest information concerning label requirements and restrictions before selecting and applying a product.

1. The same or similar products produced by different manufacturers may not have the same label requirements and restrictions.
2. Restricted entry intervals (REI's) and preharvest intervals (PHI's) are often the same within toxicity categories; however, some pesticides have product-specific intervals, higher or lower than products within a category.
3. Different uses or rates of the same product may have different intervals.
4. The REI of a product supercedes the PHI of a product. Example: if the REI of a product is 72 hours and the PHI is 48 hours, you must restrict entry prior to harvest for 72 hours after application.
5. When tank mixing products, the most restrictive reentry interval applies.

## Pesticide Licensing & Education

WSDA's Certification & Training section provides certification and continuing education for pesticide applicators, dealers and consultants. Pesticide Licensing can be reached by email at [license@agr.wa.gov](mailto:license@agr.wa.gov) or toll-free by telephone at 877-301-4555. For further information on WSDA's Farmworker Education Program call 360-902-2015. WSDA also conducts pre-license training in Spanish through its Farmworker Education Program. For further information on the Spanish language pre-license classes, you may call 360-902-2015, or call WSU Extension at 509-860-2283.

## Enclosed Cab

The Washington State Department of Agriculture has implemented an enclosed cab policy which allows a person to make pesticide applications without the label required personal protective equipment (PPE).

The policy allows two types of cab to be used in lieu of PPE: Type 1, which can be used in lieu of PPE including respirators and Type 2, which can be used in lieu of PPE such as boots, gloves and rainsuits.

Both types of cab must meet certain standards specified in the policy. Additional requirements apply for exiting and reentering a cab in a treated area. Enclosed cabs must meet Department of Labor and Industry requirements (L & I: 1-800-547-8367).

For a copy of the policy or additional information, contact the Washington State Department of Agriculture.

## Precautions in Using and Storing Pesticides

1. Read and follow label instructions when using and storing any pesticides.
2. All pesticides must be stored in a secure, locked, and labeled facility.
3. Take all reasonable measures to prevent unauthorized entry or theft of pesticides and fertilizers.

## Pesticide Disposal

The Washington State Department of Agriculture (WSDA) Waste Pesticide Program collects and disposes of unusable pesticides owned by pesticide users. The operation of this program depends on state funding. Participants are not charged a disposal fee. Several collections are held throughout the state each year.

Information on this pesticide disposal program and a schedule of pesticide collection dates can be obtained by contacting the WSDA by phone at 360-902-2056 or call toll-free at 1-877-301-4555. The information can also be found by emailing [WastePesticide@agr.wa.gov](mailto:WastePesticide@agr.wa.gov) or on the Internet at the WSU Extension Pesticide Education Program at <http://pep.wsu.edu/waste/wd.html>.

## Pesticide Container Disposal

Northwest Ag Plastics, Inc. operates the Agricultural Container Recycling Council (ACRC) plastic recycling program in Washington, Oregon and Idaho. The Washington state program was initiated by the Washington Pest Consultants Association (WaPCA) in 1992. This program recycles plastic containers that held pesticides, micro-nutrients, adjuvants and cleaners. Container recycling is provided at no charge and is supported by the major chemical manufacturers. Triple rinse or pressure rinse empty pesticide containers. Follow any label directions for proper rinsing of particular products. Container collection events are held at several locations around the state. For more information on this pesticide container disposal program and a schedule of collection events contact Steve George at 509-457-3850, Clark Brown at 509-956-6809. You may also visit the Northwest Ag Plastics, Inc. website at <http://www.nwagplastics.com/> or the WSU Extension Pesticide Education program at <http://pep.wsu.edu/waste/wd.html>.

## Pesticide Labels

**The label is a legal document. The user is required by law to use the pesticide in a manner consistent with label directions.** If, for any reason, rates given in this Crop Protection Guide are not consistent with the label, you are still legally bound by label restrictions. There are some exceptions to this under current EPA definitions: It is LEGAL to apply pesticides 1) more dilute than on the label; 2) at a lower rate than on the label; 3) less frequently than on the label; and 4) for pests not on the label, as long as the crop is on the label, and other restrictions are observed.

## Acute Toxicity Category Chart for Tree Fruit Pesticides

Note: Substantial changes in pesticide labeling requirements are now in effect for pesticides distributed since 1996. These changes include restricted entry intervals (REIs). In general, Toxicity category I chemicals require a 48-hour REI (72 hours for organophosphates used in areas with less than 25 inches of annual precipitation). Toxicity category II chemicals, in general, require a 24-hour REI, and Toxicity categories III and IV require a 12-hour REI. Product-specific reentry requirements will be set by the chemical manufacturer. **Read all labels carefully to determine the right reentry period for the product you are using.**

| FUNGICIDES AND BACTERICIDES |                     |                                | INSECTICIDES AND MITICIDES    |                     |                                |
|-----------------------------|---------------------|--------------------------------|-------------------------------|---------------------|--------------------------------|
| Common name                 | Trade name          | Toxicity Category <sup>1</sup> | Common name                   | Trade name          | Toxicity Category <sup>1</sup> |
| copper sulfate              | Several trade names | I                              | azinphos methyl               | Guthion             | I                              |
| dodine                      | Syllit              | I                              | endosulfan                    | Thiodan             | I                              |
| lime sulfur                 | Orthorix            | I                              | formetanate hydrochloride     | Carzol              | I                              |
| copper, other forms         | Kocide, Nu-Cop      | III                            | methidathion                  | Supracide           | I                              |
| fenarimol                   | Rubigan             | III                            | methomyl                      | Lannate             | I                              |
| myclobutanil                | Rally               | III                            | oxamyl <sup>2</sup>           | Vydate <sup>2</sup> | I                              |
| ziram                       | Ziram               | III                            | pyridaben                     | Pyramite            | I                              |
| propiconazole               | Orbit               | III                            | abamectin                     | Agri-Mek            | II                             |
| thiram                      | Thiram              | III                            | chlorpyrifos                  | Lorsban             | II                             |
| triflumizole                | Procure             | III                            | dimethoate                    | Dimethoate          | II                             |
| azoxystrobin                | Abound              | IV                             | esfenvalerate                 | Asana               | II                             |
| captan                      | Captan              | IV                             | fenpropathrin                 | Danitol             | II                             |
| chlorothalonil              | Bravo               | IV                             | fenpyroximate                 | FujiMite            | II                             |
| iprodione                   | Rovral              | IV                             | lambda-cyhalothrin            | Warrior             | II                             |
| kresoxim-methyl             | Sovran              | IV                             | permethrin                    | Ambush              | II                             |
| potassium bicarbonate       | Several trade names | IV                             | phosmet                       | Imidan              | II                             |
| pyraclostrobin              | Cabrio              | IV                             | thiacloprid                   | Calypso             | II                             |
| pyraclostrobin-boscalid     | Pristine            | IV                             | amitraz                       | Mitac               | III                            |
| quinoxifen                  | Quintec             | IV                             | carbaryl                      | Sevin               | III                            |
| streptomycin                | Agri-mycin          | IV                             | clofentezine                  | Apollo              | III                            |
| trifloxystrobin             | Flint               | IV                             | diazinon                      | Diazinon            | III                            |
|                             |                     |                                | fenbutatin-oxide              | Vendex              | III                            |
|                             |                     |                                | hexythiazox                   | Savey               | III                            |
|                             |                     |                                | imidacloprid                  | Provado             | III                            |
|                             |                     |                                | indoxacarb                    | Avaunt              | III                            |
|                             |                     |                                | malathion                     | Malathion           | III                            |
|                             |                     |                                | permethrin                    | Pounce, Ambush      | III                            |
|                             |                     |                                | acetamiprid                   | Assail              | IV                             |
|                             |                     |                                | azadirachtin                  | Several trade names | IV                             |
|                             |                     |                                | <i>Bacillus thuringiensis</i> | Several trade names | IV                             |
|                             |                     |                                | bifenazate                    | Acramite            | IV                             |
|                             |                     |                                | etoxazole                     | Zeal                | IV                             |
|                             |                     |                                | kaolin                        | Surround            | IV                             |
|                             |                     |                                | methoxyfenozide               | Intrepid            | IV                             |
|                             |                     |                                | pyriproxyfen                  | Esteem              | IV                             |
|                             |                     |                                | spinosad                      | Success, Entrust    | IV                             |
|                             |                     |                                | tebufenozide                  | Confirm             | IV                             |
|                             |                     |                                | thiamethoxam                  | Actara              | IV                             |

| HERBICIDES            |                         |                                |
|-----------------------|-------------------------|--------------------------------|
| Common name           | Trade name              | Toxicity Category <sup>1</sup> |
| paraquat              | Gramoxone               | I                              |
| 2,4-D                 | Several trade names     | I                              |
| sethoxydim            | Poast                   | II                             |
| glyphosate            | Roundup, several others | III                            |
| dichlobenil           | Casoron                 | III                            |
| diuron <sup>2</sup>   | Karmex <sup>2</sup>     | III                            |
| flumioxazin           | Chateau                 | III                            |
| napropamide           | Devrinol                | III                            |
| pendimethalin         | Prowl                   | III                            |
| isoxaben              | Gallery                 | III                            |
| fluazifop             | Fusilade                | IV                             |
| norflurazon           | Solicam                 | IV                             |
| oryzalin              | Surflan                 | IV                             |
| simazine <sup>2</sup> | Princep <sup>2</sup>    | IV                             |
| terbacil              | Sinbar                  | IV                             |

<sup>1</sup>Chemicals are placed in acute toxicity categories based on the composite results of inhalation, dermal absorption, eye effect and skin irritation tests. Category I materials are the most toxic, Category IV materials are the least toxic. (Source 40 CFR Ch. 1. 156.10)

<sup>2</sup>These chemicals are restricted use pesticides for the protection of groundwater. They may only be used by certified applicators or persons under their direct supervision.

It is ILLEGAL to apply pesticides 1) using less diluent (water), than on the label (increased concentration); 2) at a higher rate per acre than on the label; 3) shortening the specified interval between applications; and 4) shortening the preharvest interval (minimum number of days between the last application and crop harvest).

## Pesticide Residues on Fruit

Residues of pesticides are permitted on harvested crops only when a tolerance or exemption exists, or when they do not exceed tolerances established by the Environmental Protection Agency.

Growers are also advised to check with their buyers, processors, or packers before applying chemicals. In some cases, buyers and processors will not accept fruit treated with certain materials, **even though these materials are approved for use by federal and state agencies.**

To avoid illegal residues, it is imperative that directions be followed carefully with respect to rates of application, number of applications, and intervals between application and harvest. Avoid drift, especially where other crops are adjacent to or interplanted with the crop being treated. Pesticide residues that are permitted on one crop may be illegal when present on another.

Do not feed cull fruit or the by-products of fruit processing, such as apple and pear pomace, to livestock unless specifically permitted by the label. The use of many of the pesticides recommended in this bulletin are prohibited from use as a feed for livestock.

## Restricted Use Pesticides

*State regulations* restrict the use of a number of pesticides to certified applicators or to persons under the direct supervision of certified applicators. State restricted use pesticides which are likely to be used in orchards include oxamyl (Vydate); simazine, diuron (Karmex) and 2,4-D (all liquid formulations in packages larger than 1 gallon to be used in eastern Washington). The state of Washington has declared certain pesticides restricted for the protection of groundwater; they are footnoted in the Acute Toxicity Category Chart. For a complete list refer to WAC 16-228-1231 of WSDA's General Pesticide Rules and all 24(c), or Section 18 special label products.

*Federal regulations* also restrict the use of a number of pesticides to certified applicators or to persons under their direct supervision. The restricted use designation appears on the product label.

It is illegal to sell or deliver any restricted use pesticide to a person unless that person is a certified pesticide applicator.

## Horticultural Pest and Disease Boards

Washington counties may establish Horticultural Pest and Disease Boards to more effectively control and prevent the spread of horticultural pests and diseases. At the present time, such boards are located in all of the major fruit-growing counties of Washington.

The purpose of the boards is to prevent spread of new or persistent pests or disease from neglected or abandoned orchards. Pests most often listed are apple maggot, San Jose scale, codling moth, cherry fruit fly, and fire blight. Others may be selected in a few areas. The existence of outside sources of infestation of these pests can be a serious obstacle to pest management in commercial orchards.

The boards have the authority to require owners of neglected fruit trees to effectively control these pests. However, before action can be taken, one or more affected growers must submit a signed complaint. Complaint forms are available at most Extension or horticultural inspection service offices.

Horticultural Pest and Disease Board telephone numbers are listed on the inside front cover of this bulletin.

## Tank Mixes

Two or more pesticides may be mixed in the spray tank provided mixing is not prohibited on any of the labels. The dosage rates, timing, and other use directions must conform to those on the label for each product. If there are no directions for mixing on any of the labels, the user may be liable for problems associated with the mixture, such as crop injury or nonperformance. The safety of any specific tank mix may depend on fruit variety, growth stage, the weather, and spray solution concentration. The higher the number of products in the mix, the less predictable the effect.

## GENERAL RECOMMENDATIONS

1. Use of the Pest Control Program tables: Materials listed in the tables are not listed in order of preference. The listing of a pesticide or pesticides in the tables against a target pest at a given tree stage or timing does not imply that the application should automatically be made. On the contrary, the need to make an application should always be determined through sampling or monitoring the pest in question (see Pest Management below). Many pesticides have restrictions on the number of applications per season, the total pounds of active ingredient per season, or the interval between sprays. Multiple listings of a pesticide in the table do not imply that the pesticide may legally be used that number of times. **Always check the label to determine the use restrictions.** The Remarks column contains pertinent information regarding the proper use of one or more of the pesticides listed against that pest; however, no attempt has been made to list *all* of the restrictions on the label. In general, the preharvest interval is not listed until after petal fall period under the assumption that the PHI will not be a concern until after this time. Extremely long PHIs or short season crops may be exceptions. The rates given in the tables per 100 gallons are based on dilute sprays, usually 400 gallons per acre. Some are adjusted upwards or downwards from this figure, based on research information or restrictions placed on the product label. Check the label carefully to

determine the amount of active ingredients of insecticides, fungicides or growth regulators per acre when you apply spray as concentrates or semi-concentrates. There are some exceptions, however, particularly in the area of growth regulators and spray oils. Always read the label carefully for exceptions.

2. Proper pruning and spacing of trees is an aid in the control of many insects and diseases.
3. Both proper timing of sprays and thorough coverage are essential for good control. Orchard operations differ with regard to equipment, spacing and size of trees, local weather conditions, and particular pest problems. The timing, concentration, and gallonage of spray per acre should vary accordingly.
4. Due to the differences between districts, orchards, and even parts of the same orchard, a detailed spray program should be worked out for your orchard.
5. Heavy, brief showers (0.3 inch in 15-30 minutes, for example) or lighter rain for a longer period (0.75 inch or more in 24 hours) or overtree irrigation or fruit cooling will remove pesticides from fruit and foliage surfaces. To protect crops from pests that require control over an extended period, such as codling moth and cherry fruit fly, it may be necessary to reapply a pesticide to maintain coverage. If you wish to reapply the same product, check the between-spray interval allowed on the label.

## Pest Management

The goal of pest management is the regulation of damage caused by pests, taking into account both costs and benefits of control procedures. Pest management must be compatible with current production practices and short-term profitability, but it strives to develop strategies which lead to long-term, stable and cost-effective management programs. The potential benefits include reduced chances of pest resurgence, slower development of resistance to pesticides, lower pesticide application costs, and reduced environmental contamination. The costs include management time, monitoring, and possibly more expensive control procedures.

To implement pest management practices in an orchard system:

- become familiar with insect biology and pest management principles,
- plan a seasonal and long-term strategy,
- monitor pest populations and use control procedures based on economic injury levels, and
- keep records and use them to refine the following season's strategy.

## Formulations

*Wettable powders (WP)* are dry forms of pesticides. The toxicant is mixed with special powders; wetting agents are added to make the mixture blend readily with water. Wettable powders form a suspension-type spray which must be kept agitated in the spray tank. This type of formulation is often recommended for

use in tree fruits because it is less likely to cause fruit and foliage injury.

*Liquid concentrates (L or LC)* are formulations containing toxicants which are water soluble. No emulsifying agents or organic solvents are required.

Note—The designations L and LC are sometimes used by formulators to indicate emulsifiable concentrates.

*Emulsifiable concentrates (EC)* contain a pesticide and an emulsifying agent in a suitable solvent. These materials are diluted with water and applied as sprays. They leave much less visible residue than WP formulations, but are much more likely to injure fruit and foliage.

*Spray concentrates (SC)* are liquids containing a high percentage of active ingredient. May be diluted.

*Dry flowable (DF)* or *Water dispersible granules (WDG)* formulations are similar to wettable powders except that the powders (clay particles) are formed into tiny spheres. They do not tend to pack together so they “flow” easily from the product container.

*Flowable (F)* formulations are a liquid or viscous concentrate of suspendible pesticide in water. They usually cause less injury to fruit and foliage than EC formulations and generally, but not always, are as safe as WP formulations.

*Soluble powders (SP or S)* are powder formulations that dissolve in water. A few pesticides and many fertilizers are prepared as soluble powders.

*Dusts (D)* are usually made by mixing the chemical toxicant with finely ground talc, clay, or dried plant materials. Because of extreme drift hazards, dusts are now seldom used in orchards.

*Granules (G)* are formed by saturating an inert carrier with pesticide. The particles are 30 to 60 mesh size. Granules are usually used for soil- or water-dwelling pests.

*Controlled release (CR)* are capsules or beads of timed release pesticides.

*Baits* consist of a poison plus a substance which will attract the pest. In orchards, they are used only in cover crops and around tree trunks. They are less hazardous to the general environment than many sprays and dusts. Birds and other animals, however, do feed occasionally on baits and may die if they eat large amounts.

## Spray Adjuvants

Several different types of materials are available that may help or improve the effectiveness of spray applications. Known as adjuvants, they act differently and have different uses. A given product may provide more than one function but usually the primary use is specified on the label.

Take caution in using these adjuvants, particularly with EC formulations. Improper selection or use can result in either injury or reduced effectiveness.

*Activator* is a material which increases the effect of the chemical by increasing the penetration of the spray solution through the hairs and waxy cuticle and into the leaf or fruit.

*Acidifier* lowers the pH of alkaline spray water to reduce the potential breakdown of certain pesticides in the spray tank. Not

## Dilutions For Wettable Powder and Liquid Products

| Type of Material | Quantities of Material For Indicated Quantities of Water <sup>1</sup> |                |                |                 |
|------------------|---|----------------|----------------|-----------------|
|                  | 100 Gallons   | 5 Gallons      | 3 Gallons      | 1 Gallon        |
| Wettable Powder  | 5 pounds  | 4 ounces       | 2.40 ounces    | 0.80 ounces     |
|                  | 4 pounds  | 3.2 ounces     | 1.92 ounces    | 0.64 ounces     |
|                  | 3 pounds  | 2.4 ounces     | 1.44 ounces    | 0.48 ounces     |
|                  | 2 pounds  | 1.6 ounces     | 0.96 ounces    | 0.32 ounces     |
|                  | 1 pound   | 0.8 ounces     | 0.48 ounces    | 0.16 ounces     |
|                  | .75 pound   | 0.6 ounces     | 0.35 ounces    | 0.12 ounces     |
|                  | 0.5 pound   | 0.4 ounces     | 0.24 ounces    | 0.08 ounces     |
| Liquid Products  | 3 gallons   | 1 pint, 3 oz   | 11.5 ounces    | 7.5 tablespoons |
|                  | 2 gallons   | 13 ounces      | 7.5 ounces     | 5 tablespoons   |
|                  | 1 gallon  | 6.5 ounces     | 4 ounces       | 2.5 tablespoons |
|                  | 1 quart   | 9.5 teaspoons  | 5.5 teaspoons  | 2 teaspoons     |
|                  | 1 pint  | 4.75 teaspoons | 2.75 teaspoons | 1 teaspoon      |
|                  | 8 ounces  | 2.5 teaspoons  | 1.5 teaspoons  | 0.5 teaspoon    |
|                  | 4 ounces  | 1.25 teaspoons | 0.75 teaspoon  | 0.25 teaspoon   |

<sup>1</sup>The weight per volume of dry formulated products varies. To ensure accurate dilutions, measure these products by weight only. NOTE: 1 fluid ounce = 29.6 milliliters. 1 ounce weight = 28.3 grams. 1 teaspoon = 5 milliliters. 1 fluid ounce = 29.6 milliliters.

necessary unless spray solution has a pH of over 7. The amount of acidifier necessary to lower the pH to the desired level depends on the pH of your water source. Follow label recommendations carefully.

**Buffer** Some pesticides break down rapidly at a solution pH of over 7. A buffer is a material that lowers the pH and maintains it at a certain level of acidity. Check the pH of your spray water source periodically, as it may change during the season. Add a buffer if the water source has a pH over 7.0 and the product label indicates sensitivity to alkaline (high pH) solutions.

**De-Foamer** when added in the spray tank, breaks down or prevents the formation of foam.

**Elasticizer or Drift control agent** reduces the break-up of spray into very fine particles which cause extended drift.

**Surfactant, Spreader, wetting agent** are different names for products which reduce the surface tension around a spray droplet, allowing it to spread out more evenly on the surface of the leaf or fruit. CAUTION: some surfactants used in combination with certain pesticides can function as an activator, causing injury. This can be a problem on several types of fruit trees and is particularly a problem on Anjou pears. Consult the label or chemical supplier for more information.

**Sticker** causes the spray chemical to stick to the surface after the spray dries, thereby reducing the potential for loss from rain or overhead irrigation.

**Spreader-sticker** is a term commonly misused when referring to a surfactant or spreader. A true spreader-sticker combines the characteristics of a surfactant with that of a sticker.

### Spray Gallonages

Definitions for spray volumes vary throughout the United States. Extension entomologists in the western states have agreed on the following definitions for orchard spraying: *Dilute*

(*High-Volume Spray*)—350 to 800 gallons per acre. *Semi-Concentrate (Mid-Volume Spray)*—100 to 350 gallons per acre. *Concentrate (Low-Volume Spray)*—10 to 100 gallons per acre. *Extra High Concentrate (Very Low Volume)*—0.5 to 10 gallons per acre. *Ultra Low Volume*—4 ounces to 0.5 gallon per acre, undiluted material.

Tree size is a major factor in how wet the leaves and fruit become when sprayed. The definitions above relate to relatively large trees.

### Chemical Rates

The chemical rates listed in the tables are based on dilute sprays for relatively large trees. See General Recommendations. Adjust per-acre rates according to density and severity of the pest problem. In determining rates and proper timing consider effect on beneficial species.

For dilute application, the volume of water applied per acre may be adjusted according to tree size and density of foliage to the gallonage when fruit and foliage is fully wetted to the point where drip or runoff is occurring throughout the tree. Gallons per acre will vary depending on tree stage and size. For concentrate application, generally it is simpler and more desirable to adjust the rate of chemical per tank or per acre than to vary the gallonage of water per acre. Make only minor adjustments in per-acre rates by altering ground speed. Ground speeds should remain within the range that gives optimum spray coverage. Do not alter ground speeds after calibration when using power-take-off sprayers. Slower application speed generally improves spray coverage. Applying sprays at excessive speed is the most common cause of poor coverage. Improved coverage enhances effect of the sprayed product.

Chemical rates less than those shown may be used in certain instances. Examples of situations in which lower rates may be

desirable include dormant oil sprays on young orchards, certain growth regulators, certain miticide applications where predators are a major controlling factor, and some nutritional sprays.

Growers should carefully note restrictions on maximum rates on the label.

### Alternate Middle Spraying

Alternate middle spraying is a technique that applies full spray coverage to the outside rows and row ends, but skips every other row middle in the interior of the orchard. The operator applies the next cover for the pest or disease, if necessary, in the previously skipped row middle.

Alternate row spraying may be used when trees are small or very open to spray penetration, and the target pest or disease does not require full coverage for acceptable control.

At times, this application method is beneficial:

1. When the time it takes to apply the spray is more important than excellent coverage. For example, after an apple scab or fire blight infection, the degree of control depends on rapid treatment and full coverage. Skipping alternate rows will lead to a reduced degree of coverage, but much more rapid treatment of the orchard. In this case, spray the skipped middles as soon as possible after completing the alternate middle application.
2. When overtree irrigation, heavy rain, or cooling frequently reduces protective spray residues. The operator may apply the first of a series of spray covers at a full recommended rate to the entire orchard. Make subsequent applications to alternate row middles at a more frequent interval than usual, and at the normal rate per 100 gallons of spray mixture. Do not spray at an interval less than the product label allows.

Alternate row middle spraying is not recommended if the pest requires complete coverage for acceptable control. Complete coverage greatly improves control of pests and diseases such as codling moth, leafrollers, San Jose scale, mites, pear psylla, mealybugs, mildew, apple scab (eradicator sprays), and fire blight.

### Aerial Application

Aerial application programs that have been found effective include:

*Dormant sprays against overwintering pear psylla.* When aircraft is equipped with standard boom and nozzles, apply at rate recommended for the registered compound plus 3 gallons of horticultural mineral oil in 7 or more gallons of spray per acre.

*Codling moth.* Materials recommended for codling moth control may be applied by aircraft, provided this type of application is permitted by label registration. See Pest Control Program for Apples.

*Green apple aphid.* Aerial sprays are effective against apple aphid and are especially useful against mid-season infestations. See label for preharvest interval.

*Western cherry fruit fly.* Malathion ULV applied through Becomist dispensers at 1 pint per acre on a 7-day schedule has

provided control of western cherry fruit fly when evenly applied across the entire orchard surface. Control may not be adequate when power lines, houses, or wind complicate application. Applications should be made through 20-micron sleeves. Northwest growers have reported marking on peaches and apricots receiving this misapplied spray.

*Grasshoppers.* Malathion ULV sprays are suggested for grasshopper control only in areas adjoining orchards. This treatment is not registered for use on any tree fruit except cherries. Use 1/2 to 3/4 pint of Malathion ULV per acre. Other materials may also be used by air.

*Zinc nutrient sprays.* Applications of zinc sulfate 1.2 LC have been made to apple, pear and cherries by aircraft in the spring during the dormant period. See section on Nutrient Sprays for rates and precautions.

*Boron* may be applied to the orchard soil (granular formulation) by aircraft during the dormant season to correct boron deficiency. Apply the equivalent of 3-5 pounds of actual boron per acre. See section on Nutrient Sprays.

*Stop drop sprays.* NAA may be applied by aircraft to prevent preharvest fruit drop. Use 5 or more gallons total spray per acre. See section on Growth Regulator Sprays.

*Apple scab.* While the use of aerial application is quite satisfactory for the control of apple scab in the protective program, its use for eradicator control poses a risk for disease development. The aerial label rate per acre for dodine (Syllit) is too low for good eradicator action. Coverage by aerial application may not be adequate for eradicator control.

For protective control of apple scab any of the organic fungicides listed under Apple scab in the Pest Control Program for apples will give satisfactory control when applied by air.

*Preharvest sprays for bull's eye rot.* Ziram may be applied by aerial spray for the prevention of bull's eye rot. Use in accordance with label directions. Research shows ground applications of these sprays are more effective.

## HAZARDS TO BEES

### Bee Protection

*Bees are necessary for the pollination of fruit trees.* Orchardists must make a sincere effort to protect them.

Even though pesticides are applied to orchard trees, some of the spray may settle on the cover crop and weeds and kill foraging bees. Since normal spray programs frequently involve pesticides that are not permitted on animal feeds, it is essential that users check the label before cover crops are grazed. The following precautions will help ensure adequate pollination.

1. Do not place bees in an orchard until blossoms are open. This will help minimize the number of bees foraging on blooming cover crops and weeds.
2. Application of insecticides to orchards may be responsible for killing honey bees that are essential for pollination. Chemical residues on blooming cover crops cause most bee kills. Never apply insecticides that are hazardous to bees (see

following table) when any blossoms are open or allow drift of the material to open blossoms in cover crops adjoining orchards, or interplants, or on blooming weeds.

3. Controlling blooming broadleaf weeds (e.g. clover, dandelion) in orchards is an essential part of preventing bee kills. Mow or beat down orchard cover crops before applying sprays hazardous to bees—especially Lorsban, and carbaryl (Sevin). Blossom removal is especially important in relation to the first cover spray on apples. Treatment is applied during a critical foraging period, when bees will fly several miles when temperatures are higher than 50°F to obtain pollen and nectar from even a few blooms of dandelion, mustard, etc. Encourage use of grass sod cover crops to prevent bee losses.
4. Many insecticides commonly used in orchards are highly toxic to honey bees and have a residual hazard for several days. This includes insecticides like thiamethoxam (Actara) and chlorpyrifos (Lorsban). Carbaryl (Sevin) is highly hazardous to bees.
5. Proper timing can help to minimize the potential for bee kills if the insecticide has an intermediate or short residual hazard to bees. Cool temperatures and higher insecticide use rates can greatly lengthen the residual hazard. Spraying at night will not prevent a bee kill if the insecticide has a long residual hazard to bees. In general, herbicides and fungicides are relatively low in toxicity to bees. Captan is an exception, which may harm honey bee larvae when applied to bloom.
6. The orchardist must know who owns the bees in the orchard and where the beekeeper can be contacted. Beekeepers should

place their name and phone number on hives to identify them.

7. Beekeepers must register their bees with the Washington State Department of Agriculture, in Olympia, 360-902-2070. For technical questions contact 360-902-2071.

## POTENTIAL FRUIT AND LEAF INJURY

This section does not cover all possible sprays, combinations, and timings that may cause plant injury. Each additional product added to the spray tank increases the uncertainty of effect. Products or mixtures that may be safe at one growth stage may cause injury at another.

Faulty spray equipment, poor mixing and agitation, highly concentrated materials, or extremes of weather during or following spraying may lead to fruit or foliage injury. The risk of spray injury is greater when drought stress or extremely dry, cold and wet, or hot weather exists. At gallonages where droplets coalesce and concentrations are higher, the possibility of injury is greater. On larger trees, this often occurs between 80 and 150 gallons per acre.

Russetting of Golden Delicious or D'Anjou is most often caused by cool, rainy, or humid weather in the early growing season. Russetting may be increased by pesticides or nutritional sprays if they are applied when such conditions occur or if sprays are applied at night. **Emulsifiable materials, in foliage applications, are more likely to cause injury than wettable powders.**

### Toxicity of Pesticides to Bees

See PNW 518, *How to Reduce Bee Poisoning from Pesticides* for further information.

| I   | II  | III   | IV  |
|---|---|---|---|
| Hazardous at any time on blooming crops and weeds | Not hazardous if applied in late evening except during high temperatures <sup>1,2,6</sup> | Not hazardous if applied in evening or early morning except during high temperatures <sup>1,2,3</sup> | Not hazardous to bees at any time on blooming crops |
| azinphos methyl (Guthion)                         | abamectin (Agri-Mek)  | acetamiprid (Assail)  | amitraz (Mitac)                                     |
| carbaryl (Sevin 50 WP)                            | bifenazate (Acramite)   | endosulfan (Thiodan)  | azadirachtin  |
| chlorpyrifos (Lorsban)                            | carbaryl (Sevin 4F) <sup>4</sup>  | spinosad  | <i>Bacillus thuringiensis (Bt)</i>                  |
| diazinon  | carbaryl (Sevin XLR Plus) <sup>5</sup>  | (Success, Entrust)  | clofentezine (Apollo)                               |
| dimethoate  | esfenvalerate (Asana)   |   | dicofol (Kelthane)                                  |
| lambda-cyhalothrin (Warrior)                      | formetanate hydrochloride (Carzol)  |   | dodine (Syllit)                                     |
| malathion ULV                                     | imidacloprid (Provado)  |   | fenarimol (Rubigan)                                 |
| methidathion (Supracide)                          | malathion EC  |   | fenbutatin-oxide (Vendex)                           |
| phosmet (Imidan)                                  | permethrin  |   | hexythiazox (Savey)                                 |
| pyridaben (Pyramite)                              | (Ambush, Pounce)  |   | horticultural mineral oil                           |
| thiamethoxam (Actara)                             | oxamyl (Vydate)   |   | kaolin (Surround)                                   |
|   |   |   | lime-sulfur   |
|   |   |   | methoxyfenozide (Intrepid)                          |
|   |   |   | myclobutanil (Rally)                                |
|   |   |   | pyrethrins-PBO (Pyrenone)                           |
|   |   |   | pyriproxifen (Esteem)                               |
|   |   |   | soap (M-Pede)                                       |
|   |   |   | sulfur  |
|   |   |   | tebufenozide (Confirm)                              |
|   |   |   | triadimefon (Bayleton)                              |

<sup>1</sup>If temperature is less than 45°F, spray any time.

<sup>2</sup>If temperature is >60°F, do not begin spraying until 7 p.m.

<sup>3</sup>For early morning spray, stop at 7 a.m.

<sup>4</sup>2 pints is the upper limit of safety.

<sup>5</sup>3 pints is the upper limit of safety.

<sup>6</sup>toxic if direct contact on bee.

Combinations of materials can cause injury. Combining two emulsifiable concentrates or an emulsifiable concentrate with a wettable powder can lead to compatibility problems. Whenever possible, combine only the same type of formulation. **If tank mixes of different formulations are used, add in the following order: 1) soluble packets, 2) wettable powders, or water dispersible granules, 3) flowables, 4) emulsifiable concentrates, 5) oils.** Chemicals should be added under good agitation and when the spray tank is one-half to two-thirds full. Excess foaming may be reduced by adding surfactants after filling and by using silicone antifoaming materials.

In some cases injury results not only when two materials are mixed in the same tank, but when one material is applied after another. This is particularly true when oil is applied before or after a pesticide or nutrient spray.

The following is a list of some common pesticides, nutrients and surfactants, and the injury observed following their use (See also herbicides in Chemical Weed Control):

*Amitraz (Mitac)*—Emulsifiable concentrates may cause fruit injury if applied when cool, moist, or poor drying conditions exist or when night temperatures are below the dew point.

*Ammonium thiosulfate (ATS)*—This product can damage flower and leaf tissue when applied during bloom. Higher concentrations and warmer temperatures during application increase the level of damage.

*Azadirachtin (Neem)*—Comice pear (i.e., Taylors Gold)—Leaf damage and drop have been reported.

*Azoxystrobin (Abound)*—This fungicide may drift from application to nearby grapes or potatoes. This product may cause severe fruit damage to 'Gala' and other sensitive apple varieties.

*boron*—Do not dissolve pesticides packaged in water-soluble containers in water containing boron. If using boron with a soluble-package pesticide, fill the tank at least one-third full to dissolve the package first, then add boron.

*Calcium chloride, calcium nitrate*—Can russet apple, mark pear fruit, and cause leaf burn depending on concentration, temperature and number of applications.

*Captan (Captan)*—Avoid applying during the prepink to petal-fall period because of danger of reduced fruit set. Do not apply Captan with oil. Captan applied either before or after oil (within a 2-week period) may cause damage to sensitive varieties. The danger is greater during periods of cool weather or slow drying conditions.

*captan plus oil*—See captan.

*captan plus sulfur*—Can injure apples.

*Carbaryl (Sevin)*—If applied as a first cover spray, may cause marginal foliage burning of Bartletts, and usually causes fruit thinning of apples.

*Chlorpyrifos (Lorsban) 50WP*—Do not allow chlorpyrifos to contact sweet cherry foliage after the delayed dormant period.

*Dimethoate (Dimethoate)*—May cause damage to apple foliage and may russet Golden Delicious fruits. Causes marginal leaf damage and leaf drop on cherries when used at higher than recommended rates, concentrate sprays, and/or with poorly adjusted airblast sprayers. Avoid drift onto other stone fruits.

*Dodine (Syllit)*—May russet Golden Delicious apples when applied under slow drying conditions.

*dodine (Syllit) plus diazinon*—May injure Jonathan apples.

*Lime-sulfur*—May cause injury when followed by hot weather. Do not use on apricots. Drift from postharvest applications on pears may cause defoliation of adjoining apple blocks. This problem is most severe where Winesaps are adjacent to pears. Do not apply oil to foliage treated with lime-sulfur.

*Malathion (Malathion)*—Has caused moderate to severe fruit and foliage damage to cherries. The 'Rainier' variety is particularly susceptible. Technical grade malathion fly applied by aircraft, has the least amount of risk. However, even that can cause injury without proper ULV nozzles.

*NAA plus ziram*—Can cause red spots on Golden Delicious fruit.

*Oil*—The following conditions may cause injury: application in cool, damp, extremely dry, or windy weather; broken emulsions; applications of oil or oil-lime-sulfur at the prepink stage; summer applications preceding or following many organic insecticides or fungicides; and faulty application, including poor agitation and mixing.

*oil plus azinphos methyl (Guthion)*—May damage apple foliage and fruit and foliage of Anjou pears. May induce leaf drop in sensitive cherry varieties.

*oil plus diazinon*—As a summer spray may damage apple foliage and fruit.

*oil plus endosulfan (Thiodan)*—May damage all deciduous fruits as a foliage spray.

*oil plus lime-sulfur*—See Oil under Special Programs.

*oil plus malathion*—foliar spray: damages Anjou pears; Golden Delicious, Jonathan apples.

*Phosmet (Imidan)*—Causes injury to cherry foliage.

*Soap (M-Pede)*—Can cause fruit and foliage injury at high temperatures on apple. Fruit and foliage injury is more likely on pear and not necessarily temperature dependent. The cultivar Anjou is particularly susceptible.

*Sulfur and Sulfur Compounds*—Sulfur should not be applied when temperatures are expected to exceed 85°F within 24 hours of application. Do not use on apricots. Treat Delicious apples and Anjou pears only during prebloom.

*Surfactant (X-77)*—Can result in fruit russet on apples and pears, particularly during cool weather or slow drying conditions.

*Urea*—May injure stone fruits, apples, and pears. Use only formulations with less than 2% biuret.

*Zinc sulfate*—See cautions in text under Nutrient Sprays—Zinc.

*ziram plus NAA*—Certain formulations can cause red spots on Golden Delicious fruit.

## Limited Compatibility Materials

Materials shown here are known to be compatible only as listed:

*Calcium chloride (apple)*—Compatible with wettable powder formulations of azinphos methyl (Guthion), diazinon, phosmet (Imidan), and endosulfan (Thiodan). Pears are more sensitive than apples to the above combinations. Calcium materials may cause injury when mixed with materials containing copper and zinc and possibly other heavy metals.

*Streptomycin*—Has been combined with azinphos methyl (Guthion) WP, phosmet (Imidan) WP, boron (Solubor), endosulfan (Thiodan) WP, and ziram (Ziram) WP without caus-

ing injury to Bartlett or Anjou fruit or foliage. However, laboratory tests indicate that these combinations may reduce the effectiveness of streptomycin.

*Zinc sulfate*—May be combined with boron (Solubor) in delayed dormant sprays.

## POME AND STONE FRUIT FUNGICIDE RESISTANCE MANAGEMENT

Crop management, fungicide chemistry, and chemical usage patterns profoundly affect the emergence of pathogens' resistance to fungicides. Resistance results from prolonged and repeated use of the same, or closely related, chemicals. You may manage resistance by minimizing selection pressure on the pathogen. Begin this process early in the life of the fungicide or fungicide group. The following crop management practices can lower disease and, therefore, selection pressure: 1) using resistant varieties, 2) planting in low-disease-pressure areas, 3) reducing nitrogen fertilization, and 4) practicing sound and effective orchard sanitation and maintenance. All of these methods should reduce the number of fungal propagules exposed to the chemical. The following fungicide use patterns may prevent or delay onset of resistance: 1) apply only when absolutely necessary, 2) use to protect rather than to eradicate, 3) rotate fungicide chemistries, and 4) use mixtures of chemically unrelated fungicides.

Fungicide classes differ in their potential for resistance. Compounds possessing low inherent resistance risk include sulfurs, soaps, and oils. Fungicide classes having moderate to high resistance risk include the DMI (SI), strobilurin, benzimidazole, and anilopyrimidine groups. Mix, or preferably, rotate all of the latter with fungicides having different modes of action. For example, alternating the benzimidazoles Benlate and Topsin is virtually the same practice as using either compound continually. Starting resistance management strategies early in the life of the compound is important. Recent California research indicates powdery mildew fungi can develop resistance to DMI fungicides over a several-month period if disease pressure is high. When using resistance-prone fungicides (myclobutanil, fenarimol, tebuconazole, triflumizole, propiconazole, triadimefon, triforine, azoxystrobin, cyprodinil, pyraclostrobin, trifloxystrobin and kresoxim-methyl) for powdery mildew control, alternate with oils, soaps, sulfurs, or calcium polysulfide (Do not use cyprodinil against powdery mildew). When using these chemicals for apple scab control, alternate them with ziram, thiram, captan, or mancozeb.

## SPECIAL PROGRAMS

### Specific Orchard Replant Disease

The most common cause of poor tree growth and low yields in replanted orchards is called Specific Replant Disease. This disease is caused by soil fungi and bacteria that built up during

the growth of the previous orchard. Both apples and pears seem to be affected by similar groups of organisms. Stone fruits appear to have a somewhat separate group of pathogens that affect them. Mature trees can tolerate these root damaging organisms, but young trees are unable to develop adequate root systems when pathogen numbers are high. Young trees seldom die from this disease. Growth is slightly to severely slowed, and the trees appear to be nutrient and moisture deficient. Yields are reduced, even after the trees fill their space. This disease is more severe on sites having poor soil quality. Careful management of soils, nutrients, weeds and irrigation will reduce, but not eliminate the effects of this disease. There is no adequate treatment once the young trees are affected. Rotating the site out of orchard for at least 5-8 years may control the disease. Adding soil or other products to the planting hole may improve tree

### Mills' Apple Scab Infection Table

#### Approximate Wetting Period Required for Primary Apple Scab Infection at Different Air Temperatures and Time Required for Development of Conidia

| Average temperature (°F) | Degree of Infection         |                                |                             | Lesion Appearance (days <sup>2</sup> ) |
|--------------------------|-----------------------------|--------------------------------|-----------------------------|--|
|                          | Light (hours <sup>1</sup> ) | Moderate (hours <sup>1</sup> ) | Heavy (hours <sup>1</sup> ) |  |
| 33–36                    | 48                          | 72                             | 96                          | ?                                      |
| 37                       | 41                          | 55                             | 68                          | ?                                      |
| 38                       | 37                          | 50                             | 64                          | ?                                      |
| 39                       | 33                          | 45                             | 60                          | ?                                      |
| 40                       | 29                          | 41                             | 56                          | ?                                      |
| 41                       | 26                          | 37                             | 53                          | ?                                      |
| 42                       | 23                          | 33                             | 50                          | 17                                     |
| 43                       | 21                          | 30                             | 47                          | 17                                     |
| 44                       | 19                          | 28                             | 43                          | 17                                     |
| 45                       | 17                          | 26                             | 40                          | 17                                     |
| 46                       | 16                          | 24                             | 37                          | 17                                     |
| 47                       | 15                          | 23                             | 35                          | 17                                     |
| 48                       | 15                          | 20                             | 30                          | 17                                     |
| 49                       | 14.5                        | 20                             | 30                          | 17                                     |
| 50                       | 14                          | 19                             | 29                          | 16                                     |
| 51                       | 13                          | 18                             | 27                          | 16                                     |
| 52                       | 12                          | 18                             | 26                          | 15                                     |
| 53                       | 12                          | 17                             | 25                          | 15                                     |
| 54                       | 11.5                        | 16                             | 24                          | 14                                     |
| 55                       | 11                          | 16                             | 24                          | 14                                     |
| 56                       | 11                          | 15                             | 22                          | 13                                     |
| 57                       | 10                          | 14                             | 22                          | 13                                     |
| 58                       | 10                          | 14                             | 21                          | 12                                     |
| 59                       | 10                          | 13                             | 21                          | 12                                     |
| 60                       | 9.5                         | 13                             | 20                          | 11                                     |
| 61                       | 9                           | 13                             | 20                          | 10                                     |
| 62                       | 9                           | 12                             | 19                          | 10                                     |
| 63–75                    | 9                           | 12                             | 18                          | 9                                      |
| 76                       | 9.5                         | 12                             | 19                          |  |
| 77                       | 11                          | 14                             | 21                          |  |
| 78                       | 13                          | 17                             | 26                          |  |

<sup>1</sup>Hours of wetness from the beginning of rain (data of W.D. Mills as modified by A.L. Jones). If sporulating lesions are already present, wetting periods required to produce secondary infections are approximately 3 hours less than those listed in the table for primary infection.

<sup>2</sup>Number of days required for lesions to appear after infection has been initiated. No further wetting is required. Additional days may be required if conditions are unfavorable for lesion development (prolonged periods above 80° F or very dry weather).

growth, but will not adequately control the replant problem. Broad spectrum soil fumigants are the most common and effective controls used by orchardists who must replant quickly. Soil fumigation often leads to normal tree growth and production, while untreated areas of the same block grow and yield 20% to 50% less. Methyl bromide, metam-sodium, metam-potassium, or fumigants that contain 1,3-DCP and chloropicrin usually will provide control of this disease.

### **Verticillium Wilt of Stone Fruits**

Verticillium wilt is a disease caused by the fungus *Verticillium dahliae*, a common pathogen in crops such as potatoes and mint. This fungus builds up on these common hosts and remains in the soil as small resting structures for many years. Susceptible hosts of this disease organism include many plants, and tree fruits such as cherry, peach, nectarine, plum or any other close relative. Many relatively resistant plants may maintain the population of this organism by acting as low-grade hosts, so once the site is infested, it tends to remain so. When a susceptible host root grows near the Verticillium resting structure, the fungus breaks dormancy, penetrates the root, infests the young root tissue, then moves into the plant's vascular system. If the vascular system is greatly damaged, the plant wilts, leading to the characteristic sudden yellowing and leaf drop. Individual limbs or sections of the tree may exhibit symptoms, while other parts of the tree appear quite healthy. If there are relatively few fungal resting structures in the soil and the host is relative resistant, the stone fruit tree may be attacked for many years without showing symptoms. Each year, the vigorous young tree may grow a new layer of relatively healthy vascular tissue (new wood) that will support its growth. However, if tree growth slows, or the site has a relatively high number of Verticillium resting structures, the organism may overwhelm the tree, causing damage or death.

This disease is controlled temporarily in annual crops through crop rotation and soil fumigation. Despite this approach, the disease may still develop in the annual crop, but yields are only slightly affected. This is not a practical approach for tree fruits, as a temporary reduction of disease pressure will not prevent the disease for the expected life time of the orchard. Careful fumigation will lessen the degree that the tree is attacked by the fungus, and will have an effect if the disease potential is low. Stone fruit orchards are at great risk of developing this disease on sites where the disease pressure is high, despite long crop rotations and fumigation. There are no tests available to determine the precise disease potential on any specific site relative to tree fruits. There is no information available on the relative resistance of various stone fruit rootstocks. Growers must determine the cropping history of potential planting sites and avoid planting stone fruits on sites that produced potato, mint or other highly susceptible hosts.

### **Orchard Soil Fumigation**

Pathogenic soil organisms present in the soils of most mature orchards often reduce root growth of young fruit trees when the site is replanted. Poor root development leads to reduced vegetative growth and poor fruit yields throughout the life of the replanted orchard. Certain soil fumigants have controlled the

Specific Orchard Replant Disease when properly applied. The positive effect of controlling this disease can be measured 20 years after treatment. No soil treatments will effectively control replant disease problems after planting.

While many soil fumigants, fungicides, fertilizers and other products have been tested for effect on the orchard replant disease, only four have shown long-term growth and yield benefits in Washington orchard trials: methyl bromide, metam sodium, metam-potassium, and fumigants containing 1,3-DCP and chloropicrin.

Some fumigants must be custom applied, others may be applied by a certified private applicator. If you are unfamiliar with the product, pay special attention to use and safety information. Used improperly, fumigants can be quite hazardous to the applicator and the crop, and will not effectively control orchard replant disease. Some application methods described on fumigant product labels have not resulted in replant disease control.

Follow soil temperature and preparation guidelines on the product label. In general, colder, wetter, compacted and finer textured soils retain fumigants longer. The soil is usually in best condition for fumigation in October and early November. Treatment should be completed well ahead of the time that soil temperatures drop below the minimum recommended on the label. To reduce the chance of fumigant damage to the newly planted trees roots, dig planting holes or disturb the planting area soil a few days prior to planting.

It is far better to plant later than usual in the spring than to risk tree damage by planting while potentially dangerous fumigant residues remain in the soil. Skipping fumigation because it sets back the planting date is a poor choice. A May-planted tree planted in fumigated soil will usually out-perform a March planted tree suffering from even a mild case of replant disease. Long-term productivity should be the main concern, not date of planting.

Fumigants are safe and effective when properly used, but special training is highly recommended for first time users. Use of other pesticides or fumigants does not qualify as adequate user experience, as each fumigant has unique properties. Before using any fumigant, carefully read and follow safe handling and protective equipment information on the label. Special respirator canisters and vapor-proof eye protection may be required.

#### **Methyl Bromide:**

This product is stored as a liquid under pressure, but it turns to a gas when released under the soil surface if the soil temperature is over 45° F. It moves through the soil as a gas, in the air spaces between soil particles. It is most effective when applied to relatively dry (50% of field capacity), warm (50° to 60° F), and well plowed or ripped soil. Since it may remain in the soil for 6 to 8 weeks under cool, wet conditions, fall treatment is highly recommended. Spring treatment is possible, but should be professionally monitored to determine that the product residue is at a safe level prior to planting. Keep treatments 20 or more feet from established plantings, especially if soil is warm, sandy and dry.

For widely spaced trees, such as cherries or most pears planted at less than 120 trees per acre, spot treatment of each future tree site may be economical. Inject 1/2 to 1 pound methyl bromide by special probe about 18 inches below the soil surface

at each future tree planting site. Use a wood stake or soil to plug the hole as soon as the probe is removed, do not use your foot to press the hole closed. Injection of the product is complicated by cool temperatures and compacted or wet soils, and rocks.

For closer plantings, methyl bromide most often is commercially applied at 400 to 600 pounds per acre. The higher rates are necessary when soil conditions are less than optimum. Contact the custom applicator well ahead of treatment, and follow the applicator's directions on soil preparation. Most request a cleared, ripped, and smooth orchard surface prior to application.

Chloropicrin + DCP (Telone) mixtures:

Chloropicrin was the first soil fumigant found to effectively control replant disease. This product moves no more than 9 to 12 inches from the point of injection, so it must be custom applied by special equipment. A large volume of the future root zone must be treated to assure long-term benefits. Therefore, the application equipment must apply the product in a manner that treats the future tree row in a band at least 8 feet wide and 2 to 3 feet deep.

The chloropicrin is usually mixed with either methyl bromide or 1,3-dichloropropene. The chloropicrin is often either 17% or 35% of the mixture.

Follow the soil preparation and application timing guidelines described in the methyl bromide section.

Metam Sodium and Metam Potassium:

Originally sold as "Vapam," this product is now also available under several other trade names, including: Soil Prep, Nemasol, and Busan. Metam sodium and metam potassium are water soluble liquids moved by sprinkler irrigation water into the zone of the soil that you wish to treat. After the fumigant and water mixture stops moving downward in the soil, the metam converts into a more toxic fumigant gas. This gas moves only a few inches from the zone treated with the water mixture. Since the active ingredient moves only a short distance, it is critical that the metam and water mix penetrate the future tree root zone 2.5 to 3 feet, but no more. Broadcasting the product with sprinkler irrigation or treating a band at least 8 feet wide along the future tree row has resulted in long-term tree growth and yield improvement. Metam products are sold with various percentages of active ingredient. Apply 100 gallons per acre of those with 33% a.i., and 75 gallons per acre of products containing 42% a.i. Lower rates have resulted in reduced growth and yields.

Prior to application soil should be 45° to 75° F and relatively moist (over 85% of field capacity). Pre-irrigate the field if the soil is even moderately dry. Use approximately 1/2 to 1 inch of sprinkler irrigation water to drive the fumigant to the desired depth. Without immediate and continuous incorporation with water, the product will evaporate rapidly, creating a drift and applicator hazard. Overapplication of water will overdilute the product in the soil and greatly reduce the fumigant effect. Sandy, wet, and unworked soils require the lesser rate of water; finer textured, ripped, and drier soils require the higher amount. Measure the irrigation system application rate to determine the hours of irrigation that will apply the proper amount of water.

Most systems should be run 3 to 5 hours.

It is not always practical to work the orchard soil prior to treatment. If the soil is prepared for planting after treatment, do not mix untreated soil into the fumigated area.

Metam sodium products have a number of application methods on their labels. The only practical and effective treatment methods of replant disease involve driving the product into the soil with sprinkler irrigation water. Shankng or rototilling the product into the soil or filling planting holes with large volumes of water mixed with a per-site rate of the fumigant has not been effective. Filling 7-foot-wide, shallow basins constructed at each planting site with 35 to 45 gallons of water mixed with 12 ounces of metam is effective, if properly done. This application method is far too labor intensive to be economical on a large scale, but may be useful in limited tests. Follow directions on a 24(c) special local needs label for banding the fumigant during sprinkler application.

Fall treatment will allow you to plant the treated site in late winter or early spring. If fall weather or lack of autumn irrigation water delays treatment until spring, label instructions require 3 to 4 weeks between treatment and planting. Soil in the treated area may be prepared for planting starting 10 to 14 days after treatment. Digging planting holes or disturbing the soil a few days prior to planting speeds the release of fumigant residues that may remain. Nontoxic, but unpleasant sulfurous odors may remain in the soil for several weeks after treatment.

## Horticultural Mineral Oils

Horticultural mineral oils can play an important part in orchard pest and disease management programs during the foliar season. They are effective against scales, mites, and some other insects, as well as some diseases. All horticultural mineral oils must be registered by the EPA. Significant differences can exist in the chemical composition of horticultural mineral oils depending on source of crude oil and the manufacturing process. Efficacy and phytotoxicity can vary substantially with chemical composition and physical properties. The most important characteristics of a horticultural mineral oil to consider when assessing it for pest control are distillation parameters, molecular size and shape, unsulfonated residue (USR) measures, and viscosity.

**Molecular shape:** High concentrations of paraffinic molecules are desired since this fraction provides pesticidal activity. Paraffins are long carbon chains that interact readily with the surface waxes of mites and insects. Concentrations of paraffins in spray oils should be 60% or more to assure optimal pesticidal activity. The remainder is made up primarily of ring-shaped, naphthenic, and aromatic molecules. USR measures the aromatic component of the oil, which should be 92% or higher.

Compliance with FDA regulations on aromatics ensures that this fraction is safe to mammals.

**Distillation and molecular size:** Horticultural mineral oils available in the Pacific Northwest are either of the 415, 440, 455 or 470 type. Numbers denote the mid-boiling points (°F) of these oils when distilled under vacuum. The lighter horticultural mineral oils, 415 and 440 types, are suitable for dormant, delayed

dormant and foliar (summer) applications. Use of horticultural mineral oils with larger molecules, 455 and 470 types, is best restricted to use in the dormant and delayed dormant periods. Viscosity is a measure of a fluid's flowability. It is used in many cases to identify a horticultural mineral oil, for example, as a 60- or 100-second oil. The viscosity of a horticultural mineral oil is by itself not a measure of performance.

The critical properties regarding pest and disease control as well as plant protection are governed by a crude source with high paraffinic content (shape related), distillation (size related) and processing methods to select for paraffins vs. naphthenics and to eliminate undesirable aromatics (shape related). For a more detailed and very informative discussion of the relationship between the biological activity and the properties of a horticultural mineral oil refer to *Using Horticultural Mineral Oils to Control Orchard Pests*, a Pacific Northwest Extension Publication (PNW 328, 1996) by M. Willett and P.H. Westgard.

**Dormant or Delayed Dormant Use:** Using horticultural mineral oil plus an organophosphate in the dormant or delayed dormant period is an important part of a good pest control program. This program provides the most effective control of San Jose scale, and is essential to early season control of European red mite and leafrollers. Many growers, however, have avoided the use of horticultural mineral oil or reduced the rate per acre below an effective level because of possible injury to trees, in some cases resulting in increased problems with these pests. Several precautions in the use of horticultural mineral oil should reduce the risks of using these products.

- Calibrate the sprayer before applying sprays to ensure proper gallonage and thorough coverage.
- Check agitation system as each tank of spray mixture is prepared.
- Test oil held over from last season for proper emulsification before using.
- If possible, use emulsifiable concentrate or flowable formulations of pesticides with horticultural mineral oil. If wettable powders must be used, add wettable powder or a slurry of wettable powder formulations to tank partially filled with water before adding horticultural mineral oil to ensure proper suspension in the spray mixture.
- Avoid applying horticultural mineral oil during cool (below 45°F), damp, extremely dry, or windy weather. If subfreezing temperatures are forecast within 24 hours, discontinue spraying by mid-afternoon.
- Do not use horticultural mineral oil at more than the maximum label rate per acre. Various pesticides may have different maximum rates of oil for when it is tank-mixed with their product. Ground and aerial oil rates may vary. Reduce the rate of oil per acre below 6 gallons where concentrate applications are used. On young trees or close plantings where there is a good chance of double spraying, reduce the rate per acre.
- Do not allow the mixture to stand in the tank without agitation.

**Foliar Use:** The use of horticultural mineral oil after bloom for pest control is gaining in popularity. Horticultural minerals oils are primarily effective against pests through contact, making

thorough coverage of the foliage very important. In addition to contact activity, there appears to be repellent activity for egg-laying adults (example: white apple leafhopper). As recommendations for the foliar use of horticultural mineral oils appear in this bulletin, use care in selecting products that meet criteria discussed. In addition, recommendations are going to be based on "dilute" spray volumes unless otherwise indicated. Avoid slow drying conditions and extremes of cool or hot conditions when applying horticultural minerals oils.

## Grasshopper and Mormon Cricket Control

Grasshoppers and Mormon crickets are sporadic orchard pests. They may damage fruit, foliage and small wood. Young trees are particularly vulnerable. These pests are usually noticed in orchards in late June through mid-August. The best control procedure is to eliminate their potential sources. This means spraying or baiting areas adjoining orchards where they develop. Federally sponsored programs may be available for noncrop areas. Contact your extension agent for details.

Many chemicals used routinely in orchards will kill grasshoppers and Mormon crickets. However, when they are large enough to migrate into the orchards, the pests become more difficult to kill, and continue to migrate in after the spray is applied. The best strategy is to control grasshoppers in the nymphal stages as they develop in areas adjacent to the orchard. Carbaryl baits at 1 pound active ingredient per acre or malathion ULV (aerial application) are suitable for these areas. Avoid use of carbaryl in orchards if possible because of toxicity to predatory mites.

## Pesticides for Nonbearing Trees

While any of the pesticides listed for insect and disease control on bearing trees may be used on nonbearing trees, some products are restricted to nonbearing trees only.

The insect and mite species which attack nonbearing trees are generally the same as those which attack bearing trees; however, fruit damage is not a concern. A few species are particularly troublesome on young, rapidly growing trees. These include white apple leafhopper, green apple aphid, apple rust mite, and cutworms. San Jose scale can also establish itself on trees at this time when spray programs are generally minimal.

Cherry fruit fly may infest the first few fruit that are unsprayed and unharvested in young cherry orchard. This increases the cherry fruit fly population in the area, making control more difficult in neighboring orchards and during the first harvest season in the young block.

## Apple Maggot

Detection and containment of the apple maggot within its present geographical limits in Washington is a high priority of the WSDA.

**Management Recommendations.** Chemical controls are only required in orchards threatened by the apple maggot. Apply sprays as needed based on results of monitoring.

## Pesticide Recommendations for Apple Maggot

| Use of any of the listed materials        | Amount per acre | Amount per 100 gallons | Days from last spray to harvest |
|---|-----------------|------------------------|---------------------------------|
| azinphos methyl<br>(Guthion Solupak) 50WP | 2–3 lbs         | 0.5–0.75 lb            | 14–21*                          |
| phosmet (Imidan) 70WP                     | 3–4 lbs         | 0.75–1 lb              | 7                               |

Note: The label for azinphos products was substantially changed in 2004. Please read it prior to use.

\*Azinphos methyl: Maximum seasonal product use is now changed to 8 lbs per acre (4 lbs active ingredient). Allow at least 7 days between applications and 14 days between last application and harvest. If last application is greater than 2 lbs product per acre (1/2 lb per 100 gal), allow 21 days between last application and harvest. Applications made at rates above 2 lbs per acre can only be made in conjunction with an Integrated Pest Management (IPM) program. Restricted entry interval is 14 days. New regulations require closed systems (such as soluble packets) and prohibit hand-held spray applications. In addition to early entry exceptions allowed by the Worker Protection Standard, you may enter or allow workers to enter treated areas to perform fire blight pruning 7 days following application as long as you and any workers wear coveralls over long-sleeved shirt and long pants, chemical-resistant gloves made out of any waterproof material, chemical-resistant footwear plus socks, chemical-resistant headgear for overhead exposure, and protective eyewear. The user shall not authorize any person who is not covered by the Worker Protection Standard (WPS), such as members of the general public involved in “pick your own,” “U-pick,” or similar operations, to enter a treated area for 30 days after application.

## RESTRICTED ENTRY INTERVAL CHART FOR TREE FRUIT PESTICIDES

Do not enter or allow worker entry into pesticide-treated orchard/areas during the restricted entry interval (REI). Consult the label for exceptions and proper personal protection equipment for early entry.

| FUNGICIDES AND BACTERICIDES |                             |            | INSECTICIDES                   |                           |            | MITICIDES                 |                  |            |
|-----------------------------|-----------------------------|------------|--------------------------------|---------------------------|------------|---------------------------|------------------|------------|
| Chemical Name               | Trade Name                  | REI (days) | Chemical Name                  | Trade Name                | REI (days) | Chemical Name             | Trade Name       | REI (days) |
| azoxystrobin                | Abound                      | 4 hr       | abamectin                      | Agri-Mek                  | 12 hr      | bifenazate                | Acramite         | 12 hr      |
| Bacillus subtilis           | Serenade                    | 4 hr       | acetamiprid                    | Assail                    | 12 hr      | clofentezine              | Apollo           | 12 hr      |
| captan                      | Captan                      | 4          | amitraz                        | Mitac                     | 28         | dicofol                   | Kelthane         | *          |
| chlorothalonil              | Bravo, Echo                 | *          | azadirachtin                   | several                   | *          | etoxazole                 | Zeal             | 12 hr      |
| copper                      | Champ,                      | 1          | azinphos-methyl                | Guthion                   | **         | fenbutatin oxide          | Vendex           | 2          |
| copper hydroxide            | Kocide DF                   |            | <i>Bacillus thuringiensis</i>  | Dipel, Javelin, Deliver   | 4 hr       | fenpyroximate             | FujiMite         | 12 hr      |
| copper oxide                | Nordox                      | 1          | carbaryl                       | Sevin                     | 12 hr      | formetanate hydrochloride | Carzol           | +          |
| cyprodinil                  | Vanguard                    | 12 hr      | chlorpyrifos                   | Lorsban                   | 4          | hexythiazox               | Savey, Onager    | 12 hr      |
| dodine                      | Syllit                      | 2          | diazinon                       | Diazinon                  | 4          | pyridaben                 | Pyramite, Nexter | 12 hr      |
| fenarimol                   | Rubigan                     | 12 hr      | diflubenzuron                  | Dimilin                   | 12 hr      |                           |                  |            |
| fenbuconazole               | Indar                       | 12 hr      | dimethoate                     | Dimethoate                | 2          |                           |                  |            |
| fosetyl-Al                  | Aliette                     | 12 hr      | endosulfan                     | Thiodan, Thionex          | 1          |                           |                  |            |
| horticultural oil           | JMS Stylet oil              | 4 hr       | esfenvalerate                  | Asana                     | 12 hr      |                           |                  |            |
| iprodione                   | Rovral                      | 1          | fenpropathrin                  | Danitol                   | 1          |                           |                  |            |
| kresoxim-methyl             | Sovran                      | 12 hr      | gamma                          | Proaxis                   | 1          |                           |                  |            |
| lime sulfur                 | calcium polysulfate         | 2          | -cyhalothrin horticultural     | several                   | *          |                           |                  |            |
| mancozeb                    | Dithane, Manzate, Penncozeb | 1          | mineral oils                   |                           |            |                           |                  |            |
| metalaxyl                   | Ridomil                     | 2          | imidacloprid                   | Provado                   | 12 hr      |                           |                  |            |
| metiram                     | Polyram                     | 1          | indoxacarb                     | Avaunt                    | 12 hr      |                           |                  |            |
| myclobutanil                | Rally                       | 1          | kaolin clay                    | Surround                  | 4 hr       |                           |                  |            |
| propiconazole               | Orbit, PropiMax             | 1          | lambda                         | Warrior                   | 1          |                           |                  |            |
| pyraclostrobin              | Cabrio                      | 12 hr      | -cyhalothrin                   |                           |            |                           |                  |            |
| pyraclostrobin              | Pristine                    | 12 hr      | malathion                      | Malathion                 | 12 hr      |                           |                  |            |
| -boscalid                   |                             |            | methidathion                   | Supracide                 | 2–14       |                           |                  |            |
| streptomycin                | Agri-mycin                  | 12 hr      | methomyl                       | Lannate                   | ++         |                           |                  |            |
|                             |                             |            | methoxy-fenozide               | Intrepid                  | 4 hr       |                           |                  |            |
|                             |                             |            | oxamyl                         | Vydate                    | 2          |                           |                  |            |
|                             |                             |            | oxydemeton-methyl              | Metasystox-R <sup>1</sup> | 2–3        |                           |                  |            |
| sulfur                      | sulfur                      | 1          | permethrin                     | Ambush, Pounce            | 12 hr      |                           |                  |            |
| tebuconazole                | Elite                       | 12 hr      | phosmet                        | Imidan                    | 1          |                           |                  |            |
| terramycin                  | Mycoshield                  | 12 hr      | potassium salts of fatty acids | M-Pede                    | 12 hr      |                           |                  |            |
| thiram                      | Thiram                      | 1          | pyriproxyfen                   | Esteem                    | 12 hr      |                           |                  |            |
| triadimefon                 | Bayleton                    | 12 hr      | spinosad                       | Success, Entrust          | 4 hr       |                           |                  |            |
| trifloxystrobin             | Flint                       | 12 hr      | thiacloprid                    | Calypso                   | 12 hr      |                           |                  |            |
| triflumizole                | Procure                     | 12 hr      | thiamethoxam                   | Actara                    | 12 hr      |                           |                  |            |
| ziram                       | Ziram                       | 2          |                                |                           |            |                           |                  |            |

<sup>1</sup>Metasystox-R (Gowan Co.) is labeled for use only on certain nonbearing fruit trees.

\*REI varies by label.

\*\*REI for apples, pears, peaches, nectarines—14 days. REI for cherries—15 days.

+ REI varies by orchard activity.

++REI for apples—3 days. REI for peaches—4 days.

This table is adapted with permission from EM 8203, *Pest Management Guide for Tree Fruits In the Mid-Columbia Area* (Oregon State University, Corvallis, Oregon. Revised February 2004. )

## PREHARVEST INTERVAL (PHI) CHART FOR TREE FRUIT FUNGICIDES

Numerals indicate the number of days which must elapse between the last application and harvest. Capital letters indicate the stage(s) when you may use the material. Do not apply after or between the stages indicated. Consult the label.

| Chemical name           | Trade name | Apple             | Pear              | Cherries           | Peach              | Nectarine          | Apricot            | Plum, Prune        |
|-------------------------|------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| azoxystrobin            | Abound     | –                 | –                 | 4 hr <sup>e</sup>  | 4 hr <sup>e</sup>  | 4 hr <sup>e</sup>  | 4 hr <sup>e</sup>  | 4 hr <sup>e</sup>  |
| Bacillus subtilis       | Serenade   | 4 hr <sup>e</sup> | 4 hr <sup>e</sup> | 4 hr <sup>e</sup>  | –                  | –                  | –                  | –                  |
| captan                  | Captan     | 4 <sup>e</sup>    | –                 | 4 <sup>e</sup>     | 4 <sup>e</sup>     | 4 <sup>e</sup>     | 4 <sup>e</sup>     | 4 <sup>e</sup>     |
| chlorothalonil          | Bravo      | –                 | –                 | <sup>d</sup>       | <sup>d</sup>       | <sup>d</sup>       | <sup>d</sup>       | <sup>d</sup>       |
| cyprodinil              | Vanguard   | 72                | 72                | 2 <sup>b</sup>     | 2                  | 2                  | 2                  | 2                  |
| dodine                  | Syllit     | 7                 | 7                 | 2 <sup>e</sup>     | PF                 | –                  | –                  | –                  |
| fenarimol               | Rubigan    | 30                | 30                | 12 hr <sup>e</sup> | –                  | –                  | –                  | –                  |
| iprodione               | Rovral     | –                 | –                 | PF                 | PF                 | PF                 | PF                 | PF                 |
| kresoxim-methyl         | Sovran     | 30                | 30                | –                  | –                  | –                  | –                  | –                  |
| mancozeb                | Dithane    | <sup>c</sup>      | <sup>c</sup>      | –                  | –                  | –                  | –                  | –                  |
| myclobutanil            | Rally      | 14                | –                 | 1 <sup>e</sup>     | 1 <sup>e</sup>     | 1 <sup>e</sup>     | 1 <sup>e</sup>     | 1 <sup>e</sup>     |
| propiconazole           | Orbit      | –                 | –                 | 1 <sup>e</sup>     | 1 <sup>e</sup>     | 1 <sup>e</sup>     | 1 <sup>e</sup>     | 1 <sup>e</sup>     |
| pyraclostrobin          | Cabrio     | –                 | –                 | 12 hr <sup>e</sup> | –                  | –                  | –                  | –                  |
| pyraclostrobin-boscalid | Pristine   | –                 | –                 | 12 hr <sup>e</sup> | 12 hr <sup>e</sup> | 12 hr <sup>e</sup> | 12 hr <sup>e</sup> | 12 hr <sup>e</sup> |
| streptomycin            | Agri-mycin | 50                | 30                | –                  | –                  | –                  | –                  | –                  |
| tebuconazole            | Elite      | –                 | –                 | 12 hr <sup>e</sup> | 12 hr <sup>e</sup> | 12 hr <sup>e</sup> | –                  | –                  |
| terramycin              | Mycoshield | –                 | 60                | –                  | 21                 | 21                 | –                  | –                  |
| thiram                  | Thiram     | *                 | –                 | –                  | 7                  | –                  | –                  | –                  |
| triadimefon             | Bayleton   | 45                | 45                | –                  | –                  | –                  | –                  | –                  |
| trifloxystrobin         | Flint      | 14                | 14                | 1                  | 1                  | 1                  | 1                  | 1                  |
| triflumizole            | Procure    | 14                | 14                | 1                  | –                  | –                  | –                  | –                  |
| ziram                   | Ziram      | 14                | 5                 | 30                 | 30                 | 30                 | 30 <sup>a</sup>    | –                  |

Note: PF refers to petal fall.

<sup>a</sup>Do not apply after early cover period.

<sup>b</sup>Vanguard not registered on sweet cherries.

<sup>c</sup>Regulations vary according to rates used. Read the label carefully.

<sup>d</sup>Do not apply after shuck split and before harvest.

<sup>e</sup>Defaults to restricted entry period.

\*Registered for use on this crop, but no preharvest interval provided by registrant.

– = no registration on bearing crop.

## PREHARVEST INTERVAL CHART FOR TREE FRUIT INSECTICIDES AND MITICIDES

Numerals indicate the number of days which must elapse between the last application and harvest. Two numerals divided by a slash indicate that the required elapsed time depends on rate of application and/or number of applications. Capital letters indicate the stage(s) when you may use the material. Do not apply after or between the stages indicated. Consult the label.

| Chemical name                      | Trade name                     | Apple           | Pear               | Sweet cherry       | Tart cherry        | Peach           | Nectarine       | Apricot | Plum, prune |
|------------------------------------|--------------------------------|-----------------|--------------------|--------------------|--------------------|-----------------|-----------------|---------|-------------|
| abamectin                          | Agri-Mek                       | 28              | 28                 | —                  | —                  | —               | —               | —       | —           |
| acetamiprid                        | Assail 70WP                    | 7               | 7                  | —                  | —                  | —               | —               | —       | —           |
| amitraz                            | Mitac                          | —               | 28                 | —                  | —                  | —               | —               | —       | —           |
| azadirachtin                       | Ecozin, Aza-Direct             | f               | f                  | f                  | f                  | f               | f               | f       | f           |
| azinphos methyl                    | Guthion                        | 14/21           | 14/21              | 15                 | 15                 | 21              | 21              | —       | —           |
| <i>Bacillus thuringiensis</i> (Bt) | Dipel, Javelin, Crymax, Biobit | Δ4 hr           | Δ4 hr              | Δ4 hr              | Δ4 hr              | Δ4 hr           | Δ4 hr           | Δ4 hr   | Δ4 hr       |
| bifenazate                         | Acramite                       | 7               | 7                  | —                  | —                  | 3               | 3               | —       | 3           |
| carbaryl                           | Sevin                          | 3 <sup>b</sup>  | 3 <sup>b</sup>     | 3                  | 3                  | 3               | 3               | 3       | 3           |
| chlorpyrifos                       | Lorsban 50WP                   | DD              | —                  | —                  | 14                 | —               | —               | —       | —           |
| chlorpyrifos                       | Lorsban 4E                     | DD              | DD                 | DD/21 <sup>c</sup> | DD/21 <sup>c</sup> | 14 <sup>d</sup> | 14 <sup>d</sup> | —       | DD          |
| clofentezine                       | Apollo                         | 45              | 21                 | 21                 | 21                 | 21              | 21              | 21      | —           |
| diazinon                           | Diazinon                       | 21              | 21                 | 21                 | 21                 | 21              | 21              | 21      | 21          |
| dicofol                            | Kelthane                       | 7               | 7                  | —                  | —                  | —               | —               | —       | —           |
| diflubenzuron                      | Dimilin 2L                     | —               | 14                 | —                  | —                  | PF              | PF              | PF      | PF          |
| dimethoate                         | Dimethoate                     | 28              | 28                 | 21/28 <sup>g</sup> | 21/28 <sup>g</sup> | —               | —               | —       | —           |
| endosulfan                         | Thiodan                        | 21              | 7                  | 21                 | 21                 | 21/30           | 21/30           | 21/30   | 7           |
| esfenvalerate                      | Asana                          | 21              | 28                 | 14                 | 14                 | 14              | 14              | 14      | 14          |
| etoxazole                          | Zeal                           | 28              | 28                 | —                  | —                  | —               | —               | —       | —           |
| fenbutatin-oxide                   | Vendex                         | 14              | 14                 | 14                 | 14                 | 14              | 14              | —       | 14          |
| fenpropathrin                      | Danitol                        | 14              | 14                 | —                  | —                  | —               | —               | —       | —           |
| fenpyroximate                      | FujiMite                       | 14              | 14                 | —                  | —                  | —               | —               | —       | —           |
| formetanate hydrochloride          | Carzol                         | PF              | PF                 | —                  | —                  | PF              | PF              | —       | —           |
| gamma-cyhalothrin                  | Proaxis                        | 21              | 21                 | 14                 | 14                 | 14              | 14              | 14      | 14          |
| hexythiazox                        | Onager                         | —               | —                  | 28                 | 28                 | 28              | 28              | 28      | 28          |
| hexythiazox                        | Savey                          | 28              | 28                 | 28                 | 28                 | 28              | 28              | 28      | 28          |
| imidacloprid                       | Provado                        | 7               | 7                  | 7                  | 7                  | Δ12 hr          | Δ12 hr          | Δ12 hr  | 7           |
| indoxacarb                         | Avaunt                         | 14              | 28                 | —                  | —                  | —               | —               | —       | —           |
| kaolin clay                        | Surround                       | Δ4 hr           | Δ4 hr              | Δ4 hr              | Δ4 hr              | Δ4 hr           | Δ4 hr           | Δ4 hr   | Δ4 hr       |
| lambda-cyhalothrin                 | Warrior                        | 21              | 21                 | 14                 | 14                 | 14              | 14              | 14      | 14          |
| malathion                          | Malathion                      | —               | —                  | 1/3 <sup>g</sup>   | 1/3 <sup>g</sup>   | 7               | 7               | 7       | —           |
| methidathion                       | Supracide                      | DD              | DD                 | DD                 | DD                 | DD              | DD              | DD      | DD          |
| methomyl                           | Lannate                        | 14              | —                  | —                  | —                  | 4               | —               | —       | —           |
| methoxyfenozide                    | Intrepid                       | 14              | 14                 | 7                  | 7                  | 7               | 7               | —       | 7           |
| oxamyl                             | Vydate                         | 14 <sup>a</sup> | 14 <sup>a</sup>    | —                  | —                  | —               | —               | —       | —           |
| permethrin                         | Ambush                         | PF              | PB                 | 3                  | 3                  | 14              | —               | —       | —           |
| permethrin                         | Pounce                         | PF              | PB                 | 3                  | 3                  | 14              | 14              | —       | —           |
| phosmet                            | Imidan                         | 7               | 7                  | —                  | 7                  | 14              | 14              | 14      | 7           |
| pyridaben                          | Pyramite, Nexter               | 25              | 7                  | 300                | 300                | 7               | 7               | 300     | 7           |
| pyriproxyfen                       | Esteem                         | 45              | 45                 | 14                 | 14                 | 14              | 14              | 14      | 14          |
| soap                               | M-Pede                         | Δ12 hr          | Δ12 hr             | Δ12 hr             | Δ12 hr             | Δ12 hr          | Δ12 hr          | Δ12 hr  | Δ12 hr      |
| spinosad                           | Success, Entrust               | 7               | 7                  | 7                  | 7                  | 14              | 14              | 14      | 7           |
| thiacloprid                        | Calypso                        | 30              | 30                 | —                  | —                  | —               | —               | —       | —           |
| thiamethoxam                       | Actara                         | —               | 35/14 <sup>e</sup> | 14                 | 14                 | 14              | 14              | 14      | 14          |

Symbols: DD = Delayed Dormant PF = Petal Fall  
PB = Prebloom — = no registration on bearing crop

<sup>a</sup>Do not apply Vydate within 30 days after full bloom to avoid fruit thinning.

<sup>b</sup>Application within 30 days of full bloom may cause fruit thinning.

<sup>c</sup>Cherries: Limit 3 applications per year, one of which may be a dormant or delayed dormant. Other two only may be applied as trunk sprays. Avoid contact with sweet cherry foliage.

<sup>d</sup>Peaches and nectarines: only one application allowed during the season.

ΔPHI defaults to restricted entry Interval, see product label.

<sup>e</sup>Rates exceeding 2.75 oz/acre have 35 day PHI; rates ≤2.75 oz/acre have a 14 day PHI.

<sup>f</sup>Exempt from tolerance; may be used up to and including day of harvest.

<sup>g</sup>Labels vary. See label.

## NATURAL ENEMY RELATIVE IMPACT GUIDE—TREE FRUITS

This table is intended as a guide to the relative impact of commonly applied pesticides to natural enemies that are important components of an integrated pest management program on tree fruits. Use it in conjunction with the Pest Control Program for each fruit crop. These give recommended rates and timing of sprays. The impact of some insecticides may vary considerably with the history of use in a given orchard. This is especially true relative to their effect on the western predatory mite (WPM) and the apple rust mite (ARM).

| Compound                           | Trade Name                     | Rate/acre     | WPM <sup>2</sup> | ARM <sup>3</sup> | Relative impact rating <sup>1</sup>     |                                       |                                  |          |
|------------------------------------|--------------------------------|---------------|------------------|------------------|---|---------------------------------------|----------------------------------|----------|
|                                    |                                |               |                  |                  | <i>Colpoclypeus florus</i> <sup>4</sup> | <i>Pnigalio flavipes</i> <sup>4</sup> | <i>Coccinellids</i> <sup>5</sup> | Lacewing |
| abamectin                          | Agri-Mek                       | 10–20 fl oz   | H <sup>6</sup>   | H <sup>6</sup>   | M <sup>6</sup>                          | L                                     | M <sup>6</sup>                   | –        |
| acetamiprid                        | Assail 70WP                    | 3.4 oz        | <sup>10</sup>    | L                | –                                       | –                                     | –                                | –        |
| amitraz                            | Mitac                          | 3 pounds      | H                | –                | –                                       | –                                     | –                                | –        |
| azadirachtin                       | Ecozin                         | 10 fl oz      | –                | –                | L                                       | –                                     | L                                | –        |
| azinphos methyl                    | Guthion                        | 2 pounds      | L                | L                | H                                       | L                                     | H                                | –        |
| <i>Bacillus thuringiensis</i> (Bt) | Dipel, Javelin, Crymax, Biobit | 1–2 pounds    | L                | L                | L                                       | L                                     | L                                | –        |
| bifenazate                         | Acramite                       | 0.75–1 pound  | L                | –                | –                                       | –                                     | –                                | –        |
| carbaryl                           | Sevin 50WP                     | 2 pounds      | M-H              | L-M              | H                                       | L                                     | H                                | L        |
| chlorpyrifos                       | Lorsban 4EC                    | 2–4 pints     | L-M              | L                | H                                       | H                                     | H                                | –        |
| chlorpyrifos                       | Lorsban 50WP                   | 3 pounds      | L-M              | L                | H                                       | H                                     | H                                | L        |
| clofentezine                       | Apollo                         | 4–8 fl oz     | L                | L                | –                                       | –                                     | –                                | –        |
| diazinon                           | Diazinon 50WP                  | 4 pounds      | L                | L                | H                                       | –                                     | H                                | –        |
| dimethoate                         | Dimethoate                     | 2 quarts      | L-M              | L                | H                                       | –                                     | H                                | –        |
| endosulfan                         | Thiodan 50WP                   | 3 pounds      | L                | M-H              | M                                       | M                                     | M-H                              | L        |
| esfenvalerate                      | Asana                          | 14.5 oz       | H                | L                | M                                       | M-H                                   | –                                | L        |
| etoxazole                          | Zeal                           | 2–3 oz        | –                | –                | –                                       | –                                     | –                                | –        |
| fatty acids (soap)                 | M-Pede                         | 1–2% v/v      | M <sup>6</sup>   | M <sup>6</sup>   | –                                       | –                                     | L                                | L        |
| fenbutatin-oxide                   | Vendex                         | 1.25 pounds   | M                | H                | L                                       | –                                     | L                                | –        |
| fenpropathrin                      | Danitol                        | 20 fl oz      | H                | –                | –                                       | –                                     | –                                | –        |
| fenpyroximate                      | FujiMite                       | 1–2 pints     | –                | M                | –                                       | –                                     | –                                | –        |
| formetanate hydrochloride          | Carzol                         | 1.25 pounds   | M-H              | M-H              | H                                       | –                                     | L                                | –        |
| hexythiazox                        | Savey                          | 3–6 oz.       | L                | L                | –                                       | –                                     | –                                | –        |
| Horticultural mineral oil          |                                | 1% conc.      | M <sup>6,7</sup> | L <sup>6</sup>   | L                                       | L                                     | –                                | –        |
| imidacloprid                       | Provado                        | 4–8 fl oz     | L <sup>8</sup>   | L <sup>8</sup>   | M <sup>6</sup>                          | –                                     | M                                | L        |
| indoxacarb                         | Avaunt                         | 6 oz          | L <sup>9</sup>   | L <sup>9</sup>   | –                                       | –                                     | –                                | –        |
| kaolin                             | Surround                       | 50 pounds     | M-H              | –                | –                                       | M                                     | M-H <sup>5</sup>                 | –        |
| lime-sulfur                        |                                | 6 gal.        | M                | H                | –                                       | –                                     | –                                | –        |
| methomyl                           | Lannate LV                     | 2 pints       | H                | L                | –                                       | –                                     | –                                | –        |
| methomyl                           | Lannate SP                     | 0.5 pound     | H                | L                | –                                       | –                                     | –                                | –        |
| methoxyfenozide                    | Intrepid                       | 10 oz         | L                | L                | L                                       | L                                     | –                                | –        |
| oxamyl                             | Vydate                         | 2–4 pints     | M-H              | –                | H                                       | L-M                                   | M                                | L        |
| permethrin                         | Ambush                         | 20 fl oz      | H                | L                | M                                       | –                                     | –                                | –        |
| permethrin                         | Pounce                         | 4–8 fl oz     | H                | L                | M                                       | –                                     | –                                | –        |
| phosmet                            | Imidan                         | 3–5.33 pounds | L                | L                | H                                       | L                                     | H                                | L        |
| pyridaben                          | Pyramite                       | 4.4–8.8 oz    | M                | H                | –                                       | –                                     | –                                | –        |
| pyriproxyfen                       | Esteem 0.86 EC                 | 12 fl oz      | –                | –                | –                                       | –                                     | –                                | –        |
| spinosad                           | Success                        | 6–10 oz       | L                | –                | M-H                                     | H                                     | L                                | L        |
| thiacloprid                        | Calypso                        | 4–8 fl oz     | L                | L                | –                                       | –                                     | –                                | –        |
| thiamethoxam                       | Actara                         | 5.5 oz        | L <sup>8</sup>   | L <sup>8</sup>   | –                                       | –                                     | –                                | –        |

<sup>1</sup>Rating system: L = low impact, M = moderate impact, H = high impact, – no data available.

<sup>2</sup>WPM = western predatory mite, *Typhlodromus occidentalis*.

<sup>3</sup>ARM = apple rust mite, *Aculus schlechtendali*. Although ARM is a plant feeding species, its presence is very useful in maintaining populations of *Typhlodromus occidentalis*.

<sup>4</sup>*C. florus* is a wasp parasitoid of leafrollers; *P. flavipes* is a wasp parasitoid of western tentiform leafminer. See Orchard Pest Management for more information.

<sup>5</sup>Coccinellid data based on bioassays of late instar larvae of *Harmonia axyridis*, *Hippodamia convergens*, and *Coccinella transversoguttata*. Kaolin data based on bioassays using *Stethorus punctum*.

<sup>6</sup>Overall negative impact is reduced due to short residual activity.

<sup>7</sup>Spray volume may be important in determining toxicity.

<sup>8</sup>Preliminary data; based on field trials of 4 cover sprays.

<sup>9</sup>Preliminary data; based on field trials with a single application.

<sup>10</sup>Possible negative effect on predatory mites and/or integrated mite control.

# RELATIVE EFFICACY GUIDE FOR APPLE

This table is intended as a guide to the relative efficacy of pesticides against a given pest. Use it in conjunction with Pest Control Program for Apples, which gives recommended rates and timing of sprays. The information is based primarily on research conducted by WSU researchers in Washington. Tolerance or susceptibility may vary from one area to the next. Trade names are used for reference only and may not include all available products.

|                                    |                                   |               | Pests     |                  |                  |     |     |     |     |     |     |                  |                  |                  |     |                  |     |     |     |
|------------------------------------|-----------------------------------|---------------|-----------|------------------|------------------|-----|-----|-----|-----|-----|-----|------------------|------------------|------------------|-----|------------------|-----|-----|-----|
| Common name                        | Trade name                        | Rate/<br>acre | C         | P                | O                | W   | W   | G   | R   | W   | W   | E                | A                | T                | S   | L                | L   | C   |     |
|                                    |                                   |               | M         | L                | B                | T   | A   | A   | A   | A   | A   | F                | R                | R                | S   | J                | E   | A   | L   |
|                                    |                                   |               | PREBLOOM  |                  |                  |     |     |     |     |     |     |                  |                  |                  |     |                  |     |     |     |
| <i>Bacillus thuringiensis</i>      | Dipel DF, Javelin, Crymax, Biobit | 1–2 pounds    | —         | 3 <sup>d</sup>   | 3 <sup>d</sup>   | —   | —   | —   | —   | —   | —   | —                | —                | —                | —   | —                | —   | —   | —   |
| chlorpyrifos                       | Lorsban 4EC                       | 4 pints       | —         | 3-4              | 3-4              | 1   | —   | 2   | x   | —   | —   | —                | —                | —                | 3   | 4                | —   | 3   | —   |
| chlorpyrifos                       | Lorsban 50WP                      | 3 pounds      | —         | 3-4              | 3-4              | 1   | —   | —   | —   | —   | —   | —                | —                | —                | 4   | —                | —   | 3   | 4   |
| chlorfentazine                     | Apollo SC                         | 4–8 fl oz     | —         | —                | —                | —   | —   | —   | —   | —   | —   | 2-4 <sup>e</sup> | 1                | —                | —   | —                | —   | —   | —   |
| endosulfan                         | Thiodan 50WP                      | 4 pounds      | —         | 2                | x                | 2   | —   | 3   | 2-3 | —   | —   | —                | —                | 1                | 4   | —                | 3   | —   | —   |
| fenbutatin oxide                   | Vendex 50WP                       | 1 pound       | —         | —                | —                | —   | —   | —   | —   | —   | —   | x                | 3-4              | —                | —   | —                | —   | —   | —   |
| formetanate hydrochloride          | Carzol 92 SP                      | 1 pound       | —         | —                | —                | 1   | 4   | —   | —   | —   | 3   | 3                | 3                | 2                | x   | x                | x   | 3   | 4   |
| hexythiazox                        | Savey 50WP                        | 3–6 oz        | —         | —                | —                | —   | —   | —   | —   | —   | —   | 2-4 <sup>e</sup> | 1                | —                | —   | —                | —   | —   | —   |
| methidathion                       | Supracide 2E                      | 3 quarts      | —         | 1                | x                | x   | —   | x   | x   | —   | —   | —                | —                | 4                | 2   | —                | x   | —   | —   |
| methomyl                           | Lannate SP                        | 0.5 pound     | —         | 1                | —                | —   | —   | —   | —   | —   | —   | —                | —                | —                | 3-4 | —                | —   | —   | —   |
| horticultural mineral oil          |                                   | 1% vol: vol   | —         | 1                | x                | 1   | —   | 2   | 2   | —   | —   | 3-4              | —                | —                | 4   | —                | —   | —   | —   |
| oil + chlorpyrifos                 | Lorsban 4EC                       | 2 quarts      | —         | 3-4              | 3-4              | 1   | —   | 3   | 2-3 | —   | —   | 3-4              | —                | —                | 4   | 4                | —   | 3   | —   |
| oxamyl                             | Vydate L                          | 1 quart       | —         | x                | x                | —   | —   | x   | x   | —   | —   | —                | —                | —                | x   | x                | —   | x   | —   |
|                                    |                                   |               | POSTBLOOM |                  |                  |     |     |     |     |     |     |                  |                  |                  |     |                  |     |     |     |
| abamectin                          | Agri-Mek 0.15EC                   | 10–20 fl oz   | x         | 1                | 1                | 4   | 2   | x   | x   | x   | x   | 3 <sup>f</sup>   | 4                | 3 <sup>f</sup>   | x   | x                | x   | x   | x   |
| acetamiprid                        | Assail 70WP                       | 3.4 fl oz     | 4         | 1                | 1                | —   | 4   | 3-4 | 3-4 | —   | —   | —                | —                | 1                | —   | 1                | —   | 3-4 | 1   |
| azadirachtin                       | Neemix 4.5                        | 7 fl oz       | x         | 2                | 2                | 3   | 1-2 | 2-3 | x   | x   | x   | x                | x                | x                | x   | x                | x   | x   | x   |
| azinphos methyl                    | Guthion 50WP                      | 2 pounds      | 4         | 2 <sup>c</sup>   | x                | 1   | 1   | 2   | 1   | 2   | x   | —                | —                | —                | 2   | x                | x   | x   | 1   |
| <i>Bacillus thuringiensis</i> (Bt) | Dipel DF, Javelin, Crymax, Biobit | 1–2 pounds    | 1         | 3 <sup>d</sup>   | 3 <sup>d</sup>   | —   | —   | —   | —   | —   | —   | —                | —                | —                | —   | —                | x   | —   | —   |
| bifenazate                         | Acramite 50WS                     | 0.75–1 pound  | —         | —                | —                | —   | —   | —   | —   | —   | —   | 3-4              | x                | 4                | —   | —                | —   | —   | —   |
| carbaryl                           | Sevin 50WP                        | 2 pounds      | 2         | x                | x                | x   | 4   | 2   | x   | 1   | —   | —                | 2                | —                | 2   | x                | x   | 1   | 2   |
| diazinon                           | Diazinon 50WP                     | 4 pounds      | 2         | 1                | 1                | 1   | 2   | 2   | 3   | 4   | x   | —                | —                | 3                | x   | x                | 3   | 3   | —   |
| dimethoate                         | Dimethoate 2.67EC                 | 2 quarts      | 2         | 1                | 1                | x   | 2-3 | 2-3 | 2-3 | 3-4 | 2-3 | —                | —                | —                | x   | x                | x   | 3-4 | 1-2 |
| endosulfan                         | Thiodan 50WP                      | 3 pounds      | 1         | 1                | 1                | x   | 3-4 | 2-3 | 2-3 | 4   | 2   | —                | 2-3              | —                | x   | 3-4              | 3-4 | 3   | 2-3 |
| extoxazole                         | Zeal 72WDG                        | 2–3 oz        | —         | —                | —                | —   | —   | —   | —   | —   | —   | 3-4              | x                | 3-4              | —   | —                | —   | —   | —   |
| fenbutatin-oxide                   | Vendex 50WP                       | 1 pound       | —         | —                | —                | —   | —   | —   | —   | —   | —   | 1-4              | 3                | 2-3              | —   | —                | —   | —   | —   |
| fenpropathrin                      | Danitol 2.4EC                     | 20 fl oz      | —         | —                | —                | —   | —   | —   | —   | —   | —   | —                | —                | —                | —   | —                | —   | —   | 4   |
| fenpyroximate                      | FujiMite 5EC                      | 1–2 pints     | —         | —                | —                | —   | x   | —   | —   | —   | —   | x                | x                | x                | —   | —                | —   | —   | —   |
| formetanate hydrochloride          | Carzol 92SP                       | 1.25 pounds   | —         | —                | —                | —   | —   | —   | —   | —   | —   | —                | —                | —                | —   | —                | —   | —   | —   |
| horticultural mineral oil          |                                   | 1% vol:vol    | 3         | x                | x                | x   | 3   | 2-3 | x   | x   | x   | 2-3 <sup>g</sup> | 2-3 <sup>g</sup> | 2-3 <sup>g</sup> | x   | x                | x   | x   | x   |
| imidacloprid                       | Provado 1.6F                      | 4-8 fl oz     | x         | x                | x                | 3   | 4   | 4   | x   | x   | x   | x                | x                | x                | x   | x                | x   | x   | 1   |
| indoxacarb                         | Avaunt 30WDG                      | 6 oz          | 1-2       | 3                | 1-2              | 2-3 | 3-4 | x   | x   | x   | 2-3 | —                | —                | —                | x   | x                | 4   | x   | 1   |
| kaolin                             | Surround WP                       | 50 pounds     | 2         | 3                | 3                | —   | —   | —   | —   | —   | —   | —                | —                | —                | —   | —                | 3-4 | —   | x   |
| lambda-cyhalothrin                 | Warrior                           | 2.5–5 fl oz   | 4         | 4                | 4                | x   | x   | x   | x   | x   | x   | x                | x                | x                | x   | x                | x   | x   | 4   |
| methomyl                           | Lannate LV                        | 1.5 quarts    | x         | 2-4 <sup>b</sup> | 2-4 <sup>b</sup> | x   | 4   | 3   | x   | x   | x   | —                | —                | —                | x   | 3-4 <sup>a</sup> | x   | 3   | x   |
| methoxyfenozide                    | Intrepid 2F                       | 16 fl oz      | 3         | 3-4              | 3-4              | —   | —   | —   | —   | —   | —   | —                | —                | —                | —   | —                | 3-4 | —   | —   |
| oxamyl                             | Vydate L                          | 2 pints       | x         | 1                | 1                | 4   | 3   | 2   | x   | x   | 2   | 2                | 3                | 2-3              | x   | x                | x   | x   | —   |
| phosmet                            | Imidan 70WP                       | 3-5.33 pounds | 3-4       | —                | x                | x   | 1-2 | 2   | 1   | 2   | x   | —                | —                | —                | 2   | x                | x   | x   | —   |
| pyridaben                          | Pyramite                          | 4.4–8.8oz     | —         | —                | —                | x   | x   | x   | x   | x   | 4   | 4                | 2-3              | x                | x   | x                | x   | x   | —   |
| pyriproxyfen                       | Esteem 35 WP                      | 4–5 oz        | 3         | 4                | 4                | —   | —   | —   | —   | —   | —   | —                | —                | —                | 3-4 | —                | —   | —   | —   |
| soap                               | M-Pede                            | 1–2%          | —         | —                | —                | —   | 2-3 | 2-3 | —   | —   | —   | —                | —                | —                | —   | —                | x   | —   | 2-3 |
| spinosad                           | Success 2L                        | 6-10 fl oz    | 2-3       | 4                | 4                | 3-4 | x   | x   | x   | x   | x   | x                | x                | x                | x   | x                | 3-4 | x   | x   |
| tebufenozide                       | Confirm 2F                        | 20 fl oz      | 2-3       | 3-4              | 3-4              | 3   | —   | —   | —   | —   | —   | —                | —                | —                | —   | —                | 3-4 | —   | —   |
| thiacloprid                        | Calypso 4F                        | 4–8 oz        | 4         | 1                | 1                | —   | 4   | —   | —   | 3-4 | —   | —                | —                | —                | —   | —                | 1   | —   | 2-3 |

<sup>a</sup> Rate per 100 gallons, for trunk spray only.

<sup>b</sup> Not recommended for this use because of detrimental effects on predatory mites.

<sup>c</sup> Effective when directed against adult moth, not effective against larvae.

<sup>d</sup> Not effective against adults, use only against larval stage.

<sup>e</sup> Stages present and initial population level are critical to degree of control.

<sup>f</sup> More effective when used early in the season (before June 15). Very short residual later in summer.

<sup>g</sup> Activity by contact only. No control from residues.

Rating System: 4 = excellent control 3 = acceptable in low pressure situations  
 2 = suppression activity only 1 = poor control  
 x = no data available — = inappropriate for this pest or at this time

CM = Codling moth; PL = Pandemis leafroller; OBL = Obliquebanded leafroller; WTL = Western tentiform leafminer; WAL = White apple leafhopper; GAA = Green apple aphid; RAA = Rosy apple aphid; WAA = Woolly apple aphid; WFT = Western Flower thrips; ERM = European red mite; ARM = Apple rust mite; TSM = Twospotted spider mite; SJS = San Jose scale; LEP = cutworms, armyworms, fall webworm; LB = Lygus bug; CAM = campyloomma; LAC = Lacanobia fruitworm; SB = Stink bug.

## PEST CONTROL PROGRAM FOR APPLES

Application rates in the tables are for dilute sprays, generally 400 gallons per acre. Gallonage requirements will vary depending on tree size, density, and spray equipment. In the case of large, heavy barked trees severely infested with scale insects, more than 400 gallons may be necessary for adequate control. Concentrate applications should base rates on the amount per acre rather than the amount per 100 gallons. Regardless of the amount used per 100 gallons, do not exceed the amounts per acre given in the following table unless permitted by the label. See General Recommendations. For some of the pesticides recommended in this table, the target pest is not on the label. Such use is permissible, however, as long as the pesticide is labeled on the crop, and all other use restrictions are followed.


The materials in the following tables are not listed in order of preference.

| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations  | Amount per acre  | Amount per 100 gallons (dilute sprays)  | Minimum days between last use and harvest; restrictions, remarks   |
|---|---|--|---|--|
|  | STAGES 0–1, bud development chart (Dormant)   |  |   |  |
| San Jose scale  | 1. horticultural mineral oil + lime sulfur*   | 6 gals<br>12 gals  | 1.5 gals<br>3 gals  | See text—Special Programs.   |
|  | STAGES 2–3 (Delayed-Dormant)  |  |   |  |
| Apple mildew  | 1. myclobutanil (Rally) 40W<br>2. triflumizole (Procure) 50WS<br>3. lime sulfur*<br>4. fenarimol (Rubigan) 1EC<br>5. kresoxim-methyl (Sovran) 50WG<br>6. flowable/micronized sulfur<br>7. trifloxystrobin (Flint) 50WG  | 5 oz<br>8–16 oz<br>See label<br>12 fl oz<br>4–6.4 oz<br>See label<br>2.0–2.5 oz  | 1.25 oz<br>2–4 oz<br>See label<br>3 fl oz<br>1.0–1.6 oz<br>See label<br>0.5–0.63 oz   | Place Rally into solution before adding oil. Apply no sooner than half-inch green.<br><br>See remarks under Apple Scab.  |
| Apple scab  | 1. dodine (Syllit) 65WP<br>2. lime-sulfur*<br>3. captan (Captan) 50WP**<br>4. cyprodinil (Vanguard) 75 WG<br>5. fenarimol (Rubigan) 1EC<br>6. kresoxim-methyl (Sovran) 50WG<br>7. mancozeb (Dithane M-45)**<br>(pre-bloom schedule)<br>8. flowable/micronized sulfur<br>9. myclobutanil (Rally) 40W<br>10. thiram (Granuflo) 75WDG<br>11. triadimefon (Bayleton) 50DF<br>12. trifloxystrobin (Flint) 50WG<br>13. triflumizole (Procure) 50WS (protective schedule)<br>14. ziram (Ziram)<br><br>15. metiram (Polyram) 80DF | 2–3 lbs<br>See label<br>6 lbs<br>5 oz<br>12 fl oz<br>4–6.4 oz<br>6 lbs<br><br>See label<br>5 oz<br>5.2–6.8 lbs<br>6–8 oz<br>2.0–2.5 oz<br>8–16 oz<br><br>See label | 0.5–0.75 lbs<br>See label<br>1.5 lbs<br>1.25 oz<br>3 fl oz<br>1.0–1.6 oz<br><br>See label<br>1.25 oz<br>1.3–1.7 lbs<br>1.5–2 oz<br>0.5–0.63 oz<br>2–4 oz<br><br>See label | Use 0.5 lb. dodine 65WP per 100 gal. for protective spray; 0.75 lb. for eradicant spray. Lime sulfur rates vary by label. Do not use captan on pink through blossom stages. Place myclobutanil into solution before adding oil. Mancozeb: Begin application at half-inch green and continue on 7- to 10-day schedule through bloom. <b>Do not apply after bloom.</b> See label for restrictions. Procure: Rates vary with postinfective schedule; see label. Thiram: For concentrate ground application, apply the recommended rate in a minimum of 20 gal/A. Sovran: Do not apply more than two sequential, or exceed four total applications of Sovran, or apply more than a total of 1.6 pounds (25.6 ounces) of Sovran per acre per season. Do not apply as the final fungicide spray of the season. Flint: Do not apply more than 11 oz. of Flint per acre per season. Do not exceed more than four total applications of Flint or other strobilurin fungicides per acre per season. Vanguard: Do not apply more than 22 oz of Vanguard WG per acre per season. Do not apply within 72 days of harvest. Vanguard rate may be reduced to 3 oz/A when tank-mixed with other effective fungicides. Resistance of the scab pathogen to dodine may accelerate its resistance to another class of unrelated fungicides.<br><br>Begin applications at 1/4 to 1/2 inch green and continue on a 7- to 10-day schedule through bloom. Do not exceed 7 applications per season. Do not apply within 77 days of harvest or more than 21 lbs per acre per year. Do not graze livestock in treated areas. |

\*Lime sulfur used in prepink or pink could destroy apple rust mites, the alternate prey of predatory mites.

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.


## PEST CONTROL PROGRAM FOR APPLES (CONTINUED)

| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations  | Amount per acre  | Amount per 100 gallons (dilute sprays)  | Minimum days between last use and harvest; restrictions, remarks  |
|---|---|--|---|---|
| Cutworms  | 1. endosulfan (Thiodan) 50WP<br>2. endosulfan (Thiodan) 3EC<br>3. chlorpyrifos (Lorsban) 50WP<br>4. chlorpyrifos (Lorsban) 4EC<br>5. indoxacarb (Avaunt) 30DG<br>6. methoxyfenozide (Intrepid) 2 F  | See label<br>See label<br>See label<br>See label<br>See label<br>See label                                     | 1 lb<br>0.67 qt<br>0.5–0.75 lb<br>0.5–1.0 pint<br>1.5 oz<br>4 fl oz             | Apply thoroughly to lower trunk and base of tree.   |
| European red mite (overwintering eggs)  | 1. horticultural mineral oil  | See remarks  |   | Oil is indispensable for an integrated mite control program. Oil rate: See information in SPECIAL PROGRAMS, "Horticultural Mineral Oils, Dormant or Delayed Dormant Use."   |
| Grape mealybug  | horticultural mineral oil + one of the following:<br>1. diazinon (Diazinon) 50WP<br>2. chlorpyrifos (Lorsban) 4EC<br>3. azinphos methyl (Guthion) 50WP  | See remarks<br>4 lbs<br>4 pints<br>2–3 lbs   | 1 lb<br>1 pint<br>0.5–0.75 lbs  | Diazinon: Limited to 2 applications per season. Azinphos methyl: Applications made at rates above 2 lbs per acre can only be made in conjunction with an IPM program. New regulations require closed mixer-loader systems. Chemigation and fixed-wing aerial applications are prohibited for apples. Do not exceed 4 pounds a.i. per acre per season.   |
| Green apple aphid, apple grain aphid, rosy apple aphid                              | 1. horticultural mineral oil + chlorpyrifos (Lorsban) 4EC   | 6 gals<br>4 pints  | 1.5 gals<br>1 pint  | Bee caution: see bee hazard section. Do not allow spray or drift to reach blossoms on weeds, cover crops, or early flowering crops nearby.  |
| Lygus bugs, stink bugs  | 1. endosulfan (Thiodan) 50WP<br>2. endosulfan (Thiodan) 3EC<br>3. chlorpyrifos (Lorsban) 50WP<br>4. chlorpyrifos (Lorsban) 4EC  | 4 lbs<br>2.67 qts<br>3 lbs<br>4 pints  | 1 lb<br>0.67 qt<br>0.75 lb<br>1 pint  | Thiodan: There is a 3 lb. per acre ai limit per year. Plan ahead for potential use later in the season. If using with oil, a liquid formulation is preferred.   |
| Pandemis leafroller, obliquebanded leafroller                                       | 1. chlorpyrifos (Lorsban) 50WP<br>2. chlorpyrifos (Lorsban) 4EC   | 2–3 lbs<br>3–4 pints   | 0.5–0.75 lb<br>0.75–1.0 pint  | Apply chlorpyrifos at stage 3. If using with oil, liquid formulations are preferred.  |
| San Jose scale  | horticultural mineral oil + one of the following:<br>1. chlorpyrifos (Lorsban) 4EC<br>2. methidathion (Supracide) 2EC<br>3. pyriproxyfen (Esteem) 0.86EC  | See remarks<br>4 pints<br>3 qts<br>16 fl oz  | 1 pint<br>1.5 pints<br>4 fl oz  | Oil rate: See information in SPECIAL PROGRAMS, "Horticultural Mineral Oils, Dormant or Delayed Dormant Use." Liquid formulations are preferred for use with oil. Oil plus organo-phosphate is preferred.  |
|  | STAGES 3–4 (Prepink)  | Apply insecticides early in prepink (Stage 3) if stone fruit orchards are adjacent to minimize effect on bees. |   |   |
| Apple mildew  | 1. lime-sulfur*<br>2. calcium polysulfide (Sulfurix) 27.5<br>3. myclobutanil (Rally) 40W<br>4. triadimefon (Bayleton) 50DF<br>5. fenarimol (Rubigan) 1EC<br>6. kresoxim-methyl (Sovran) 50WG<br>7. trifloxystrobin (Flint) 50WG<br>8. triflumizole (Procure) 50WS | See label<br>5 oz<br>6–8 oz<br>12 oz<br>4.0–6.4 oz<br>2.0–2.5 oz<br>8–16 oz                                    | See label<br>1.25 oz<br>1.5–2 oz<br>3 oz<br>1.0–1.6 oz<br>0.5–0.63 oz<br>2–4 oz | DO NOT APPLY lime-sulfur or calcium polysulfide WHEN TEMPERATURES EXCEED 75°F. Other fungicides may be used at higher temperatures. Treat mildew-susceptible varieties only. Lime-sulfur appears to have little direct effect on predatory mites but use in prepink or pink could result in destruction of apple rust mites. See remarks—Apple Scab, Stages 2–3. Kresoxim-methyl: see Apple Scab, stages 2–3. |

\*Lime sulfur used in prepink or pink could destroy apple rust mites, the alternate prey of predatory mites.

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

## PEST CONTROL PROGRAM FOR APPLES (CONTINUED)


| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations  | Amount per acre              | Amount per 100 gallons (dilute sprays) | Minimum days between last use and harvest; restrictions, remarks  |
|---|---|------------------------------|--|---|
| Apple scab  | See stages 2–3  |                              |  | Start scab sprays no later than bud stage 3.  |
| Cutworms  | See stages 2–3  |                              |  |   |
| Grape mealybug  | 1. diazinon (Diazinon) 50WP<br>2. chlorpyrifos (Lorsban) 50WP<br>3. azinphos methyl (Guthion) 50WP  | 4 lbs<br>3 lbs<br>2–3 lbs    | 1 lb<br>0.75 lb<br>0.5–0.75 lb         | Azinphos methyl: see comments under stages 2–3.   |
| Green apple aphid, rosy apple aphid, apple grain aphid  | 1. endosulfan (Thiodan) 50WP<br>2. dimethoate (Dimethoate) 400  | 4 lbs<br>2.67 pints          | 1 lb<br>0.67 pint                      | Thiodan: There is a 3 lb per acre a.i. limit per year. Plan ahead for potential use later in the season. No current data exist on efficacy of materials against rosy apple aphid. Sprays become progressively less effective as the season advances and leaves curl. Prebloom sprays are preferred because of the danger of russetting Golden Delicious in the 2–4 weeks following bloom. |
| Green fruitworm   | 1. azinphos methyl (Guthion) 50WP   | 2 lbs                        | 0.5 lb                                 | Azinphos methyl: see comments under Grape mealybug, stages 2–3.   |
| Lygus bugs, stink bugs  | 1. endosulfan (Thiodan) 50WP<br>2. dimethoate (Dimethoate) 400<br>3. diazinon (Diazinon) 50WP   | 4 lbs<br>2.67 pints<br>4 lbs | 1 lb<br>0.67 pint<br>1 lb              | Diazinon: Limited to two applications per season.   |
| Pandemis leafroller, obliquebanded leafroller   | 1. chlorpyrifos (Lorsban) 50WP<br>2. <i>Bacillus thuringiensis</i> (Bt) (Dipel DF, Javelin, Biobit)<br>3. <i>Bacillus thuringiensis</i> (Bt) (Crymax) | 3 lbs<br>1–2 lbs<br>1.5 lbs  | 0.75 lb                                | Apply chlorpyrifos at stage 3 to minimize the effect on bees in adjacent cherry orchards. Bts are stomach poisons so complete coverage is very important for control. Two or three applications are usually required. Apply when forecasts predict a warm weather pattern for 3 or more days.   |
| San Jose scale  | 1. methidathion (Supracide) 25WP  | 6–12 lbs                     | 1.5–3 lbs                              | If scale is a serious problem, control should be applied at stages 2–3.   |
|  Stages 5–6 (Pink) | See text section on hazards to bees. Do not apply Class I bee toxicants when blossoms are open or after hives have been placed in the orchards.       |                              |  |   |
| Apple mildew (all varieties)  | See stages 3–4  |                              |  | EXCEPTION: On Jonathan and Rome, reduce lime-sulfur rate to 10 gals. per acre, 2.5 gals. per 100. Powdery mildew—for best results, wait until a few king blossoms are open.   |
| Apple rust mite   | 1. fenbutatin-oxide (Vendex) 50WP   | 1–1.5 lbs                    | 4–6 oz                                 | Apply only where a problem exists on Golden Delicious.  |
| Apple scab  | See stages 2–3  |                              |  | Captan should not be used during the pink through blossom stages as it may have an adverse effect on pollen germination. Apply Vanguard WG in tank mix combination with the recommended rate of a registered protectant fungicide. See label for the tank mixture instruction. Do not apply more than 22 oz of Vanguard WG per acre per season. Do not apply within 72 days of harvest.   |

## PEST CONTROL PROGRAM FOR APPLES (CONTINUED)

| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations   | Amount per acre  | Amount per 100 gallons (dilute sprays)    | Minimum days between last use and harvest; restrictions, remarks  |
|---|--|--|---|---|
| Campyloomma   | 1. formetanate hydrochloride* (Carzol) 92SP<br>2. chlorpyrifos (Lorsban) 50WP<br>3. acetamiprid (Assail) 70WP  | 1 lb<br>3 lbs<br>1.7–3.4 oz  | 0.25 lb<br>0.75 lb                        | If campyloomma nymphs are detected prior to bloom apply treatment immediately. Apply in late evening or at night; Carzol maybe applied at night after blossoms open. Carzol use is limited to 1.24 pounds per acre per season. Minimize bee hazard by spraying before bees are placed in the orchard. <b>Formetanate hydrochloride is toxic to predatory mites.</b> Assail: Use higher rates for high population numbers. |
| Codling moth  | Hand applied pheromone dispenser (e.g. Isomate-C Plus, NoMate CM, Isomate CTT)<br><br><b>+supplemental insecticides:</b> azinphos methyl (Guthion), phosmet (Imidan), acetamiprid (Assail, horticultural mineral oil, methoxyfenozide (Intrepid), pyriproxyfen (Esteem), thiacloprid (Calypso), codling moth granulosis virus (Virosoft, Cyd-X, Carpovirusine) | 400 to 200 dispensers<br><br>See rates under appropriate timing period | See rates under appropriate timing period | The number of dispensers per acre will depend on the product and pest pressure. Using reduced rates of dispensers increases the risk of fruit injury and the need for more supplemental insecticide applications. See notes below for more information.   |
| <b>Mating Disruption Program:</b> Hand-applied pheromone dispensers must be in place before the first moth flight, that is prior to bloom. Place dispensers in the top 2 feet of the tree canopy. It is strongly recommended that full label rates of any hand-applied pheromone dispenser be used. Reducing the rate of dispensers per acre will reduce efficacy and result in use of more insecticides or increased damage from codling moth. Different kinds of hand-applied pheromone dispensers release pheromone at different rates over time. Some dispensers may need to be reapplied late in the season or supplemented with insecticides if pheromone runs low.   |  |  |   |   |
| If the orchard has a history of codling moth problems, had damage the previous year (greater than 1%), or monitoring of codling moth the previous season indicated high pressure then insecticides applied at the proper timing should be used to supplement pheromone treatments. Any insecticide recommended for control of codling moth can be used as a supplement to pheromone treatments. However, Intrepid, Esteem and horticultural mineral oil should only be used in combination with pheromone treatments. Supplemental insecticides are NOT applied at the same time as the pheromone dispensers. First generation timing for horticultural mineral oil, pyriproxyfen (Esteem) or methoxyfenozide (Intrepid) is at 75 to 100 degree-days (about petal fall) after first moth (Biofix) and may be repeated as needed (see petal fall section). Intrepid, Guthion, Assail, Calypso, or Imidan can also be applied at the normal hatch timing (250 degree-days after Biofix) and repeated every 14 to 21 days as needed (see late spring and summer period). |  |  |   |   |
| Lygus bugs  | 1. dimethoate (Dimethoate) 400<br>2. endosulfan (Thiodan) 50WP   | 2.67 pints<br>4 lbs  | 0.67 pint<br>1 lb                         | Note bee hazard.<br>Thiodan: There is a 3 lb. per acre a.i. limit per year. Plan ahead for potential use later in the season.   |
| Pandemis leafroller, obliquebanded leafroller   | 1. <i>Bacillus thuringiensis</i> (Bt) (Dipel DF, Javelin, Biobit)<br>2. <i>Bacillus thuringiensis</i> (Bt) (Crymax)  | 1–2 lbs<br>1.5 lbs   |   | Bts are stomach poisons so complete coverage is very important for control. Two or three applications are usually required. Apply when forecasts predict a warm weather pattern for 3 or more days.   |
| Rosy apple aphid  | 1. dimethoate (Dimethoate) 400   | 2.67 pints   | 0.67 pint                                 | See remarks under Prepink.<br>Note bee hazard.  |
| Western flower thrips   | 1. formetanate hydrochloride* (Carzol) 92SP  | 1 lb   | 0.25 lb                                   | Minimize bee hazard by spraying before bees are placed in the orchard. Apply late evening or at night. <b>Formetanate hydrochloride is toxic to predatory mites.</b>  |

\*Detrimental to predatory mites.

## PEST CONTROL PROGRAM FOR APPLES (CONTINUED)

| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations   | Amount per acre   | Amount per 100 gallons (dilute sprays)    | Minimum days between last use and harvest; restrictions, remarks   |
|---|--|---|---|--|
|  | Stage:7<br>Bloom   | See text section on hazards to bees. Do not apply Class I bee toxicants when blossoms are open or after hives have been placed in the orchards. |   |  |
| Campyloomma   | 1. formetanate hydrochloride* (Carzol) 92SP<br>2. acetamiprid (Assail) 70WP  | 1 lb<br>1.7–3.4 oz  | 0.25 lb                                   | Carzol: See Bee Hazard information<br>Assail: Use higher rates for high populations.   |
| Fire blight   | 1. A-506 <i>Pseudomonas fluorescens</i> (BlightBan)  |   | See label                                 | Note: Apply A-506 when blossoms are open, 2-3 days before predicted warm weather (predicted high risk on Smith FB model). Repeat applications may be beneficial.<br>Apply to open flowers in sufficient water to fully wet their interiors. To suppress fire blight bacteria colony growth, begin application during the three or four days leading up to a potential fire blight infection period. If an infection event occurs, apply an effective registered antibiotic within 24 hours. Most effective fire blight control requires a combination of methods and materials.<br>Apply antibiotic spray during high or extreme risk periods. Best results obtained when applied within 24-hour window before flower wetting. Often beneficial if applied within 24 hours following flower wetting. Product used must contact the interior of the flowers in sufficient water to completely wet the interior. Application by ground equipment is most highly recommended. |
|   | 2. <i>Bacillus subtilis</i> (QST 713 Strain) (Serenade) WP   | 6–8 lb  |   |  |
|   | 3. registered antibiotic   |   | See label                                 |  |
| Pandemis leafroller, obliquebanded leafroller                                     | 1. <i>Bacillus thuringiensis</i> (Bt)<br>2. methoxyfenozide (Intrepid) 2F  | 1–2 lbs<br>16 fl oz   | 4–8 fl oz<br>4 fl oz                      |  |
| Codling moth  | Hand applied pheromone dispenser (e.g. Isomate-C Plus, NoMate CM, Isomate-CTT)   | 400 to 200 dispensers   |   | The number of dispensers per acre will depend on the product and pest pressure. Using reduced rates of dispensers increases the risk of fruit injury and the need for more supplemental insecticide applications. See notes below for more information.  |
|   | <b>+supplemental insecticides:</b><br>azinphos methyl (Guthion), phosmet (Imidan), acetamiprid (Assail), horticultural mineral oil, methoxyfenozide (Intrepid), pyriproxyfen (Esteem), thiacloprid (Calypso), codling moth granulosus virus (Virosoft, Cyd-X, Carpovirusine) | See rates under appropriate timing period   | See rates under appropriate timing period |  |

**Mating Disruption Program:** Hand-applied pheromone dispensers must be in place before the first moth flight, that is prior to bloom. Place dispensers in the top 2 feet of the tree canopy. It is strongly recommended that full label rates of any hand-applied pheromone dispenser be used. Reducing the rate of dispensers per acre will reduce efficacy and result in use of more insecticides or increased damage from codling moth. Different kinds of hand-applied pheromone dispensers release pheromone at different rates over time. Some dispensers may need to be reapplied late in the season or supplemented with insecticides if pheromone runs low.

If the orchard has a history of codling moth problems, had damage the previous year (greater than 1%), or monitoring of codling moth the previous season indicated high pressure then insecticides applied at the proper timing should be used to supplement pheromone treatments. Any insecticide recommended for control of codling moth can be used as a supplement to pheromone treatments. However, Intrepid, Esteem and horticultural mineral oil should only be used in combination with pheromone treatments. Supplemental insecticides are NOT applied at the same time as the pheromone dispensers. First generation timing for horticultural mineral oil, pyriproxyfen (Esteem) or methoxyfenozide (Intrepid) is at 75 to 100 degree-days (about petal fall) after first moth (Biofix) and may be repeated as needed (see petal fall section). Intrepid, Guthion, Assail, Calypso, or Imidan can also be applied at the normal hatch timing (250 degree-days after Biofix) and repeated every 14 to 21 days as needed (see late spring and summer period).

\*Detrimental to predatory mites.

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

## PEST CONTROL PROGRAM FOR APPLES (CONTINUED)

| Pest or disease to be controlled                                | Use any one of the listed materials or the listed combinations  | Amount per acre   | Amount per 100 gallons (dilute sprays)  | Minimum days between last use and harvest; restrictions, remarks   |
|---|---|---|---|--|
| PETAL-FALL  |   | See Hazards to Bees.  |   |  |
| Apple mildew  | <ol style="list-style-type: none"> <li>1. fenarimol (Rubigan) 1EC</li> <li>2. kresoxim-methyl (Sovran) 50WG</li> <li>3. lime-sulfur</li> <li>4. flowable/micronized sulfur 80W</li> <li>5. myclobutanil (Rally) 40W</li> <li>6. triadimefon (Bayleton) 50DF</li> <li>7. trifloxystrobin (Flint) 50WG</li> <li>8. triflumizole (Procure) 50WS</li> </ol> | 12 fl oz<br>4.0–6.4 oz<br>See label<br>See label<br>5 oz<br>6 oz<br>2.0–2.5 oz<br>8–16 oz | 3 fl oz<br>1.0–1.6 oz<br>See label<br>See label<br>1.25 oz<br>1.5 oz<br>0.5–0.63 oz<br>2–4 oz | Do not apply lime-sulfur if temperatures will exceed 75°F within 3 days of application. See mite discussion in remarks, Apple Mildew, stages 3–4. Fenarimol has a 30-day preharvest interval. Do not apply more than two sequential or exceed four total applications of Sovran, or apply more than a total of 1.6 pounds (25.6 ounces) of Sovran per acre per season. |
| Apple scab  | See stages 2–3  |   |   | Do not use captan during pink through blossom stages. See remarks on Vanguard in "pink" section.   |
| Bull's eye rot  | <ol style="list-style-type: none"> <li>1. captan (Captan) 50WP</li> <li>2. ziram (Ziram)</li> </ol>   | 6 lbs<br>See label  | 1.5 lbs<br>See label  | Use one of these materials only if scab spray is NOT used.   |
| Codling moth  | <b>Supplements to pheromone treatments:</b> <ol style="list-style-type: none"> <li>1. methoxyfenozide (Intrepid) 2F</li> <li>2. pyriproxyfen (Esteem) 35WP</li> </ol>   | 16 fl oz<br>4–5 oz  | 4 fl oz<br>See label  | See comments on timing of these products under Mating Disruption Program (pink and bloom stages).  |
| Rosy apple aphid  | <ol style="list-style-type: none"> <li>1. imidacloprid (Provado) 1.6F</li> <li>2. acetamiprid (Assail) 70WP</li> <li>3. diazinon (Diazinon) 50WP</li> <li>4. dimethoate (Dimethoate) 2.67EC</li> </ol>  | 8 fl oz<br>1.7 oz<br>4 pounds<br>4 pints  | 2 fl oz<br>See label<br>1 pound<br>1 pint   | See remarks under prepink. Diazinon and dimethoate may cause russetting of Golden Delicious. Note bee hazard. Diazinon: Limited to two applications per season.  |
| European red mite, twospotted spider mite, McDaniel spider mite | <ol style="list-style-type: none"> <li>1. hexythiazox (Savey) 50W</li> </ol>  | 4–6 oz  | 1–1.5 oz  | Hexythiazox is most effective on the egg stage. When mite populations are high and leaf bronzing has already occurred, a miticide more effective on the adult stage may be used in combination. Any of the other materials listed under spider mites in the "Late Spring and Summer" timing will also be effective at this timing.                                     |
| Grape mealybug  | <ol style="list-style-type: none"> <li>1. azinphos methyl (Guthion) 50WP</li> <li>2. diazinon (Diazinon) 50WP</li> <li>3. imidacloprid (Provado) 1.6F</li> </ol>  | 2–3 lbs<br>4 lbs<br>8 oz  | 0.5–0.75 lb<br>1 lb<br>2 fl oz  | Diazinon applied at this time may russet Golden Delicious. Note bee hazard. Diazinon: Limited to two applications per season. Azinphos methyl: See remarks, stages 2-3.  |
| Lygus bugs  | <ol style="list-style-type: none"> <li>1. endosulfan (Thiodan) 50WP</li> </ol>  | 4 lbs   | 1 lb  | Thiodan: There is a 3 lb. per acre a.i. limit per year. Plan ahead for potential use later in the season.  |
| Pandemis leafroller, obliquebanded leafroller                   | <ol style="list-style-type: none"> <li>1. <i>Bacillus thuringiensis</i> (Bt) (Dipel DF, Javelin, Biobit)</li> <li>2. <i>Bacillus thuringiensis</i> (Bt) (Crymax)</li> <li>3. methoxyfenozide (Intrepid) 2F</li> <li>4. pyriproxyfen (Esteem) 0.86EC</li> <li>5. spinosad (Success) 2L</li> </ol>  | 1–2 lbs<br>1.5 lbs<br>16 fl oz<br>16 fl oz<br>6–10 fl oz                                  | 4 fl oz<br>4 fl oz<br>2–3.3 fl oz   | All products listed are stomach poisons so complete coverage is very important for efficacy. Two or three applications of BT products are usually required to achieve acceptable control. Repeat application of methoxy-fenozide should be based on the size of leafroller populations. Esteem should be applied before the last stage leafroller larvae are present.  |

## PEST CONTROL PROGRAM FOR APPLES (CONTINUED)

| Pest or disease to be controlled | Use any one of the listed materials or the listed combinations  | Amount per acre   | Amount per 100 gallons (dilute sprays)  | Minimum days between last use and harvest; restrictions, remarks   |
|----------------------------------|---|---|---|--|
| Western tentiform leafminer      | 1. abamectin (Agri-Mek) 0.15EC<br>2. spinosad (Success) 2L  | 10 fl oz<br>6 fl oz   | 2.5 fl oz<br>1.5 fl oz  | For best results against leafminer, use an adjuvant with abamectin and spinosad. See labels for specific adjuvant recommendations. Spinosad: Best results occur when applications are timed for egg hatch, which may occur during bloom. See section on Hazards to Bees. Timing of spinosad may also be suitable for leafroller control.   |
| White apple leafhopper           | 1. endosulfan (Thiodan) 50WP<br>2. formetanate hydrochloride* (Carzol) 92SP<br>3. imidacloprid (Provado) 1.6F<br>4. indoxacarb (Avaunt) 30WDG<br>5. kaolin (Surround) WP  | 2–3 lbs<br>1 lb<br>4–8 fl oz<br>6 oz<br>See label   | 0.5–0.75 lb<br>0.25 lb<br>1–2 fl oz<br>1.5 oz<br>See label  | Carbaryl, if used for thinning is a very effective material, but the canopy spray technique may not provide adequate coverage for leafhopper control. Imidacloprid: Do not use until pollination is complete and bees have been removed from the area.   |
| 14–28 DAYS AFTER FULL BLOOM      |   | Avoid killing bees on blooming cover crops. See Hazards to Bees.  |   |  |
| Apple mildew                     | 1. fenarimol (Rubigan) 1EC<br>2. kresoxim-methyl (Sovran) 50WG<br>3. myclobutanil (Rally) 40W<br>4. triadimefon (Bayleton) 50DF<br>5. trifloxystrobin (Flint) 50WG<br>6. triflumizole (Procure) 50WS  | 12 fl oz<br>4.0–6.4 oz<br>5 oz<br>6 oz<br>2.0–2.5 oz<br>8–16 oz   | 3 fl oz<br>1.0–1.6 oz<br>1.25 oz<br>1.5 oz<br>0.5–0.63 oz<br>2–4 oz   | Sovran: See remarks under petal fall.  |
| Apple scab                       | 1. captan (Captan) 50WP**<br>2. cyprodinil (Vanguard) 75WG<br>3. dodine (Syllit) 65WP<br>4. fenarimol (Rubigan) 1EC<br>5. kresoxim-methyl (Sovran) 50WG<br>6. metiram (Polyram) 80DF<br>7. myclobutanil (Rally) 40W<br>8. thiram (Thiram Granuflo) 75WDG<br>9. trifloxystrobin (Flint) 50WG<br>10. triflumizole (Procure) 50WS<br>11. ziram (Ziram) | 6 lbs<br>See label<br>2–3 lbs<br>12 fl oz<br>4.0–6.4 oz<br>See label<br>5 oz<br>5.2–6.8 lbs<br>2.0–2.5 oz<br>8–16 oz<br>See label | 1.5 lbs<br>See label<br>0.5–0.75 lb<br>3 fl oz<br>1.0–1.6 oz<br>See label<br>1.25 oz<br>1.3–1.7 lbs<br>0.5–0.63 oz<br>2–4 oz<br>See label | Use 0.5 lb. dodine 65WP per 100 gals. for protective spray; 0.75 lb. for eradicant spray. Triflumizole: Rates vary with postinfective schedule; see label. kresoxim-methyl: See remarks under stages 2-3. Vanguard: See remarks under "pink." Metiram: Begin applications at 1/4 to 1/2 inch green and continue on a 7- to 10-day schedule through bloom. Do not exceed seven applications per season. Do not apply within 77 days of harvest or more than 21 pounds per acre per year. Do not graze livestock in treated areas. |
| Codling moth                     | 1. azinphos methyl (Guthion) 50WP<br>2. acetamiprid (Assail) 70WP + horticultural mineral oil<br>3. phosmet (Imidan) 70WP<br>4. thiacloprid (Calypso) 4F  | 3 lbs<br>3.4 oz +<br>5.33 lbs<br>4–8 fl oz  | 0.75 lbs<br>See label<br>1 lb<br>See label  | Some orchards are experiencing lower levels of control with organophosphate insecticides. Alternative approaches in these situations are suggested. Use of Assail may cause increased problems with spider mites. Guthion: Applications made at rates greater than 2 lbs/A can only be made in conjunction with an IPM program.  |

\*Detrimental to predatory mites.

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

## PEST CONTROL PROGRAM FOR APPLES (CONTINUED)

| Pest or disease to be controlled   | Use any one of the listed materials or the listed combinations   | Amount per acre  | Amount per 100 gallons (dilute sprays)   | Minimum days between last use and harvest; (PHI) restrictions, remarks  |
|--|--|--|--|---|
| Codling moth (continued)   | <b>Specific supplements to mating disruption programs:</b><br>1. horticultural mineral oil<br>2. methoxyfenozide (Intrepid) 2F<br>3. codling moth granulosis virus (Virosoft, Cyd-X, Carpovirusine)          | 1% concentration<br>16 fl oz<br>See label                | 1 gallon<br>4 fl oz<br>See label   | See comments on timing of these supplemental products under Mating Disruption Program below.  |
| <b>Mating Disruption Program:</b> Apply horticultural mineral oil as a 1% solution in water at 200, 400, and 600 degree days after biofix (first moth flight) as a supplement to mating disruption (pheromone treatments). Avoid slow drying conditions. In the second generation horticultural mineral oil should be applied to coincide with egg laying, approximately 1200, 1350, 1500 and 1650 degree days. Use of large amounts of oil year after year may cause reduced tree vigor and in some cases fruit size. |  |  |  |   |
| Methoxyfenozide is a stomach poison so complete coverage is important to good control. This product is recommended only as a supplement to mating disruption. Apply the first application of methoxyfenozide at 250 degree days and follow with additional applications at 14 day intervals for a total of 3 sprays. Methoxyfenozide can also be used in the second generation timed at egg hatch and using the same re-treatment intervals. Do not exceed limits on the amount of product allowed per year (64 oz).   |  |  |  |   |
| Codling moth granulosis virus is a highly specific control for this pest that should always be used as a component of a multi-tactic pest management program. Apply the virus one or more times per codling moth generation. The residual activity lasts only about 7 days. The affect of the virus is most often seen in a suppression of the pest's densities over time.   |  |  |  |   |
| White apple leafhopper   | 1. endosulfan (Thiodan) 50WP<br>2. horticultural mineral oil<br>3. imidacloprid (Provado) 1.6F<br>4. indoxacarb (Avaunt) 30WDG<br>5. kaolin (Surround) WP<br>6. soap (M-Pede)<br>7. thiacloprid (Calypso) 4F | 2–3 lbs<br><br>4–8 fl oz<br>6 oz<br>See label<br>4 fl oz | 0.5–0.75 lb<br>1 gal<br>1–2 fl oz<br>1.5 oz<br>See label<br>1% vol: vol<br>1 fl oz | Carbaryl, if used for thinning, is a very effective material, but the canopy spray technique may not provide adequate coverage for leafhopper control. Soap: time when egg hatch is complete, or before adults appear. Best use is for soft programs where initial leafhopper populations are low to moderate. May be phytotoxic.<br>Imidacloprid: Do not use until pollination is complete and bees have been removed from the orchard and neighboring orchards.<br>Oil: Thorough coverage is necessary for this contact material. Apply after eggs finish hatching. |
| Rosy apple aphid   | 1. acetamiprid (Assail) 70WP<br>2. imidacloprid (Provado) 1.6F   | 1.7 oz<br>8 fl oz  | See label<br>2 fl oz   | If applied to control codling moth it will provide control of rosy apple aphid as well in this timing. Use an appropriate surfactant to enhance coverage and penetration.   |

### LATE SPRING AND SUMMER

Avoid killing bees on blooming cover crops. See Hazards to Bees.

|                 |  |  |  |   |
|-----------------|--|--|--|---|
| Apple scab      | 1. captan (Captan) 50WP**<br>2. cyprodinil (Vanguard) 75WG<br>3. dodine (Syllit) 65WP<br>4. fenarimol (Rubigan) 1EC<br>5. kresoxim-methyl (Sovran) 50WG<br>6. myclobutanil (Rally) 40W<br>7. thiram (Thiram Granuflo) 75WDG<br>8. trifloxystrobin (Flint) 50WG<br>9. triflumizole (Procure) 50WS (protective schedule) | 8 lbs<br>See label<br>2–3 lbs<br>12 oz<br>4.0–6.4 oz<br>5 oz<br>5.2–6.8 lbs<br>2.0–2.5 oz<br>8–16 oz | 2 lbs<br>See label<br>0.5–0.75 lb<br>3 oz<br>1.0–1.6 oz<br>1.25 oz<br>1.3–1.7 lbs<br>0.5–0.63 oz<br>2–4 oz | Δ4 Use 0.5 lb. dodine 65WP per 100 gal. protective spray; 0.75 lb. for eradicant spray.<br>72 Procure: Rates vary with postinfective schedule; see label. Thiram: See remarks under stages 2–3. Sovran: See remarks under stages 2-3. Vanguard: See remarks under "pink."<br>30<br>14<br>Δ1<br>14<br>14 |
| Apple rust mite | 1. endosulfan (Thiodan) 50WP   | 2–4 lbs  | 0.5–1 lb   | 21 In an integrated program, do not reduce apple rust mite populations unless very high.  |

\*Detrimental to predatory mites.

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

ΔPHI not listed on label, revert to REI.

## PEST CONTROL PROGRAM FOR APPLES (CONTINUED)

| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations    | Amount per acre          | Amount per 100 gallons (dilute sprays) | Minimum days between last use and harvest; (PHI); restrictions, remarks   |
|---|---|--------------------------|--|---|
| Codling moth  | 1. azinphos methyl (Guthion) 50WP                                 | 3 lbs                    | 0.75 lb                                | 21  |
|   | 2. acetamiprid (Assail) 70WP + horticultural mineral oil          | 1.4 oz + 0.25–1.0% conc. | See label                              | 7   |
|   | 3. phosmet (Imidan) 70WP  | 5.33 lbs                 | 1 lb                                   | 7   |
|   | 4. thiacloprid (Calypso) 4F                                       | 4–8 fl oz                | 1 fl oz                                | 30  |
|   | <b>Supplements to mating disruption programs:</b>                 |                          |  |   |
|   | 1. horticultural mineral oil                                      | 1% concentration         | 1 gallon                               |   |
|   | 2. methoxyfenozide (Intrepid) 2F                                  | 16 fl oz                 | 4 fl oz                                | 14  |
|   | 3. codling moth granulosis virus (Virosoft, Cyd-X, Carpovirusine) | See label                | See label                              |   |
| <p><b>Mating Disruption Program:</b> Apply horticultural mineral oil as a 1% solution in water at 200, 400, and 600 degree days after biofix (first moth flight) as a supplement to mating disruption (pheromone treatments). Avoid slow drying conditions. In the second generation horticultural mineral oil should be applied to coincide with egg laying, approximately 1200, 1350, 1500 and 1650 degree days. Use of large amounts of oil year after year may cause reduced tree vigor and in some cases fruit size.</p> <p>Methoxyfenozide is a stomach poison so complete coverage is important to good control. This product is recommended only as a supplement to mating disruption. Apply the first application of methoxyfenozide at 250 degree days and follow with additional applications at 14 day intervals for a total of 3 sprays. Methoxyfenozide can also be used in the second generation timed at egg hatch and using the same re-treatment intervals. Do not exceed limits on the amount of product allowed per year (64 oz).</p> <p>Codling moth granulosis virus is a highly specific control for this pest that should always be used as a component of a multi-tactic pest management program. Apply the virus one or more times per codling moth generation. The residual activity lasts only about 7 days. The affect of the virus is most often seen in a suppression of the pest's densities over time.</p> |   |                          |  |   |
| Cutworms  | 1. endosulfan (Thiodan) 50WP                                      | 4 lbs                    | 1 lb                                   | 21  |
| European red mite, McDaniel spider mite, two spotted spider mite  | 1. bifentazate (Acrامة) 50WS                                      | 12–16 oz                 | 3–4 oz                                 | 7   |
|   | 2. etoxazole (Zeal) 72WDG   | 2–3 oz                   | 0.5–0.75 oz                            | 28  |
|   | 3. hexythiazox (Savey) 50W  | 4–6 oz                   | 1–1.5 oz                               | 28  |
|   | 4. pyridaben (Nexter) 75WP  | 4.4–8.8 oz               | 1.1–2.2 oz                             | 25  |
|   |   |                          |  | Nexter: use a low to moderate rate for ERM; a moderate to high rate for twospotted and McDaniel spider mites. Hexythiazox is most effective on the egg stage. When mite populations are high and leaf bronzing has already occurred, a miticide more effective on the adult stage may be used in combination. |
| Grape mealybug  | 1. azinphos methyl (Guthion) 50WP                                 | 2 lbs                    | 0.5 lb                                 | 14  |
|   | 2. carbaryl*, (Carbaryl) 4F**                                     | 2 qts                    | 1 pint                                 | 3   |
|   | 3. diazinon (Diazinon) 50WP                                       | 4 lbs                    | 1 lb                                   | 21  |
|   | 4. imidacloprid (Provado) 1.6F                                    | 8 fl oz                  | 2 fl oz                                | 7   |
|   | 5. phosmet (Imidan) 70WP  | 4.5 lbs                  | 1 lb                                   | 7   |
|   |   |                          |  | Diazinon: Limited to two applications per season.   |
| Grasshoppers  | 1. carbaryl*, (Sevin) 50WP**                                      | 2 lbs                    | 0.5 lb                                 |   |
|   | 2. carbaryl*, (Sevin) 4F**  | 2 pints                  | 8 fl oz                                |   |
|   |   |                          |  | See Special Programs.   |
| Green apple aphid   | 1. imidacloprid (Provado) 1.6F                                    | 4–8 fl. oz               | 1–2 fl. oz                             | 7   |
|   | 2. acetamiprid (Assail) 70WP                                      | 1.7 oz                   | See label                              | 7   |
|   | 3. endosulfan (Thiodan) 50W                                       | 4–5 lbs                  | 1 lb                                   | 21  |
|   |   |                          |  | Imidacloprid: Aerial application may result in slower activity or reduced control.  |
| Lacanobia fruitworm   | 1. endosulfan (Thiodan) 50WP                                      | 3 lbs                    | 0.75 lb                                | 21  |
|   | 2. indoxacarb (Avaunt) 30DG                                       | 4–6 oz                   | 1–1.5 oz                               | 28  |
|   | 3. kaolin (Surround)  | 50 lbs                   |  | Δ4hr  |
|   | 4. methoxyfenozide (Intrepid) 2F                                  | 16 fl oz                 | 4 fl oz                                | 14  |
|   | 5. spinosad (Success) 2L  | 6–10 fl oz               | 2–3.3 fl oz                            | 7   |
|   |   |                          |  | Spinosad: use only against young larvae and NOT after larvae have changed color from green to brown.  |

\*Detrimental to predatory mites.

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

ΔReverts to REI. Follow label directions, as REIs may vary from label to label.

## PEST CONTROL PROGRAM FOR APPLES (CONTINUED)

| Pest or disease to be controlled              | Use any one of the listed materials or the listed combinations    | Amount per acre | Amount per 100 gallons (dilute sprays) | Minimum days between last use and harvest; (PHI) restrictions, remarks   |
|---|---|-----------------|--|--|
| Pandemis leafroller, obliquebanded leafroller | 1. <i>Bacillus thuringiensis</i> (Bt) (Dipel DF, Javelin, Biobit) | 1–2 lbs         |  | Δ4hr Apply Intrepid, or Bt products against leafroller larvae in late June or early July.  |
|   | 2. <i>Bacillus thuringiensis</i> (Bt) (Crymax)                    | 1.5 lbs         |  | Δ4hr Bts and Intrepid are stomach poisons, so complete coverage is very important for efficacy. Two or three Bt applications are usually required to achieve acceptable control. Intrepid acts only as a stomach poison. Complete coverage is very important. Time the first application to coincide with leafroller egg hatch. A repeat application might be required if leafroller populations are high.   |
|   | 3. methoxyfenozide (Intrepid) 2F                                  | 16 fl oz        | 4 fl oz                                | 14   |
|   | 4. spinosad (Success) 2L  | 6–10 fl oz      | 2–3.3 oz                               | 7  |
| San Jose scale                                | 1. diazinon (Diazinon) 50WP**                                     | 4 lbs           | 1 lb                                   | 21 If problem is serious, apply 2 sprays, one in early to mid-June, and one 14 days later.   |
| Shothole borer                                | 1. endosulfan (Thiodan) 50WP                                      | 4 lbs           | 1 lb                                   | 21   |
| Stink bugs                                    | 1. endosulfan (Thiodan) 50WP                                      | 4–5 lbs         | 1 lb                                   | 21 Spraying orchard borders may help in control. Danitol and Warrior are highly effective against stink bugs invading orchards in late summer. Apply them only if the orchard is threatened and only to the orchard borders unless pest pressure is extreme. WARNING: Both Danitol and Warrior are toxic to predatory mites and their use can result in increased problems with spider mites. All treatments applied in late evening or early morning will have a better chance of controlling stink bugs. |
|   | 2. fenprothrin* (Danitol) 2.4EC                                   | 20 fl oz        | 5 fl oz                                | 14   |
|   | 3. lambda-cyhalothrin* (Warrior)                                  | 2.5–5 fl oz     | See label                              | 21   |
| Western tentiform leafminer                   | 1. abamectin (Agri-Mek) 0.15EC                                    | 10 fl oz        | 2.5 fl oz                              | 28 For best results against leafminer, use an adjuvant with abamectin and spinosad. See labels for specific adjuvant recommendations. Agri-Mek: May provide control of mites if used early in the season. Spinosad: Most effective when applied early in the tissue feeder stage, or earlier (peak sap feeder).  |
|   | 2. spinosad (Success) 2L  | 6–10 fl oz      | 2–3.3 fl oz                            | 7  |
| White apple leafhopper                        | 1. carbaryl*, (Sevin) 50WP**                                      | 1–2 lbs         | 0.25–0.5 lb                            | 3 Leafhoppers in some areas may be resistant to endosulfan. Carbaryl may disrupt integrated mite control depending on history of use. Use higher rate if leafhopper population is composed primarily of adults.  |
|   | 2. carbaryl*, (Sevin) 4F**  | 1–2 pints       | 4–8 fl oz                              | 3  |
|   | 3. endosulfan (Thiodan) 50WP                                      | 3 lbs           | 0.75 lb                                | 21   |
|   | 4. horticultural mineral oil                                      |                 | 1 gal                                  | 7  |
|   | 5. imidacloprid (Provado) 1.6F                                    | 4–8 fl oz       | 1–2 fl oz                              | 7  |
|   | 6. indoxacarb (Avaunt) 30WDG                                      | 4–6 oz          | 1–1.5 oz                               | 28   |
|   | 7. kaolin (Surround) WP   | See label       | See label                              | Δ4hr in slower activity or reduced control. Oil: Thorough coverage is necessary for this contact material. Repeat application may be necessary.  |
| Woolly apple aphid                            | 1. endosulfan (Thiodan) 50WP                                      | 3–4 lbs         | 0.75–1 lb                              | 21 Diazinon: Limited to two applications per season.   |
|   | 2. diazinon (Diazinon) 50WP**                                     | 4 lbs           | 1 lb                                   | 21   |
|   | 3. dimethoate (Dimethoate) 2.67EC**                               | 4 pints         | 1 pint                                 | 28   |

\*Detrimental to predatory mites.

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

ΔReverts to REI. Follow label directions, as REIs may vary from label to label.

## PEST CONTROL PROGRAM FOR APPLES (CONTINUED)

| Pest or disease to be controlled              | Use any one of the listed materials or the listed combinations    | Amount per acre          | Amount per 100 gallons (dilute sprays) | Minimum days between last use and harvest; (PHI) restrictions, remarks  |
|---|---|--------------------------|--|---|
| PREHARVEST                                    |   |                          |  |   |
| Apple scab                                    | 1. captan (Captan) 50WP**   | 6 lbs                    | 1.5 lbs                                | Δ4 Use 0.5 lb. dodine 65WP per 100 gals. for protective spray; 0.75 lb. for eradicator spray.<br>Δ1<br>14   |
|   | 2. dodine (Syllit) 65WP   | 2–3 lbs                  | 0.5–0.75 lb                            |   |
|   | 3. thiram (Thiram Granuflo) 75WDG                                 | 5.2 lbs                  | 1.3 lbs                                |   |
|   | 4. ziram (Ziram)  | See label                | See label                              |   |
| Bull's eye rot                                | 1. captan (Captan) 50WP   | 6 lbs                    | 1.5 lbs                                | Δ4<br>14  |
|   | 2. ziram (Ziram)  | See label                | See label                              |   |
| Storage rots                                  | 1. thiram (Thiram Granuflo) 75WDG                                 | 6.8 lbs                  | 1.7 lbs                                | Δ1 A ground applied, dilute application leading to excellent fruit coverage is essential for control of storage rots. Ziram: Do not exceed three applications per season.<br>14<br>14 |
|   | 2. trifloxystrobin (Flint) 50WG                                   | 2.5 oz                   | 0.63 oz                                |   |
|   | 3. ziram (Ziram Granuflo) 76WDG                                   | 8 lbs                    | 2 lbs                                  |   |
| Codling moth                                  | 1. carbaryl (Sevin) 4F  | 2 pints                  | 0.5 pint                               | 3 Use carbaryl or acetamiprid near harvest or on late-maturing varieties to prevent fruit damage from codling moth where pressure is high.<br>7                                       |
|   | 2. acetamiprid (Assail) 70WP + horticultural mineral oil          | 3.4 oz<br>0.25–1.0% conc | See label                              |   |
| Pandemis leafroller, obliquebanded leafroller | 1. <i>Bacillus thuringiensis</i> (Bt) (Dipel DF, Javelin, Biobit) | 1–2 lbs                  |  | Δ4hr Bts are stomach poisons so complete coverage is very important for control. Two or three applications are usually required.<br>Δ4hr  |
|   | 2. <i>Bacillus thuringiensis</i> (Bt) (Crymax)                    | 1.5 lbs                  |  |   |

\*Detrimental to predatory mites.

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

ΔReverts to REI. Follow label directions, as REIs may vary from label to label.

# RELATIVE EFFICACY GUIDE FOR PEARS

This table is intended as a guideline to the relative efficacy of pesticides against a certain pest. Use it in conjunction with the pest Control Program for Pears, which gives recommended rates and timing of sprays. The information in the table is based on research conducted at the WSU Wenatchee Tree Fruit Research and Extension Center. Tolerance or susceptibility may vary from one area to the next.

| Common Name               | Trade Name                | Rate/acre        | Pests <sup>d</sup> |     |       |       |       |                  |       |     |       |                  |     |     |     |
|---------------------------|---------------------------|------------------|--------------------|-----|-------|-------|-------|------------------|-------|-----|-------|------------------|-----|-----|-----|
|                           |                           |                  | P P                | C M | G M B | S J S | G A A | E R M            | P R M | S M | P B M | L E P            | S B | L B | L R |
| <b>PREBLOOM</b>           |                           |                  |                    |     |       |       |       |                  |       |     |       |                  |     |     |     |
| acetamiprid               | Assail 70WP               | 2.3–3.4 ounces   | 4                  | –   | 3-4   | x     | –     | –                | –     | –   | –     | –                | x   | x   | –   |
| azadirachtin              | Several                   |                  | 2-3                | –   | 1     | –     | x     | –                | –     | –   | –     | x                | –   | –   | –   |
| azinphos methyl           | Guthion 50WP              | 2–3 pounds       | –                  | –   | 3-4   | x     | x     | –                | –     | –   | –     | –                | 4   | x   | x   |
| chlorpyrifos              | Lorsban 4EC               | 4 pints          | –                  | –   | 3-4   | x     | x     | –                | –     | –   | –     | –                | 4   | x   | x   |
| diflubenzuron             | Dimilin 2L                | 40–48 fl ounces  | 3-4                | x   | –     | –     | –     | –                | 2-3   | –   | –     | x                | –   | –   | x   |
| endosulfan                | Thiodan 3EC               | 3 quarts         | 3-4                | –   | –     | –     | 1     | –                | 4     | –   | x     | 3-4 <sup>b</sup> | 2-3 | 2-3 | 2   |
| esfenvalerate             | Asana 0.66EC <sup>a</sup> | 1 pint           | 1-4 <sup>f</sup>   | –   | –     | –     | –     | –                | –     | –   | –     | x                | 4   | 4   | x   |
| fenpyroximate             | FujiMite 5EC              | 1–2 pints        | 3-4                | –   | –     | x     | –     | x                | 3     | x   | x     | –                | –   | –   | –   |
| horticultural mineral oil |                           | 4–6 gals         | 2-3                | –   | –     | 3     | –     | 3-4 <sup>b</sup> | x     | –   | –     | –                | –   | –   | x   |
| kaolin                    | Surround WP               | 50 lbs           | 3-4                | –   | –     | –     | –     | –                | –     | –   | –     | –                | –   | –   | –   |
| oil + chlorpyrifos        | oil + Lorsban 4EC         | 6 gal + 2 quarts | 2-3                | –   | 3     | 4     | 3     | 3-4              | x     | –   | x     | 2                | 2-3 | 2-3 | 3-4 |
| oil + diazinon            | oil + Diazinon 50WP       | 6 gal + 4 pounds | 2-3                | –   | 3     | 4     | 3     | 3                | 2     | –   | 2     | 2                | 2-3 | 2-3 | x   |
| oxamyl                    | Vydate 2L                 | 3–4 quarts       | –                  | –   | –     | –     | –     | 2                | x     | 2-3 | x     | –                | –   | –   | x   |
| permethrin                | Ambush 2EC                | 20 fl ounces     | 1-4                | –   | –     | –     | x     | –                | –     | –   | –     | –                | 4   | 4   | 4   |
| permethrin                | Pounce 3.2EC              | 12 fl ounces     | 1-4                | –   | –     | –     | –     | –                | –     | –   | –     | –                | 4   | 4   | 4   |
| pyridaben                 | Pyramite 60WP             | 8.8–13.2 ounces  | 3-4                | –   | 1-2   | –     | –     | 4                | 3-4   | 2-4 | x     | –                | x   | x   | –   |
| pyriproxyfen              | Esteem 0.86 EC            | 12–16 ounces     | 3                  | –   | –     | 3-4   | –     | –                | –     | –   | –     | –                | –   | –   | x   |
| thiacloprid               | Calypso 4F                | 6–8 fl ounces    | 4                  | –   | 3-4   | x     | x     | –                | –     | –   | –     | –                | x   | x   | –   |
| thiamethoxam              | Actara 25WP               | 5.5 ounces       | 4                  | –   | 3-4   | x     | x     | –                | –     | –   | –     | –                | x   | x   | –   |
| <b>POSTBLOOM</b>          |                           |                  |                    |     |       |       |       |                  |       |     |       |                  |     |     |     |
| abamectin                 | Agri-Mek 0.15EC           | 10–20 ounces     | 3-4                | –   | –     | –     | –     | 4                | 4     | 3-4 | –     | –                | –   | –   | –   |
| acetamiprid               | Assail 70WP               | 3.4 ounces       | 4                  | 4   | 3-4   | x     | x     | –                | –     | –   | –     | x                | x   | x   | –   |
| amitraz                   | Mitac 50W                 | 3 pounds         | 3                  | –   | 2-3   | –     | –     | 1                | 1     | 1   | x     | x                | x   | x   | –   |
| azadirachtin              | Several                   |                  | 2-3                | 1   | 1     | –     | x     | –                | –     | –   | –     | x                | –   | –   | –   |
| azinphos methyl           | Guthion 50WP              | 2.5 pounds       | 1                  | 4   | 3-4   | 2     | 1     | –                | –     | –   | –     | x                | x   | x   | 2   |
| bifenazate                | Acramite 50WS             | 0.75–1 pound     | –                  | –   | –     | –     | –     | 4                | 1-2   | 4   | x     | –                | –   | –   | –   |
| carbaryl                  | Sevin 50WP                | 4–6 pounds       | –                  | 2   | x     | 1     | 1     | –                | 3     | –   | x     | x                | 1   | 1   | –   |
| clofentezine <sup>e</sup> | Apollo SC                 | 4–8 fl ounces    | –                  | –   | –     | –     | –     | 2-4              | 1     | 2-4 | –     | –                | –   | –   | –   |
| diazinon                  | Diazinon 50WP             | 4 pounds         | –                  | 2   | 3-4   | 3     | 2-3   | –                | –     | –   | –     | x                | 3   | 3   | –   |
| diflubenzuron             | Dimilin 2L                | 1 pint           | 2-3                | 3   | –     | –     | –     | –                | 2-3   | –   | –     | x                | –   | –   | x   |
| dimethoate                | Dimethoate 2.67EC         | 4 pints          | –                  | 2   | x     | x     | 2-3   | –                | –     | –   | –     | x                | 3-4 | 3-4 | –   |
| endosulfan                | Thiodan 50WP              | 3 pounds         | 1                  | 1   | –     | 1     | 2     | –                | 1-3   | –   | x     | 3-4              | 2-3 | 2-3 | –   |
| etoxazole                 | Zeal 72WDG                | 3 ounces         | –                  | –   | –     | –     | –     | 4                | x     | 4   | x     | –                | –   | –   | –   |
| fenbutatin-oxide          | Vendex 50WP               | 1.5–2 pounds     | –                  | –   | –     | –     | –     | 1-4              | 2-4   | 2-4 | x     | –                | –   | –   | –   |
| fenpropathrin             | Danitol 2.4EC             | 20 fl ounces     | x                  | x   | x     | x     | x     | x                | x     | x   | x     | x                | 4   | x   | x   |
| fenpyroximate             | FujiMite 5EC              | 1–2 pints        | 3-4                | –   | –     | x     | –     | 4                | 3     | 4   | x     | –                | –   | –   | –   |
| formetanate hydrochloride | Carzol 92SP               | 1 pound          | 1                  | x   | x     | x     | x     | 3                | 3-4   | 2   | x     | x                | 3   | 3   | –   |
| hexythiazox               | Savey 50WP                | 4–6 ounces       | –                  | –   | –     | –     | –     | 2-4 <sup>a</sup> | 1     | 2-4 | x     | –                | –   | –   | –   |
| imidacloprid              | Provado 1.6F              | 15–20 ounces     | 3-4                | –   | 3-4   | x     | 1     | –                | –     | –   | –     | –                | –   | –   | –   |
| kaolin                    | Surround WP               | 50 lbs           | 3-4                | 2-3 | x     | x     | x     | 1-2              | 1-2   | 1-2 | x     | –                | x   | x   | x   |
| methoxyfenozide           | Intrepid 2F               | 16 fl ounces     | –                  | 2-3 | –     | –     | –     | –                | –     | –   | –     | –                | –   | –   | 3-4 |
| phosmet                   | Imidan 70WP               | 3–5.33 pounds    | 1-3                | 3-4 | 3     | 2     | 2     | –                | –     | –   | –     | x                | x   | x   | –   |
| pyridaben                 | Pyramite 60WP             | 4.4–13.2 ounces  | 3-4                | –   | x     | –     | –     | 4                | 3     | 2-3 | x     | –                | –   | –   | –   |
| pyriproxyfen              | Esteem 35WP               | 5 fl ounces      | 2-3                | 2-3 | 1     | x     | –     | –                | –     | –   | –     | x                | –   | –   | 2-4 |
| spinosad                  | Success 2L                | 6–10 ounces      | 1                  | 2-3 | –     | –     | –     | –                | –     | –   | –     | –                | 4   | –   | 4   |
| thiacloprid               | Calypso 4F                | 6–8 fl ounces    | 4                  | 3-4 | 3-4   | x     | x     | –                | –     | –   | –     | –                | x   | x   | –   |
| thiamethoxam              | Actara 25WP               | 5.5 ounces       | 4                  | –   | 3-4   | x     | x     | –                | –     | –   | –     | –                | x   | x   | –   |

<sup>a</sup>Recommended for prebloom use

<sup>b</sup>Rate per 100 gallons (cutworm spray), use as a trunk spray

<sup>c</sup>For use only on 'Bartlett' pears intended for processing

<sup>d</sup>See Relative Efficacy Guide—Apple, for information on pests not listed here

<sup>e</sup>Stages present and initial population level are critical to degree of control

<sup>f</sup>Resistance is present in many areas

Rating System:

4 = excellent control

3 = acceptable in low pressure situations

2 = suppression activity only

1 = poor control



– = inappropriate for this pest or at this time

x = no data available

PP = Pear psylla; CM = Codling moth; GMB = Grape mealybug; SJS = San Jose scale; GAA = Green apple aphid; ERM = European red mite; PRM = Pear rust mite; SM = Spider mite; PBM = Pearleaf blister mite; LEP = Cutworm, Armyworm and Fall webworm; SB = Stink bug; LB = Lygus bug, LR = Leafrollers.


## PEST CONTROL PROGRAM FOR PEARS

Application rates in the tables are for dilute sprays, generally 400 gallons per acre. Gallonage requirements will vary depending on tree size, density, and spray equipment. In the case of large, heavy-barked trees severely infested with scale insects, more than 400 gallons may be necessary for adequate control. Rates for concentrate applications should be based on the amount per acre rather than the amount per 100 gallons. Regardless of the amount used per 100 gallons, do not exceed the amounts per acre given in the following tables unless permitted by the label. See General Recommendations. For some of the pesticides recommended in this table, the target pest is not on the label. Such use is permissible, however, as long as the pesticide is labeled on the crop, and you follow all other use restrictions. The materials in the following tables are not listed in order of preference. Ask your licensed pesticide consultant for information about any emergency registrations (Section 18's) that may have been issued for use on pears after this manual was published.

| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations   | Amount per acre  | Amount per 100 gallons (dilute sprays)  | Minimum days between last use and harvest; restrictions, remarks   |
|---|--|--|---|--|
|  | STAGE 0, bud development chart (Dormant)   |  |   |  |
| Pear psylla   | horticultural mineral oil + one of the following:<br>1. endosulfan (Thiodan) 3EC<br>2. esfenvalerate (Asana XL) 0.66EC<br>3. lime sulfur<br>4. flowable/micronized sulfur<br>5. kaolin (Surround) WP<br>6. permethrin (Ambush) 2EC<br>7. permethrin (Pounce) 3.2EC<br>8. lambda-cyhalothrin (Warrior)  | 4–6 gals<br>3 qts<br>1 pint<br>11 gals<br>See label<br>25–50 lbs<br>20 fl oz<br>12 fl oz<br>2.5–5 fl oz  | 1–1.5 gals<br>0.67 qt<br>4 fl oz<br>See label<br>5 fl oz<br>3 fl oz<br>0.64–1.25 fl oz  | Do not use esfenvalerate and permethrin more than 2 times per season. Pyrethroid (numbers 2, 4, 5, 8) resistance is present in many areas and may severely reduce efficacy. Thiodan: Note the 3 lb ai/A yearly limit on endosulfan. Plan for potential use for entire season. Surround: Apply two to three applications as necessary to cover growth between dormant/delayed dormant and first bloom.  |
|  | STAGES 1–2, (Delayed-Dormant, Bud Scale Separation) Apply before new growth is exposed to minimize spray injury.   |  |   |  |
| Cutworms  | 1. chlorpyrifos (Lorsban) 4EC<br>2. endosulfan (Thiodan) 50WP<br>3. endosulfan (Thiodan) 3EC   |  | 0.5–1 pint<br>1.0 lb<br>0.67 qt   | Apply thoroughly to lower trunk and cover crop with a handgun. Note the 3 lb ai/A yearly limit on endosulfan.  |
| European red mite   | 1. horticultural mineral oil   | 6 gals   | 1.5 gals  | Use no more than 5 gals. oil per acre in concentrate sprays. In areas where pears are susceptible to oil injury, reduce dosage so that no more than 5 gals. per acre are applied during the prebloom period.   |
| Grape mealybug  | horticultural mineral oil + one of the following:<br>1. chlorpyrifos (Lorsban) 4EC<br>2. diazinon (Diazinon) 50WP**  | 6 gals<br>4 pints<br>4 lbs   | 1.5 gals<br>1 pint<br>1 lb  | Diazinon is limited to one application per season.   |
| Lygus bugs, stink bugs  | 1. dimethoate (Dimethoate) 2.67EC**<br>2. endosulfan (Thiodan) 3EC**   | 4 pints<br>3 qts   | 1 pint<br>0.67 qt   | Lygus bugs and stink bugs will be controlled by pyrethroids if they are used at this time. Note endosulfan limit above.  |
| Pear psylla   | horticultural mineral oil + one of the following:<br>1. calcium polysulfide (Sulforix)<br>2. endosulfan (Thiodan) 3EC<br>3. esfenvalerate (Asana XL) 0.66EC<br>4. kaolin (Surround) WP<br>5. lime sulfur<br>6. flowable/micronized sulfur<br>7. permethrin (Pounce) 3.2EC<br>8. acetamiprid (Assail) 70WP<br><br>9. pyriproxyfen (Esteem) 35WP<br>10. diflubenzuron (Dimilin) 2L<br>11. lambda-cyhalothrin (Warrior) | 4–6 gals<br>2 gals<br>3 qts<br>1 pint<br>25–50 lbs<br>11 gals<br>See label<br>12 fl oz<br>2.3–3.4 oz<br><br>5 oz<br>40–48 fl oz<br>2.5–5 fl oz | 1–1.5 gals<br>2 qts<br>0.67 qt<br>4 fl oz<br><br>See label<br>3 fl oz<br>See label<br><br>See label<br>10–12 fl oz<br>0.64–1.25 fl oz | Pyrethroid (e.g., Asana, Pounce, Ambush, Warrior) resistance is present in many areas and may severely reduce efficacy. Note endosulfan limit above. Surround: Apply two to three applications between dormant/delayed dormant and first bloom. Coverage of green tissue is important; apply every 2-3 weeks or as needed to cover new tree growth. Do not apply flowable micronized sulfur to Anjou pears. Note: Insect growth regulators Dimilin and Esteem are most effective when applied prior to significant egg deposition. See label. Dimilin use is limited to no more than 64 fl oz per acre per year. |



\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

## PEST CONTROL PROGRAM FOR PEARS (CONTINUED)

| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations | Amount per acre  | Amount per 100 gallons (dilute sprays) | Minimum days between last use and harvest; restrictions, remarks  |
|---|--|--|--|---|
| Pear rust mite, pearleaf blister mite   | horticultural mineral oil + one of the following:              | 4 gals   | 1 gal                                  | See remarks pertaining to oil under European red mite. Note the 3 lb ai/A yearly limit on endosulfan.   |
|   | 1. carbaryl (Sevin) 50WP                                       | 4 lbs  | 1 lb                                   |   |
|   | 2. carbaryl (Sevin) 4F   | 4 pints  | 1 pint                                 |   |
|   | OR without oil:  |  |  |   |
|   | 3. lime sulfur   | 11 gals  |  |   |
|   | 4. flowable/micronized sulfur                                  | See label  | See label                              |   |
| San Jose scale  | 5. calcium polysulfide (Sulfoxid)                              | 2 gals   | 2 qts                                  | See remarks pertaining to oil under European red mite. If scale is a problem, use a dilute spray. Use handgun for hard-to-cover problem areas.  |
|   | 6. endosulfan (Thiodan) 3EC                                    | 3 qts  | 0.67 qt                                |   |
|   | horticultural mineral oil + one of the following:              | 6 gals   | 1.5 gals                               |   |
|   | 1. chlorpyrifos (Lorsban) 4EC                                  | 4 pints  | 1 pint                                 |   |
|   | 2. methidathion (Supracide) 25WP                               | 6 lbs  | 1.5 lbs                                |   |
|   |  |  |  |   |
|  | STAGES 3–4<br>(Prepink, clusterbud to popcorn)                 | Avoid killing bees on blooming cover crops. See Hazards to Bees. |  |   |
| European red mite   | 1. horticultural mineral oil                                   | 4 gals   | 1 gal                                  | Liquid formulations are preferred for use with oil. Adequate agitation is required!   |
| Grape mealybug  | 1. diazinon (Diazinon) 50WP                                    | 4 lbs  | 1 lb                                   | Diazinon is limited to one application per season. Use a dilute spray for full coverage.<br><br>Actara: Do not make more than one prebloom application. Rate restricted to no more than 8 oz per acre per year. Use caution around bees and when applying while bees are in adjacent orchards. Follow the label restrictions regarding use around bee hives and actively foraging bees. |
|   | 2. azinphos methyl (Guthion) 50W                               | 2–3 lbs  | 0.5–0.75 lb                            |   |
|   | 3. phosmet (Imidan) 70WP                                       | 5–7 lbs  | 0.75–1 lb                              |   |
|   | 4. thiamethoxam (Actara) 25WP                                  | 5.5 oz   | See label                              |   |
|   | 5. acetamiprid (Assail) 70WP                                   | 2.3–3.4 oz   | 1.5–2 fl oz                            |   |
|   | 6. thiacloprid (Calypso) 4F                                    | 6–8 fl oz  |  |   |
| Leafrollers, lygus bugs, stink bugs, green fruitworm                              | See Pest Control Program on Apples                             |  |  | Check the label to make sure the pesticide is registered on pears.  |
| Pear psylla   | 1. esfenvalerate (Asana XL) 0.66EC                             | 1 pint   | 4 fl oz                                | Do not use esfenvalerate, pyridaben and permethrin more than 2 times per season.<br><br>Actara: Do not make more than one prebloom application. Rate restricted to no more than 8 oz per acre per year. Use caution around bees and when applying while bees are in adjacent orchards. Follow the label restrictions regarding use around bee hives and actively foraging bees.         |
|   | 2. permethrin (Pounce) 3.2EC                                   | 12 fl oz   | 3 fl oz                                |   |
|   | 3. permethrin (Ambush) 2EC                                     | 20 fl oz   | 5 fl oz                                |   |
|   | 4. pyridaben (Pyramite) 60 WP                                  | 18.8–13.2 oz   | 2.2–3.3 oz                             |   |
|   | 5. pyriproxyfen (Esteem) 35WP                                  | 5 oz   | See label                              |   |
|   | 6. diflubenzuron (Dimilin) 2L                                  | 40–48 fl oz  | 10–12 fl oz                            |   |
|   | 7. thiamethoxam (Actara) 25WP                                  | 5.5 oz   | See label                              |   |
|   | 8. acetamiprid (Assail) 70WP                                   | 2.3–3.4 oz   | 1.5–2 fl oz                            |   |
|   | 9. thiacloprid (Calypso) 4F                                    | 6–8 fl oz  |  |   |
| Pear rust mite, brown mite  | 1. formetanate hydrochloride (Carzol) 92SP                     | 1 lb   |  |   |
| San Jose scale  | See Stages 1–2   |  |  | If oil has been applied in stages 0–2, apply no more than 4 gals. per acre. Do not apply after stage 3.   |

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

## PEST CONTROL PROGRAM FOR PEARS (CONTINUED)

| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations   | Amount per acre  | Amount per 100 gallons (dilute sprays)                                 | Minimum days between last use and harvest; restrictions, remarks  |
|---|--|--|--|---|
|    | STAGES 5–6<br>(Pink, fingerbud to first white)   | Avoid killing bees on blooming cover crops. See Hazards to Bees.     |  |   |
| Pandemis leafroller, obliquebanded leafroller                                       | 1. <i>Bacillus thuringiensis</i> (Bt) (Dipel DF, Javelin, Biobit)<br>2. <i>Bacillus thuringiensis</i> (Bt) (Crymax)  | 1–2 lbs<br>1.5 lbs   |  | Bts are stomach poisons, so complete coverage is very important for control. Two or three applications are usually required. Apply when forecasts predict a warm weather pattern for 3 or more days.  |
| Pear mildew (Anjou)   | 1. kresoxim-methyl (Sovran) 50WG<br>2. triadimefon (Bayleton) 50DF<br>3. trifloxystrobin (Flint) 50WG<br>4. triflumizole (Procure) 50WS  | 4.0–6.4 oz<br>6–8 oz<br>2.0–2.5 oz<br>8–16 oz                        | 1.0–1.6 oz<br>1.5–2 oz<br>0.5–0.63 oz<br>2–4 oz                        | Sovran: Do not apply more than two sequential or exceed 4 total applications of Sovran, or apply more than a total of 1.6 pounds (25.6 ounces) of Sovran per acre per season. Do not apply as the final fungicide of the season. Do NOT use lime-sulfur or flowable micronized sulfur on Anjou.   |
| Pear mildew (other varieties)   | 1. kresoxim-methyl (Sovran) 50WG<br>2. lime-sulfur<br>3. flowable/micronized sulfur<br>4. triadimefon (Bayleton) 50DF<br>5. trifloxystrobin (Flint) 50WG<br>6. triflumizole (Procure) 50WS   | 4.0–6.4 oz<br>8 gals<br>See label<br>6–8 oz<br>2.0–2.5 oz<br>8–16 oz | 1.0–1.6 oz<br>2 gals<br>See label<br>1.5–2 oz<br>0.5–0.63 oz<br>2–4 oz | Sovran: Do not apply more than two sequential or exceed 4 total applications of Sovran, or apply more than a total of 1.6 pounds (25.6 ounces) of Sovran per acre per season.   |
| Pear scab   | 1. cyprodinil (Vanguard) 75 WG<br>2. dodine (Syllit) 65WP<br>3. kresoxim-methyl (Sovran) 50WG<br>4. lime-sulfur<br>5. mancozeb (Dithane) M-45**<br>(pre-bloom schedule)<br>6. triflumizole (Procure) 50WS<br>(protective schedule) | See label<br>3 lbs<br>4.0–6.4 oz<br>8 gals<br>6 lbs<br>8–16 oz       | See label<br>0.75 lb<br>1.0–1.6 oz<br>2 gals<br>2–4 oz                 | Do not apply Vanguard alone to pears. Do not apply more than 22 oz of Vanguard per acre per season. Do not apply within 72 days of harvest. Apply Vanguard WG in tank mixture with the recommended rate of a protectant or systemic fungicide registered on pome fruits. See label for mixing procedures. Sovran: Do not apply more than two sequential or exceed 4 total applications of Sovran, or apply more than a total of 1.6 pounds (25.6 ounces) of Sovran per acre per season. Do NOT use lime-sulfur on Anjou. Mancozeb: Begin application at half-inch green and continue on 7- to 10-day schedule through bloom. See label for restrictions. Do not apply after bloom. Procure: Rate varies when used in eradicant (postinfective) schedules. |
|  | STAGE 7<br>(First bloom to late bloom)   | Avoid killing bees on blooming cover crops. See Hazards to Bees.     |  |   |
| Codling moth  |  |  |  | See remarks in the apple section, Stage 7.  |
| Fire blight (Anjou)   | 1. terramycin (Mycoshield) 17WP  | 16 oz  | 16 oz  | Apply within 24 hours before to 24 hours after a blight infection event. Use terramycin in ground application as a concentrate spray, 1 pound per 100 gallons per acre. Preharvest interval is 60 days. Acidify alkaline spray water to below pH7.  |

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

## PEST CONTROL PROGRAM FOR PEARS (CONTINUED)

| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations    | Amount per acre | Amount per 100 gallons (dilute sprays) | Minimum days between last use and harvest (PHI); restrictions, remarks   |
|---|---|-----------------|--|--|
| Fire blight (Anjou) (continued)   | 2. A-506 <i>Pseudomonas fluorescens</i> (BlightBan)               |                 | See label                              | Note: Apply A-506 when blossoms are open, 2-3 days before predicted warm weather (predicted high risk on Smith FB model). Repeat applications may be necessary. Do not mix with other Fire Blight control materials.   |
|   | 3. <i>Bacillus subtilis</i> (QST 713 strain) (Serenade) WP        | 6–8 lbs         |  | Serenade - Apply to open flowers in sufficient water to fully wet their interiors. To suppress fire blight bacteria colony growth, begin application during the three or four days leading up to a potential fire blight infection period. If an infection event occurs, apply an effective registered antibiotic within 24 hours. Most effective fire blight control requires a combination of methods and materials.   |
| Fire blight (other varieties)   | 1. terramycin (Mycoshield) 17WP                                   | 16 oz           | 16 oz                                  | For other percentages of fixed copper, use a rate equivalent to 0.25 lb. metallic copper per 100 gals. See remarks under Fire blight-Anjou above for restrictions on terramycin.<br><br>Serenade - Apply to open flowers in sufficient water to fully wet their interiors. To suppress fire blight bacteria colony growth, begin application during the three or four days leading up to a potential fire blight infection period. If an infection event occurs, apply an effective registered antibiotic within 24 hours. Most effective fire blight control requires a combination of methods and materials. |
|   | 2. fixed copper 53WP  | 2 lbs           | 0.5 lb                                 |  |
|   | 3. copper hydroxide (Kocide 101) 77WP                             | 1 lb            | 0.5 lb                                 |  |
|   | 4. A-506 <i>Pseudomonas fluorescens</i> (BlightBan)               |                 | See label                              |  |
|   | 5. <i>Bacillus subtilis</i> (QST 713 strain) (Serenade) WP        | 6–8 lbs         |  |  |
| Pandemis leafroller, obliquebanded leafroller                               | 1. <i>Bacillus thuringiensis</i> (Bt) (Dipel DF, Javelin, Biobit) | 1–2 lbs         |  | Bts are stomach poisons, so complete coverage is very important for control. Two or three applications are usually required. Apply when forecasts predict a warm weather pattern for 3 or more days.   |
|   | 2. <i>Bacillus thuringiensis</i> (Bt) (Crymax)                    | 1.5 lbs         |  |  |
| Pear mildew   | See stages 5–6  |                 |  |  |
| Pear scab   | See stages 5–6  |                 |  |  |
| PETAL-FALL—Avoid killing bees on blooming cover crops. See Hazards to Bees. |   |                 |  |  |
| Bull's eye rot  | 1. ziram** (Ziram)  | See label       | See label                              | Apply while pear calyx is still upright.   |
| Codling moth  | See Stage 7 recommendations in apple section.                     |                 |  |  |
| Fire blight   | See stage 7 (Blossom)   |                 |  | Monitor for infection risk whenever blossoms are present. Full bloom through 30 days postbloom is time of highest risk.  |

## PEST CONTROL PROGRAM FOR PEARS (CONTINUED)

| Pest or disease to be controlled              | Use any one of the listed materials or the listed combinations   | Amount per acre   | Amount per 100 gallons (dilute sprays)  | Minimum days between last use and harvest (PHI); restrictions, remarks   |
|---|--|---|---|--|
| Grape mealybug                                | 1. azinphos methyl (Guthion) 50WP<br>2. diazinon (Diazinon) 50WP**<br>3. imidacloprid (Provado) 1.6F<br>4. phosmet (Imidan) 70WP<br>5. acetamiprid (Assail) 70WP<br>6. thiamethoxam (Actara) 25WP<br>7. thiacloprid (Calypso) 4F   | 2–3 lbs<br>4 lbs<br>16–20 fl oz<br>5.33 lbs<br>2.3–3.4 oz<br>4.5–5.5 oz<br>6–8 fl oz                          | 0.5–0.75 lb<br>1 lb<br>4–5 fl oz<br>1 lb<br>See label<br>See label<br>See label                                 | See Hazards to Bees in text.<br>Imidacloprid: Efficacy may be increased by adding 0.25% horticultural oil. Diazinon is limited to one application per season.  |
| Lygus bugs                                    | 1. dimethoate (Dimethoate) 400**<br>2. endosulfan (Thiodan) 50WP   | 2.67 pints<br>3 lbs   | 10.7 fl oz<br>0.75 lb   |  |
| Pandemis leafroller, obliquebanded leafroller | 1. <i>Bacillus thuringiensis</i> (Bt) (Dipel DF, Javelin, Biobit)<br>2. <i>Bacillus thuringiensis</i> (Bt) (Crymax)<br>3. methoxyfenozide (Intrepid) 2F<br>4. pyriproxyfen (Esteem) 35WP<br>5. spinosad (Success) 2L   | 1–2 lbs<br>1.5 lbs<br>16 fl oz<br>4–5 oz<br>6–10 fl oz  | <br><br>4 fl oz<br>1–1.25 oz<br>See label   | Bts and Intrepid are stomach poisons so complete coverage is very important for efficacy. Two or three applications of BT products are usually required to achieve acceptable control. Repeat application of Intrepid should be based on the size of leafroller populations. Apply Esteem before the last stage leafroller larvae are present. |
| Pear mildew                                   | 1. kresoxim-methyl (Sovran) 50WG<br>2. triadimefon (Bayleton) 50DF<br>3. triflumizole (Procure) 50WS   | 4.0–6.4 oz<br>6–8 oz<br>8–16 oz   | 1.0–1.6 oz<br>1.5–2 oz<br>2–4 oz  | Sovran: See remarks under stages 5–6.  |
| Pear psylla                                   | 1. abamectin (Agri-Mek) 0.15EC + horticultural mineral oil<br>2. imidacloprid (Provado) 1.6F<br>3. pyridaben (Pyramite) 60WP<br>4. thiamethoxam (Actara) 25WP<br>5. acetamiprid (Assail) 70WP<br>6. thiacloprid (Calypso) 4F<br>7. pyriproxifen (Esteem) 35WP<br>8. fenpyroximate (FujiMite) 5EC | 16–20 fl oz<br>1 gal<br>15–20 fl oz<br>8.8–13.2 oz<br>5.5 oz<br>2.3–3.4oz<br>6–8 fl oz<br>5 oz<br>16–32 fl oz | 4–5 fl oz<br>1 qt<br>3.75–5 fl oz<br>2.2–3.3 oz<br>5.5 oz<br>See label<br>1.5–2 fl oz<br>See label<br>See label | Abamectin: Do not use within 110 feet upwind of aquatic areas. Apply with 0.25% oil. Two applications maximum per season. See label.<br>Provado: Apply with horticultural mineral oil.<br>Actara: Use restrictions of 8 oz per acre per year.<br>Do not apply Assail if bees are present.  |
| Pear rust mite                                | 1. dicofol (Kelthane) 50WSP<br>2. fenbutatin-oxide (Vendex) 50WP<br>3. pyridaben (Pyramite) 60WP   | 4 lbs<br>1–1.5 lbs<br>8.8–13.2 oz   | 1 lb<br>4–6 oz<br>2.2–3.3 oz  | Kelthane: Do not make more than two applications per season.   |
| Pear scab                                     | See stages 5-6   |   |   |  |

### 14–32 DAYS AFTER FULL BLOOM (Traditional "First Cover")

|              |  |  |   |  |
|--------------|--|--|---|--|
| Codling moth | 1. azinphos methyl (Guthion) 50WP<br>2. acetamiprid (Assail) 70WP<br>3. phosmet (Imidan) 70WP<br>4. methoxyfenozide (Intrepid) 2F<br>5. methoxyfenozide (Intrepid) 2F + Isomate-C Plus<br>6. thiacloprid (Calypso) 4F<br>7. diflubenzuron (Dimilin) 2L | 3 lbs<br>3.4 oz<br>5.33 lbs<br>16 fl oz<br>16 fl oz (see petal fall for timing)<br>400 dispensers<br>(applied prior to bloom)<br>6–8 fl oz<br>16 fl oz | 0.75 lb<br>See label<br>1 lb<br>4 fl oz<br>4 fl oz<br>See label<br>1.5–2 fl oz<br>See label |  |
|--------------|--|--|---|--|

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

## PEST CONTROL PROGRAM FOR PEARS (CONTINUED)

| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations    | Amount per acre      | Amount per 100 gallons (Dilute sprays) | Minimum days between last use and harvest (PHI); restrictions, remarks |   |
|---|---|----------------------|--|--|---|
| LATE SPRING AND SUMMER (May to August)—Avoid killing bees on blooming cover crops. See Hazards to Bees. |   |                      |  |  |   |
| Codling moth  | 1. azinphos methyl (Guthion) 50WP                                 | 1–3 lbs              | 0.25–0.75 lb                           | 14   | Timing: apply first spray by 250 degree days after first moth (Biofix); if needed, apply the second spray 17–21 days later. Methoxyfenozone is a stomach poison, so complete coverage is essential for adequate control.  |
|   | 2. phosmet (Imidan) 70WP  | 3–5.33 lbs           | 0.75–1 lb                              | 7  |   |
|   | 3. methoxyfenozone (Intrepid) 2F                                  | 16 fl oz             | 4 fl oz                                | 14   |   |
|   | 4. acetamiprid (Assail) 70WP                                      | 3.4 oz               | See label                              | 7  |   |
|   | 5. pyriproxifen (Esteem) 35WP                                     | 5 oz                 | 1.25 oz                                | 45   |   |
|   | 6. diflubenzuron (Dimilin) 2L                                     | 16 fl oz             | 4 fl oz                                | 14   |   |
|   | 7. thiacloprid (Calypso) 4F                                       | 6–8 fl oz            | 1.5–2 fl oz                            | 30   |   |
| Fire blight   | See stage 7 (Blossom)   |                      |  |  |   |
| Grape mealybug  | 1. amitraz (Mitac) 50W  | 3 lbs                | 0.75 lb                                | 28   | Imidacloprid: Efficacy may be increased by adding 0.25% horticultural oil. Actara: Use no more than 8 oz of product per acre per year. Rate of more than 2.75 oz per acre has 35-day PHI; rate of less than 2.75 oz per acre has 14-day PHI.  |
|   | 2. azinphos methyl (Guthion) 50WP                                 | 2 lbs                | 0.5 lb                                 | 14   |   |
|   | 3. diazinon (Diazinon) 50WP                                       | 4 lbs                | 1 lb                                   | 21   |   |
|   | 4. imidacloprid (Provado) 1.6F                                    | 16–20 fl oz          | 4–5 fl oz                              | 7  |   |
|   | 5. phosmet (Imidan) 70WP  | 4.5 lbs              | 1 lb                                   | 7  |   |
|   | 6. thiamethoxam (Actara) 25 WP                                    | 5.5 oz               |  | 14/35  |   |
|   | 7. acetamiprid (Assail) 70WP                                      | 3.4 oz               | See label                              | 7  |   |
|   | 8. thiacloprid (Calypso) 4F                                       | 6–8 fl oz            | 1.5–2 fl oz                            | 30   |   |
| Grasshoppers  | See text—Special Programs   |                      |  |  |   |
| Green apple aphid   | 1. endosulfan (Thiodan) 50WP                                      | 2 lbs                | 0.5 lb                                 | 7  | Dimethoate may cause russetting of Anjou. Actara: See above for PHI explanation.  |
|   | 2. dimethoate (Dimethoate) 2.67EC**                               | 4 pints              | 1 pint                                 | 28   |   |
|   | 3. thiamethoxam (Actara) 25WP                                     | 4.5–5.5 oz           |  | 14/35  |   |
| Lygus bugs, stink bugs  | 1. endosulfan (Thiodan) 50WP                                      | 3 lbs                | 0.75 lb                                | 7  |   |
| McDaniel spider mite, twospotted spider mite, European red mite   | 1. abamectin (Agri-Mek) 0.15EC + horticultural mineral oil        | 10–20 fl oz<br>1 gal | 2.5–5 fl oz<br>1 qt                    | 28   | Clofentezine and hexythiazox are ovicides. When initial mite populations are high, use in combination with an adulticide. Agri-Mek: Do not use within 110 feet upwind of aquatic areas. Apply with 0.25% oil. Two applications maximum per season. See label. Pyridaben: Use 4.4–6.6 oz/A for ERM, use 8.8–13.2 oz/A for Two spotted and McDaniel spider mites. Do not apply dicofol or pyridaben more than twice per season. |
|   | 2. clofentezine (Apollo) SC                                       | 4–8 fl oz            | 1–2 fl oz                              | 21   |   |
|   | 3. dicofol (Kelthane) 50 WSP                                      | 4–6 lbs              | 1–1.5 lbs                              | 7  |   |
|   | 4. fenbutatin-oxide (Vendex) 50WP                                 | 1.5–2 lbs            | 6–8 oz                                 | 14   |   |
|   | 5. hexythiazox (Savey) 50WP                                       | 4–6 oz               | 1–1.5 oz                               | 28   |   |
|   | 6. pyridaben (Pyramite) 60WP                                      | 4.4–13.2 oz          | 1.1–3.3 oz                             | 7  |   |
|   | 7. bifentazate (Acramite) 50WS                                    | 12–16 oz             | 3–4 oz                                 | 7  |   |
|   | 8. etoxazole (Zeal) 72 WDG  | 3 oz                 | See label                              | 28   |   |
|   | 9. fenpyroximate (FujiMite) 5EC                                   | 16–32 fl oz          | See label                              | 14   |   |
| Pandemis leafroller, obliquebanded leafroller   | 1. <i>Bacillus thuringiensis</i> (Bt) (Dipel DF, Javelin, Biobit) | 1–2 lbs              |  | Δ4hr   | Bts are stomach poisons so complete coverage is very important for control. Two or three applications are usually required. Apply when forecasts predict a warm weather pattern for 3 or more days.   |
|   | 2. <i>Bacillus thuringiensis</i> (Bt) (Crymax)                    | 1.5 lbs              |  | Δ4hr   |   |
|   | 3. methoxyfenozone (Intrepid) 2F                                  | 16 fl oz             | 4 fl oz                                | 14   |   |
|   | 4. spinosad (Success) 2L  | 6–10 fl oz           | See label                              | 7  |   |

\*Detrimental to predatory mites.

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

ΔPHI defaults to restricted entry Interval.

## PEST CONTROL PROGRAM FOR PEARS (CONTINUED)

| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations | Amount per acre      | Amount per 100 gallons (Dilute sprays) | Minimum days between last use and harvest (PHI); restrictions, remarks   |  |
|---|--|----------------------|--|--|--|
| Pearleaf blister mite   | 1. carbaryl (Sevin) 50WP**                                     | 4–6 lbs              | 1–1.5 lbs                              | 3  | If used in apple/pear interplant blocks, carbaryl may disrupt biological mite control, depending on history of use. Do not apply carbaryl prior to 30 days after full bloom.   |
|   | 2. carbaryl (Sevin) 4F**                                       | 4–6 pints            | 1–1.5 pints                            | 3  |  |
|   | 3. abamectin (Agri-Mek) 0.15EC + horticultural mineral oil     | 16 fl oz<br>1 gal    | 4 fl oz<br>1 qt                        | 28   |  |
| Pear psylla   | 1. abamectin (Agri-Mek) 0.15EC + horticultural mineral oil     | 16–20 fl oz<br>1 gal | 4–5 fl oz<br>1 qt                      | 28   | Agri-Mek: Do not use within 110 feet upwind of aquatic areas. Apply with 0.25% oil. Two applications maximum per season. See label. Imidacloprid: Efficacy may be increased by adding 0.25% horticultural oil. Actara: Yearly total use restriction is 8 oz of product per acre. See PHI explanation in remarks under Grape mealybug. Acetamiprid: Yearly total use restriction is 13.5 oz of product per acre. Azadirachtin: These products have relatively short residues; reapplication may be necessary for control. |
|   | 2. amitraz (Mitac) 50W   | 3 lbs                | 0.75 lb                                | 28   |  |
|   | 3. imidacloprid (Provado) 1.6F                                 | 16–20 fl oz          | 4–5 fl oz                              | 7  |  |
|   | 4. pyridaben (Pyramite) 60WP                                   | 8.8–13.2 oz          | 2.2–3.3 oz                             | 7  |  |
|   | 5. thiamethoxam (Actara) 25WP                                  | 5.5 oz               | See label                              | 14/35  |  |
|   | 6. acetamiprid (Assail) 70WP                                   | 2.3–3.4 oz           | See label                              | 7  |  |
|   | 7. azadirachtin (several)                                      | See label            |  |  |  |
|   | 8. thiacloprid (Calypso) 4F                                    | 6–8 fl oz            | 1.5–2 fl oz                            | 30   |  |
|   | 9. fenpyroximate (FujiMite) 5EC                                | 16–32 fl oz          | See label                              | 14   |  |
| Pear rust mite  | 1. fenbutatin-oxide (Vendex) 50WP                              | 1.5–2 lbs            | 6–8 oz                                 | 14   | Resistance to fenbutatin-oxide exists in many areas.   |
|   | 2. dicofol (Kelthane) 50WSP                                    | 4 lbs                | 1 lb                                   | 7  |  |
|   | 3. pyridaben (Pyramite) 60WP                                   | 8.8–13.2 oz          | 2.2–3.3 oz                             | 7  |  |
| Pear sawfly   | 1. azinphos methyl (Guthion) 50WP                              | 1–2 lbs              | 0.25–0.5 lb                            | 14   |  |
| Pear scab   | 1. dodine (Syllit) 65WP  | 3 lbs                | 0.75 lb                                | 7  | Apply every 12 days until dry weather. Sovran: Do not apply more than 2 sequential, or exceed 4 total applications of Sovran, or apply more than a total of 1.6 pounds (25.6 ounces) of Sovran per acre per season.  |
|   | 2. kresoxim-methyl (Sovran) 50WG                               | 4.0–6.4 oz           | 1.0–1.6 oz                             | 30   |  |
|   | 3. trifloxystrobin (Flint) 50WG                                | 2.0–2.5 oz           | 0.5–0.63 oz                            | 14   |  |
| San Jose scale  | 1. diazinon (Diazinon) 50WP**                                  | 4 lbs                | 1 lb                                   | 21   |  |
| <b>PREHARVEST</b>   |  |                      |  |  |  |
| Bull's eye rot  | 1. ziram (Ziram Granuflo) 76WDG                                | 8 lbs                | 2 lbs                                  | 5  | Because of visible residues, do not use ziram on Asian pears.  |
| Storage rots  | 1. trifloxystrobin (Flint) 50WG                                | 2.5 oz               | 0.63                                   | 14   | A ground applied, dilute application leading to excellent coverage is essential for the control of storage rots. Ziram: Make no more than three applications per season.   |
|   | 2. ziram (Ziram Granuflo) 76WDG                                | 8 lbs                | 2 lbs                                  | 5  |  |
| <b>POSTHARVEST—Avoid killing bees on blooming cover crops. See Hazards to Bees.</b> |  |                      |  |  |  |
| Pearleaf blister mite, pear rust mite   | 1. carbaryl (Sevin) 50WP**                                     | 4–6 lbs              | 1–1.5 lbs                              | Lime-sulfur: See text—Potential Fruit & Leaf Injury. If used in apple/pear interplant blocks, carbaryl may disrupt biological mite control, depending on history of use. Thiodan use is limited to a total of 3 pounds of active ingredient per acre per year. |  |
|   | 2. carbaryl (Sevin) 4F**                                       | 4–6 pints            | 1–1.5 pints                            |  |  |
|   | 3. endosulfan (Thiodan) 50WP                                   | 3 lbs                | 0.75 lb                                |  |  |
|   | 4. lime-sulfur + horticultural mineral oil                     | See label<br>3 gals  | See label<br>3 qts                     |  |  |
|   | 5. flowable/micronized sulfur                                  | See label            | See label                              |  |  |

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

## PEST CONTROL PROGRAM FOR PEARS (CONTINUED)



| Pest or disease to be controlled | Use any one of the listed materials or the listed combinations   | Amount per acre                            | Amount per 100 gallons (Dilute sprays)   | Minimum days between last use and harvest (PHI); restrictions, remarks  |
|----------------------------------|--|--|--|---|
| Pear psylla                      | 1. lime-sulfur + horticultural mineral oil<br>2. flowable/micronized sulfur<br>3. calcium polysulfide (Sulforix) | See label<br>3 gals<br>See label<br>2 gals | See label<br>3 qts<br>See label<br>2 qts | Lime-sulfur: Follow label directions regarding apple interplants and orchard borders. See text—Potential Fruit & Leaf Injury. |

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

# STONE FRUITS



## PEST CONTROL PROGRAM FOR CHERRIES

Application rates in the tables are for dilute sprays, generally 400 gallons per acre. Gallonage requirements will vary depending on tree size, density, and spray equipment. In the case of large, heavy-barked trees severely infested with scale insects, more than 400 gallons may be necessary for adequate control. Concentrate applications should base rates on the amount per acre rather than the amount per 100 gallons. Regardless of the amount used per 100 gallons, do not exceed the amounts per acre given in the following tables unless permitted by the label. See General Recommendations. For some of the pesticides recommended in this table, the target pest is not on the label. Such use is permissible, however, as long as the pesticide is labeled on the crop, and you follow all other use restrictions. The materials in the following tables are not listed in order of preference.

| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations   | Amount per acre               | Amount per 100 gallons (dilute sprays) | Minimum days between last use and harvest; restrictions, remarks  |
|---|--|-------------------------------|--|---|
|  | STAGE 0, bud development chart (Dormant)   |                               |  |   |
| Coryneum blight, bacterial gummosis   | 1. copper hydroxide (numerous products)<br>2. fixed copper (+ sticker)   | See label<br>See label        | See label<br>See label                 | Rates vary according to manufacturer. Convert copper formulations so that there are 2.5 lbs. metallic copper per 100 gals. To best control gummosis, apply copper sprays before break of dormancy, frost, and wet weather.  |
|  | STAGE 1 (Delayed-Dormant)  |                               |  |   |
| Black cherry aphid  | 1. horticultural mineral oil + an insecticide registered for this pest   | 4–6 gals                      | 1–1.5 gals                             | Liquid formulations are preferred for use with oil. Adequate agitation is required.   |
| Coryneum blight   | 1. chlorothalonil (Bravo)  | See label                     | See label                              |   |
| Cutworms  | 1. endosulfan (Thiodan) 50WP<br>2. endosulfan (Thiodan) 3EC**<br>3. chlorpyrifos (Lorsban) 4EC                         |                               | 1 lb<br>1.3 pints<br>0.5–1 pint        | Apply thoroughly to lower trunk and cover crop with a handgun. Endosulfan application is limited to 3 lbs ai/A per season. Plan ahead for full season's potential use.  |
| European red mite   | 1. horticultural mineral oil<br>2. clofentezine (Apollo) SC<br>3. hexythiazox (Savey) 50WP                             | 4 gals<br>4–8 fl oz<br>4–6 oz | 1 gal<br>1–2 fl oz<br>1–1.5 oz         | Adequate agitation is required.   |
| Spider mite (two spotted)   | 1. fenbutatin-oxide (Vendex) 50WP  | 1–2 lbs                       | 0.25–0.5 lb                            | Vendex: Make no more than 2 applications per year.  |
| San Jose scale, lecanium scale  | horticultural mineral oil + one of the following:<br>1. chlorpyrifos (Lorsban) 4EC<br>2. methidathion (Supracide) 25WP | 4–6 gals<br>4 pints<br>6 lbs  | 1–1.5 gals<br>1 pint<br>1.5 lbs        | Oil plus an organophosphate is preferred because the combination provides the most effective control for scale insects and other pests. Liquid formulations are preferred with oils, and tank agitation is required. Do not use more than 5 gallons of oil per acre concentrate on mature trees. See text—Special Programs. |
| Shothole borer, ambrosia beetle   | 1. endosulfan (Thiodan) 50WP<br>2. endosulfan (Thiodan) 3EC  |                               | 1 lb<br>1.3 pints                      | Adults are active when daily high temperatures exceed 65°F. Spray to control active adults. Note endosulfan limit above.  |

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

## PEST CONTROL PROGRAM FOR CHERRIES (CONTINUED)

| Pest or disease to be controlled  | Use any one the listed materials or the listed combinations  | Amount per acre   | Amount per 100 gallons (dilute sprays)   | Minimum days between last use and harvest; restrictions, remarks  |
|---|--|---|--|---|
|    |  |   |  |   |
| STAGES 2–5 (Prebloom)   |  | See text—Hazards to Bees  |  |   |
| Black cherry aphid  | 1. endosulfan (Thiodan) 50WP<br>2. diazinon (Diazinon) 50WP**  | 4 lbs<br>4 lbs  | 1 lb<br>1 lb   | Endosulfan is restricted to a total of 3 lbs ai/A per year. Plan ahead for potential applications needed later in the season. Diazinon is limited to one application per season.  |
| Coryneum blight   | 1. azoxystrobin (Abound)<br>2. pyraclostrobin + boscalid (Pristine)  | 11–15.4 fl oz<br>10.5–14.5 oz   | 2.75–3.85 fl oz<br>2.6–3.6 oz  | <b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label.<br>Pristine: Apply no more than 72.5 oz per acre per season.   |
| Cherry rust mite  | 1. endosulfan (Thiodan) 50WP   | 4 lbs   | 1 lb   | Note endosulfan limit above.  |
| Cutworms  | 1. endosulfan (Thiodan) 50WP   |   | 1 lb   | Apply thoroughly to lower trunk and cover crop with a handgun.  |
| Lecanium scale  | 1. malathion (Malathion) 8EC**<br>2. diazinon (Diazinon) 4 EC  | 3 pints<br>4 pints  | 12 fl oz<br>1 pint   | Malathion EC may cause leaf injury. See Potential Fruit & Leaf Injury. Diazinon is limited to one application per season.   |
| Pandemis leafroller, oblique-banded leafroller                                      | 1. <i>Bacillus thuringiensis</i> (Bt)<br>2. spinosad (Success) 2L  | Rates vary<br>4–8 fl oz   | See label<br>1–2 fl oz   | Bts are stomach poisons so complete coverage is very important for control. Two or three applications are usually required. Apply when forecasts predict a warm weather pattern for 3 or more days.   |
|  |  |   |  |   |
| STAGES 6–7 (Blossom)  |  |   |  |   |
| Brown rot (blossom blight)  | 1. azoxystrobin (Abound)<br>2. captan (Captan) 50WP**<br>3. fenbuconazole (Indar) 75WSP<br>4. iprodione (Rovral) 50W**<br>5. flowable/micronized sulfur<br>6. myclobutanil (Rally) 40W<br>7. propiconazole (Orbit)<br>8. triflumizole (Procure) 50WS<br>9. pyraclostrobin (Cabrio)<br>10. pyraclostrobin + boscalid (Pristine) | 11–15.4 fl oz<br>4 lbs<br>2 oz<br>1–2 lbs<br>See label<br>5 oz<br>4 fl oz<br>12–16 oz<br>9.5 oz<br>10.5–14.5 oz | 2.75–3.85 fl oz<br>1 lb<br>0.5 oz<br>0.25–0.5 lb<br>See label<br>1.25 oz<br>See label<br>3–4 oz<br>See label<br>2.6–3.6 oz | Myclobutanil: Make a second application at petal fall if disease-conducive weather occurs.<br>Iprodione: Apply at 5% bloom; do not exceed two preharvest applications per season. Apply again at full bloom or at petal fall if disease-conducive weather occurs.<br>Fenbuconazole: Do not apply more than 0.75 pound ai per acre per season.<br><b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season.<br>Pristine: Apply no more than 72.5 oz per acre per season. |
| Coryneum blight   | 1. azoxystrobin (Abound)<br>2. pyraclostrobin + boscalid (Pristine)  | 11–15.4 fl oz<br>10.5–14.5 oz   | 2.75–3.85 fl oz<br>2.6–3.6 oz  | Pristine: Apply no more than 72.5 oz per acre per season.   |

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

## PEST CONTROL PROGRAM FOR CHERRIES (CONTINUED)

| Pest or disease to be controlled                                    | Use any one of the listed materials or the listed combinations  | Amount per acre  | Amount per 100 gallons (dilute sprays)   | Minimum days between last use and harvest (PHI); restrictions, remarks  |
|---|---|--|--|---|
| Powdery mildew  | 1. myclobutanil (Rally) 40W<br>2. azoxystrobin (Abound)<br>3. trifloxystrobin (Flint)<br>4. triflumizole (Procure) 50WS<br>5. potassium bicarbonate<br>6. pyraclostrobin (Cabrio)<br>7. pyraclostrobin + boscalid (Pristine)<br>8. quinoxyfen (Quintec) | 5 oz<br>11–15.4 fl oz<br>2–4 oz<br>10–16 oz<br>Rates vary<br>9.5 oz<br>10.5–14.5 oz<br>7 fl oz | 1.25 oz<br>2.75–3.85 fl oz<br>0.5–1 oz<br>2.5–4 oz<br>See label<br>See label<br>2.6–3.6 oz<br>1.75 fl oz | Place into solution before adding oil.<br><b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season.<br>Pristine: Apply no more than 72.5 oz per acre per season.<br>Quintec: Do not apply more than 35 oz per calendar year. Do not make more than two sequential applications or more than five total applications per year. |
| PETAL-FALL (100% petal fall)—See Hazards to Bees.                   |   |  |  |   |
| Black cherry aphid  | 1. diazinon (Diazinon) 4EC**<br>2. imidacloprid (Provado) 1.6   | 4 pints<br>4–8 fl oz   | 1 pint<br>2 fl oz  | Diazinon is limited to one application per season.  |
| Brown rot   | See stages 6–7 (Blossom)  |  |  |   |
| Fruittree leafroller  | 1. endosulfan (Thiodan) 50WP  | 4 lbs  | 1 lb   | Endosulfan is limited to 3 lbs ai/A per season.   |
| Pandemis leafroller, obliquebanded leafroller                       | 1. <i>Bacillus thuringiensis</i> (Bt)<br>2. spinosad (Success) 2L<br>3. spinosad (Entrust)<br>4. pyriproxyfen (Esteem) 35WP   | Rates vary<br>4–8 fl oz<br>1.25–2.5 oz<br>4–5 oz   | See label<br>1–2 fl oz<br>0.3–0.6 oz<br>See label  | Bts must be ingested by pest, so complete coverage is necessary for efficacy. Apply when warm weather is predicted for 3 or more days. Two or three applications per pest generation may be required to achieve adequate control. Time pyriproxyfen to coincide with the presence of large leafroller larvae for best effect.   |
| Powdery mildew  | 1. fenarimol (Rubigan) 1EC<br>2. azoxystrobin (Abound)<br>3. trifloxystrobin (Flint)<br>4. triflumizole (Procure) 50WS<br>5. potassium bicarbonate<br>6. pyraclostrobin + boscalid (Pristine)<br>7. quinoxyfen (Quintec)                                | 6–12 fl oz<br>11–15.4 fl oz<br>2–4 oz<br>10–16 oz<br>10.5–14.5 oz<br>7 fl oz                   | 1.5–3 fl oz<br>2.75–3.85 fl oz<br>0.5–1 oz<br>2.5–4 oz<br>See label<br>2.6–3.6 oz<br>1.75 fl oz          | <b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season. Pristine: Apply no more than 72.5 oz per acre per season. Quintec: Do not apply more than 35 oz per calendar year. Do not make more than two sequential applications or more than five applications per year.   |
| SHUCK FALL—See Hazards to Bees.                                     |   |  |  |   |
| Black cherry aphid  | See Petal-Fall  |  |  |   |
| Brown rot   | See stages 6–7 (Blossom)  |  |  |   |
| Coryneum blight   | 1. captan (Captan) 50WP**<br>2. azoxystrobin (Abound)<br>3. pyraclostrobin + boscalid (Pristine)  | 4 lbs<br>11–15.4 fl oz<br>10.5–14.5 oz   | 1 lb<br>2.75–3.85 fl oz<br>2.6–3.6 oz  | Azoxystrobin: See remarks under powdery mildew at petal fall.<br>Pristine: Apply no more than 72.5 oz per acre per season.  |
| Pandemis leafroller, fruittree leafroller, obliquebanded leafroller | 1. <i>Bacillus thuringiensis</i> (Bt)<br>2. spinosad (Success) 2L<br>3. spinosad (Entrust)  | Rates vary.<br>6–8 fl oz<br>1.25–2.5 oz  | See label<br>1.5–2 fl oz<br>0.3–0.6 oz   | Bts are stomach poisons so complete coverage is very important for control. Two or three applications are usually required. Apply when forecasts predict a warm weather pattern for 3 or more days.   |

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

\*Detrimental to predatory mites.

## PEST CONTROL PROGRAM FOR CHERRIES (CONTINUED)

| Pest or disease to be controlled              | Use any one of the listed materials or the listed combinations   | Amount per acre  | Amount per 100 gallons (dilute sprays)   | Minimum days between last use and harvest (PHI); restrictions, remarks  |
|---|--|--|--|---|
| Powdery mildew                                | 1. fenarimol (Rubigan) 1EC<br>2. myclobutanil (Rally) 40W<br>3. tebuconazole (Elite) 45DF<br>4. flowable/micronized sulfur<br>5. propiconazole (Orbit)<br>6. azoxystrobin (Abound)<br>7. horticultural mineral oil (light summer weight)<br>8. trifloxystrobin (Flint)<br>9. triflumizole (Procure) 50WS<br>10. potassium bicarbonate<br>11. pyraclostrobin (Cabrio)<br>12. pyraclostrobin + boscalid (Pristine)<br>13. quinoxyfen (Quintec) | 6–12 fl oz<br>5 oz<br>8 oz<br>Rates vary.<br>4 fl oz<br>11–15.4 fl oz<br>2–4 oz<br>10–16 oz<br>Rates vary<br>9.5 oz<br>10.5–14.5 oz<br>7 fl oz | 1.5–3 fl oz<br>1.25 oz<br>2 oz<br>See label<br>2.75–3.85 fl oz<br>0.5–1%<br>0.5–1 oz<br>2.5–4 oz<br>See label<br>See label<br>2.6–3.6 oz<br>1.75 fl oz | Myclobutanil: Place into solution before adding oil. <b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season. Make no more than two preharvest oil applications. Oil may be used for mildew management between petal fall and pit hardening. Do not apply between pit hardening and harvest. Azinphosmethyl may induce leaf drop if oil is applied to foliage for mildew control. Do not apply within 14 days of a sulfur application. Pristine: Apply no more than 72.5 oz per acre per season. Quintec: Do not apply more than 35 oz per calendar year. Do not make more than 2 sequential applications or more than 5 total application per year. |
| White apple leafhopper                        | 1. carbaryl (Sevin) 50WP<br>2. carbaryl (Sevin) 4F<br>3. endosulfan (Thiodan) 50WP   | 1–2 lbs<br>1–2 pints<br>4 lbs  | 0.25–0.5 lb<br>4–8 fl oz<br>1 lb   | Effective against nymphs; if adults of other leafhopper species are present, they will be more difficult to control.  |
| LATE SPRING AND SUMMER                        |  |  | Avoid killing bees on blooming cover crops. See Hazards to Bees.   |   |
| Black cherry aphid                            | 1. diazinon (Diazinon) 4EC<br>2. imidacloprid (Provado) 1.6  | 4 pints<br>4–8 fl oz   | 1 pint<br>2 fl oz  | 21 Diazinon: May mark light colored cherries.<br>7 Check with packinghouses for export restrictions prior to use. Imidacloprid: best control timing is petal fall.  |
| Brown rot (fruit rot)                         | 1. flowable/micronized sulfur<br>2. captan (Captan) 50WP**<br>3. fenbuconazole (Indar) 75WSP<br>4. propiconazole (Orbit)<br>5. triflumizole (Procure) 50WS<br>6. pyraclostrobin + boscalid (Pristine)  | See label<br>4 lbs<br>2 oz<br>4 fl oz<br>12–16 oz<br>10.5–14.5 oz  | See label<br>1 lb<br>0.5 oz<br>4 fl oz<br>3–4 oz<br>2.6–3.6 oz   | Δ1 Sulfur: see text—Potential Fruit & Leaf<br>Δ4 Injury. Fenbuconazole: Begin applications<br>Δ12hr 2 to 3 weeks before harvest and continue at<br>Δ1 7- to 10-day intervals. Do not apply more<br>Δ1 than 0.75 pound ai per acre per season.<br>Δ12hr Pristine: Apply no more than 72.5 oz per acre per season.  |
| Cherry rust mite                              | 1. flowable/micronized sulfur<br>2. endosulfan (Thiodan) 50WP<br>3. fenbutatin-oxide (Vendex) 50WP   | See label<br>2 lbs<br>1–2 lbs  | See label<br>0.5 lb<br>0.25–0.5 lb   | Δ1 Sulfur: see text—Potential Fruit & Leaf<br>21 Injury. Endosulfan is restricted to a total of<br>14 3 pounds ai/A per year. Plan ahead for potential applications needed later in the season. Vendex: Make no more than 2 applications per year.  |
| Pandemis leafroller, obliquebanded leafroller | 1. <i>Bacillus thuringiensis</i> (Bt)<br>2. spinosad (Success) 2L<br>3. pyriproxyfen (Esteem) 35WP<br>4. methoxyfenozide (Intrepid) 2F   | Rates vary<br>4–8 fl oz<br>4–5 oz<br>8–16 fl oz  | See label<br>1–2 fl oz<br>See label<br>See label   | Δ4hr Control of young larvae in early July is<br>7 more likely with spinosad. Bts are stom-<br>14 ach poisons so complete coverage is very<br>7 important for control. Two or three appli-<br>cations are usually required. Time<br>pyriproxyfen to coincide with the presence<br>of large leafroller larvae for best effect.   |
| Powdery mildew                                | 1. azoxystrobin (Abound)<br>2. fenarimol (Rubigan) 1EC<br>3. micronized/flowable sulfur<br>4. myclobutanil (Rally) 40W<br>5. propiconazole (Orbit)<br>6. horticultural mineral oil (light summer weight)   | 11–15.4 fl oz<br>6–12 fl oz<br>Rates vary<br>5 oz<br>4 fl oz   | 2.75–3.85 fl oz<br>1.5–3 fl oz<br>See label<br>1.25 oz<br>0.5–1%   | Δ4hr Sulfur: see text—Potential Fruit & Leaf<br>Δ12hr Injury.<br>Δ1 Do not apply more than 48 fluid ounces of<br>Δ1 fenarimol prior to harvest. Myclobutanil:<br>Δ1 Place into solution before adding oil. Cal-<br>cium polysulfide: Do not apply at tempera-<br>tures above 84°F.  |

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

ΔDefault to REI.

## PEST CONTROL PROGRAM FOR CHERRIES (CONTINUED)

| Pest or disease to be controlled | Use any one of the listed materials or the listed combinations | Amount per acre | Amount per 100 gallons (dilute sprays) | Minimum days between last use and harvest (PHI); restrictions, remarks |  |
|----------------------------------|--|-----------------|--|--|--|
| Powdery mildew (continued)       | 7. trifloxystrobin (Flint)                                     | 2–4 oz          | 0.5–1 oz                               | 1  | <b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season.<br>7 Make no more than two preharvest oil applications. Oil may be used for mildew management between petal fall and pit hardening. Do not apply between pit hardening and harvest. Azinphos methyl may induce leaf drop if oil is applied to foliage for mildew control. Do not apply within 14 days of a sulfur application.<br>Pristine: Apply no more than 72.5 oz per acre per season.<br>Quintec: Do not apply more than 35 oz per calendar year. Do not make more than 2 sequential applications or more than 5 total application per year. |
|                                  | 8. triflumizole (Procure) 50WS                                 | 10–16 oz        | 2.5–4 oz                               | 1  |  |
|                                  | 9. potassium bicarbonate                                       | Rates vary      | See label                              |  |  |
|                                  | 10. pyraclostrobin (Cabrio)                                    | 9.5 oz          | See label                              | Δ12hr  |  |
|                                  | 11. pyraclostrobin + boscalid (Pristine)                       | 10.5–14.5 oz    | 2.6–3.6 oz                             | Δ12hr  |  |
|                                  | 12. quinoxyfen (Quintex)                                       | 7 fl oz         | 1.75 fl oz                             | 7  |  |
| San Jose scale, Lecanium scale   | 1. diazinon (Diazinon) 4EC                                     | 4 pints         | 1 pint                                 | 21   | If problem is serious, apply 2 sprays, one in early to mid-June, and one 14 days later. Pyriproxyfen: Timing for leafrollers should also provide control of scale.   |
|                                  | 2. pyriproxyfen (Esteem) 35WP                                  | 4–5 oz          | See label                              | 14   |  |
| Shothole borer, ambrosia beetle  | 1. endosulfan (Thiodan) 50WP                                   | 4 lbs           | 1 lb                                   | 21   | Sprays are effective only on emerged adults. Watch for adult activity starting in late April or early May.   |
| Spider mites                     | 1. fenbutatin-oxide (Vendex) 50WP                              | 1–2 lbs         | 0.25–0.5 lb                            | 14   | Apply sprays in early May. Make no more than 2 applications per year.  |
| Stink bugs                       | 1. endosulfan (Thiodan) 50WP                                   | 4 lbs           | 1 lb                                   | 21   | Wettable powder formulations may leave visible residues when applied near harvest. WARNING: multiple applications of carbaryl may cause mite problems. Apply 1 malathion ULV by air only (see text—Aerial Application). Malathion may cause leaf injury. Application of dimethoate is recommended postharvest only. Azinphos methyl may induce leaf drop in sensitive varieties if oil was applied within 21 days.   |
| Western cherry fruit fly         | 1. diazinon (Diazinon) 4EC                                     | 4 pints         | 1 pint                                 | 21   | Note: Diazinon may mark light colored cherries. Export restrictions may prohibit diazinon. Check with packinghouse prior to use. Spray interval is 7 days for malathion ULV and spinosad products. GF-120 bait: Apply to alternate rows with special auxiliary applicator; dilute with no more than 3 quarts of water per acre. For special application method, see label and web site <a href="http://www.ncw.wsu.edu/treefruit/index.html">www.ncw.wsu.edu/treefruit/index.html</a><br>Diazinon is limited to one application per season.  |
|                                  | 2. malathion (Malathion) 8EC                                   | 3 pints         | 12 fl oz                               | 3  |  |
|                                  | 3. malathion (Malathion ULV) 9.79EC                            | 1 pint          |  | 1  |  |
|                                  | 4. azinphos methyl (Guthion) 50WP                              | 1.5 lbs         | 0.5 lb                                 | 15   |  |
|                                  | 5. carbaryl* (Sevin XLR Plus)                                  | 4 pints         | 1 pint                                 | 3  |  |
|                                  | 6. spinosad (Success) 2L                                       | 4–6 fl oz       | 2 fl oz                                | 7  |  |
|                                  | 7. spinosad (Entrust)  | 1.25–1.88 oz    | 1.25 oz                                | 7  |  |
|                                  | 8. spinosad (GF-120 NF Bait)                                   | 20 fl oz        | See label                              | Δ4 hr  |  |
|                                  | 9. imidacloprid (Provado) 1.6F                                 | 4.0–6.0 fl oz   | 2.0 fl oz                              | 7  |  |

\*Detrimental to predatory mites.

ΔDefault to REI.

## PEST CONTROL PROGRAM FOR CHERRIES (CONTINUED)

| Pest or disease to be controlled              | Use any one of the listed materials or the listed combinations | Amount per acre | Amount per 100 gallons (dilute sprays) | Minimum days between last use and harvest (PHI); restrictions, remarks   |
|---|--|-----------------|--|--|
| <b>PREHARVEST AND HARVEST</b>                 |  |                 |  |  |
| Brown rot (fruit rot)                         | 1. micronized/flowable sulfur                                  | Rates vary      | See label                              | Δ1 Apply 20 and 10 days before harvest, and  |
|   | 2. fenbuconazole (Indar) 75WSP                                 | 2 oz            | 0.5 oz                                 | Δ12 hr at picking time. See text—Potential Fruit   |
|   | 3. propiconazole (Orbit)                                       | 4 fl oz         |  | Δ1 & Leaf Injury. See General Recommen-  |
|   | 4. triflumizole (Procure) 50WS                                 | 12-16 oz        | 3-4 oz                                 | 1 dations.   |
|   | 5. pyraclostrobin (Cabrio)                                     | 9.5 oz          | See label                              | Δ12 hr Fenbuconazole: Begin applications 2 to 3  |
|   | 6. pyraclostrobin + boscalid (Pristine)                        | 10.5–14.5 oz    | 2.6–3.6 oz                             | Δ12 hr weeks before harvest and continue at 7- to 10-day intervals. Do not apply more than 0.75 pound ai per acre per season. Pristine: Apply no more than 72.5 oz per acre per season.  |
| Grasshoppers, Mormon crickets                 | See text—Special Programs                                      |                 |  |  |
| Powdery mildew                                | 1. fenarimol (Rubigan) 1EC                                     | 6–12 fl oz      | 1.5–3 fl oz                            | Δ12 hr Myclobutanil: Place into solution before  |
|   | 2. myclobutanil (Rally) 40W                                    | 5 oz            | 1.25 oz                                | Δ1 adding oil.   |
|   | 3. tebuconazole (Elite) 45DF                                   | 8 oz            | 2 oz                                   | Δ12 hr   |
|   | 4. flowable/micronized sulfur                                  | Rates vary      | See label                              | Δ1   |
|   | 5. propiconazole (Orbit)                                       | 4 fl oz         |  | Δ1   |
|   | 6. azoxystrobin (Abound)                                       | 11–15.4 oz      | 2.75–3.85 oz                           | Δ4hr See remarks in shuck fall section.  |
|   | 7. trifloxystrobin (Flint)                                     | 2–4 oz          | 0.5–1 oz                               | 1  |
|   | 8. triflumizole (Procure) 50WS                                 | 10–16 oz        | 2.5–4 oz                               | 1  |
|   | 9. potassium bicarbonate                                       | See label       | See label                              |  |
|   | 10. pyraclostrobin (Cabrio)                                    | 9.5 oz          | See label                              | Δ12 hr   |
|   | 11. pyraclostrobin + boscalid (Pristine)                       | 10.5–14.5 oz    | 2.6–3.6 oz                             | Δ12 hr Pristine: Apply no more than 72.5 oz per acre per season.   |
|   | 12. quinoxyfen (Quintec)                                       | 7 fl oz         | 1.75 fl oz                             | 7 Quintec: Do not apply more than 35 oz per calendar year. Do not make more than two sequential applications or more than five total application per year.   |
| Western cherry fruit fly                      | 1. malathion (Malathion ULV) 9.79EC                            | 1 pint          |  | 1 Apply malathion by air only. See text—Aerial Application. Carbaryl may cause   |
|   | 2. carbaryl* (Sevin) 4F  | 4 pints         | 1 pint                                 | 3 mite flare-ups, especially with multiple   |
|   | 3. spinosad (Success) 2L                                       | 4–6 fl oz       | 2 fl oz                                | 7 applications.  |
|   | 4. spinosad (Entrust)  | 1.25–1.88 oz    | 1.25 oz                                | 7  |
|   | 5. spinosad (GF-120 NF Bait)                                   | 20 fl oz        | See label                              | Δ4hr GF-120 bait: Apply to alternate rows with   |
|   | 6. imidacloprid (Provado) 1.6F                                 | 4.0–6.0 fl oz   | 2.0 fl oz                              | 7 special auxiliary applicator; dilute with no more than 3 quarts of water per acre. For special application method, see label and web site <a href="http://www.ncw.wsu.edu/treefruit/index.html">www.ncw.wsu.edu/treefruit/index.html</a> |
| <b>POSTHARVEST</b>                            |  |                 |  |  |
| Pandemis leafroller, obliquebanded leafroller | 1. <i>Bacillus thuringiensis</i> (Bt)                          | Rates vary      | See label                              | Bts are stomach poisons so complete coverage is very important for control. Two or three Bt applications are usually required.   |
| Powdery mildew                                | 1. horticultural mineral oil (light summer weight)             | 4 gals          | 1–1.5 gals                             | Apply to reduce next season's powdery mildew potential. Apply within 30 days after harvest. Optimum timing is 7 to 10 days after harvest. Full wetting of the foliage is required.   |
|   | 2. calcium polysulfide (Sulforix)                              | 2 gals          | 2 qts                                  | Quintec: Do not apply more than 35 oz per calendar year. Do not make more than two sequential applications or more than five total application per year.   |
|   | 3. quinoxyfen (Quintec)  | 7 fl oz         | 1.75 fl oz                             |  |

\*Detrimental to predatory mites.

ΔDefault to REI.

## PEST CONTROL PROGRAM FOR CHERRIES (CONTINUED)



| Pest or disease to be controlled | Use any one of the listed materials or the listed combinations  | Amount per acre            | Amount per 100 gallons (dilute sprays) | Minimum days between last use and harvest (PHI); restrictions, remarks   |
|----------------------------------|---|----------------------------|--|--|
| Shothole borer, ambrosia beetle  | 1. endosulfan (Thiodan) 50WP  | 4 lbs                      | 1 lb                                   | Sprays are effective only on emerged adults. Watch for adult activity.   |
| Spider mites                     | 1. fenbutatin-oxide (Vendex) 50WP<br>2. propargite (Omite) CR or 30WS<br>3. horticultural mineral oil | 1–2 lbs<br>6 lbs<br>4 gals | 0.25–0.5 lb<br>1.5 lbs<br>1–1.5 gals   | Vendex: Make no more than 2 applicatons per year.  |
| Western cherry fruit fly         | 1. azinphos methyl (Guthion) 50WP<br>2. dimethoate (Dimethoate) 267                                   | 1.5 lbs<br>4 pints         | 0.5 lb<br>1 pint                       | Dimethoate is the only product that will control larvae inside of the fruit when sprayed. Use higher volumes of water when applying this product. Dimethoate is limited to one application per season; postharvest is it's best use. |

### FALL

|                                     |   |           |           |   |
|-------------------------------------|---|-----------|-----------|---|
| Coryneum blight, bacterial gummosis | 1. copper hydroxide (numerous products) | See label | See label | Rates vary according to manufacturer. Convert so there are 2.5 pounds metallic copper per 100 gallons. Optimum timing for control of bacterial gummosis is in the late winter and spring. |
|                                     | 2. fixed copper                         | See label | See label |   |
| Powdery mildew                      | 1. lime sulfur                          | See label | See label | Apply lime sulfur shortly before leaf fall. Allow for thorough wetting of foliage, scaffold limbs and trunks.   |

## PEST CONTROL PROGRAM FOR PEACHES AND NECTARINES\*


Application rates in the tables are for dilute sprays, generally 400 gallons per acre. Gallonage requirements will vary depending on tree size, density, and spray equipment. In the case of large heavy barked trees, severely infested with scale insects, more than 400 gallons may be necessary for adequate control. Concentrate applications should base rates on the amount per acre rather than the amount per 100 gallons. Regardless of the amount used per 100 gallons, do not exceed the amounts per acre given in the following tables unless permitted by the label. See General Recommendations. For some of the pesticides recommended in this table, the target pest is not on the label. Such use is permissible, however, as long as the pesticide is labeled on the crop, and you follow all other use restrictions. The materials in the following tables are not listed in order of preference.

| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations  | Amount per acre                                 | Amount per 100 gallons (dilute sprays)         | Minimum days between last use and harvest; restrictions, remarks  |
|---|---|---|--|---|
|  | STAGE 0, bud development chart (Dormant)  |   |  |   |
| Coryneum blight (shothole)  | 1. fixed copper 53WP** (+ sticker)<br>2. copper hydroxide<br>3. chlorothalonil (Bravo)**  | See label<br>See label<br>See label             | See label<br>See label<br>See label            | Rates vary according to manufacturer. Convert copper formulations so that there are 2.5 lbs. metallic copper per 100 gals. See remarks at Petal Fall.   |
| Peach leaf curl   | 1. chlorothalonil (Bravo)<br>2. fixed copper 53WP** (+ sticker)<br>3. thiram (Thiram Granuflo) 75WDG<br>4. ziram (Ziram)                                | See label<br>20 lbs<br>3.9–5.1 lbs<br>See label | See label<br>5 lbs<br>1.3–1.7 lbs<br>See label | Convert copper formulations so that there are 2.5 lbs. metallic copper per 100 gals. Thiram: See label for alternate spray timings. Not for use on nectarines.  |
|  | STAGE 1 (Delayed-Dormant)   |   |  |   |
| Cutworms  | 1. endosulfan (Thionex) 50WP**<br>2. endosulfan (Thionex) 3EC**   |   | 1 lb<br>1.3 pints                              | Apply thoroughly to lower trunk and cover crop with a handgun. Note: Endosulfan use is limited to a total of two applications per season.   |
| European red mite (overwintering eggs)  | 1. horticultural mineral oil  | 6 gals  | 1.5 gals                                       | Oil is indispensable for an integrated mite control program. Do not use over 5 gals. oil per acre concentrate on mature trees.  |
| Green peach aphid   | 1. horticultural mineral oil + one of the following:<br>2. esfenvalerate (Asana XL) 0.66EC<br>3. diazinon (Diazinon) 50WP                               | 6 gals<br>6–8 fl oz<br>4 lbs                    | 1.5 gals<br>1.5–2 fl oz<br>1 lb                | Delaying green peach aphid sprays past stage 2 will reduce effectiveness of recommended materials. Warning: Asana may cause increased mite problems, especially when used after delayed dormant. Diazinon is limited to one application per season. Resistance to diazinon is common.                                       |
| San Jose scale, Lecanium scale  | horticultural mineral oil + one of the following:<br>1. chlorpyrifos (Lorsban) 4EC<br>2. methidathion (Supracide) 2E<br>3. pyriproxyfen (Esteem) 0.86EC | 6 gals<br>4 pints<br>8 pints<br>13–16 fl oz     | 1.5 gals<br>1 pint<br>2 pints<br>3.25–4 fl oz  | Oil plus an organophosphate is preferred because the combination provides the most effective control for scale insects and other pests. Liquid formulations are preferred with oils, and tank agitation is required. Do not use more than 5 gallons of oil per acre concentrate on mature trees. See text—Special Programs. |

\*Nectarine pests can probably be controlled by this program, but there is inadequate information on plant injury.


\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

## PEST CONTROL PROGRAM FOR PEACHES AND NECTARINES\* (CONTINUED)

| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations  | Amount per acre   | Amount per 100 gallons (dilute sprays)   | Minimum days between last use and harvest; restrictions, remarks   |
|---|---|---|--|--|
|  | STAGES 2–5<br>(Prebloom)  | Avoid killing bees on blooming cover crops. See Hazards to Bees.                  |  |  |
| Brown rot<br>(blossom blight)   | 1. iprodione (Rovral) 50W**<br>2. myclobutanil (Rally) 40W<br>3. fenbuconazole (Indar) 75WSP<br>4. azoxystrobin (Abound)<br>5. pyraclostrobin + boscalid (Pristine)   | 1–2 lbs<br>5 oz<br>2 oz<br>11–15.4 fl oz<br>10.5–14.5 oz                          | 0.25–0.5 lb<br>1.25 oz<br>0.5 oz<br>2.75–3.85 fl oz<br>2.6–3.6 oz                  | Rovral: Apply at 5% bloom. Apply again at full bloom or at petal fall if disease-conducive weather occurs. Indar: Do not apply more than 0.75 pound ai per acre per season.<br><b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season. Pristine: Apply no more than 72.5 oz per acre per season. |
| Coryneum blight<br>(shothole)   | 1. azoxystrobin (Abound)<br>2. captan (Captan) 50WP<br>3. chlorothalonil (Bravo)<br>4. myclobutanil (Rally) 40W<br>5. pyraclostrobin + boscalid (Pristine)  | 11–15.4 fl oz<br>8 lbs<br>See label<br>5 oz<br>10.5–14.5 oz                       | 2.75–3.85 fl oz<br>2 lbs<br>See label<br>1.25 oz<br>2.6–3.6 oz                     | Rally: See label for specific use recommendations. Place into solution before adding oil.<br>Pristine: Apply no more than 72.5 oz per acre per season.   |
| Cutworms  | 1. endosulfan (Thionex) 50WP**<br>2. endosulfan (Thionex) 3EC**   |   | 1 lb<br>1.3 pints  | Apply thoroughly to lower trunk and cover crop with a handgun. Endosulfan is restricted to two applications per year. Plan ahead for potential applications needed later in the season.  |
| Lecanium scale  | 1. malathion (Malathion) 8EC<br>2. diazinon (Diazinon) 50WP<br>3. methidathion (Supracide) 25WP<br>4. pyriproxyfen (Esteem) 35WP  | 3 pints<br>4 lbs<br>6–12 lbs<br>4–5 oz  | 12 fl oz<br>1 lb<br>1.5–3 lbs<br>1–1.25 oz   | Diazinon is limited to one application per season.   |
| Lygus bugs,<br>stink bugs   | 1. endosulfan (Thionex) 50WP**<br>2. formetanate hydrochloride (Carzol) 92SP<br>3. lambda-cyhalothrin (Warrior)   | 4 lbs<br>1 lb<br>2.5–5 fl oz  | 1 lb<br>0.25 lb<br>0.6–1.25 fl oz  | Carzol: May be applied during bloom, but applications must be made in late evening or when bees are not actively foraging. Do not apply after petal fall.  |
| Oriental fruit moth   | 1. Isomate-M<br>2. Checkmate-OFM  | 150 dispensers<br>200 dispensers  | See label  | Dispensers must be in place before the first oriental fruit moth adult flight. Checkmate dispensers may be applied more than once per season.  |
| Peach silver mite   | 1. propargite (Omite) 30WS<br>2. endosulfan (Thionex) 50WP**  | 5 lbs<br>2 lbs  | 1.25 lbs<br>0.5 lb   | Propargite: Use on nectarines only.  |
| Peach twig borer  | 1. endosulfan (Thionex) 50WP**<br>2. azinphos methyl (Guthion) 50WP<br>3. <i>Bacillus thuringiensis</i> (Bt)<br>4. esfenvalerate (Asana XL) 0.66EC<br>5. methidathion (Supracide) 25WP<br>6. spinosad (Success) 2L<br>7. spinosad (Entrust) 80W | 4 lbs<br>2 lbs<br>Rates vary<br>6–8 fl oz<br>6–12 lbs<br>4–8 fl oz<br>1.25–2.5 oz | 1 lb<br>0.5 lb<br>See label<br>1.5–2 fl oz<br>1.5–3 lbs<br>1–2 fl oz<br>0.3–0.6 oz | Azinphos methyl: maximum of 4.5 pounds of product per acre per year. Bts must be ingested by pest, so complete coverage is necessary for efficacy. Apply when warm weather is predicted for 3 or more days. Two or three applications per pest generation may be required to achieve adequate control. Asana: apply in early to mid-pink (stages 2 or 3). Use only once per season.  |
| Shothole borer,<br>ambrosia beetle  | 1. endosulfan (Thionex) 50WP**  | 4 lbs   | 1 lb   | See label for season-use restrictions on endosulfan. Plan ahead to set use priorities.   |
| Western flower<br>thrips  | 1. formetanate hydrochloride (Carzol) 92SP<br>2. endosulfan (Thionex) 50WP**  | 1 lb<br>4 lbs   | 0.25 lb<br>1 lb  | Carzol may be applied during bloom, but applications must be made in late evening or other times when bees are not actively foraging.  |

\*Nectarine pests can probably be controlled by this program, but there is inadequate information on plant injury.

## PEST CONTROL PROGRAM FOR PEACHES AND NECTARINES\* (CONTINUED)

| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations   | Amount per acre   | Amount per 100 gallons (dilute sprays)   | Minimum days between last use and harvest; restrictions, remarks   |
|---|--|---|--|--|
|  | STAGES 6-7 (Blossom)   | Avoid killing bees on blooming cover crops. See Hazards to Bees.  |  |  |
| Brown rot (blossom blight)  | <ol style="list-style-type: none"> <li>1. azoxystrobin (Abound)</li> <li>2. captan (Captan) 50WP</li> <li>3. fenbuconazole (Indar) 75WSP</li> <li>4. iprodione (Rovral) 50W**</li> <li>5. flowable/micronized sulfur</li> <li>6. propiconazole (Orbit)</li> <li>7. tebuconazole (Elite) 45DF</li> <li>8. thiram (Thiram Granuflo) 75WDG</li> <li>9. wettable sulfur</li> <li>10. pyraclostrobin+boscalid (Pristine)</li> </ol> | 11-15.4 fl oz<br>8 lbs<br>2 oz<br>1-2 lbs<br>See label<br>4 fl oz<br>4-8 oz<br>3.9-5.1 lbs<br>10-12 lbs<br>10.5-14.5 oz | 2.75-3.85 fl oz<br>2 lbs<br>0.5 oz<br>0.25-0.5 lb<br>See label<br>2 oz<br>1.3-1.7 lbs<br>2.5-3 lbs<br>2.6-3.6 oz | Apply if disease-conducive weather occurs. Propiconazole: Apply at 5-10% and 80-100% bloom. Fenbuconazole: Do not apply more than 0.75 pound ai per acre per season. Thiram: Apply at 3- to 4-day intervals during bloom. See label for fruit rot management recommendations. Not for use on nectarines. <b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season. Pristine: Apply no more than 72.5 oz per acre per season. |
| Leafrollers   | <ol style="list-style-type: none"> <li>1. <i>Bacillus thuringiensis</i> (Bt)</li> <li>2. methoxyfenozide (Intrepid) 2F</li> </ol>  | Rates vary<br>8-16 fl oz  | See label<br>2-4 fl oz   | Bts are stomach poisons so complete coverage is essential for control. Two or three applications are usually required. Apply when forecasts predict a warm weather pattern for 3 or more days.   |
| PETAL-FALL (100% petal fall)  |  | Avoid killing bees on blooming cover crops. See Hazards to Bees.  |  |  |
| Brown rot (blossom blight)  | <ol style="list-style-type: none"> <li>1. azoxystrobin (Abound)</li> <li>2. fenbuconazole (Indar) 75WSP</li> <li>3. iprodione (Rovral) 50W**</li> <li>4. myclobutanil (Rally) 40W</li> <li>5. tebuconazole (Elite) 45DF</li> <li>6. pyraclostrobin-boscalid (Pristine)</li> </ol>  | 11-15.4 fl oz<br>2 oz<br>1-2 lbs<br>5 oz<br>4-8 oz<br>10.5-14.5 oz  | 2.75-3.85 fl oz<br>0.5 oz<br>0.25-0.5 lb<br>1.25 oz<br>2 oz<br>2.6-3.6 oz  | Iprodione: Apply again at petal fall if disease-conducive weather occurs. Myclobutanil: See label for specific use recommendations. Place into solution before adding oil. Fenbuconazole: Do not apply more than 0.75 pound ai per acre per season. Pristine: Apply no more than 72.5 oz per acre per season.  |
| Coryneum blight (shothole)  | <ol style="list-style-type: none"> <li>1. chlorothalonil (Bravo)</li> <li>2. azoxystrobin (Abound)</li> <li>3. pyraclostrobin-boscalid (Pristine)</li> </ol>   | See label<br>11-15.4 fl oz<br>10.5-14.5 oz  | See label<br>2.75-3.85 fl oz<br>2.6-3.6 oz   | Apply Bravo no later than shuck split. <b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Pristine: Apply no more than 72.5 oz per acre per season.  |
| Leafrollers   | <ol style="list-style-type: none"> <li>1. <i>Bacillus thuringiensis</i> (Bt)</li> <li>2. methoxyfenozide (Intrepid) 2F</li> </ol>  | Rates vary<br>8-16 fl oz  | See label<br>2-4 fl oz   | Bts must be ingested by pest, so complete coverage is necessary for efficacy. Apply when warm weather is predicted for 3 or more days. Two or three applications per pest generation may be required to achieve adequate control.  |
| Lygus bugs, stink bugs  | See stages 2-5 (Prebloom)  |   |  |  |
| Oriental fruit moth   | <ol style="list-style-type: none"> <li>1. azinphos methyl (Guthion) 50WP</li> <li>2. phosmet (Imidan) 70WP</li> <li>3. spinosad (Entrust) 80W</li> </ol>   | 1-2 lbs<br>4.25 lbs<br>1.25-2.5 oz  | 0.25-0.5 lb<br>1.06 lbs<br>0.3-0.6 oz  | Azinphos methyl: maximum of 4.5 pounds per acre per season.  |
| Peach twig borer  | <ol style="list-style-type: none"> <li>1. azinphos methyl (Guthion) 50WP</li> <li>2. <i>Bacillus thuringiensis</i> (Bt)</li> <li>3. endosulfan (Thionex) 50WP**</li> <li>4. phosmet (Imidan) 70WP</li> <li>5. spinosad (Success) 2L</li> <li>6. spinosad (Entrust) 80W</li> </ol>  | 2 lbs<br>Rates vary<br>4 lbs<br>3-4.25 lbs<br>4-8 fl oz<br>1.25-2.5 oz  | 0.5 lb<br>See label<br>1 lb<br>0.75-1 lb<br>1-2 fl oz<br>0.3-0.6 oz  | Azinphos methyl: maximum of 4.5 pounds per acre per season. Endosulfan is restricted to a total of 3 pounds ai/A per year. Plan ahead for potential applications needed later in the season.   |

\*Nectarine pests can probably be controlled by this program, but there is inadequate information on plant injury.

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

## PEST CONTROL PROGRAM FOR PEACHES AND NECTARINES\* (CONTINUED)

| Pest or disease to be controlled | Use any one of the listed materials or the listed combinations   | Amount per acre   | Amount per 100 gallons (dilute sprays)   | Minimum days between last use and harvest (PHI); restrictions, remarks   |
|----------------------------------|--|---|--|--|
| Green peach aphid                | 1. imidacloprid (Provado) 1.6F   | 4–8 fl oz   | 2 fl oz  |  |
| Powdery mildew                   | 1. flowable/micronized sulfur<br>2. myclobutanil (Rally) 40W<br>3. propiconazole (Orbit)<br>4. azoxystrobin (Abound)<br>5. horticultural mineral oil (light summer weight)<br>6. trifloxystrobin (Flint)   | See label<br>5 oz<br>4 fl oz<br>See Brown rot section<br>2–4 oz                                 | See label<br>1.25 oz<br>0.5–1%   | Myclobutanil: See label for specific use recommendations. Place into solution before adding oil. <b>Do not apply oil within 14 days of a sulfur application.</b>   |
| Western flower thrips            | 1. formetanate hydrochloride (Carzol) 92SP<br>2. spinosad (Success) 2L<br>3. spinosad (Entrust) 80W  | 1 lb<br>4–8 fl oz<br>1.25–2.5 oz  | 0.25 lb<br>1–2 fl oz<br>0.3–0.6 oz   | Carzol: May be applied during bloom, but applications must be made in late evening or when bees are not actively foraging. Do not apply after petal fall.  |
| SHUCK FALL                       |  | Avoid killing bees on blooming cover crops. See Hazards to Bees.                                |  |  |
| Brown rot                        | 1. azoxystrobin (Abound)<br>2. captan (Captan) 50WP<br>3. flowable/micronized sulfur<br>4. pyraclostrobin + boscalid (Pristine)  | 11–15.4 fl oz<br>8 lbs<br>See label<br>10.5–14.5 oz   | 2.75–3.85 fl oz<br>2 lbs<br>See label<br>2.6–3.6 oz  | <b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season. Pristine: Apply no more than 72.5 oz per acre per season.  |
| Coryneum blight (Shothole)       | 1. azoxystrobin (Abound)<br>2. captan (Captan) 50WP<br>3. ziram (Ziram) 76WDG<br>4. pyraclostrobin + boscalid (Pristine)   | 11–15.4 fl oz<br>6 lbs<br>6 lbs<br>10.5–14.5 oz   | 2.75–3.85 fl oz<br>1.5 lbs   | Abound: See note above. Pristine: Apply no more than 72.5 oz per acre per season.  |
| Leafrollers                      | 1. <i>Bacillus thuringiensis</i> (Bt)<br>2. methoxyfenozide (Intrepid) 2F  | Rates vary<br>8–16 fl oz  | See label<br>2–4 fl oz   | Bts must be ingested by pest, so complete coverage is necessary for efficacy. Apply when warm weather is predicted for 3 or more days. Two or three applications per pest generation may be required to achieve adequate control.  |
| Powdery mildew                   | 1. azoxystrobin (Abound)<br>2. calcium polysulfide (Sulfurix)<br>3. micronized/flowable sulfur<br>4. myclobutanil (Rally) 40W<br>5. propiconazole (Orbit)<br>6. horticultural mineral oil (light summer weight)<br>7. trifloxystrobin (Flint)                      | 11–15.4 fl oz<br>2 gals<br>See label<br>5 oz<br>4 fl oz<br>2–4 oz                               | 2.75–3.85 fl oz<br>2 qts<br>See label<br>1.25 oz<br>0.5–1%<br>0.5–1 oz                               | Myclobutanil: See label for specific use recommendations. Place into solution before adding oil. Calcium polysulfide: Do not apply at temperatures above 84°F. Allow 30 days to elapse between Sulfurix and oil sprays. <b>Do not apply oil within 14 days of a sulfur application.</b>  |
| SUMMER                           |  | Avoid killing bees on blooming cover crops. See Hazards to Bees.                                |  |  |
| Brown rot (fruit rot)            | 1. azoxystrobin (Abound)<br>2. captan (Captan) 50WP<br>3. fenbuconazole (Indar) 75WSP<br>4. propiconazole (Orbit)<br>5. tebuconazole (Elite) 45DF<br>6. thiram (Thiram Granuflo) 75WDG<br>7. flowable/micronized sulfur<br>8. pyraclostrobin + boscalid (Pristine) | 11–15.4 fl oz<br>5 lbs<br>2 oz<br>4 fl oz<br>4–8 oz<br>3.9–5.1 lbs<br>See label<br>10.5–14.5 oz | 2.75–3.85 fl oz<br>1.25 lbs<br>0.5 oz<br>See label<br>2 oz<br>1.3–1.7 lbs<br>See label<br>2.6–3.6 oz | Δ4hr Fenbuconazole: Begin applications 2 to 3 weeks before harvest and continue at 7- to 10-day intervals. Do not apply more than 0.75 pound a.i. per acre per season. Apply tebuconazole 21, 14, and 7 days before harvest.<br>Δ1 Thiram: not for use on nectarines.<br>Δ12hr Pristine: Apply no more than 72.5 oz per acre per season. |

\*Nectarine pests can probably be controlled by this program, but there is inadequate information on plant injury.

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

ΔDefaults to REI.

## PEST CONTROL PROGRAM FOR PEACHES AND NECTARINES\* (CONTINUED)

| Pest or disease to be controlled                                | Use any one of the listed materials or the listed combinations  | Amount per acre   | Amount per 100 gallons (dilute sprays)                                 | Minimum days between last use and harvest (PHI); restrictions, remarks   |
|---|---|---|--|--|
| Cutworms  | 1. endosulfan (Thionex) 50WP**  | 4 lbs   | 1 lb   | 21/30 The PHI for endosulfan is 21 days when applied as a trunk spray, 30 days if applied as a cover spray. Endosulfan is restricted to a total of 3 pounds ai/A per season.   |
| Earwigs   | 1. carbaryl (Sevin) 80WP**<br>2. carbaryl (Sevin) 4F**  | 2.5–3.75 lbs<br>2–3 qts   | 0.6–0.9 lb<br>0.5–0.75 qt  | 3 Apply around bases of trees and on trunks. Do not apply carbaryl on blooming cover crops because of hazard to bees.  |
| Grasshoppers, Mormon crickets                                   | See text—Special Programs   |   |  |  |
| McDaniel spider mite, twospotted spider mite, European red mite | 1. clofentezine (Apollo) SC<br>2. fenbutatin-oxide (Vendex) 50WP<br>3. hexythiazox (Savey) 50WP<br>4. propargite (Omite) 30WS<br>5. bifenazate (Acramite) 50WS  | 4–8 fl oz<br>1–2 lbs<br>3–6 oz<br>5–6 lbs<br>0.75–1 lb            | 1–2 fl oz<br>4–8 oz<br>1.25–1.5 lbs<br>0.2–0.25 lb                     | 21 Apollo and Savey: Do not apply either product more than once per season. Both products are most effective on the egg stage and are not effective on the adult stage. Vendex: Make no more than 2 applications per year. Propargite: Use higher rate on European red mite. Use on nectarines only.   |
| Oriental fruit moth   | 1. azinphos methyl (Guthion) 50WP<br>2. phosmet (Imidan) 70WP<br>3. spinosad (Entrust) 80W  | 2 lbs<br>3–4.25 lbs<br>1.25–2.5 oz                                | 0.5 lb<br>0.75–1 lb<br>0.3–0.6 oz                                      | 21<br>14<br>14   |
| Pandemis leafroller, obliquebanded leafroller                   | 1. <i>Bacillus thuringiensis</i> (Bt)<br>2. spinosad (Success) 2L<br>3. spinosad (Entrust) 80W<br>4. methoxyfenozide (Intrepid) 2F  | Rates vary<br>4–8 fl oz<br>1.25–2.5 oz<br>8–16 fl oz              | See label<br>1–2 fl oz<br>0.3–0.6 oz<br>2–4 fl oz                      | Δ4hr<br>14<br>14<br>7 Bts must be ingested by pest, so complete coverage is necessary for efficacy. Apply when warm weather is predicted for 3 or more days. Two or three applications per pest generation may be required to achieve adequate control.  |
| Peach silver mite   | 1. flowable/micronized sulfur<br>2. endosulfan (Thionex) 50WP**<br>3. propargite (Omite) 30WS   | See label<br>4 lbs<br>5 lbs                                       | See label<br>1 lb<br>1.25 lbs  | Δ1<br>30<br>14 Propargite: Use on nectarines only and no more than two applications per season. Endosulfan is restricted to two applications per season.   |
| Peachtree borer   | 1. endosulfan (Thionex) 50WP**<br>2. chlorpyrifos (Lorsban) 4EC<br>3. Isomate-P   | 100 dispensers  | 1 lb<br>3 qts  | 21/30<br>14 Spray trunks, crotches, and ground around trees with a handgun. Chlorpyrifos: Do not allow spray to contact fruit. Isomate-P: Apply dispensers in late June or when the first moths are caught in pheromone traps. Place dispensers in upper half of canopy.   |
| Peach twig borer  | 1. endosulfan (Thionex) 50WP**<br>2. azinphos methyl (Guthion) 50WP<br>3. phosmet (Imidan) 70WP<br>4. spinosad (Success) 2L<br>5. spinosad (Entrust) 80W  | 4 lbs<br>2 lbs<br>3–4.25 lbs<br>4–8 fl oz<br>1.25–2.5 oz          | 1 lb<br>0.5 lb<br>0.75–1 lb<br>1–2 fl oz<br>0.3–0.6 oz                 | 30<br>21<br>14<br>14<br>14 Apply in late May or early June.  |
| Powdery mildew  | 1. flowable/micronized sulfur<br>2. myclobutanil (Rally) 40W<br>3. calcium polysulfide (Sulforix)<br>4. propiconazole (Orbit)<br>5. azoxystrobin (Abound)<br>6. horticultural mineral oil (light summer weight)<br>7. trifloxystrobin (Flint) | See label<br>5 oz<br>2 gals<br>4 fl oz<br>11–15.4 fl oz<br>2–4 oz | See label<br>1.25 oz<br>2 qts<br>2.75–3.85 fl oz<br>0.5–1%<br>0.5–1 oz | Δ1<br>Δ1<br>Δ2<br>Δ1<br>Δ4hr<br>1 Sulfur: Apply 2–3 weeks after shuck fall. Myclobutanil: See label for specific use recommendations. Place into solution before adding oil. Calcium polysulfide: Do not apply at temperatures above 84°F. Allow 30 days to elapse between Sulforix and oil sprays. <b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. <b>Do not apply oil within 14 days of a sulfur application.</b> |

\*Nectarine pests can probably be controlled by this program, but there is inadequate information on plant injury.

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

ΔDefaults to REI.

## PEST CONTROL PROGRAM FOR PEACHES AND NECTARINES\* (CONTINUED)

| Pest or disease to be controlled                     | Use any one of the listed materials or the listed combinations   | Amount per acre   | Amount per 100 gallons (dilute sprays)  | Minimum days between last use and harvest (PHI); restrictions, remarks   |
|--|--|---|---|--|
| San Jose scale                                       | 1. diazinon (Diazinon) 50WP**<br>2. diazinon (Diazinon) 4EC  | 4 lbs<br>4 pints  | 1 lb<br>1 pint  | 21 Diazinon is limited to one application per season.  |
| Shothole borer, ambrosia beetle                      | 1. endosulfan (Thionex) 50WP**   | 4 lbs   | 1 lb  | 21/30 Apply when adults are present.   |
| PREHARVEST AND HARVEST                               |  |   |   |  |
| Brown rot  | 1. azoxystrobin (Abound)<br>2. captan (Captan) 50WP<br>3. fenbuconazole (Indar) 75WSP<br>4. flowable/micronized sulfur<br>5. propiconazole (Orbit)<br>6. tebuconazole (Elite) 45DF<br>7. thiram (Thiram Granuflo) 75WDG<br>8. pyraclostrobin + boscalid (Pristine) | 11–15.4 fl oz<br>6 lbs<br>2 oz<br>See label<br>4 fl oz<br>4–8 oz<br>3.9–5.1 lbs<br>10.5–14.5 oz | 2.75–3.85 fl oz<br>1.5 lbs<br>0.5 ounce<br>See label<br>2 oz<br>1.3–1.7 lbs<br>2.6–3.6 oz | Δ4hr Fenbuconazole: Begin applications 2 to 3 weeks before harvest and continue at 7- to 10-day intervals. Do not apply more than 0.75 pound ai per acre per season. Apply tebuconazole 21, 14, and 7 days before harvest.<br>Δ12hr Thiram: not for use on nectarines.<br>Δ12hr Pristine: Apply no more than 72.5 oz per acre per season.                      |
| Oriental fruit moth, peach twig borer                | 1. carbaryl (Sevin) 80WP**<br>2. carbaryl (Sevin) 4F**<br>3. spinosad (Success) 2L   | 2.5-3.75 lbs<br>2–3 qts<br>4–8 oz   | 0.6–0.9 lb<br>0.5–0.75 qt<br>1–2 oz   | 3<br>3<br>14   |
| Powdery mildew                                       | 1. azoxystrobin (Abound)<br>2. calcium polysulfide (Sulforix)<br>3. propiconazole (Orbit)<br>4. trifloxystrobin (Flint)  | 11-15.4 fl oz<br>2 gals<br>4 fl oz<br>2–4 oz  | 2.75-3.85 fl oz<br>2 quarts<br>0.5–1 oz   | Δ4hr Calcium polysulfide: Do not apply at temperatures above 84° F. Allow 30 days to elapse between Sulforix and oil sprays.<br>Δ1 <b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season. |
| POSTHARVEST  |  |   |   |  |
| Coryneum blight (shothole)                           | 1. captan (Captan) 50WP<br>2. chlorothalonil (Bravo)<br>3. ziram (Ziram) 76WDG   | 6 lbs<br>See label<br>6 lbs   | 1.5 lbs<br>See label<br>1.5 lbs   | Apply before autumn rains.   |
| Peach leaf curl, bacterial gummosis, Coryneum blight | 1. copper hydroxide (numerous labels)<br>2. fixed copper (+ sticker)   | See label<br>See label  | See label<br>See label  | Rates vary according to manufacturer. Do not use copper materials before Oct. 1. Leaves have to have fallen. Convert so there are 2.5 pounds metallic copper per 100 gallons.  |
| Peach silver mite                                    | 1. propargite (Omite) 30WS<br>2. flowable/micronized sulfur  | 5 lbs<br>See label  | 1.25 lbs<br>See label   | Propargite: Use on nectarines only and no more than 2 applications per season.   |
| Shothole borer, ambrosia beetle                      | 1. endosulfan (Thionex) 50WP**   | 4 lbs   | 1 lb  | Apply when adults are present.   |
| Spider mites   | 1. fenbutatin-oxide (Vendex) 50WP<br>2. propargite (Omite) 30WS  | 1–2 lbs<br>4 lbs  | 4–8 oz<br>1 lb  | Vendex: Make no more than 2 applications per year. Propargite: Use on nectarines only.   |




\*Nectarine pests can probably be controlled by this program, but there is inadequate information on plant injury.

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

ΔDefaults to REI.


## PEST CONTROL PROGRAM FOR APRICOTS

Application rates in the tables are for dilute sprays, generally 400 gallons per acre. Gallonage requirements will vary depending on tree size, density, and spray equipment. In the case of large heavy barked trees, severely infested with scale insects, more than 400 gallons may be necessary for adequate control. Concentrate applications should base rates on the amount per acre rather than the amount per 100 gallons. Regardless of the amount used per 100 gallons, do not exceed the amounts per acre given in the following tables unless permitted by the label. See General Recommendations. For some of the pesticides recommended in this table, the target pest is not on the label. Such use is permissible, however, as long as the pesticide is labeled on the crop, and you follow all other use restrictions. The materials in the following tables are not listed in order of preference.

| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations   | Amount per acre  | Amount per 100 gallons (dilute sprays)                            | Minimum days between last use and harvest; restrictions, remarks   |
|---|--|--|---|--|
|    | STAGE 0, bud development chart (Dormant)   |  |   |  |
| Coryneum blight (shothole)  | 1. fixed copper 53WP** (+ sticker)<br>2. copper hydroxide<br>3. chlorothalonil (Bravo)   | See label<br>See label<br>See label                      | See label<br>See label<br>See label                               | Rates vary according to manufacturer. Convert copper formulations so that there are 2.5 lbs. metallic copper per 100 gals.   |
|    | STAGE 1 (Delayed-Dormant)  |  |   |  |
| Cutworms  | 1. endosulfan (Thionex) 50WP**<br>2. endosulfan (Thionex) 3EC**  |  | 1 lb<br>1.3 pints   | Apply thoroughly to lower trunk and cover crop with a handgun. Endosulfan is restricted to a total of 3 pounds ai/A or no more than two applications per year. Plan ahead for potential applications needed later in the season.   |
| European red mite (overwintering eggs)  | 1. horticultural mineral oil   | 3–6 gals   | 1.5 gals  | Oil is indispensable for an integrated mite control program. Avoid spraying oil during cool (lower than 45°F), damp, or windy weather.   |
| San Jose scale, Lecanium scale  | horticultural mineral oil +<br>1. methidathion (Supracide) 25WP**<br>2. diazinon (Diazinon) 4EC**<br>3. pyriproxyfen (Esteem) 0.86EC**                               | 6 gals<br>6 lbs<br>4 pints<br>13–16 fl oz                | 1.5 gals<br>1.5 lbs<br>1 pint<br>3.25–4 fl oz                     | Oil plus an organophosphate is preferred because the combination provides the most effective control for scale insects and other pests. Liquid formulations are preferred with oils, and tank agitation is required. Diazinon is limited to one application per season.  |
|  | STAGES 2–5 (Prebloom)  |  |   | Avoid killing bees on blooming cover crops. See Hazards to Bees.   |
| Brown rot (blossom blight)  | 1. iprodione (Rovral) 50WP**<br>2. myclobutanil (Rally) 40W<br>3. fenbuconazole (Indar) 75WSP<br>4. azoxystrobin (Abound)<br>5. pyraclostrobin + boscalid (Pristine) | 1–2 lbs<br>5 oz<br>2 oz<br>11–15.4 fl oz<br>10.5–14.5 oz | 0.25–0.5 lb<br>1.25 oz<br>0.5 oz<br>2.75–3.85 fl oz<br>2.6–3.6 oz | Iprodione: Apply at 5% bloom. Apply again at full bloom or petal fall if disease-conducive weather occurs. Apply no more than two times per season. Fenbuconazole: Do not apply more than 0.75 pound ai per acre per season. <b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season. Pristine: Apply no more than 72.5 oz per acre per season. |
| Coryneum blight   | 1. captan (Captan) 50WP**<br>2. chlorothalonil (Bravo)<br>3. myclobutanil (Rally) 40W<br>4. pyraclostrobin + boscalid (Pristine)                                     | 5 lbs<br>See label<br>5 oz<br>10.5–14.5 oz               | 1.25 lbs<br>See label<br>1.25 oz<br>2.6–3.6 oz                    | Captan: Do not apply more than 25 lbs. per acre (12.5 pounds a.i.) per season. Myclobutanil: See label for specific use recommendations. Place into solution before adding oil. Apply no more than 2.75 lbs. of product per acre per season. Pristine: Apply no more than 72.5 oz per acre per season.   |

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

## PEST CONTROL PROGRAM FOR APRICOTS (CONTINUED)

| Pest or disease to be controlled   | Use any one of the listed materials or the listed combinations   | Amount per acre  | Amount per 100 gallons (dilute sprays)  | Minimum days between last use and harvest; restrictions, remarks  |
|--|--|--|---|---|
| Cutworms   | 1. endosulfan (Thionex) 50WP**<br>2. endosulfan (Thionex) 3EC**  |  | 1 lb<br>1.3 pints   | Apply thoroughly to lower trunk and cover crop with a handgun. Endosulfan is restricted to a total of 3 pounds ai/Aor two applications per year. Plan ahead for potential applications needed later in the season.  |
| Grape mealybug, aphids   | 1. diazinon (Diazinon) 50WP<br>2. endosulfan (Thionex) 50WP**  | 4 lbs<br>4 lbs   | 1 lb<br>1 lb  | Diazinon is limited to one application per season.  |
| Lecanium scale   | 1. diazinon (Diazinon) 50WP**<br>2. malathion (Malathion) 8EC**<br>3. pyriproxyfen (Esteem) 35WP**   | 4 lbs<br>4 pints<br>4–5 oz   | 1 lb<br>1 pint<br>1–1.25 oz   | Diazinon is limited to one application per season.  |
| Lygus bugs, stink bugs   | 1. endosulfan (Thionex) 50WP**<br>2. lambda-cyhalothrin (Warrior)  | 4 lbs<br>2.56–5.12 fl oz   | 1 lb<br>0.64–1.28 fl oz   |   |
| Oriental fruit moth  | 1. Checkmate-OFM<br>2. Isomate-M   | 100–200 dispensers<br>100–150 dispensers                                 |   | Dispensers must be in place before the first oriental fruit moth adult flight. Checkmate dispensers may be applied more than once per season.   |
| Peach silver mite  | 1. endosulfan (Thionex) 50WP**   | 4 lbs  | 1 lb  |   |
| Peach twig borer   | 1. <i>Bacillus thuringiensis</i> (Bt)<br>2. endosulfan (Thionex) 50WP**<br>3. esfenvalerate (Asana XL) 0.66EC<br>4. methidathion (Supracide) 25WP<br>5. spinosad (Success) 2L<br>6. spinosad (Entrust) 80W | Rates vary<br>4 lbs<br>6–8 fl oz<br>6–12 lbs<br>4–8 fl oz<br>1.25–2.5 oz | See label<br>1 lb<br>1.5–2 fl oz<br>1.5–3 lbs<br>1–2 fl oz<br>0.3–0.6 oz      | Bts must be ingested by pest, so complete coverage is necessary for efficacy. Apply when warm weather is predicted for 3 or more days. Two or three applications per pest generation may be required to achieve adequate control.<br>Asana: apply in early to mid-pink (stages 2 or 3).   |
| Western flower thrips  | 1. endosulfan (Thionex) 50WP**   | 4 lbs  | 1 lb  |   |
|  STAGES 6–7 (Blossom) |  |  |   | Avoid killing bees on blooming cover crops. See Hazards to Bees.  |
| Brown rot (blossom blight)   | 1. azoxystrobin (Abound)<br>2. captan (Captan) 50WP**<br>3. fenbuconazole (Indar) 75WSP<br>4. iprodione (Rovral) 50W**<br>5. propiconazole (Orbit)<br>6. pyraclostrobin + boscalid (Pristine)              | 11–15.4 fl oz<br>5 lbs<br>2 oz<br>1–2 lbs<br>4 fl oz<br>10.5–14.5 oz     | 2.75–3.85 fl oz<br>1.25 lbs<br>0.5 oz<br>0.25–0.5 lb<br>4 fl oz<br>2.6–3.6 oz | Captan: Do not apply more than 25 lbs per acre (12.5 lbs ai) per season.<br>Propiconazole: Apply at 5–10% and 80–100% bloom. Fenbuconazole: Do not apply more than 0.75 pound ai per acre per season.<br><b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season.<br>Iprodione: Apply at 5% bloom. Apply again at full bloom or petal fall if disease-conducive weather occurs. Apply no more than <b>two</b> times per season.<br>Pristine: Apply no more than 72.5 oz per acre per season. |

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

## PEST CONTROL PROGRAM FOR APRICOTS (CONTINUED)

| Pest or disease to be controlled | Use any one of the listed materials or the listed combinations  | Amount per acre  | Amount per 100 gallons (dilute sprays)                            | Minimum days between last use and harvest; restrictions, remarks   |
|----------------------------------|---|--|---|--|
| Leafrollers                      | 1. <i>Bacillus thuringiensis</i> (Bt)   | Rates vary   | See label   | Bts must be ingested by pest, so complete coverage is necessary for efficacy. Apply when warm weather is predicted for 3 or more days. Two or three applications per pest generation may be required to achieve adequate control.  |
| PETAL-FALL (100% petal fall)     |   | Avoid killing bees on blooming cover crops. See Hazards to Bees. |   |  |
| Brown rot (blossom blight)       | 1. iprodione (Rovral) 50W**<br>2. myclobutanil (Rally) 40W<br>3. fenbuconazole (Indar) 75WSP<br>4. azoxystrobin (Abound)<br>5. pyraclostrobin + boscalid (Pristine) | 1–2 lbs<br>5 oz<br>2 oz<br>11–15.4 fl oz<br>10.5–14.5 oz         | 0.25–0.5 lb<br>1.25 oz<br>0.5 oz<br>2.75–3.85 fl oz<br>2.6–3.6 oz | Rovral: Apply again at petal fall if disease-conducive weather occurs. Apply no more than two times per season. Rally: See label for specific use recommendations. Place into solution before adding oil. Indar: Do not apply more than 0.75 pound ai per acre per season. <b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season. Pristine: Apply no more than 72.5 oz per acre per season. |
| Coryneum blight (shothole)       | 1. chlorothalonil (Bravo)<br>2. azoxystrobin (Abound)<br>3. pyraclostrobin + boscalid (Pristine)  | See label<br>11–15.4 fl oz<br>10.5–14.5 oz                       | See label<br>2.75–3.85 fl oz<br>2.6–3.6 oz                        | Apply no later than shuck split. Abound: see comments above. Pristine: Apply no more than 72.5 oz per acre per season.   |
| Grape mealybug, aphids           | 1. diazinon (Diazinon) 50WP<br>2. endosulfan (Thionex) 50WP**<br>3. imidacloprid (Provado) 1.6F   | 4 lbs<br>4 lbs<br>4–8 fl oz                                      | 1 lb<br>1 lb<br>2 fl oz   | Diazinon is limited to one application per season.   |
| Leafrollers                      | 1. <i>Bacillus thuringiensis</i> (Bt) (Dipel DF, Javelin, Biobit)   | Rates vary   | See label   | Bts must be ingested by pest, so complete coverage is necessary for efficacy. Apply when warm weather is predicted for 3 or more days. Two or three applications per pest generation may be required to achieve adequate control.  |
| Lygus bugs                       | See stages 2–5 (Prebloom)   |  |   |  |
| Oriental fruit moth              | 1. phosmet (Imidan) 70WP  | 3–4.25 lbs   | 0.75–1 lb   |  |
| Peach twig borer                 | 1. <i>Bacillus thuringiensis</i> (Bt)<br>2. endosulfan (Thionex) 50WP**<br>3. phosmet (Imidan) 70WP<br>4. spinosad (Success) 2L<br>5. spinosad (Entrust) 80W        | Rates vary<br>4 lbs<br>3–4.25 lbs<br>4–8 fl oz<br>1.25–2.5 oz    | See label<br>1 lb<br>0.75–1 lb<br>1–2 fl oz<br>0.3–0.6 oz         | Bts are stomach poisons so complete coverage is very important for control. Two or three applications are usually required. Apply when forecasts predict a warm weather pattern for 3 or more days. Endosulfan is restricted to 2 applications per year. Plan ahead for potential applications needed later in the year. Success: Do not apply more than 29 fl oz of product per acre per season.  |
| Powdery mildew (Perfection spot) | 1. myclobutanil (Rally) 40W<br>2. propiconazole (Orbit)<br>3. azoxystrobin (Abound)<br>4. trifloxystrobin (Flint)   | 5 oz<br>4 fl oz<br>11–15.4 fl oz<br>2–4 oz                       | 1.25 oz<br>2.75–3.85 fl oz<br>0.5–1 oz                            | Rally: See label for specific use recommendations. Place into solution before adding oil. Do not apply more than 2.75 lbs of product per acre per season.  |

## PEST CONTROL PROGRAM FOR APRICOTS (CONTINUED)

| Pest or disease to be controlled | Use any one of the listed materials or the listed combinations   | Amount per acre  | Amount per 100 gallons (dilute sprays)               | Minimum days between last use and harvest (PHI); restrictions, remarks  |
|----------------------------------|--|--|--|---|
| SHUCK FALL                       |  | Avoid killing bees on blooming cover crops. See Hazards to Bees. |  |   |
| Brown rot                        | 1. captan (Captan) 50WP**<br>2. azoxystrobin (Abound)<br>3. pyraclostrobin + boscalid (Pristine)   | 5 lbs<br>11–15.4 fl oz<br>10.5–14.5 oz                           | 1.25 lbs<br>2.75–3.85 fl oz<br>2.6–3.6 oz            | Captan: Do not apply more than 12.5 lbs ai per acre per season.<br><b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season.<br>Pristine: Apply no more than 72.5 oz per acre per season.   |
| Coryneum blight (Shothole)       | 1. azoxystrobin (Abound)<br>2. captan (Captan) 50WP<br>3. ziram (Ziram) 76WDG<br>4. pyraclostrobin + boscalid (Pristine)                                       | 11–15.4 fl oz<br>5 lbs<br>6 lbs<br>10.5–14.5 oz                  | 2.75–3.25 fl oz<br>1.25 lbs<br>1.5 lbs<br>2.6–3.6 oz | <b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season.<br>Pristine: Apply no more than 72.5 oz per acre per season.  |
| Leafrollers                      | 1. <i>Bacillus thuringiensis</i> (Bt)<br>2. spinosad (Success) 2L<br>3. spinosad (Entrust) 80W   | Rates vary<br>4–8 fl oz<br>1.25–2.5 oz                           | See label<br>1–2 fl oz<br>0.3–0.6 oz                 | Bts must be ingested by pest, so complete coverage is necessary for efficacy. Apply when warm weather is predicted for 3 or more days. Two or three applications per pest generation may be required to achieve adequate control. Do not apply more than 29 fl oz of Success per acre per growing season.   |
| Powdery mildew (Perfection spot) | 1. azoxystrobin (Abound)<br>2. myclobutanil (Rally) 40W<br>3. propiconazole (Orbit)<br>4. trifloxystrobin (Flint)  | 11–15.4 fl oz<br>5 oz<br>4 fl oz<br>2–4 oz                       | 2.75–3.85 fl oz<br>1.25 oz<br>0.5–1 oz               | Rally: See label for specific use recommendations. Place into solution before adding oil. Do not apply more than 2.75 lbs product per acre per year.<br>Abound : See comments above.  |
| SUMMER                           |  | Avoid killing bees on blooming cover crops. See Hazards to Bees. |  |   |
| Brown rot (fruit rot)            | 1. azoxystrobin (Abound)<br>2. captan (Captan) 50WP**<br>3. fenbuconazole (Indar) 75WSP<br>4. propiconazole (Orbit)<br>5. pyraclostrobin + boscalid (Pristine) | 11–15.4 fl oz<br>5 lbs<br>2 oz<br>4 fl oz<br>10.5–14.5 oz        | 2.75–3.85 fl oz<br>1.25 lbs<br>0.5 oz<br>2.6–3.6 oz  | Δ4hr<br>Δ4<br>Δ12hr<br>Δ1<br>Δ12hr<br>Indar: Begin applications 2 to 3 weeks before harvest and continue at 7- to 10-day intervals. Do not apply more than 0.75 pound ai per acre per season.<br><b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season.<br>Pristine: Apply no more than 72.5 oz per acre per season. |
| Cutworms                         | 1. endosulfan (Thionex) 50WP**   | 4 lbs  | 1 lb   | 21/30 The PHI for endosulfan is 21 days when applied as a trunk spray, 30 days if applied as a cover spray. Endosulfan is restricted to a total of 3 pounds active ingredient per season and no more than two applications.   |

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

ΔDefaults to REI.

## PEST CONTROL PROGRAM FOR APRICOTS (CONTINUED)

| Pest or disease to be controlled              | Use any one of the listed materials or the listed combinations  | Amount per acre                                 | Amount per 100 gallons (dilute sprays)       | Minimum days between last use and harvest (PHI); restrictions, remarks  |
|---|---|---|--|---|
| Earwigs                                       | 1. carbaryl (Sevin) 80WP**<br>2. carbaryl (Sevin) 4F**  | 2.5–3.75 lbs<br>3 qts                           | 0.75 qt                                      | 3 Apply around bases of trees and on trunks.<br>3 Do not apply carbaryl on blooming cover crops because of hazard to bees.  |
| Grasshoppers, Mormon crickets                 | See text—Special Programs   |   |  |   |
| Oriental fruit moth                           | 1. phosmet (Imidan) 70WP  | 3–4.25 lbs                                      | 0.75–1 lb                                    | 14  |
| Pandemis leafroller, obliquebanded leafroller | 1. <i>Bacillus thuringiensis</i> (Bt)<br>2. spinosad (Success) 2L<br>3. spinosad (Entrust) 80W                      | Rates vary<br>4–8 fl oz<br>1.25–2.5 oz          | See label<br>1–2 fl oz<br>0.3–0.6 oz         | Δ4hr Bts are stomach poisons so complete coverage is very important for control. Two or three applications are usually required. Do not apply more than 29 fl oz Success per acre per growing season.   |
| Peach silver mite                             | 1. endosulfan (Thionex) 50WP**  | 4 lbs   | 1 lb   | 30  |
| Peachtree borer                               | 1. endosulfan (Thionex) 50WP**<br>2. endosulfan (Thionex) 3EC**<br>3. Isomate-P                                     | 100 dispensers                                  | 1 lb<br>1 quart                              | 21 Spray trunks, crotches, and ground around trees with a handgun. Endosulfan preharvest interval is 30 days unless applied as a trunk spray. Isomate-P: Apply dispensers in late June or when the first moths are caught in pheromone traps. Place dispensers in upper half of canopy.   |
| Peach twig borer                              | 1. endosulfan (Thionex) 50WP**<br>2. phosmet (Imidan) 70WP<br>3. spinosad (Success) 2L<br>4. spinosad (Entrust) 80W | 4 lbs<br>3–4.25 lbs<br>4–8 fl oz<br>1.25–2.5 oz | 1 lb<br>0.75–1 lb<br>1–2 fl oz<br>0.3–0.6 oz | 30 Use temperature model to time application in late May or early June. The PHI for endosulfan is 21 days when applied as a trunk spray, 30 days if applied as a cover spray. Endosulfan is restricted to a total of 3 pounds ai/A per acre per season. Do not apply more than 29 fl oz of Success per acre per growing season. |
| Powdery mildew                                | 1. myclobutanil (Rally) 40W<br>2. propiconazole (Orbit)<br>3. trifloxystrobin (Flint)                               | 5 oz<br>4 fl oz<br>2–4 oz                       | 1.25 oz<br><br>0.5–1 oz                      | Δ1 Myclobutanil: See label for specific use recommendations. Place into solution before adding oil.<br>Δ1   |
| San Jose scale                                | 1. diazinon (Diazinon) 50WP<br>2. diazinon (Diazinon) 4EC   | 4 lbs<br>4 pints                                | 1 lb<br>1 pint                               | 21 Do not make more than one application of diazinon per season.  |
| Shothole borer                                | 1. endosulfan (Thionex) 50WP**  | 4 lbs   | 1 lb   | 21/30   |

### PREHARVEST AND HARVEST

|           |   |               |                 |   |
|-----------|---|---------------|-----------------|---|
| Brown rot | 1. captan (Captan) 50WP**               | 5 lbs         | 1.25 lbs        | Δ4 Captan: Do not apply more than 25 lbs per acre (12.5 lbs a.i.) per season.   |
|           | 2. propiconazole (Orbit)                | 4 fl oz       |                 | Δ1  |
|           | 3. fenbuconazole (Indar) 75WSP          | 2 oz          | 0.5 oz          | Δ12hr Indar: Begin applications 2 to 3 weeks before harvest and continue at 7- to 10-day intervals. Do not apply more than 0.75 pound ai per acre per season. |
|           | 4. azoxystrobin (Abound)                | 11–15.4 fl oz | 2.75–3.85 fl oz | Δ4hr  |
|           | 5. pyraclostrobin + boscalid (Pristine) | 10.5–14.5 oz  | 2.6–3.6 oz      | Δ12hr   |

**Abound is extremely phytotoxic to certain apple varieties.** See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season.  
Pristine: Apply no more than 72.5 oz per acre per season.

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

ΔDefaults to REI.

## PEST CONTROL PROGRAM FOR APRICOTS (CONTINUED)

| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations | Amount per acre | Amount per 100 gallons (dilute sprays) | Minimum days between last use and harvest (PHI); restrictions, remarks |
|---|--|-----------------|--|--|
| Oriental fruit moth, peach twig borer   | 1. carbaryl (Sevin) 80WP**                                     | 2.5–3.75 lbs    | 0.6–0.9 lb                             | 3  |
|   | 2. carbaryl (Sevin) 4F**                                       | 4 pints         | 1 pint                                 | 3  |
| Powdery mildew  | 1. propiconazole (Orbit)                                       | 4 fl oz         |  | Δ1   |
|   | 2. azoxystrobin (Abound)                                       | 11–15.4 fl oz   | 2.75–3.85 fl oz                        | Δ4hr   |
|   | 3. trifloxystrobin (Flint)                                     | 2–4 oz          | 0.5–1 oz                               | 1  |
| <b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season. |  |                 |  |  |

### POSTHARVEST



|                                     |                                       |           |           |  |
|-------------------------------------|---------------------------------------|-----------|-----------|--|
| Coryneum blight (shothole)          | 1. captan (Captan) 50WP               | 5 lbs     | 1.25 lbs  | Apply before autumn rains. Captan: Do not apply more than 25 lbs (12.5 lbs a.i.) per acre per season.<br>Ziram: Do not apply more than 30 lbs per acre per year (22.8 lbs a.i.). |
|                                     | 2. ziram (Ziram)                      | See label | See label |  |
|                                     | 3. chlorothalonil (Bravo)             | See label | See label |  |
| Bacterial gummosis, Coryneum blight | 1. copper hydroxide (numerous labels) | See label | See label | Rates vary according to manufacturer. Do not use copper materials before trees begin to drop leaves. Convert so there are 2.5 pounds metallic copper per 100 gallons.            |
|                                     | 2. fixed copper (+ sticker)           | See label | See label |  |
| Shothole borer, ambrosia beetle     | 1. endosulfan (Thionex) 50WP**        | 4 lbs     | 1 lb      | Apply when adults are present. Endosulfan is restricted to a total of 3 pounds a.i./A per year and no more than two applications.  |

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

ΔDefaults to REI.


## PEST CONTROL PROGRAM FOR PRUNES AND PLUMS

Application rates in the tables are for dilute sprays, generally 400 gallons per acre. Gallonage requirements will vary depending on tree size, density, and spray equipment. In the case of large, heavy-barked trees severely infested with scale insects, more than 400 gallons may be necessary for adequate control. Concentrate applications should base rates on the amount per acre rather than the amount per 100 gallons. Regardless of the amount used per 100 gallons, do not exceed the amounts per acre given in the following tables unless permitted by the label. See General Recommendations. For some of the pesticides recommended in this table, the target pest is not on the label. Such use is permissible, however, as long as the pesticide is labeled on the crop, and you follow all other use restrictions. The materials in the following tables are not listed in order of preference.

| Pest or disease to be controlled   | Use any one of the listed materials or the listed combinations  | Amount per acre                                 | Amount per 100 gallons (dilute sprays)           | Minimum days between last use and harvest; restrictions, remarks  |
|--|---|---|--|---|
|   | STAGE 1, bud development chart (Delayed-Dormant)  |   |  |   |
| Cutworms   | 1. endosulfan (Thionex) 50WP**<br>2. endosulfan (Thionex) 3EC**<br>3. chlorpyrifos (Lorsban) 4EC  |   | 1 lb<br>1.3 pints<br>0.5–1 pint                  | Endosulfan is restricted to a maximum of two applications or a total of 3 pounds ai/A per year. Plan ahead for potential applications needed later in the season.   |
| European red mite (overwintering eggs)   | 1. horticultural mineral oil  | 3–5 gals  | 1–1.25 gals                                      | Adequate agitation is required. Do not use over 5 gals. oil per acre concentrate on mature trees.   |
| San Jose scale, Lecanium scale   | horticultural mineral oil + one of the following:<br>1. chlorpyrifos (Lorsban) 4EC<br>2. methidathion (Supracide) 25WP**<br>3. pyriproxyfen (Esteem) 0.86EC** | 3–5 gals<br>4 pints<br>6 lbs<br>13–16 fl oz     | 1–1.25 gals<br>1 pint<br>1.5 lbs<br>3.25–4 fl oz | Oil plus an organophosphate is preferred because the combination provides the most effective control for scale insects and other pests. Liquid formulations are preferred with oils, and tank agitation is required. Do not use more than 5 gallons of oil per acre concentrate on mature trees. See text-Special Programs. |
|  | STAGES 2–5 (Prebloom) <span style="float: right;">See Hazards to Bees.</span>   |   |  |   |
| Cutworms   | 1. endosulfan (Thionex) 50WP**<br>2. endosulfan (Thionex) 3EC**   |   | 1 lb<br>1.3 pints                                | Endosulfan is restricted to a total of 3 pounds ai/A per year and no more than two applications. Plan ahead for potential applications needed later in the season.  |
| Grape mealybug, Mealy plum aphid, leaf curl plum aphid                             | 1. phosmet (Imidan) 70WP<br>2. diazinon (Diazinon) 50WP<br>3. endosulfan (Thionex) 50WP**   | 4.25 lbs<br>4 lbs<br>4 lbs                      | 1 lb<br>1 lb<br>1 lb                             | Diazinon is limited to one application per season.  |
| Lecanium scale   | 1. diazinon (Diazinon) 50WP**   | 4 lbs   | 1 lb   | Diazinon is limited to one application per season.  |
| Lygus bugs, stink bugs   | 1. endosulfan (Thionex) 50WP**  | 4 lbs   | 1 lb   |   |
| Pandemis leafroller, obliquebanded leafroller                                      | 1. <i>Bacillus thuringiensis</i> (Bt)<br>2. spinosad (Success) 2L<br>3. spinosad (Entrust) 80W  | Rates vary<br>4–8 fl oz<br>1.25–2.5 oz          | See label<br>1–2 fl oz<br>0.3–0.6 oz             | Bts must be ingested by pest, so complete coverage is necessary for efficacy. Apply when warm weather is predicted for 3 or more days. Two or three applications per pest generation may be required to achieve adequate control.   |
| Peach twig borer   | 1. endosulfan (Thionex) 50WP**<br>2. spinosad (Success) 2L<br>3. spinosad (Entrust) 80W<br>4. <i>Bacillus thuringiensis</i> (Bt)                              | 4 lbs<br>4–8 fl oz<br>1.25–2.5 oz<br>Rates vary | 1 lb<br>1–2 fl oz<br>0.3–0.6 oz<br>See label     |   |
| Plum rust mite   | 1. endosulfan (Thionex) 50WP**  | 4 lbs   | 1 lb   |   |

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

## PEST CONTROL PROGRAM FOR PRUNES AND PLUMS (CONTINUED)

| Pest or disease to be controlled  | Use any one of the listed materials or the listed combinations  | Amount per acre  | Amount per 100 gallons (dilute sprays)                    | Minimum days between last use and harvest (PHI); restrictions, remarks   |
|---|---|--|---|--|
|  | STAGES 6–7<br>(Blossom)   |  |   | See Hazards to Bees.   |
| Brown rot   | 1. azoxystrobin (Abound)<br>2. captan (Captan) 50WP<br>3. propiconazole (Orbit)<br>4. flowable/micronized sulfur<br>5. pyraclostrobin + boscalid (Pristine) | 12.3–15.4 fl oz<br>6 lbs<br>4 fl oz<br>See label<br>10.5–14.5 oz | 3.08–3.85 fl oz<br>1.5 lbs<br><br>See label<br>2.6–3.6 oz | Propiconazole. Do not use on Stanley-type plums earlier than 21 days prior to harvest.<br><b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season.<br>Pristine: Apply no more than 72.5 oz per acre per season. |
| PETAL-FALL (100% petal fall)—See Hazards to Bees                                  |   |  |   |  |
| Brown rot   | See stages 6–7 (Blossom)  |  |   |  |
| Grape mealybug, mealy plum aphid, leaf curl plum aphid                            | 1. imidacloprid (Provado) 1.6F<br>2. phosmet (Imidan) 70WP<br>3. diazinon (Diazinon) 50WP<br>4. endosulfan (Thionex) 50WP**                                 | 4–8 fl oz<br>4.25 lbs<br>4 lbs<br>4 lbs                          | 1–2 fl oz<br>1 lb<br>1 lb<br>1 lb                         | Diazinon is limited to one application per season.   |
| Pandemis leafroller, obliquebanded leafroller                                     | 1. <i>Bacillus thuringiensis</i> (Bt)<br>2. spinosad (Success) 2L<br>3. spinosad (Entrust) 80W<br>4. methoxyfenozide (Intrepid) 2F                          | Rates vary<br>4–8 fl oz<br>1.25–2.5 oz<br>8–16 fl oz             | See label<br>1–2 fl oz<br>0.3–0.6 oz<br>2–4 fl oz         | Bt: See remarks in Prebloom section.   |
| Peach twig borer  | See stages 2–5 (Prebloom)   |  |   |  |
| Plum rust mite  | See stages 2–5 (Prebloom)   |  |   |  |
| White apple leafhopper  | 1. endosulfan (Thionex) 50WP**  | 4 lbs  | 1 lb  | Endosulfan is restricted to a total of 3 pounds ai/A per year and no more than two applications. Plan ahead for potential applications needed later in the season.   |
| SHUCK FALL  |   |  |   |  |
| Avoid killing bees on blooming cover crops. See Hazards to Bees.                  |   |  |   |  |
| Brown rot   | 1. wettable sulfur<br>2. captan (Captan) 50WP   | 10–12 lbs<br>6 lbs   | 2.5–3 lbs<br>1.5 lbs                                      |  |
| LATE SPRING AND SUMMER  |   |  |   |  |
| Avoid killing bees on blooming cover crops. See Hazards to Bees.                  |   |  |   |  |
| Brown rot   | 1. flowable/micronized sulfur<br>2. captan (Captan) 50WP<br>3. azoxystrobin (Abound)<br>4. pyraclostrobin + boscalid (Pristine)                             | See label<br>6 lbs<br>12.3–15.4 fl oz<br>10.5–14.5 oz            | See label<br>1.5 lbs<br>3.08–3.85 fl oz<br>2.6–3.6 oz     | Δ1<br>Δ4<br>Δ4hr<br>Δ12hr<br><b>Abound is extremely phytotoxic to certain apple varieties.</b> See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 1.92 quarts of product per acre per season.<br>Pristine: Apply no more than 72.5 oz per acre per season.  |
| Earwigs   | 1. carbaryl (Sevin) 80WP**<br>2. carbaryl (Sevin) 4F**  | 2.5–3.75 lbs<br>2–3 qts  | 0.6–0.9 lb<br>0.5–0.75 qt                                 | 3 Apply thoroughly to trunks and soil around<br>3 base of trees.   |

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

ΔDefaults to Restricted Entry Interval.

## PEST CONTROL PROGRAM FOR PRUNES AND PLUMS (CONTINUED)

| Pest or disease to be controlled                                      | Use any one of the listed materials or the listed combinations                                     | Amount per acre                        | Amount per 100 gallons (dilute sprays) | Minimum days between last use and harvest; restrictions, remarks   |
|---|--|--|--|--|
| Grasshoppers<br>Mormon crickets                                       | See Special Programs   |  |  |  |
| McDaniel spider mite,<br>twospotted spider mite,<br>European red mite | 1. fenbutatin-oxide (Vendex) 50WP<br>2. hexythiazox (Savey) 50WP<br>3. bifentazate (Acramite) 50WS | 1–2 lbs<br>3–6 oz<br>0.75–1 lb         | 4–8 oz<br>0.75–1.5 oz<br>0.2–0.25 lb   | 14<br>28<br>3<br>Vendex is restricted to no more than two applications and no more than 3 lbs of product per acre per year.<br>Hexythiazox: most effective on the egg stage, does not control adult mites. Do not make more than one application per year.   |
| Grape mealybug  | 1. diazinon (Diazinon) 4EC**<br>2. endosulfan (Thionex) 50WP**<br>3. imidacloprid (Provado) 1.6F   | 4 pints<br>4 lbs<br>4–8 fl oz          | 1 pint<br>1 lb<br>2 fl oz              | 21<br>7<br>7<br>Diazinon is limited to one application per season. Endosulfan is restricted to 2 applications per year. Plan ahead for potential applications needed later in the season.  |
| Pandemis leafroller,<br>Obliquebanded leafroller                      | 1. <i>Bacillus thuringiensis</i> (Bt)<br>2. spinosad (Success) 2L<br>3. spinosad (Entrust) 80W     | Rates vary<br>4–8 fl oz<br>1.25–2.5 oz | See label<br>1–2 fl oz<br>0.3–0.6 oz   | Δ4hr<br>7<br>7<br>Apply June 10–20 (or 1st brood peak moth flight). Apply again August 15–25 (or 2nd brood peak moth flight) if problem persists. Success: Do not apply more than 29 fl oz per acre per year.<br><br>Bts must be ingested by pest, so complete coverage is necessary for efficacy. Apply when warm weather is predicted for 3 or more days. Two or three applications per pest generation may be required to achieve adequate control. |
| Peachtree borer   | 1. endosulfan (Thionex) 50WP**   |  | 1 lb                                   | 7<br>Apply thoroughly to trunk and soil around base of trees.  |
| Peach twig borer  | 1. endosulfan (Thionex) 50WP**<br>2. spinosad (Success) 2L<br>3. spinosad (Entrust) 80W            | 4 lbs<br>4–8 fl oz<br>1.25–2.5 oz      | 1 lb<br>1–2 fl oz<br>0.3–0.6 oz        | 7<br>7<br>7<br>Apply when traps show significant adult presence and models indicate proper spray timing. This usually occurs in early to mid-June. Success: Do not apply more than 29 fl oz per acre per year.   |
| Plum rust mite  | 1. endosulfan (Thionex) 50WP**<br>2. flowable/micronized sulfur                                    | 4 lbs<br>See label                     | 1 lb<br>See label                      | 7<br>Δ1  |
| San Jose scale,<br>Lecanium scale                                     | 1. diazinon (Diazinon) 4EC   | 4 pints                                | 1 pint                                 | 21<br>Diazinon is limited to one application per season.   |
| Shothole borer  | 1. endosulfan (Thionex) 50WP**   | 4 lbs                                  | 1 lb                                   | 7  |
| White apple leafhopper  | 1. endosulfan (Thionex) 50WP**<br>2. carbaryl (Sevin XLR Plus)                                     | 4 lbs<br>4 pints                       | 1 lb<br>1 pint                         | 7<br>3   |
| <b>POSTHARVEST</b>  |  |  |  |  |
| Bacterial gummosis  | 1. fixed copper + sticker  | See label                              | See label                              | Apply most materials after October 1.  |
| Shothole borer  | 1. endosulfan (Thionex) 50WP**   | 4 lbs                                  | 1 lb                                   | Endosulfan is restricted to 2 applications per season.   |

\*\*Other formulations used at equivalent rates may be suitable. See individual labels.

ΔDefaults to Restricted Entry Interval.

## NUTRIENT SPRAYS

Fertilizers can be applied to fruit trees as nutrient sprays. Although only limited amounts of nutrients can be absorbed by the tree through foliar application methods, such spray applications can be timed for maximum effect in overcoming or preventing certain mineral deficiencies or to enhance tree performance and fruit quality.

*Caution:* Nutrient sprays can cause severe injury to fruit, leaves, shoots, and buds. Therefore their use should be considered as hazardous. Do NOT apply unless a deficiency or low level of that specific nutrient is known to exist and has been confirmed by visual symptoms or tissue tests. Use dilute sprays and as low a rate as possible. Concentrates can cause serious injury.

**Note: Nutrients are not classified as pesticides and therefore do not require pesticide label registration. Only a limited number of materials are specifically formulated and labeled for use as nutrient sprays. Do not combine these with pesticides unless permitted on the product label. Use of products not labeled for nutrient sprays may result in crop injury.**

### Ammonium thiosulfate

Enhancing the nitrogen status of blossom and young fruitlets can increase ovule longevity and cell division. Furthermore, sulfur deficiency in Washington orchards has become more common because of reduced use of sulfur-containing pesticides and fertilizers. Application of ammonium thiosulfate provides plant-available nitrogen and sulfur. Ammonium thiosulfate is corrosive; excessive application or improper timing may damage flower, fruit, and foliage. Consult the product label.

### Boron

Boron deficiencies are common in fruit trees throughout the Pacific Northwest. Dry soils, particularly in the fall, aggravate the problem. Symptoms include poorly developed stamens in the blossom, blast of pear blossoms, inadequate fruit set, low seed numbers, bark necrosis in apple, fruit cork, and sometimes fruit cracking.

Deficiencies in most orchards can be prevented or corrected by soil applications of boron, broadcast over the entire soil surface. One application should last up to three years. Because of the potential for serious injury and even loss of the crop or trees if too much boron is used, precautions should be taken. Do not apply more than 3 pounds of actual boron per acre unless higher rates are required as determined by soil tests, sampling to 3 feet. If an aircraft is used for soil application, apply only during the dormant season.

Spray applications can be used to prevent the development of deficiency symptoms or to correct deficiencies. An annual

application at the maintenance rate should supply sufficient boron to prevent deficiencies. This may be applied at any time but is more effective in improving blossom quality and fruit set if applied shortly before full bloom. Sprays also can be applied early during the growing season or postharvest while the leaves are still green and active. Higher maintenance rates may be required for orchards planted on very sandy or calcareous soils or in the White Salmon area. Use the annual per acre deficiency rate at these locations, applying half the boron in a single prebloom spray and the remainder in one or more postbloom sprays. Boric acid- and polyborate-based spray products are equally effective, when applied as single-product sprays. With the exception of Mor-Bor 17 and B-17, all boron spray products tested to date at WSU produce alkaline spray tank solutions and may require acidifying adjuvants if used in pH-sensitive tank mixes. Tank mixes with Mor-Bor 17 or B-17 may require acidification when prepared using very alkaline well waters. Because boron product and water chemistries vary, the best practice is to measure and adjust the pH of the boron product-water-acidifier mix before adding pH-sensitive pesticides or growth regulators.

If deficiencies appear during the growing season, apply boron as soon as possible but do not use high rates after May because of the potential for fruit breakdown in storage. If deficiency symptoms occur frequently, make soil tests and consider ground applications.

Where pear "blossom blast" occurs, make spray applications in the fall after harvest but while the leaves are still green and active or in the spring during the first white to white blossom stages. Note: "blossom blast" is readily confused with false fire blight (*Pseudomonas* blight) and fire blight. See section on Diseases of Apples and Pears.

*Caution:* Both high rates and high concentrations of boron can cause shoot dieback and even tree death. High rates or late applications during the growing season can cause severe fruit loss in storage.

### Calcium

Calcium sprays applied to fruit during the growing season may reduce the incidence of certain fruit disorders and may improve fruit quality. Responses to calcium sprays are not predictable from calcium levels in soil or leaves. Physiological disorders such as bitter pit of apples, cork spot and alfalfa greening of Anjou pears, and cracking and firmness of cherries are often related to calcium content of the fruit; however, the relationships are not precise.

The most commonly used calcium spray material is calcium chloride, available as either food-grade product or specifically formulated for use as a foliar spray. Construction-grade calcium chloride contains impurities that can severely damage fruit. Calcium chloride can cause leaf burn and fruit injury, and has limited compatibility with pesticides (see sections on Plant Injury-Chemical Combinations, and Limited Compatibility Materials). Calcium nitrate also has been successfully used to reduce bitter pit of apple; however, it is more likely to cause fruit

injury than calcium chloride. Calcium nitrate sprays applied at the rates and frequencies used for bitter pit control will not improve green color of green apple varieties and may produce a duller red color in red apple varieties. The practice of using calcium nitrate during the first half of the season then switching to calcium chloride for the latter half has not been tested in Washington but has theoretical merit. Foliar sprays of calcium sulfate may actually increase bitter pit and should not be used. Calcium-containing chelates and organic complexes have not been more effective than calcium chloride. Use only chelates and organic complexes that are specifically labeled for foliar application to tree fruits.

*Caution:* The risk of calcium chloride or calcium nitrate causing fruit russet rises with increasing number of applications, high rates, and when applied in less than 100 gallons of water per acre. The possibility of fruit injury is highest at gallonages where droplets coalesce and pool on the lower part of the fruit. The hazard is reduced by using low rates and dilute sprays. Avoid spraying calcium chloride or calcium nitrate under slow drying conditions or at temperatures above 80°F to 85°F. Fruit size of cherries may be reduced by calcium chloride sprays.

*Bitter pit of apple* is a physiological disorder often related to low fruit calcium levels. Five to eight applications of calcium chloride or calcium nitrate applied at periodic intervals from early June to late August will significantly reduce the risk of bitter pit development. Effectiveness varies with variety, orchard location, and growing season. If severe bitter pit is common, more frequent applications may be required. Calcium sprays are not required in orchards that historically have not produced fruit with bitter pit.

*Cork spot and alfalfa greening of Anjou pears* are physiological disorders which are often reduced by foliar calcium chloride sprays. Pears are more susceptible to calcium spray injury than are apples. Foliar sprays of calcium nitrate should not be used on pears. Apply no more than 4 pounds calcium chloride dissolved in 400 to 800 gallons per acre (the 800 gallon rate is for larger trees). Make four to five applications at 3-week intervals from June to August.

*Fruit firmness and rain cracking of cherries* are influenced by calcium chloride sprays. Research suggests that three or more sprays applied at weekly intervals before anticipated harvest are likely to reduce fruit softening, postharvest injury, and minor rain cracking. Severe cracking will not be prevented. Fruit size may be reduced.

## Copper

Copper deficiency or "wither tip" has become more common in Washington apple and pear orchards. About mid-June, terminal leaves on part or most of the tree turn yellow, wither and fall. Bark may be cracked and rough.

Postharvest foliar applications of 1 pound of copper per acre as copper sulfate or basic copper sulfate will usually correct the symptoms. If symptoms are severe, mid-season sprays of

copper chelate or basic copper sulfate products (bearing trees) or copper chelate, copper sulfate, or basic copper sulfate products (non-bearing trees) can be applied but may cause foliage and fruit injury.

Adding copper to zinc dormant sprays will not increase leaf copper levels.

*Caution:* All copper products are potentially phytotoxic. Applying copper sprays when fruit is present can cause severe fruit russetting, particularly on Anjou. If possible, delay applications until after harvest. Fruit injury sometimes can occur when foliar copper products are mixed with calcium chloride or applied within a week of calcium chloride sprays. Excessive copper application can increase soil copper to levels that are toxic to fruit trees.

## Iron

Trees affected by iron chlorosis may be made green by foliage applications of iron chelates or similar compounds. **This is a temporary measure and does not correct the basic cause.** Usually two sprays are required. Apply the first about 4 weeks after bloom and the second about 3 weeks later. Apply as a separate spray.

*Caution:* Some iron chelate sprays may cause severe injury to fruit, especially pears.

## Potassium

**Midsummer Potassium Sprays.** During the past several years, there has been increasing use of foliar applications of potassium based on undocumented claims that such sprays can enhance red color of apples. These sprays have been applied regardless of actual potassium status of the fruit trees. Low soil potassium is widespread in humid regions, including western Washington; however, potassium deficiency is uncommon in central Washington orchards. Recent evidence suggests that depletion of soil potassium may be enhanced in orchards that have been farmed for very long periods of time, are on very sandy soils, especially where evaporative cooling is used, or where high-frequency fertigation through trickle (drip) irrigation systems is practiced. Although there is justification to apply potassium fertilizer where potassium levels in trees and grass cover crops are truly low, we have received an increasing number of reports of potassium sprays inducing severe bitter pit in apple and cork spot in pears. These disorders are associated with high potassium-to-calcium ratios in fruit.

*Caution:* indiscriminant use of potassium sprays can increase the incidence of bitter pit in apples and cork spot in pears.

## Magnesium

Chronic magnesium deficiency is best treated with soil applications of magnesium fertilizers or dolomite. Apply magnesium sprays only when moderate or severe deficiency symptoms appear suddenly or are not controlled by soil applications

of magnesium. To avoid creating other nutrient imbalances, magnesium deficiency should be confirmed before applying sprays. Two sprays are required. Apply the first during June and the second about 4 or 5 weeks later. Apply as a separate spray. Trees with little or no fruit need not be sprayed as the deficiency is severe only on trees with heavy crops of fruit.

## Urea

Urea sprays may be used on apple trees to supplement soil applications of nitrogen. They are not effective on stone fruits or pear and can cause injury.

To reduce the hazard of injury on apples do not use rates over 3-5 pounds of urea per 100 gallons of water, or more than 10 to 20 pounds per acre.

*Caution:* On apple use only formulations that contain less than 2% biuret because of potential injury. Applications of urea with some pesticides can reduce their effectiveness. On the other hand, applications with growth regulators can increase their absorption, resulting in an over effect. Consult the product label.

## Zinc

Low levels of leaf zinc and associated zinc deficiency symptoms are common in eastern Washington. The visual symptom is small, thin leaves. With acute deficiencies, leaves also appear chlorotic (pale yellow), and new growth is limited to a short rosette. The first symptoms of a deficiency with spur-type Red Delicious apples may be a limited number of small leaves on spurs, poor fruit set, and small fruit size.

Soil applications of zinc have not been effective except with young trees where applications have been worked into the soil prior to tree planting. Effects can last for 3 to 5 years. Spray applications of zinc are required with established trees. Annual applications are more effective in preventing deficiencies than making applications at high rates every 2 or 3 years. Ground sprayer applications are more effective than those by aircraft because they give a better distribution of zinc to the lower and inside portions of trees where weak spurs, lower levels of zinc, and small fruit size are greater problems.

Where zinc levels are known to be low, make annual spray applications at low rates, either after harvest in the fall while leaves are still green and active, or as a dormant spray in the spring. Higher rates of zinc can be applied in the early spring than in the fall. With an acute deficiency, both a fall and spring application may be necessary.

Where zinc deficiency symptoms are observed during the growing season, avoid the use of zinc sulfate because of potential injury to fruit and foliage. Various zinc chelates and organic complexes are available which reduce the potential for injury. They differ in their compatibility with oil, and in their effectiveness, in correcting deficiencies. Follow manufacturer's directions carefully.

*Caution:* Excess zinc and high rates of application can cause

severe injury to shoots, buds, leaves and fruit. When using zinc sulfate crystals be certain all crystals are dissolved before spraying or injury can occur. Zinc sulfate is highly corrosive. After use, thoroughly rinse spray tank, pump, lines, and nozzles.

**Zinc Dormant Spray Application.** The most effective time to apply zinc is in the spring before the buds open. Higher rates can be used at this stage than later in the season. To improve effectiveness and reduce potential injury, delay spray applications as late as possible, but spray at or before stage 2 (greentip).

*Caution:* Injury from spring applications has been associated with oil sprays and cool weather at the time of application. Some zinc formulations can be applied with oil as shown on the label. It is suggested that zinc sulfate and other formulations not be applied within three days before or after applying oil. Longer periods may be desired during cool weather. Where multiple applications of oil are required on pear, or where management problems occur, late fall applications of zinc are suggested.

**Zinc Foliage Applications.** Where deficiency symptoms occur during the growing season, spray applications should be made. If symptoms occur late in the season and fruit is present, delay applications until after harvest. To aid absorption, thoroughly wet foliage.

*Caution:* Where fruit is present, applications to apple and pear can cause fruit russetting. This is most likely to occur under cool, slow drying conditions in the spring. On bearing stone fruits, use lower rates or organic complexes.

**Zinc Postharvest Applications.** Zinc may be applied in the fall, but fall applications are usually less effective than those made in spring as a dormant application. Fall application may be needed where deficiencies are difficult to correct or where multiple applications of oil in the spring may cause injury. With some deficiencies, particularly on sweet cherry, both a fall and spring application may be necessary.

Make applications after harvest while leaves remain green and active but before the trees have begun to go dormant.

*Caution:* High rates of zinc sulfate create potential for injury, particularly to buds. Late-maturing varieties are more susceptible to such injury. Postharvest applications of zinc sulfate, especially concentrate sprays, frequently cause direct injury to leaves and possibly buds. Zinc chelates are less likely to cause direct injury. Do not make fall zinc applications to apricots.

## PROGRAM FOR NUTRIENTS

| Nutrient  | Alternate materials or combinations           | Amount per acre | Amount per 100 gallons (dilute sprays) | Remarks and restrictions  |
|---|---|-----------------|--|---|
| <b>DORMANT AND DELAYED DORMANT</b>                          |   |                 |  |   |
| Zinc maintenance  | 1. zinc sulfate, dry, 36% Zn                  | 6–12 lbs        | 1.5–3 lbs                              | Dormant spray only. Dissolve in hot water before adding to spray tank. See precautions in text.   |
|   | 2. zinc sulfate, liquid, 10–12% Zn            | 2–4 gals        | 0.5–1 gal                              | Dormant spray only. See precautions in text.  |
|   | 3. basic zinc sulfate, dry, 50–52% Zn         | 6–12 lbs        | 2 lbs (with oil)<br>3 lbs (w/o oil)    | Oil-free sprays are more effective. Follow manufacturer's recommendations for oil sprays.   |
|   | 4. basic zinc sulfate, liquid, 20–25% Zn      |                 |  | Follow manufacturer's label for rates.  |
|   | 5. zinc chelate or organic complex            |                 |  | Follow manufacturer's label for rates.  |
| Zinc deficiency   | 1. zinc sulfate, dry, 36% Zn                  | 40 lbs          | 10 lbs                                 | Dormant spray only. Dissolve in hot water before adding to spray tank. See precautions in text.   |
|   | 2. zinc sulfate, liquid, 10–12% Zn            | 12 gals         | 3 gals                                 | Dormant spray only. See precautions in text.  |
|   | 3. basic zinc sulfate, dry, 50–52% Zn         | 16 lbs          | 4 lbs                                  | Apply without oil.  |
|   | 4. basic zinc sulfate, liquid, 20–25% Zn      |                 |  | Follow manufacturer's label for rates.  |
|   | 5. zinc chelate or organic complex            |                 |  | Follow manufacturer's label for rates.  |
| <b>PREPINK OR PINK</b>                                      |   |                 |  |   |
| Boron maintenance   | 1. sodium borate, dry, 16.5–20.5% B           | 2.5–3 lbs       | 0.75 lb                                | All products—Apply amount equivalent to 0.5 pound actual B per acre. See text.  |
|   | 2. boric acid, dry, 17% B                     | 3 lbs           | 0.75 lb                                |   |
|   | 3. boric acid liquid, 10% B                   | 2 qts           | 1 pint                                 |   |
| Boron deficiency  | 1. sodium borate, dry, 16.5–20.5% B           | 5–6 lbs         | 1.25–1.5 lbs                           | All products—Apply amount equivalent to 1.0 pound actual B per acre. See text.  |
|   | 2. boric acid, dry, 17% B                     | 6 lbs           | 1.5 lb                                 |   |
|   | 3. boric acid liquid, 10% B                   | 1 gall          | 1 qt                                   |   |
| <b>BLOOM</b>  |   |                 |  |   |
| Nitrogen and sulfur maintenance                             | 1. ammonium thiosulfate, liquid, 12% N, 26% S | See label       | See label                              | Apply after sufficient blossom set. Can cause flower and fruitlet injury. Warm temperatures can increase injury. Follow manufacturer's label for rates. See text. |
| <b>FOLIAGE—After bloom and before harvest.</b>              |   |                 |  |   |
| Boron maintenance   | 1. sodium borate, dry, 16.5–20.5% B           | 2.5–3 lbs       | 0.75 lb                                | All products—Prepink to pink or postharvest timing is preferred. Apply amount equivalent to 0.5 pound actual B per acre. See text.                                |
|   | 2. boric acid, dry, 17% B                     | 3 lbs           | 0.75 lb                                |   |
|   | 3. boric acid liquid, 10% B                   | 2 qts           | 1 pint                                 |   |
| Boron deficiency  | 1. sodium borate, dry, 16.5–20.5% B           | 5–6 lbs         | 1.25–1.5 lbs                           | All products—Apply only if boron deficiency appears during growing season. Apply amount equivalent to 1.0 pound actual B per acre. See text.                      |
|   | 2. boric acid, dry, 17% B                     | 6 lbs           | 1.5 lbs                                |   |
|   | 3. boric acid liquid, 10% B                   | 1 gall          | 1 qt                                   |   |
| Calcium (cherry fruit firmness and reduced cracking)        | 1. calcium chloride, dry, 34–36% Ca           | 8–12 lbs        | 2–3 lbs                                | Limited effect and can reduce fruit size. Three or more applications are needed at weekly intervals before anticipated harvest. See text.                         |
|   | 2. calcium chloride, liquid, 12% Ca           | 4 qts           | 1 qt                                   |   |
| Calcium (bitterpit of apple)                                | 1. calcium chloride, dry, 34–36% Ca           | 6–8 lbs         | 1.5–2 lbs                              | All products—Apply five to eight applications from early June to late August. Dilute sprays are most effective. Can cause fruit injury. See text.                 |
|   | 2. calcium chloride, liquid, 12% Ca           | 4 qts           | 1 qt                                   |   |
|   | 3. calcium nitrate liquid, 6–11% Ca           | 4 qts           | 1 qt                                   |   |
| Calcium (alfalfa greening of pear, cork spot of Anjou pear) | 1. calcium chloride, dry, 34–36% Ca           | 4 lbs           | 0.5–1 lb                               | Both products—Apply four applications from early June to August. Dilute sprays are most effective. Can cause fruit injury. See text.                              |
|   | 2. calcium chloride liquid, 12% Ca            | 2 qts           | 0.5 qt                                 |   |

## PROGRAM FOR NUTRIENTS (CONTINUED)

| Nutrient                          | Alternate materials or combinations   | Amount per acre                                  | Amount per 100 gallons (dilute sprays)          | Remarks and restrictions  |
|-----------------------------------|---|--|---|---|
| Copper deficiency                 | 1. copper chelate or organic complex<br>2. basic copper sulfate, liquid   |  |   | Both products—Follow manufacturer's label. May be incompatible with calcium chloride. Can cause fruit injury. See text.                 |
| Iron (lime-induced chlorosis)     | 1. iron chelate or organic complex  |  |   | Follow manufacturer's label.  |
| Potassium                         | See text  | none   | none  | See text.   |
| Magnesium deficiency              | 1. magnesium nitrate, dry, 13.5% Mg<br>2. magnesium nitrate 0.4LC<br>3. calcium nitrate (fertilizer grade) + Epsom salts (magnesium sulfate)<br>4. magnesium chelate or organic complex       | 20–40 lbs<br>6–12 gals<br>24–48 lbs<br>40–80 lbs | 5–10 lbs<br>1.5–3 gals<br>6–12 lbs<br>10–20 lbs | Apply in June. Repeat in July if necessary. Do not apply after August 1. Follow manufacturer's label for labeled product rates.         |
| Nitrogen deficiency               | 1. urea   | 2–10 lbs   | 0.5–2.5 lbs                                     | Apply only as needed to apples or cherries. Not effective on pear or other stone fruits and can cause injury. See text.                 |
| Zinc deficiency, nonbearing trees | 1. zinc sulfate, dry, 36% Zn<br>2. zinc sulfate, liquid, 10–12% Zn<br>3. basic zinc sulfate, dry, 50–52% Zn<br>4. basic zinc sulfate, liquid, 20–25% Zn<br>5. zinc chelate or organic complex | 6–12 lbs<br>2–4 gals<br>6–12 lbs                 | 1.5–3 lbs<br>0.5–1.0 gal<br>1.5–3 lbs           | All products—See precautions in text. Can cause injury, particularly on stone fruits. Follow manufacturer's label for labeled products. |
| Zinc deficiency, bearing trees    | 1. zinc chelate or organic complex  |  |   | Follow manufacturer's label.  |

### POSTHARVEST—Apply after harvest and while leaves are still green and active.

|                   |   |                                  |                                     |   |
|-------------------|---|----------------------------------|-------------------------------------|---|
| Boron maintenance | 1. sodium borate, dry, 16.5–20.5% B<br>2. boric acid, dry, 17% B<br>3. boric acid liquid, 10% B   | 2.5–3 lbs<br>3 lbs<br>2 qts      | 0.75 lb<br>0.75 lb<br>1 pint        | All products—Apply amount equivalent to 0.5 pound actual B per acre. See text.  |
| Boron deficiency  | 1. sodium borate, dry, 16.5–20.5% B<br>2. boric acid, dry, 17% B<br>3. boric acid liquid, 10% B   | 5–6 lbs<br>6 lbs<br>1 gal        | 1.25–1.5 lbs<br>1.5 lbs<br>1 qt     | All products—Apply amount equivalent to 1.0 pound actual B per acre. See text.  |
| Zinc maintenance  | 1. zinc sulfate, dry, 36% Zn<br>2. zinc sulfate, liquid, 10–12% Zn<br>3. basic zinc sulfate, dry, 50–52% Zn<br>4. basic zinc sulfate, liquid, 20–25% Zn<br>5. zinc chelate or organic complex | 6–12 lbs<br>2–4 gals<br>6–12 lbs | 1.5–3 lbs<br>0.5–1 gal<br>1.5–3 lbs | All products—Do not apply before daytime temperatures drop below 80°F (usually October). Do not apply on apricot. Follow manufacturer's label for labeled product rates. See precautions in text. |
| Zinc deficiency   | 1. zinc sulfate, dry, 36% Zn<br>2. zinc sulfate, liquid, 10–12% Zn<br>3. basic zinc sulfate, dry, 50–52% Zn<br>4. basic zinc sulfate, liquid, 20–25% Zn<br>5. zinc chelate or organic complex | 10–12 lbs<br>7 gals<br>14 lbs    | 2.5–3 lbs<br>1.75 gals<br>3.5 lbs   | All products—Do not apply before October 1. Do not apply on apricot. Follow manufacturer's label for labeled product rates. See precautions in text.  |
| Copper deficiency | 1. copper sulfate, dry, 25% Cu<br>2. copper sulfate or basic copper sulfate, liquid, 4–14% Cu   | 4 lbs                            | 1 lb                                | Both products—OK to tank-mix with postharvest zinc sulfate or basic zinc sulfate sprays. Follow manufacturer's label for labeled product rates.   |

## BIOREGULATOR SPRAYS

A number of different kinds of responses can be obtained from the application of various bioregulators. The response varies with the chemical and the condition or stage of development of the tree and fruit. Therefore, before you apply a bioregulator product you should understand how it affects the tree and crop and the important side effects, if any.

The degree of effect of any bioregulator application depends on how much of the material is absorbed and the condition of the tree. Factors such as cool weather, slow drying conditions, and good foliage will normally increase product absorption and may increase the response. High temperatures following application of some bioregulators may increase the response or promote injury. Although poor foliage reduces absorption, weak trees generally will be overly sensitive to even small amounts of bioregulators. Applying bioregulator sprays in concentrate form increases the concentration of the bioregulator product in the spray water; higher concentrations of bioregulators may cause injury to trees or fruit. Similarly, adding a surfactant, unless so indicated, can result in greater absorption and possible injury. Be sure to achieve complete coverage of the canopy with any bioregulator spray. Bioregulators do not translocate in the tree, so the effect of any bioregulator only occurs where the product is applied. Uniform coverage greatly improves the likelihood of a good response to any bioregulator application.

### Chemical Thinning—Apple

Chemical thinning uses caustic materials or hormonal-type bioregulators to adjust the quantity and location of fruit set with three goals: 1) reduce the amount of green fruitlet hand thinning; 2) improve fruit size and quality; and 3) enhance return bloom in the next season and suppress biennial bearing. Successful chemical thinning usually requires the use of several different chemicals and combinations during the bloom and postbloom period.

Efficacy of the thinning program depends on a number of factors: variety, strain and rootstock, tree condition, proximity to pollenizers, weather, the chemical, application method, timing, and coverage. Therefore, thinning programs will be designed for individual blocks. Adjust materials used, timing and rates accordingly. Do not use rates higher than those on the label.

*NOTE:* The effectiveness of NAA, NAD (Amid-Thin W), and carbaryl (Sevin) is related to spring temperatures. During cool springs, when growth of fruit is slow, fruit size is a better guide for timing sprays than days after full bloom. Neither NAD (Amid-Thin W) nor NAA is effective below 50°F. Avoid use of carbaryl at temperatures below 70°F. Use can result in seed abortion, no thinning, and small sized fruit. Delay applications until the predicted maximum daytime temperature is likely to

reach these limits within five days after application.

To avoid overthinning, use caution in making applications following spring frosts. Frost predisposes leaves to absorb more of the thinning product. Avoid excessive application of thinning products to lower and inside limbs since they are lower in vigor and more easily thinned. Direct most of the thinning spray to the top two-thirds of the canopy.

**Blossom Thinning:** Caustic or desiccating compounds are used to remove lateral blooms. These chemicals tend to be acids or salts; the mode of action is burning of the stigmas and styles, which prevents pollination and seed formation. The only available bloom thinning products registered for use in Washington are Wilthin and lime sulfur.

**Wilthin:** WILTHIN can be applied once per season and should be tank mixed with Regulaid or other suitable surfactant to enhance coverage. Apply 3 pints of WILTHIN per 100 gallons of spray volume in a full coverage spray (400 gpa) or use 3 to 4 quarts per acre in 200 gallons/acre of spray solution. Do not exceed 3 pt/100 gallons or 6 quarts/acre. The 3 pint/100 gallon rate is usually optimum, but results may vary depending on bloom uniformity, tree size, tree vigor and bloom density. Apply as a dilute spray in sufficient volume to achieve thorough wetting of the flowers, but not to runoff. Adequate wetting of the target flowers is usually achieved with 150 to 250 gallons per acre of total spray volume, depending on tree size. The best timing for application of WILTHIN is when the king bloom is 80% pollinated (earliest recommended timing) up until 90% of the total blossoms are open (latest recommended timing.). WILTHIN should not be applied after petal fall begins on the earliest blooming side of the tree, or severe fruit marking and lack of performance may occur. Use of WILTHIN is recommended on Delicious, Newton Pippin, Braeburn, Rome Beauty and Golden Delicious.

**Lime-sulfur/Oil Products:** Lime-sulfur (Rex Lime Sulfur Solution) is registered for use as a blossom-thinning treatment either alone or in combination with fish-oil or petroleum-oil products on Red Delicious, Gala, Braeburn, Pink Lady, Granny Smith or Jonagold varieties. Apply a 6% to 10% v/v solution of Rex Lime Sulfur alone or a 1-2% v/v solution of Rex Lime Sulfur in combination with 2% v/v fish oil, or 0.5-1.0% v./v dormant oil or 1-1.5% v/v summer oil in sufficient water to fully cover blossoms. Applications should be made from 20% bloom to petal-fall according to label directions. If using an oil with lime-sulfur, check and follow the oil label recommendations for specific information about precautions for use. Since Rex Lime Sulfur is labeled under a 24C SLN provision in WA, lime-sulfur users are required by the registrant, Pest Management Northwest, Inc., to sign a special conditions and use waiver prior to obtaining and using this product. **Lime-sulfur and oil products are acceptable for blossom thinning in organic apple orchards.**

## Postbloom Thinning

**NAA.** Apply NAA 15 to 25 days past full bloom with a surfactant (wetting agent). Use a higher concentration if applied without a surfactant. During cool springs delay application as necessary until the largest fruits are 10 to 15 mm in diameter and forecasted daytime temperatures are likely to rise above 50°F within the next 5 days.

To increase the amount of thinning, combine with carbaryl (see section on carbaryl). The effect is greater than when these materials are applied separately.

**NAD (Amid-Thin W).** For use on varieties other than Delicious. Application on Red Delicious can cause abnormally small (pygmy) fruit. Apply 3 to 14 days past full bloom with a surfactant (wetting agent). Without a surfactant, higher concentrations are needed. When the weather is cool after bloom, delay applications until the largest fruit are 2-3 mm in diameter and forecasted temperatures after spraying are above 50°F, and preferably above 65°F.

To increase the amount of thinning, combine NAD (Amid-Thin W) and carbaryl in a single spray. (See section on carbaryl.) The effect is greater than when these materials are applied separately.

**Carbaryl (Sevin).** Carbaryl is an insecticide that can be applied to apple as a chemical thinner any time from 10 to 25 days after full bloom or when fruit are 3 to 20 mm in diameter. Rate, use, and time of application depend on the variety, fruit set, and degree of thinning desired, presence of bees in or near the orchard, and the potential effect on mites.

Because carbaryl is effective up to 25 days after full bloom, it can be used to treat trees not adequately thinned with other materials.

*NOTE:* When the weather is cool after bloom, delay applications of carbaryl until the largest fruit is 10 to 15 mm in diameter and forecasted temperatures after spraying are 70°F or higher. Unless the daytime temperature rises above 70°F within 5 days after application, the result can be poor thinning and small seedless fruit. Fruit damage and russet may occur under slow drying or cool conditions. Presence of frost or winter injury may cause fruit deformities.

Carbaryl may be applied with NAA or NAD (Amid-Thin W) in an earlier application. Their use in combination is more effective in thinning than these same materials used separately. For best response, apply the combination of carbaryl + NAD earlier (5 to 10 days after bloom) than with carbaryl alone, when the largest fruit is 3 to 5 mm in diameter. Overthinning can occur if daytime temperatures are above 90°F.

*Caution:* Carbaryl (Sevin WP) is highly toxic to bees. Use Sevin XLR Plus or Sevin 4F, which are the least hazardous formulations to bees. If blooms are present, apply when bees are not foraging. If you use the carbaryl formulation WP, be sure to remove blooms in the cover crop.

Carbaryl also can be highly toxic to predatory mites and the rust mites on which they feed. The hazard is greatest in orchards

where carbaryl has *not* been used extensively and therefore where little resistance has developed. Reduce the hazard of injury to mites by directing sprays towards the top of trees, by keeping sprays off the trunk and lower limbs, applying carbaryl earlier in the season, and limiting the total number of applications per season.

**Ethephon (Ethrel).** Ethephon may be applied with NAA or NAD (Amid-Thin W) to increase fruit thinning and to promote greater return bloom. Also see section on other programs for apple. *Caution:* Ethephon applied to Red Delicious earlier than 3 weeks after bloom can affect fruit shape by reducing calyx end development.

**6-benzyladenine (6BA, Maxcel, Exilis Plus, Accel):** 6BA is a synthetic cytokinin that is currently marketed in 3 different formulations. The Accel formulation contains a low concentration of GA<sub>4+7</sub> in addition to 6BA. Exilis Plus contains only 6BA. Maxcel contains a surfactant in the formulation in addition to 6BA. 6BA has been used as a chemical thinning agent, as well as a fruit size enhancing material on varieties such as Gala, Empire, Rome Beauty, Fuji, and Red Delicious. However, the effects on fruit size and thinning have not been consistent under Washington growing conditions. In Washington, 6BA may be used in combination with carbaryl **ONLY** in accordance with specific label instructions. Combination sprays of 6BA and NAA may increase the occurrence of pygmy fruits, especially with Red Delicious and are specifically prohibited for Exilis Plus. If planning to mix NAA with a 6BA product, consult and follow label recommendations carefully.

For thinning and fruit sizing, use one to two applications of 6BA when king-bloom fruit are 5 to 15 mm fruit diameter according to specific recommendations of the product-specific label. Best results are obtained when temperatures greater than 60-65°F occur during and after a period of several days following application. Optimum temperatures for response are between 70°F and 80°F. It is best to apply any 6BA product under slow drying conditions to enhance uptake.

Use a well-calibrated sprayer for 6BA applications to ensure uniform and complete coverage. Spray volumes of 100 to 200 gallons per acre should be adequate for most orchard spacing and tree row volumes. As with most plant bioregulators, dilute sprays are recommended. Maxcel has a specific preharvest interval (PHI) of 86 days.

## Varietal Differences in Thinning Response

Golden Delicious, Cameo, and Fuji are some of the most difficult varieties to adequately thin. Regulating cropping from one season to another also is a serious problem. Whenever a high percentage of the spurs and lateral buds bloom in a single season (snowball bloom), severe alternate bearing can develop the following year. Snowball bloom often develops the year after a light bloom or a severe frost.

To overcome this problem and to maintain annual produc-

tion, a series of sprays is usually required. Start with a bloom thinner, if available, followed by NAA and an application of carbaryl at 80% petal fall or 3 to 5 mm fruit size. Even greater thinning will occur with a third spray by combining NAA and carbaryl when the fruit are 10 to 15 mm in diameter. When the desired effect is both greater thinning and increased return bloom, ethephon can be used in combination with NAA and carbaryl.

**Spur-type Delicious.** Spur-type Red Delicious is usually more difficult to thin than nonspur Red Delicious. When a high percentage of spurs bloom in a single season, adequate thinning is more likely to be obtained by starting with a bloom thinner, if available, followed by a carbaryl or NAA spray, or by a combination of carbaryl plus NAA at a fruit size of 10 to 15 mm diameter. Use caution with petal fall sprays of Sevin XLR to Bisbee, RedChief and Vallee Spur as fruit damage and deformation may occur.

### Chemical Thinning—Pear

The chemical thinning of pears is not as common or as generally satisfactory as with apples. Problems with inadequate fruit set are more common. Delay application of thinning sprays until fruit set can be adequately appraised. During cool seasons, when the bloom period has been prolonged, delay application until 21 days from bloom or when fruit are 10 to 15 mm in diameter.

Both NAD (Amid-Thin W) and NAA have been used successfully to thin Bartlett pears. Inadequate thinning is more likely to be a problem than overthinning. NAA may not thin Bartlett pears in some seasons.

Apply NAD or NAA 15 to 21 days after bloom. Use a wetting agent to improve their effectiveness. Use higher rates on vigorous trees. Avoid spraying weak trees.

*Note:* Not all formulations of NAA are registered for use as thinning materials on pear. NAD may cause a "flattening" of leaves, but does not adversely affect tree performance. Rates of NAD or NAA that thin Bartlett pears are likely to overthin other varieties.

### Other Programs for Apple and Pear

**To Suppress Apple Shoot Growth.** Apogee: Prohexadione calcium (Apogee) is a potent inhibitor of gibberellin biosynthesis. Gibberellins are associated with normal shoot elongation during the growing season. Inhibition of the production of these naturally occurring gibberellins can produce a decrease in shoot growth and overall tree vigor. The control of vegetative growth allows a balance between canopy development and fruit growth and may favorably affect fruit quality.

However, in research trials, Apogee applications to vigorous apple trees under Washington conditions have not resulted in improved flowering the following year. Do not expect Apogee treatments to produce improved flowering or yield. Similarly, research trials with Apogee in Washington have not produced beneficial changes in fruit postharvest or storage behavior.

The manufacturer's label indicates Apogee can be used on trees with various levels of vigor, from high to low. However, under Washington growing conditions, Apogee is recommended ONLY on medium to high vigor trees. Apogee has not shown beneficial effects on low vigor trees under Washington conditions. Indirect evidence from other growing regions indicates Apogee may reduce the incidence of shoot blight infections from the fireblight (*Erwinia amylovora*) bacterium. Fire blight infection through shoots rarely occurs under Washington conditions, and successful control of fire blight using Apogee in Washington has not been demonstrated. Washington growers should exercise considerable caution if interested in this use for Apogee.

Treatment of vigorous shoots with Apogee does not necessarily result in the stimulation of terminal bud formation. If shoots do not form terminal buds, they have the potential to resume growth later in the season. Research with Apogee in Washington has shown that two or more applications of Apogee in the spring can still result in a second growth flush in midsummer, although the vigor of this flush is reduced with a greater number of applications. Once an Apogee program is started, be sure to maintain an application sequence of every 2-3 weeks per application to sustain the active control over GA biosynthesis in the new shoots. Once a second growth flush has started, this second, midsummer flush is more difficult to control with additional applications of Apogee, especially if there has been an interruption in the application sequence earlier in the growing season.

Growth control from a single application of Apogee lasts only a short time (4 to 6 weeks maximum under most conditions). A minimum of two applications per season is advised under Washington conditions, but more may be needed to maintain season-long control over shoot growth. The first application should be made when newly-forming terminal shoots are no more than about 1-3 inches in length. The second and any subsequent applications should be made at intervals of 2-3 weeks. Good results have been obtained in Washington using a rate of 6 ounces per 100 gallons spray volume (dilute). Using a higher rate may be beneficial for trees in extremely high vigor but has not improved growth control in Washington research trials. Growers should carefully follow the growth response to Apogee in their orchards and make adjustments in both rate and timing as necessary to improve the response. In Washington research trials, properly applied low volume sprays of Apogee have proven as effective as dilute spray volumes. Three to five applications of Apogee may be necessary for high vigor trees having a light crop load. Follow manufacturer's directions for adjuvants and recommendations for mixing and applying Apogee. Please note the following restrictions on Apogee use: 1) Do not apply more than 99 ounces (6.2 lbs) of Apogee per acre in one growing season; 2) Do not apply more than a total of 48 ounces (3 pounds) of Apogee within any 21-day interval; 3) Do not apply Apogee to apple trees within 45 days of harvest; 4) the Restricted Entry Interval (REI) for Apogee is 12 hours. Do not apply through any irrigation system. Apogee is rainfast after 8 hours.

The effectiveness of Apogee can be reduced if Apogee is applied in water containing high concentrations of calcium salts such as calcium carbonate, typical of “hard” water. It is better to use water free of calcium salts. If using “hard” water, add one pound of high-quality, spray-grade ammonium sulfate for each pound of Apogee used, check spray water pH and adjust to a pH value lower than 7 if spray water is alkaline in pH. **CAUTION:** This approach may not produce satisfactory growth control if Apogee is applied in high-calcium water. Do not mix Apogee with any spray products containing calcium; the efficacy of Apogee will very likely be reduced substantially.

**CAUTION: DO NOT APPLY APOGEE TO PEAR TREES.** Apogee is no longer registered for use on pear. Research trials in both Washington and Oregon have shown that Apogee applied to pear trees may reduce fruit size and may also reduce return bloom.

**To Control Sprouts and Suckers.** Water sprouts can develop on the upper side of main scaffold branches and adjacent to heavy pruning cuts. Root suckers can be a problem around the base of trees. Both types of growth can be controlled by application of either a paint or spray, containing from 0.5% to 1.0% NAA. The lower rate has given adequate control of water sprouts and root suckers of apple and pear, but the higher rate is required for control of pear root suckers.

**To Control Water Sprouts on Limbs.** NAA should be incorporated in a white interior water base latex paint free from mildewcides and applied with a brush. NAA applied without a white paint can result in serious limb and trunk damage from sunburn. Applying NAA as a spray increases the hazard of drift to adjacent and lower branches, spurs, and buds, resulting in excessive fruit thinning

Use a mixture of 5 or 10 fluid ounces of Tre-Hold Sprout Inhibitor A-112 plus 1 quart of white interior water base latex paint and enough water to make 1 gallon of paint mixture. A 0.5% NAA mixture (5 fluid ounces of Tre-Hold Sprout Inhibitor A-112) should be sufficient for most conditions and will control sprouting for 2 to 3 years. Do not use exterior-grade latex paint, latex paint for use in bathrooms or other than a water-base latex paint because of the hazard of paint injury. Do not use less than 25% paint in the mixture. Lower rates give insufficient protection from sunburn.

Brush on the paint mixture around heavy pruning cuts and 3 to 6 inches below the cut to prevent sprouting. Where existing sprouts are to be controlled, remove undesired sprouts and cover the base and up and down the exposed top of limbs and trunk where sunburn is likely. Complete this application before bud swell in the spring.

**Tre-Hold RTU Sprout Inhibitor, a ready-to-use formulation (1.15% Ethyl-1-NAA) is also available to control sprouts and sucker growth on apples and pears.** Follow manufacturer's label for use instruction.

*Caution:* Avoid treating old, weak, or winter injured limbs with the NAA paint mixture because of the potential of additional injury from reduced sprout growth and sunburn.

**To Control Root Suckers.** Prune back suckers, but do not treat with chemicals until the end of May (4 weeks after petal fall) to avoid potential excess fruit thinning. Spray suckers thoroughly when they are 4 to 6 inches high and still growing actively. Use a 1% NAA solution, (8 gallons of Tre-Hold Sprout Inhibitor A-112 per 100 gallons of spray) and low pressure, 10 to 20 psi, to avoid spray drift.

Control of root suckering may require repeat spray treatment in successive seasons, particularly where root suckering is excessive and has been a problem for many years.

## Other Programs for Apple

**To Improve Fruit Shape.** Three products that contain mixtures of gibberellic acids (GA<sub>4+7</sub>) and benzyladenine (BA) are labeled for use in Washington to improve fruit shape. These products are Promalin, Perlan, and Typy. Any of these products can be applied during the bloom period to improve the shape and length of apples, particularly strains of Red Delicious. Flat apples or a lack of typiness can be the result of 1) excessively warm or cool weather during bloom or early fruit development, 2) the excessive use of ethephon (Ethrel) in previous years, or 3) use of NAA at a rate of 10 ppm or higher.

Application can be made at any time during the bloom period up to petal fall. However, GA<sub>4+7</sub> + BA may be more effective if applied just before full bloom during the balloon stage, when wetting of the entire blossom cluster can be achieved. Where poor wetting occurs, use a nonionic wetting agent.

*Caution:* Fruit thinning can result if GA<sub>4+7</sub>+BA is applied to young trees just coming into full bearing. Do not apply more than once per season.

**To Control Russetting of Golden Delicious.** GA<sub>4+7</sub> (Pro Vide, TypRus, Novagib) often reduces the development of physiological russetting in years when russet conditions are present. Physiological russetting is associated with climatic factors such as precipitation, high humidity, and cool temperatures in the early stages of fruit development. Apply GA<sub>4+7</sub> (Pro Vide, TypRus) as two to four consecutive sprays of 10-13 fl. oz./100 gallons (dilute basis), beginning at petal fall and continuing at 7- to 10-day intervals. Novagib should be applied as 20–26 fl oz per 100 gallons per acre at petal-fall, repeating this treatment at 7–10 day intervals, applying a total of 52–80 fl oz per acre. Use of a wetting agent is not recommended. Four sprays of GA<sub>4+7</sub> are normally recommended, but two sprays of ProVide, TypRus or Novagib are often sufficient.

*Caution:* Do not exceed 40 oz of ProVide or TypRus or 80 oz of Novagib per acre per season. Avoid application to weak or very young trees. Use of GA<sub>4+7</sub> at the higher rate should be accompanied by an aggressive chemical thinning program to avoid reductions in return bloom.

**To Promote Side Branching.** Young apple trees can be slow to develop side branches and fruiting spurs. As a result,

they become leggy and difficult to bring into heavy fruiting. This is particularly a problem with trees on vigorous rootstocks in deep, fertile soils.

To promote more lateral bud break, apply GA<sub>4+7</sub> + BA-containing products such as Promalin, Perlan, or Typy as a foliar spray or spot-apply with a brush using a latex paint mixture. Low rates of foliar applied product (0.25-1 pt/5 gallons spray solution) should be timed when there are 1 to 3 inches of new terminal growth. For the latex application, high rates (3.2-5.3 fl. oz. product/pint latex paint) are applied in the spring when terminal buds begin to swell but before green tissue emerges. The same precautions about suitable latex paint formulations described under “To Control Watersprouts on Limbs” above apply here.

The response to any of these products will depend on growing conditions, rootstocks, variety, and strain. The degree of growth response to treatment with any of these products will be directly related to tree vigor. More dwarfing rootstocks and spur-type scions will produce a smaller growth response than more vigorous trees. Do not apply these products on low vigor trees or trees under stress from such factors as drought, low fertility, or winter injury.

*Caution:* Do not apply any of these products when air temperatures are lower than 40°F or greater than 90°F. Do not exceed one application per growing season.

**To Promote Bloom.** *Nonbearing trees.* Bioregulators can be used to improve flowering and fruiting in young apple trees. The selection of material or combination of materials and rates depends on the age and condition of the trees and the desired effect. Ethephon may be applied 2-4 weeks after full bloom to stimulate flowerbud initiation. Treatment can result in excessive thinning and reduced fruit size and yield in the year of application if trees produce any flowers that year. Do not treat trees that have not achieved sufficient size to carry a crop the following year. *Caution:* Avoid using ethephon on weak trees or trees on M.9 rootstock because of the hazard of excessive fruitset and stunting of tree growth.

*Bearing trees.* Young trees that are slow to bear or mature trees that produce only a limited number of flowers in off years may be helped by applications of ethephon. Delay ethephon application until at least 5-6 weeks after bloom (after the beginning of June drop) to avoid excessive fruit thinning.

Alternate-year cropping on older, mature trees, particularly Golden Delicious and Fuji, can occur when a high percentage of the spurs flower and set fruit in any one season. Although some of these flowers may not set fruit or may be removed by chemical thinning, there still may not be adequate return bloom the following season for a satisfactory crop. An ethephon application 5-6 weeks after bloom in the heavy crop year may improve flowering the next season. Trees with a snowball bloom will require a thorough chemical thinning program as well as the use of ethephon; even such aggressive strategies may not totally overcome alternate cropping.

*Caution:* Applications of ethephon may reduce fruit size. Early-season applications of ethephon before the start of June

drop may cause excessive thinning. Use of ethephon on weak trees can produce excessive thinning, excessive flowering the following season, and stunting of growth.

**To Advance Fruit Maturity.** To promote more color by advancing fruit maturity, ethephon (Ethrel) can be applied 7 to 21 days before expected harvest, depending on cultivar and season of fruit maturity. Follow label instructions carefully. Applications to advance maturity 3 to 5 days can result in smaller fruit size, and can shorten storage and shelf life of fruit not harvested at proper maturity. Ethephon may not promote color when warm weather persists late in the season. Ethephon may not improve color on poor-coloring varieties and standard strains; it is less effective on inside, poorly exposed fruit. *Caution:* Ethephon promotes abscission and fruit drop. Use in combination with a preharvest stop-drop spray. Ethephon is not effective for color change on Golden Delicious or advancing maturity of Granny Smith.

**To Control Preharvest Drop.** NAA may be used to prevent preharvest drop of apples. NAA does not tighten up the fruit attachment, but only prevents further loosening from the pedicel (fruit stem). Experimental evidence shows that these sprays are best applied alone and are more effective at dilute concentrations. Application timing of NAA products to prevent preharvest drop of apples is critical. Generally, NAA should be applied 7 to 14 days prior to harvest, but no closer than 2 to 5 days before harvest. Use caution in planning the storage program for NAA-treated fruit. Such fruit may not be suitable for long-term storage.

NAA becomes effective 3 to 4 days following application and has an effective period of 2 weeks. NAA has been applied as stop-drop for apples by aircraft in those cases where it is not possible or desirable to make ground application. By aircraft, the rate used is 0.25 to 0.5 pint of NAA 800 per acre. See manufacturer's label for specific recommendations as products may differ. Use caution in planning the storage program for NAA-treated fruit. Such fruit may not be suitable for long-term storage.

**ReTain.** ReTain (aminoethoxyvinylglycine, AVG) is an inhibitor of ethylene biosynthesis in fruit tissues and shows great promise as a harvest aid. It is registered for use on both apples and pears. Inhibition of ethylene biosynthesis in apples delays maturation and permits fruit to remain on the trees longer for better color and greater size without adverse effects on storage life. For pear growers, ReTain may help maintain fruit firmness for 7–10 days. The preharvest interval (PHI) for ReTain has been set at 21 days before the start of normal harvest; the manufacturer recommends that ReTain be applied **4 weeks before the anticipated beginning of normal harvest for that season** based on appropriate maturity indices. The recommended application rate for ReTain is 50 grams active ingredient per acre (one 0.73-lb. pouch per acre). Variety-specific rates have not been determined. If weather conditions are not favorable for ReTain application, it is suggested that the

product be applied slightly earlier than normal harvest to avoid problems with PHI. Use with a registered organosilicone surfactant. Tank-mixes of ReTain with NAA or ethephon are discouraged because these products may counteract the ethylene inhibition produced by ReTain. Tank mixes with Biobit, DiPel, or XenTari biological insecticides are permitted.

For optimum response, apply ReTain during periods of slow drying conditions to enhance uptake. ReTain should be applied in a sufficient amount of water to ensure thorough wetting of the fruit, but not to runoff. Generally, 100 gallons per acre is adequate for most Washington orchards. Adjust water volumes based on tree size, spacing and canopy density. Do not use overhead irrigation or cooling systems for at least 8 hours following a ReTain application.

To minimize foaming of spray mixture, fill spray tank with half the amount of water needed for the final spray volume, add ReTain (in its soluble packaging) and continue to fill tank. Add the surfactant just prior to filling the tank. Minimize agitation of the mixture. Use approved surfactants at a concentration of between 0.05% and 0.1% v/v (0.4-0.8 pint/100 gallons maximum). Compatibility and performance data with anti-foaming agents are not available; such products are not recommended for use with ReTain.

## Other Programs for Pear

**To Control Preharvest Drop.** NAA is effective in preventing preharvest drop of pears. NAA does not tighten up the attachment of the fruit to the pedicel (fruit stem), but only prevents further loosening. Application timing of NAA products to prevent preharvest drop of pears is critical. Generally, NAA should be applied 6 to 7 days prior to harvest, but no closer than 2 to 5 days before harvest.

NAA becomes effective 3 to 4 days following application, and has an effective period of about 2 weeks. Due to differences in time of harvest, a single application of NAA at one date will not prevent preharvest drop on all varieties in the planting. Short-stemmed varieties may respond erratically. Rates of application by air vary by pear variety. Consult the label.

## Programs for Stone Fruits

**To Extend Harvest—Sweet Cherries.** [The normal harvest period for sweet cherries can be extended by use of GA<sub>3</sub> (ProGibb, Falgro).]

Two formulations of ProGibb are now registered for use on sweet cherry: 1) ProGibb 4% solution and 2) ProGibb 40% water-soluble granules. Falgro 4L is also registered for use on sweet cherries. ProGibb or Falgro should be applied as a single spray of 16 to 48 grams active ingredient per acre when fruit is light green to straw colored. ProGibb or Falgro application delays fruit maturity from 3 to 7 days. It gives larger and much firmer fruit, bright green stems, and much longer storage life. Its use on soft varieties, such as Chinook and Van, as well as

Rainier, appears promising for canning. Rates of GA<sub>3</sub> can be reduced on lightly cropped trees. Complete coverage of the tree is important for uniform fruit maturity.

GA<sub>3</sub> can reduce soluble solids and slightly reduce fruit bud set the following year.

## CRITICAL TEMPERATURES/BUD DEATH TABLE

|              | Bud Stage          |    |    |    |    |    |    |
|--------------|--------------------|----|----|----|----|----|----|
|              | 1                  | 2  | 3  | 4  | 5  | 6  | 7  |
|              | degrees Fahrenheit |    |    |    |    |    |    |
| Apple        |                    |    |    |    |    |    |    |
| 10% kill     | 15                 | 18 | 23 | 27 | 28 | 28 | 28 |
| 90% kill     | 2                  | 0  | 15 | 21 | 24 | 25 | 25 |
| Pear         |                    |    |    |    |    |    |    |
| 10% kill     | 15                 | 20 | 24 | 25 | 26 | 26 | 27 |
| 90% kill     | 0                  | 6  | 15 | 19 | 22 | 22 | 23 |
| Peach        |                    |    |    |    |    |    |    |
| 10% kill     | 18                 | 21 | 23 | 25 | 26 | 26 | 27 |
| 90% kill     | 1                  | 5  | 9  | 15 | 18 | 21 | 24 |
| Apricot      |                    |    |    |    |    |    |    |
| 10% kill     | 15                 | 20 | 22 | 24 | 25 | 25 | 27 |
| 90% kill     | 0                  | 0  | 9  | 14 | 17 | 19 | 22 |
| Cherry       |                    |    |    |    |    |    |    |
| 10% kill     | 22                 | 25 | 26 | 27 | 27 | 28 | 28 |
| 90% kill     | 9                  | 14 | 17 | 21 | 24 | 25 | 25 |
| Plum (Prune) |                    |    |    |    |    |    |    |
| 10% kill     | 17                 | 20 | 24 | 25 | 26 | 27 | 28 |
| 90% kill     | 3                  | 7  | 16 | 20 | 22 | 23 | 23 |

NOTE: Samples composed of 200 to 500 flowers. The actual stage is defined by the most advanced buds in the sample, and the 10% and 90% numbers reflect the entire sample. Caution is advised—it is dangerous to attribute too much precision to critical temperature data.

## CHEMICAL THINNING PROGRAMS FOR APPLES AND PEARS

| Fruit Variety  | Formulated material per 100 gallons  | Remarks and restrictions   |
|--|--|--|
| BLOOM—Spray to thoroughly wet the blooms. Based on 200 gallons per acre (for average-sized trees). |  |  |
| Braeburn, Red Delicious, Gala, Granny Smith, Jonagold, Pink Lady                                   | 6-10 gallons Rex Lime Sulfur alone<br>OR 1-2 gallons Rex Lime Sulfur in combination with 2 gallons Fish Oil OR 0.5-1 gallons dormant petroleum spray oil OR 1-1.5 gallons summer petroleum spray oil | Apply in sufficient water for full coverage of blossoms. Make applications from 20% full bloom through petal-fall. No more than 3 applications of Lime-sulfur/oil combinations per growing season. Waiver and release must be signed before product can be used. |
| Spur Delicious; Golden Delicious; Granny Smith, Gala, Braeburn, Newton and Fuji                    | 2 to 3 pints Wilthin (see text)  | Apply when 70% to 80% of the blooms are open. Can use 1 pt. Regulaid per 100 gal spray solution; reduce Wilthin to 2 pints.  |

| Fruit Variety   | Use any one of the listed materials or the listed combinations | Spray concentration (ppm active ingredient) | Formulated material per 100 gallons | Remarks and restrictions   |
|---|--|---|-------------------------------------|--|
| POSTBLOOM—Use a well-calibrated sprayer to ensure complete and uniform coverage. Based on 200 gallons per acre (for average sized trees). Avoid killing bees on blooming cover crops. See Hazards to Bees and Plants. |  |   |                                     |  |
| All apple varieties (early thinning)  | 1. carbaryl* (Sevin XLR Plus)                                  | 600 ppm                                     | 1 pint                              | Apply at 80% petal fall or up to 5 mm fruit diameter. Use full volume spray when possible. Spray upper half of trees. Caution is advised with Bisbee, Red Chief, and Vallee Spur, as fruit damage may occur.   |
| Red Delicious, Braeburn   | 1. carbaryl* (Sevin 4F)  | 150–300 ppm                                 | 0.25–0.5 pint                       | Sevin XLR is the preferred formulation for reduced hazard to bees. If blooms are present in cover crop, apply while bees are not foraging. If you use Sevin WP, be sure to remove weed blooms in the cover crop. Apply carbaryl any time from 3–25 days after full-bloom. Apply NAA 15–25 days after full-bloom. To increase thinning on spur-type Delicious, use combinations of carbaryl and NAA shown below. Do not apply carbaryl more than twice during the postbloom period. |
|   | (Sevin XLR Plus)   | 150–300 ppm                                 | 0.25–0.5 pint                       |  |
| (Sevin 50WP)  | 150–300 ppm  | 0.25–0.5 lb                                 |                                     |  |
| 2. NAA (+surfactant**) (K-Salt Fruit Fix 200)   | 2–5 ppm  | 0.5–1.2 oz                                  |                                     |  |
|   | (K-Salt Fruit Fix 800)   | 2–5 ppm                                     | 0.12–0.3 oz                         |  |
| Delicious, spur types   | 1. Combination carbaryl + NAA carbaryl*                        |   |                                     | See bee hazard remarks under Post-bloom Stage—Delicious. Combination spray for use where increased thinning is desired. Apply anytime 15–25 days after full bloom when the largest fruit is 10 mm in diameter or larger. When daytime temperatures exceeded the low 80°s F, overthinning can occur. Good thinning can be obtained under the latter conditions with lower rates of chemicals.   |
|   | (Sevin 4F)   | 150–300 ppm                                 | 0.25–0.5 pint                       |  |
|   | (Sevin XLR Plus)   | 150–300 ppm                                 | 0.25–0.5 pint                       |  |
|   | (Sevin 50WP)   | 150–300 ppm                                 | 0.25–0.5 lb                         |  |
|   | + NAA (K-Salt Fruit Fix 200)                                   | 2–5 ppm                                     | 0.5–1.2 oz                          |  |
|   | (K-Salt Fruit Fix 800)   | 2–5 ppm                                     | 0.12–0.3 oz                         |  |

\*Carbaryl (Sevin WP) is highly hazardous to bees and predatory mites. See text—Hazards to Bees.

\*\*Use surfactant according to manufacturer's recommendations, but not more than 1 pint per 100 gallons of spray.

For easier and more accurate measurement of small amounts of liquids, dilute them first. For example, make a 1/10th dilution by putting 1 part in 9 parts water. From this stock solution, measure out and use 10 times the amount shown in the table.

## CHEMICAL THINNING PROGRAMS FOR APPLES AND PEARS (CONTINUED)

| Fruit Variety  | Use any one of the listed materials or the listed combinations   | Spray concentration (ppm active ingredient)                           | Formulated material per 100 gallons                                       | Remarks and restrictions  |
|--|--|---|---|---|
| POSTBLOOM—(Continued)  |  |   |   |   |
| Golden Delicious<br>Granny Smith,<br>Gala, Fuji,<br>Jonagold, Cameo<br>Pink Lady | 1. carbaryl*<br>(Sevin 4F)<br>(Sevin XLR Plus)<br>(Sevin 50WP)   | 300–450 ppm<br>300–450 ppm<br>300–450 ppm                             | 0.5–0.75 pint<br>0.5–0.75 pint<br>0.5–0.75 lb                             | See bee hazard remarks under Post-bloom—Delicious. Apply carbaryl at 3–25 days, NAD 3–14 days and NAA 15–25 days after bloom, when the largest fruit is 10 to 15 mm in diameter.  |
|  | 2. NAA (+surfactant**)<br>(K-Salt Fruit Fix 200)<br>(K-Salt Fruit Fix 800)   | 3–5 ppm<br>3–5 ppm  | 0.7–1.2 oz<br>0.2–0.3 oz  |   |
|  | 3. NAD (Amid-Thin W) (+surfactant**)   | 25 ppm  | 4 oz  | For greater thinning use a combination of carbaryl + NAD 3–14 days after full-bloom. For more response apply carbaryl + NAA when largest fruit is 10–15 mm in diameter. Overthinning can occur if daytime temperatures exceed 80°F. |
|  | 4. Combination carbaryl + NAD or + carbaryl*<br>(Sevin 4F)<br>(Sevin XLR Plus)<br>(Sevin 50WP)<br>+NAA<br>(K-Salt Fruit Fix 200)<br>(K-Salt Fruit Fix 800)<br>or + NAD (Amid-Thin W) | 150–300 ppm<br>150–300 ppm<br>150–300 ppm<br>3 ppm<br>3 ppm<br>25 ppm | 0.25–0.5 pint<br>0.25–0.5 pint<br>0.25–0.5 lb<br>0.7 oz<br>0.2 oz<br>4 oz |   |
|  | 5. Combination NAD (Amid-Thin W) +ethephon<br>NAD (Amid-Thin W)<br>+ethephon (Ethrel)  | 25 ppm<br>300–450 ppm   | 4 oz<br>1.0–1.5 pints   | NAD plus ethephon gives good thinning and return bloom.   |
| Winesap  | 1. carbaryl*<br>(Sevin 4F)<br>(Sevin 50WP)<br>(Sevin XLR Plus)   | 450 ppm<br>450 ppm<br>450 ppm   | 0.75 pint<br>0.75 lb<br>0.75 pint   | See bee hazard remarks under Post-bloom—Delicious. Apply carbaryl once any time from 3–14 days after full bloom, NAD 3–14 days after full bloom, NAA 15–25 days after full bloom.   |
|  | 2. NAA (+surfactant**)<br>(K-Salt Fruit Fix 200)<br>(K-Salt Fruit Fix 800)   | 2–5 ppm<br>2–5 ppm  | 0.5–1.2 oz<br>0.12–0.3 oz   |   |
|  | 3. NAD (Amid-Thin W) (+surfactant**)   | 17 ppm  | 2.7 oz  |   |
| Jonathan,<br>Yellow Newton,<br>Pippin,<br>Rome Beauty                            | 1. carbaryl*<br>(Sevin 4F)<br>(Sevin XLR Plus)<br>(Sevin 50WP)   | 300–600 ppm<br>300–600 ppm<br>300–600 ppm                             | 0.5–1 pint<br>0.5–1 pint<br>0.5–1 lb                                      | See bee hazard remarks under Post-bloom—Delicious. Apply carbaryl any time from 3–25 days after full bloom, NAA 15–25 days after full-bloom. NAA is less effective on Jonathan and Rome Beauty.                                     |
|  | 2. NAA (+surfactant**)<br>(K-Salt Fruit Fix 200)<br>(K-Salt Fruit Fix 800)   | 3–5 ppm<br>3–5 ppm  | 0.7–1.2 oz<br>0.2–0.3 oz  |   |
| Bartlett   | 1. NAD (Amid-Thin W) (+surfactant**)<br>2. NAA (K-Salt Fruit Fix 200) (+surfactant**)  | 10–15 ppm<br>10–15 ppm  | 1.6–2.4 oz<br>2.4–3.6 oz  | Apply 15–21 days after full bloom. NAD may overthin varieties other than Bartlett. NAA and NAD may not produce consistent thinning responses in Bartlett.   |
| Apples and Pears   |  |   |   |   |
| To control water sprouts   | NAA (Tre-Hold A-112)<br>+ Interior Latex paint   | 0.5–1.0 percent<br>25 percent paint                                   | 4–8 gals<br>25 gals   | Brush on as a paint during the season, before bud break. Use interior latex paint. Cover around major cuts or base of sprouts. (See text).  |
| To control root suckers  | NAA (Tre-Hold A-112)   | 0.5–1.0 percent   | 4–8 gals  | Spray suckers when 4 to 6 inches high and growing rapidly, but not within 4 weeks after petal fall. (See text).   |

\*Carbaryl (Sevin WP) is highly hazardous to bees and predatory mites. See text—Hazards to Bees.

\*\*Use surfactant according to manufacturer's recommendations, but not more than 1 pint per 100 gallons of spray.

For easier and more accurate measurement of small amounts of liquids, dilute them first. For example, make a 1/10th dilution by putting 1 part in 9 parts water. From this stock solution, measure out and use 10 times the amount shown in the table.

## GROWTH REGULATOR PROGRAM FOR APPLES AND PEARS

| Effect                                    | Use any one of the listed materials or the listed combinations                     | Spray concentration (ppm active ingredient) | Formulated material per 100 gallons                       | Formulated material per acre (approx.) | Remarks and restrictions  |
|---|--|---|---|--|---|
| <b>APPLES—Young, nonbearing trees</b>     |  |   |   |  |   |
| To promote lateral branching              | 1. GA <sub>4+7</sub> + BA (Promalin, Perlan, Typy)–latex applied                   | 5000–7500 ppm                               | 0.2 to 0.33 pt product per pint of latex paint.           |  | Apply in spring when terminal buds begin to swell but before green tissues emerge. Apply the GA <sub>4+7</sub> + BA-latex paint mixture with a brush or sponge to thoroughly cover the bark surface where growth is desired. Apply only to 1-year-old wood.   |
|   | 2. GA <sub>4+7</sub> + BA (Promalin, Perlan, Typy)–foliar applied<br>+<br>Regulaid | 125–500 ppm<br><br>+<br>0.2–0.3 percent v/v | 0.25–1 pt per 5 gals<br><br>+<br>1.6–2.4 pts per 100 gals |  | Apply at 1 to 3 inches of new terminal growth. Approximately 5 to 10 gallons of spray mixture applied with a pressurized hand sprayer will treat 200 to 300 nonbearing orchard trees 1 to 4 years old. Rate depends on conditions and tree vigor; use higher rates with vigorous trees. Do not use on weak trees or stunted trees on M.9 rootstocks.<br><br>NOTE: Do not apply after buds break. Applications after buds have broken may cause some injury to tender shoot tips and fail to promote shoot growth from that point. |
| To promote bloom the following year       | 1. ethephon (Ethrel) (+ surfactant*)   | 300–600 ppm                                 | 1–2 pints   |  | Apply 4–5 weeks after bud break. If some fruit is present, delay application of ethephon 6 weeks after bloom. Avoid double coverage or use on low-vigor trees. Material and rate depend on condition. See text.   |
| <b>APPLES—Bearing trees</b>               |  |   |   |  |   |
| To promote longer, tarty Red Delicious    | 1. GA <sub>4+7</sub> +BA (Promalin, Perlan, or Typy)                               | 25 ppm                                      | 1 pint  | (1–2 pints)                            | Apply when first blossoms are open, but not within 6 hours before or after rain. Can cause excess thinning on young trees.  |
| To control russetting of Golden Delicious | 1. GA <sub>4+7</sub> (ProVide, Novagib, or TypRus)                                 | 15–20 ppm                                   | ProVide or TypRus<br>10–13 oz                             | ProVide or TypRus<br>10–13 oz          | Apply in no more than 100 gallons of water per acre per application beginning at petal fall and continuing every 7–10 days up to 4 applications. Do not exceed 40 oz of ProVide or TypRus or 80 oz of Novagib per acre per year. See text.  |
|   |  |   | Novagib<br>20–26 oz                                       | Novagib<br>20–26 oz                    |   |
| To promote bloom the following year       | 1. ethephon (Ethrel) (+ surfactant*)   | 300 ppm                                     | 1 pint  | (3 pints)                              | Apply ethephon sprays 5–6 weeks after full bloom. To prevent excess thinning, delay application until June drop begins. Avoid use on low-vigor trees. See text.   |
| Vegetative growth control in apple        |  |   |   |  |   |
| Single application                        | 1. prohexadione calcium (Apogee)   | 125–250 ppm                                 | 6–12 oz   | 18–36 oz                               | Apply at 1-3 inches of shoot growth. Use 300 gal of dilute spray/acre.  |
| Split application (preferred)             | 1. prohexadione calcium (Apogee)   | 125 ppm                                     | 6 oz  | 18 oz                                  | Apply at 1-3 inches shoot growth, repeat at 17- to 21-day intervals. Do not apply within 45 days of harvest. Use 300 gal of dilute spray/acre.  |

\*Use surfactant according to manufacturer's recommendations, but not more than 1 pint per 100 gallons of spray. For easier and more accurate measurement of small amounts of liquids, dilute them first. For example, make a 1/10th dilution by putting 1 part in 9 parts water. From this stock solution, measure out and use 10 times the amount shown in the table.

## GROWTH REGULATOR PROGRAM FOR APPLES AND PEARS (CONTINUED)

| Effect   | Use any one of the listed materials or the listed combinations | Spray concentration (ppm active ingredient) | Formulated material per 100 gallons                          | Grams active ingredient (a.i.) per acre (approx.) | Remarks and restrictions   |
|--|--|---|--|---|--|
| To increase fruit size   | 1. 6-BA (Accel)  | 25–38 ppm                                   | 17.8–26.7 fl oz<br>(NOTE: 1 bottle = 71.2 fl oz = 40 g a.i.) | 10–15 g a.i.                                      | See text. Apply Accel sprays from petal fall to 10–12 mm fruit diameter. One to two applications of 10–15 g a.i. per acre, 5 to 10 days apart, are suggested. Recommended for Gala in Washington.  |
| To advance maturity and promote red color on some varieties                                      | 1. ethephon (Ethrel) (+surfactant*)                            | 300 ppm                                     | 1 pint   |   | Apply 7–14 days before expected harvest. Caution: Use in combination with stop-drop spray. May not improve color under adverse weather conditions and on poor coloring varieties and strains or on heavily shaded fruit. Can shorten storage life of fruit if not harvested at proper firmness and maturity.   |
| To prevent preharvest fruit drop   | 1. NAA (K-Salt Fruit Fix 200**)<br>2. (K-Salt Fruit Fix 800**) | 15–20 ppm<br>15–20 ppm                      | 4–8 fl oz<br>1–2 fl oz                                       | 25 to 50 g a.i.<br>25 to 50 g a.i.                | Apply 7 to 14 days prior to harvest, but no closer than 2 to 5 days before harvest depending on product label, or more than twice as a stop drop treatment. Do not apply more than 2 pints NAA 200 or 0.5 pint NAA 800 per acre. ReTain: Apply 4 weeks before anticipated harvest. A spray volume of 100 gallons per acre is suggested. Adjust to ensure adequate coverage. Do not exceed 50 grams a.i. per acre (one bag of formulated material). Use with registered surfactants. Refer to text. |
| To decrease preharvest fruit drop, to delay watercore and to improve harvest maturity management | 1. AVG (ReTain) + surfactant organosilicone                    | no ppm rate given<br>0.05% v/v<br>0.10% v/v | 0.73 pound<br>6.5 fl oz<br>13.0 fl oz                        | 50 g a.i. (1 bag)<br>(See remarks)                |  |

PEARS—Spray to run-off Pears-spray to runoff (based on 400 gallons/acre for average-sized trees)

|  |  |                      |                          |                                  |  |
|--|--|----------------------|--------------------------|----------------------------------|--|
| To prevent preharvest fruit drop (Anjou, Bartlett, Bosc) | 1. NAA (K-Salt Fruit Fix 200**)<br>2. (K-Salt Fruit Fix 800**) | 8–16 ppm<br>8–16 ppm | 2–4 fl oz<br>0.5–1 fl oz | 12.5–25 g a.i.<br>12.5–25 g a.i. | Apply 5 to 7 days prior to harvest but no closer than 2 days before harvest nor more than twice for stop-drop. Do not delay harvest beyond optimum maturity. |
|--|--|----------------------|--------------------------|----------------------------------|--|

## GROWTH REGULATOR PROGRAM FOR STONE FRUITS

SWEET CHERRY—Spray to run-off

|                         |   |                                     |   |   |   |
|-------------------------|---|-------------------------------------|---|---|---|
| To delay fruit maturity | 1. GA <sub>3</sub> (ProGibb 4L)<br>2. GA <sub>3</sub> (ProGibb 40WSG)<br>3. GA <sub>3</sub> (Falgro 4L) | 10–30 ppm<br>10–30 ppm<br>10–30 ppm | 0.25–0.75 pint<br>0.33–1 oz<br>0.25–0.75 pint | 16 to 48 g a.i.<br>16 to 48 g a.i.<br>16 to 48 g a.i. | Apply 3 weeks before expected harvest when fruit is straw colored. Improves fruit firmness and storage life. Delays maturity 3 to 7 days. |
|-------------------------|---|-------------------------------------|---|---|---|

Note: 20 ppm = 0.50 pint (8 fl oz) ProGibb 4L, Falgro 4L or 2/3 oz ProGibb 40WSG/100 gallons

\*Use surfactant according to manufacturer's recommendations, but not more than 1 pint per 100 gallons of spray.

\*\*Rate applied by air is the same per acre but uses much lower water volume. See manufacturer's label for more information.

For easier and more accurate measurement of small amounts of liquids, dilute them first. For example, make a 1/10th dilution by putting 1 part in 9 parts water. From this stock solution, measure out and use 10 times the amount shown in the table.

## CHEMICAL WEED CONTROL

Controlling undesired orchard vegetation is very important. Vegetation surrounding or close to the trunk can reduce tree and fruit growth and increase the hazard from mice. Broadleaf weeds that blossom in early spring attract bees and impair tree pollination.

### General Precautions

1. Read label directions carefully and do not use herbicides unless specifically registered on that crop and at the age or stage approved by label registrations.
2. Do not use rates or combinations of chemicals and herbicides unless these have been adequately tested to avoid injuries and illegal residues.
3. Apply herbicides in precise amounts at pressures of 20 to 35 pounds. Use only fixed booms with flat fan-type nozzles that have been properly calibrated.
4. Shut off spray boom before stopping or turning at the end of the row.

### Tank Mixes

You may mix two or more herbicides in the spray tank, provided mixing is not prohibited on any of the labels. Rates, timing, and other directions must conform to the label for each product. If the labels do not carry directions for mixing, the user may be liable for problems associated with the mixture, such as crop injury or nonperformance.

Always add chemical under good and constant agitation, in the following order: 1) wettable powders, 2) flowables, 3) emulsifiable concentrates, 4) oils. Do not add surfactants until the tank is full. If excess foaming occurs, add an antifoaming material.

### Partially Excavated Trees

The crown or roots of trees are sometimes exposed for treatment and control of phytophthora crown rot. Many herbicides are readily absorbed by the crown and root, resulting in serious injury or even death of the tree.

### Application

Carefully consider timing and conditions of application. Some chemicals are more effective when applied in the fall, at a certain stage of plant growth, or when preceded or followed by precise management procedures.

Unless procedures are carefully followed, the chemicals may 1) fail to provide adequate control, or 2) result in serious injury to the trees and crop.

*Note:* Herbicide injury symptoms resemble and can be confused with symptoms of nutrient deficiencies, fertilizer burn, excess salts, and plant diseases.

### Chemical Information

Chemicals act in different ways. Some are effective only on germinating weed seeds. Others act only on the developing weed and do not provide long-term control.

**Foliage-Applied Herbicides** kill weeds present in the orchard but do not provide long-term or seasonal control of developing weeds. Use alone or in combination.

**Soil-Active Herbicides** provide long-term or seasonal control of developing weeds. These herbicides act on plants through the root system. To be effective, they must be incorporated into the soil or applied to the soil surface where rain or sprinkler irrigation can move the herbicide down into the soil. Select and use these chemicals with caution as some can leach down into the root zone of the trees and cause severe injury or even death.

Herbicides differ in mode of action, use, and effectiveness against weeds. In general, soil-applied herbicides are more effective when applied after November 1 and before the ground is frozen, than in the spring. Make fall applications in rill or furrow-irrigated orchards so rain will move the herbicide into the soil.

Combinations of soil-active herbicides can be used to reduce the hazard of injury and increase the range of effectiveness. Where established weeds are present, combinations can be made with certain foliage-applied herbicides.

*Caution: Do not apply soil-active herbicides on shallow or coarse-sandy or gravelly soils, or to trees established less than one season unless permitted by the labels. Note other label restrictions as to fruit crop, tree age, time of application, and rate.*

## CHEMICAL SUPPRESSION OF PERENNIAL GRASS COVER CROPS

| Herbicide                                   | Rates*, Application and Remarks  |
|---|--|
| 1. <b>glyphosate</b><br>(numerous products) | 4.5 to 6.0 ounces acid equivalent per acre (/A)<br>See label for rate.<br><br>Used to suppress (chemically mow) perennial grass covers between tree rows in orchards. Use the highest rate when treating tall (coarse) fescue, fine fescue, orchardgrass, or quackgrass covers. Use the lower rate, when treating Kentucky bluegrass covers. Apply treatments in 20 gallons of water per acre to actively growing grass covers. For best spray distribution and coverage, use flat fan nozzles. For best results, mow plots in the spring to even up grass cover, then apply appropriate glyphosate rate 3 to 4 days after mowing. Low rates of glyphosate will not adequately suppress broadleaf weeds, such as dandelion or plantain. Where broadleaf weeds make up more than 10% ground cover, tank mix with 0.90 to 0.95 pound acid equivalent per acre of 2,4-D labeled for orchard use. Do not treat grass covers under poor growing conditions such as drought stress (drip irrigation), disease, or insect damage, since poor suppression and/or grass injury may result. Do not allow spray to drift. |

## WEED CONTROL PROGRAM FOR APPLES AND PEARS

| Herbicide  | Rates*, Application and Remarks  |
|--|--|
| SEASONAL CONTROL—Grass and/or broadleaf weeds  |  |
| 1. <b>oryzalin</b><br>Surflan AS<br>oryza AG<br>oryzalin 4AS   | 2.0 to 6.0 pounds active ingredient per acre (/A)<br>2.0 to 6.0 quarts product/A<br>2.0 to 6.0 quarts product/A<br>2.0 to 6.0 quarts product/A<br><br>Apply oryzalin to weed-free soil or with paraquat or glyphosate when established weeds are present. One-half inch moisture (rain or sprinkler irrigation) needed to activate. Delay application to newly planted trees until ground has settled. Lower rate is for 4 month's control; higher rate for 8–12 months. Controls many annual grasses and broadleaf weeds but will not completely control some mustards, nightshades, or weeds in the sunflower family.  |
| 2. <b>napropamide</b><br>Devrinol 50DF   | 4.0 pounds pounds active ingredient/A<br>8.0 pounds product/A<br><br>Napropamide can be used in newly planted or established orchards. Apply to weed-free soil or with paraquat or glyphosate when established weeds are present. If applied in the fall, must be incorporated with overhead moisture or cultivation within 2 weeks. With spring application, irrigate into the soil the same day to wet soil to 2–4 inches. Controls many annual grasses and broadleaf weeds but will not completely control some mustards, nightshades, or weeds in the sunflower family.  |
| 3. <b>dichlobenil</b><br>Casoron 4G  | 6.0 pounds active ingredient/A<br>150.0 pounds product/A<br><br>Dichlobenil can be applied where weeds are present. More effective when applied in the fall when the soil is cool and still not frozen. If used under special conditions or applied in the spring, follow label directions closely.  |
| 4. <b>diuron</b><br>Karmex DF<br>Diuron 80 WDG<br>Direx or Diuron 4L   | 1.6 to 3.2 pounds active ingredient/A<br>2.0 to 4.0 pounds product/A<br>2.0 to 4.0 pounds product/A<br>1.6 to 3.2 quarts product/A<br><br>Diuron can be applied to weed-free soil or with paraquat or glyphosate when established weeds are present. More effective when applied in the fall, after November 1 and before ground is frozen. Use fall application in rill- or furrow-irrigated orchard. Do not treat varieties grafted on full-dwarf root stocks. The diuron-terbacil combination can be used on apple at lower rates to reduce the hazard of injury. If leached into the root system of the tree, diuron can cause serious tree injury. Do not use in orchards that have gravelly, sandy, or loamy sand soils and with less than 1% organic matter, particularly if sprinkler irrigation is used. Do not apply in orchards established less than 12 months. Limit initial sprinkler irrigation to 0.5 inch of water. Note label restrictions and follow label directions closely. Do not treat apples recently grafted onto full-dwarf rootstocks. |
| 5. <b>simazine</b><br>Princep 4L<br>Princep Caliber 90<br>Simazine 4L<br>Sim-Trol 4L<br>Simazine 90DF<br>Sim-Trol 90DF | 1.6 to 3.2 pounds active ingredient/A<br>1.6 to 3.2 quarts product/A<br>1.8 to 3.6 pounds product/A<br>1.6 to 3.2 quarts product/A<br>1.6 to 3.2 quarts product/A<br>1.8 to 3.6 pounds product/A<br>1.8 to 3.6 pounds product/A<br><br>Simazine can be applied to weed-free soil, or with paraquat or glyphosate when established weeds are present. More effective when applied in the fall, after November 1 and before ground is frozen. Use fall application in rill- or furrow-irrigated orchard. The simazine-oryzalin combination can be used on apples and pears at lower rates to reduce the hazard of injury. If leached into the root system of the tree, simazine can cause serious tree injury. Do not use in orchards that have gravelly, sandy, or loamy sand soils and with less than 1% organic matter, particularly if sprinkler irrigation is used. Do not apply in orchards established less than 12 months. Limit initial sprinkler irrigation to 0.5 inch of water. Note label restrictions and follow label directions closely.             |

\*Rates are given per acre of ground sprayed. For band or spot treatment, calculate rates according to the actual portion of an acre treated.

## WEED CONTROL PROGRAM FOR APPLES AND PEARS (CONTINUED)

| Herbicide   | Rates*, Application and Remarks   |
|---|---|
| 6. <b>terbacil</b><br>Sinbar (not on pears)                         | 1.6 pounds active ingredient/A<br>2.0 pounds product/A<br><br>Do not use terbacil on pears. Terbacil can be applied to weed-free soil or with paraquat or glyphosate when established weeds are present. More effective when applied in the fall, after November 1 and before ground is frozen. Use fall application in rill- or furrow-irrigated orchard. The diuron-terbacil combination can be used on apples at lower rates to reduce the hazard of injury. If leached into the root system of the tree, terbacil can cause serious tree injury. Do not use in orchards that have gravelly, sandy, or loamy sand soils and with less than 1% organic matter, particularly if sprinkler irrigation is used. Do not apply in apple orchards established less than 36 months. Limit initial sprinkler irrigation to 0.5 inch of water. Note label restrictions and follow label directions closely.                      |
| 7. <b>norflurazon</b><br>Solicam DF                                 | 2.0 to 4.0 pounds active ingredient/A<br>2.5 to 5.0 pounds product/A<br><br>Norflurazon can be applied to apple at any time, but pears must be established at least 18 months. Apply to weed and trash-free soil. Rainfall or irrigation must follow application. Make only one application per year. Repeated applications over a period of years may result in tree injury. The norflurazon-simazine combination can be used to reduce the hazard of injury. Note cautions in label.  |
| 8. <b>pronamide</b><br>Kerb 50-W                                    | 1.0 to 3.0 pounds active ingredient/A<br>2.0 to 6.0 pounds product/A<br><br>Pronamide should be applied in the fall after harvest, but before leaf drop and soil freeze up to trash-free soil. Use the lower rates for annual grasses and susceptible broadleaf weeds; use the higher rates for controlling quackgrass. Rainfall or overhead irrigation is required following application. Soil temperatures above 55°F may result in reduced weed control. It is most effective on cool season grasses. Do not apply around seedling trees less than 1 year old or fall-transplanted trees established less than 1 year or spring transplanted trees established less than 6 months.   |
| 9. <b>pendimethalin</b><br>Prowl (nonbearing orchards only)         | 2.0 to 4.0 pounds active ingredient/A<br>2.4 to 4.8 quarts/A<br><br>Pendimethalin is registered in nonbearing orchards only and should be applied to weed-free soil. Delay application to newly planted trees until ground has settled and no cracks are present. Use lower rate for 4-month control and higher rate for 6–8 months control. Controls most germinating annual grasses and some annual broadleaf weeds. Treatments are most effective if rainfall or irrigation is received within 7 days after application.   |
| 10. <b>oxyfluorfen</b><br>Goal 2XL<br>Galigan 2E<br>Oxiflo 2EC      | 0.5 to 2.0 pounds active ingredient/A<br>2.0 to 8.0 pints product/A<br>2.0 to 8.0 pints product/A<br>2.0 to 8.0 pints product/A<br><br>Apply to trash-free soil as a directed spray towards the base of dormant trees to control susceptible broadleaf weeds. Rate depends on weed species to be controlled and whether applied preemergence or postemergence to the weeds. Apply only to healthy trees. Do not apply after tree buds start to swell or when foliage or fruits are present. Often tank-mixed with other materials to control grass weeds.   |
| 11. <b>isoxaben</b><br>Gallery 75DF<br>(nonbearing orchards only)   | 0.5 to 1.0 pound active ingredient/A<br>0.66 to 1.33 pounds product/A<br><br>Isoxaben is registered for use in nonbearing orchards. Controls broadleaf weeds only. Apply to weed-and debris-free soil in late summer or early fall or in early spring prior to germination of targeted weeds, or immediately after cultivation. One-half inch or more moisture (rainfall or sprinkler irrigation) needed to activate. Delay application on newly planted trees until ground has settled by packing and irrigation or rainfall and no cracks are present. Isoxaben + trifluralin (Snaphot 2.5G) will control grasses.  |
| 12. <b>flumioxazin</b><br>Chateau WDG<br>(nonbearing orchards only) | 0.19 to 0.38 pound active ingredient/A<br>6.0 to 12.0 ounces product/A<br><br>Flumioxazin is registered for use in nonbearing orchards that will not be harvested within one year. Controls broadleaf weeds primarily. Rate depends on soil type, soil organic matter, weeds to be controlled and age of trees. Apply to weed free soil or with glyphosate, paraquat or glufosinate. Must be incorporated into soil with overhead moisture for residual control. Flumioxazin has some postemergence activity to small weeds. Do not apply to trees established less than one year unless protected from spray contact by nonporous wraps, grow tubes or waxed containers. Do not apply over 0.19 lb ai/A (6 oz product/A) to trees established less than 3 years of age if growing on soil that has a sand plus gravel content of over 80%. Do not make a sequential application within 30 days of the first application. |

\*Rates are given per acre of ground sprayed. For band or spot treatment, calculate rates according to the actual portion of an acre treated.

## WEED CONTROL PROGRAM FOR APPLES AND PEARS (CONTINUED)

| Herbicide  | Rates*, Application and Remarks   | Herbicide   | Rates*, Application and Remarks  |
|--|---|---|--|
| <b>TANK MIXES FOR APPLES AND PEARS</b>   |   |   |  |
| 13. <b>diuron</b><br>Karmex DF<br>Diuron 80 WDG<br>+<br><b>terbacil</b><br>Sinbar<br>(not on pears)                                    | 0.8 to 1.6 pounds active ingredient/A<br>1.0 to 2.0 pounds product/A<br>1.0 to 2.0 pounds product/A<br><br>0.8 to 1.6 pounds active ingredient/A<br>1.0 to 2.0 pounds product/A   | 19. <b>paraquat</b><br>Gramoxone Max<br>+<br>nonionic surfactant<br>+<br><b>diuron</b><br>or<br><b>simazine</b><br>or<br><b>terbacil</b><br>(not on pears)<br>or<br><b>diuron</b><br>+<br><b>terbacil</b><br>(not on pears)<br>or<br><b>oryzalin</b><br>or<br><b>norflurazon</b><br>or<br><b>simazine</b><br>+<br><b>oryzalin</b><br>or<br><b>oxyfluorfen</b> | 0.66 to 1.0 pound active ingredient/A<br>1.75 to 2.7 pints product/A<br><br>1.0 pint/100 gal spray solution<br><br>1.6 to 3.2 pounds active ingredient/A<br><br>0.5 to 3.2 pounds active ingredient/A<br><br>1.6 pounds active ingredient/A<br><br>0.8 to 1.6 pounds active ingredient/A<br><br>0.8 to 1.6 pounds active ingredient/A<br><br>2.0 to 6.0 pounds active ingredient/A<br><br>2.0 to 4.0 pounds active ingredient/A<br><br>0.5 to 3.2 pounds active ingredient/A<br><br>2.0 to 4.0 pounds active ingredient/A<br><br>0.5 to 2.0 pounds active ingredient/A |
| 14. <b>norflurazon</b><br>Solicam DF<br>+<br><b>simazine</b><br>Princep 4L<br>Princep Caliber 90                                       | 1.6 pounds active ingredient/A<br>2.0 pounds product/A<br><br>1.0 to 1.6 pounds active ingredient/A<br>1.0 to 1.6 quarts product/A<br>1.1 to 1.8 pounds product/A   | 20. <b>glyphosate</b><br>(numerous products)<br>+<br><b>diuron</b><br>or<br><b>simazine</b><br>or<br><b>oryzalin</b><br>or<br><b>norflurazon</b><br>or<br><b>simazine</b><br>+<br><b>oryzalin</b><br>or<br><b>oxyfluorfen</b>   | 0.75 to 3.75 pounds acid equivalent/A<br>See label for rates.<br><br>1.6 to 3.2 pounds active ingredient/A<br><br>0.5 to 3.2 pounds active ingredient/A<br><br>2.0 to 4.0 pounds active ingredient/A<br><br>2.0 to 4.0 pounds active ingredient/A<br><br>0.5 to 3.2 pounds active ingredient/A<br><br>2.0 to 4.0 pounds active ingredient/A<br><br>0.5 to 2.0 pounds active ingredient/A   |
| 15. <b>norflurazon</b><br>Solicam DF<br>+<br><b>diuron</b><br>Karmex DF<br>Diuron 80 WDG   | 1.4 to 2.0 pounds active ingredient/A<br>1.75 to 2.5 pounds product/A<br><br>0.8 to 1.2 pounds active ingredient/A<br>1.0 to 1.5 pounds product/A<br>1.0 to 1.5 pounds product/A  |   |  |
| 16. <b>diuron</b><br>Karmex DF<br>+<br><b>oryzalin</b><br>Surflan AS   | 1.6 to 3.2 pounds active ingredient/A<br>2.0 to 4.0 pounds product/A<br><br>2.0 to 4.0 pounds active ingredient/A<br>2.0 to 4.0 quarts product/A  |   |  |
| 17. <b>simazine</b><br>Princep 4L<br>Princep Caliber 90<br>+<br><b>oryzalin</b><br>Surflan AS  | 0.5 to 3.2 pounds active ingredient/A<br>0.5 to 3.2 quarts product/A<br>0.5 to 3.6 pounds product/A<br><br>2.0 to 4.0 pounds active ingredient/A<br>2.0 to 4.0 quarts product/A   |   |  |
| 18. <b>oxyfluorfen</b><br>Goal 2XL<br>+<br><b>oryzalin</b><br>or<br><b>norflurazon</b><br>or<br><b>diuron</b><br>or<br><b>simazine</b> | 0.5 to 2.0 pounds active ingredient/A<br>2.0 to 8.0 pints product/A<br><br>2.0 to 6.0 pounds active ingredient/A<br><br>2.0 to 4.0 pounds active ingredient/A<br><br>0.8 to 1.2 pounds active ingredient/A<br><br>0.5 to 3.0 pounds active ingredient/A |   |  |

\*Rates are given per acre of ground sprayed. For band or spot treatment, calculate rates according to the actual portion of an acre treated.

## WEED CONTROL PROGRAM FOR APPLES AND PEARS (CONTINUED)

| Herbicide  | Rates*, Application and Remarks   |
|--|---|
| TEMPORARY CONTROL—Broadleaf weeds  |   |
| 1. <b>2,4-D</b><br>Orchard Master<br>Weedar 64<br>Opti-Amine<br>Saber<br>Amine 4 2,4-D   | 1.425 pounds acid equivalent/A<br>1.5 quarts product/A<br>1.5 quarts product/A<br>1.5 quarts product/A<br>1.5 quarts product/A<br>1.5 quarts product/A      |
| Kills most annual and many perennial broadleaf weeds. Apply as directed spray on weeds to point of run-off. Avoid contact with tree foliage, limbs and trunk. Do not apply during windy periods. May be used at any time but most effective when weeds are small and growing actively. Do not make more than two applications per season. Can be absorbed by tree roots and cause serious injury. Best results are obtained when applied within 2 days following an irrigation and the weeds are growing actively. In sprinkler-irrigated orchards, apply only after irrigation and never to dry or bare ground. The Gala, Fuji and Golden Delicious apple varieties appear to be more sensitive to root uptake of 2,4-D than other varieties. Reduce possible root uptake by applying 2,4-D at a time of season when frequent irrigation is not necessary. Do not apply to trees established in orchard less than 1 year. |   |
| TEMPORARY CONTROL—Grass weeds  |   |
| 1. <b>fluazifop</b><br>Fusilade DX<br>(nonbearing orchards only)   | 0.25 to 0.375 pound active ingredient/A<br>1 to 1.5 pints product/A   |
| Apply to actively growing grasses. Use with either a crop oil concentrate or nonionic surfactant. Annual grasses should be treated when they are 2–8 inches tall, before tillering and/or head formation. Perennial grasses should be treated according to size indicated on the label. Will control most annual and perennial grasses except for annual bluegrass and fine fescues. Do not tank-mix with other pesticides. Do not apply within 1 year of harvest.   |   |
| 2. <b>sethoxydim</b><br>Poast  | 0.28 to 0.47 pound active ingredient/A<br>1.5 to 2.5 pints product/A  |
| Apply to actively growing grasses. Use with a crop oil concentrate. Annual grasses should be treated when they are less than 12 inches tall. Rate applied will depend on grass size. Perennial grasses should be treated according to size indicated on the label. Will control many annual and perennial grasses, but will not control annual bluegrass and fine fescues. Do not apply within 14 days of harvest.   |   |
| TEMPORARY CONTROL—Grass and broadleaf weeds  |   |
| 1. <b>paraquat</b><br>Gramoxone Max<br>+<br>nonionic surfactant  | 0.66 to 1.0 pound active ingredient/A<br>1.75 to 2.7 pints product/A<br>1.0 pint/100 gal spray solution   |
| Apply as a directed spray. May be used at any time, but most effective when weeds are no more than 4–6 inches tall and growing actively. Keep off tree foliage, fruit, and green bark. Often tank-mixed with soil residual herbicides to control established weeds. Use a full face shield, gloves and apron when filling and mixing. Do not ingest or inhale spray mist when spraying.  |   |
| 2. <b>glyphosate</b><br>(numerous products)  | 0.75 to 3.75 pounds acid equivalent/A<br>See label for rate.  |
| Apply as a directed spray. Rate depends on weed species to be controlled. Allow a minimum of 1 day between last application and harvest. Keep off tree foliage, root suckers, fruit, and green bark. Plants do not readily metabolize glyphosate. If a tree is inadvertently sprayed, the chemical may persist and cause injury the following year. Often tank-mixed with soil residual herbicides to control later germinating weeds. Do not use in galvanized or mild steel tanks because of chemical reaction. Follow label directions for addition of wetting agents.  |   |
| 3. <b>paraquat</b><br>+<br>nonionic surfactant<br>+<br><b>2,4-D</b>  | 0.66 to 1.0 pound active ingredient/A (1.75 to 2.7 pints product)<br>1.0 pint/100 gal spray solution<br>0.95 pound acid equivalent/A<br>1.0 quart product/A |
| Use only 2,4-D labeled for use on apples and pears. Apply as a directed spray. The combination increases effectiveness over a broader spectrum of weeds. Observe all precautions for both products.  |   |

\*Rates are given per acre of ground sprayed. For band or spot treatment, calculate rates according to the actual portion of an acre treated.

## WEED CONTROL PROGRAM FOR APPLES AND PEARS (CONTINUED)

| Herbicide                                   | Rates*, Application and Remarks  |
|---|--|
| 4. <b>glufosinate Rely</b><br>(apples only) | 0.75 to 1.5 pounds active ingredient/A<br>3 to 6 quarts product/A<br><br>Apply as a directed spray. Rate determined by weeds to be controlled. Keep off tree foliage, fruit, and green bark. Can be tank mixed with soil residual herbicides to control later germinating weeds. Do not apply within 14 days of harvest. |

## WEED CONTROL PROGRAM FOR STONE FRUITS

| Herbicide  | Rates*, Application and Remarks   |
|--|---|
| SEASONAL CONTROL—Grass and/or broadleaf weeds                |   |
| 1. <b>oryzalin</b><br>Surflan AS<br>Oryza AG<br>Oryzalin 4AS | 2.0 to 6.0 pounds active ingredient/A<br>2.0 to 6.0 quarts product/A<br>2.0 to 6.0 quarts product/A<br>2.0 to 6.0 quarts product/A<br><br>Oryzalin should be applied to weed-free soil or with paraquat or glyphosate when established weeds are present. One-half inch moisture (rain or sprinkler irrigation) needed to activate. Delay application to newly planted trees until ground is settled. Lower rate is for 4 month's control; higher rate for 8–12 months. Controls many annual grasses and broadleaf weeds but will not completely control some mustards or nightshades.  |
| 2. <b>napropamide</b><br>Devrinol 50DF                       | 4.0 pounds active ingredient/A<br>8.0 pounds product/A<br><br>Napropamide can be used in newly planted or established orchards. Apply to weed-free soil, or with paraquat or glyphosate when established weeds are present. If applied in the fall, must be incorporated with overhead moisture or cultivation within 2 weeks. With spring application, irrigate into the soil the same day to wet soil to 2–4 inches. Controls many annual grasses and broadleaf weeds but will not completely control some mustards, nightshades, or weeds in the sunflower family.   |
| 3. <b>dichlobenil</b><br>Casoron 4G<br>(cherries only)       | 6.0 pounds active ingredient/A<br>150.0 pounds product/A<br><br>Dichlobenil can be applied where weeds are present. More effective when applied in the fall when the soil is cool and still not frozen. If used under special conditions or applied in the spring, follow label directions closely.   |
| 4. <b>terbacil</b><br>Sinbar<br>(peach only)                 | 1.6 pounds active ingredient/A<br>2.0 pounds product/A<br><br>Terbacil is registered on peaches only. Terbacil can be applied to weed-free ground or with paraquat or glyphosate when established weeds are present. More effective when applied in the fall, after November 1 and before ground is frozen. Use fall application in rill- or furrow-irrigated orchard. Do not apply on very sandy, shallow, or gravelly soils because of potential tree injury. Do not apply until trees have been in orchard for 3 years. If leached into the root system of the tree, terbacil can cause serious tree injury. Do not use in orchards that have gravelly, sandy, or loamy sand soils and with less than 1% organic matter, particularly if sprinkler irrigation is used. Limit initial sprinkler irrigation to 0.5 inch of water. Note label restrictions and follow label directions closely. |
| 5. <b>norflurazon</b><br>Sollicam DF                         | 2.0 to 4.0 pounds active ingredient/A<br>2.5 to 5.0 pounds product/A<br><br>Trees must be established in orchard at least 18 months. Apply to weed and trash-free soil. Rainfall or irrigation must follow within 4 weeks after application. Make only one application per year. Repeated applications over a period of years may result in tree injury. Do not apply to gravelly, sandy, loamy sand soils under sprinkler irrigation because of potential tree injury; death of young cherry trees has occurred under these conditions. Note cautions in label.  |
| 6. <b>pronamide</b><br>Kerb 50-W                             | 1.0 to 3.0 pounds active ingredient/A<br>2.0 to 6.0 pounds product/A<br><br>Apply pronamide in the fall after harvest, but before leaf drop and soil freeze up to trash-free soil. Use the lower rates for annual grasses and susceptible broadleaf weeds; use the higher rates for controlling quackgrass. Rainfall or overhead irrigation is required following application. Soil temperatures above 55°F may result in reduced weed control. It is most effective on cool season grasses. Do not apply around seedling trees less than 1 year old or fall-transplanted trees established less than 1 year, or spring transplanted trees established less than 6 months.  |

\*Rates are given per acre of ground sprayed. For band or spot treatment, calculate rates according to the actual portion of an acre treated.

## WEED CONTROL PROGRAM FOR STONE FRUITS (CONTINUED)

| Herbicide   | Rate*, Application and Remarks   |
|---|--|
| 7. <b>pendimethalin</b><br>Prowl<br>(nonbearing orchards only)      | 2.0 to 4.0 pounds active ingredient/A<br>2.4 to 4.8 quarts/A<br><br>Pendimethalin is registered in nonbearing orchards only and should be applied to weed-free soil. Delay application to newly planted trees until ground has settled and no cracks are present. Use lower rate for 4 -month control and higher rate for 6–8 months control. Controls most germinating annual grasses and some annual broadleaf weeds. Treatments are most effective if rainfall or irrigation is received within 7 days after application.   |
| 8. <b>oxyfluorfen</b><br>Goal 2XL<br>Galigan 2E<br>Oxiflo 2EC       | 0.5 to 2.0 pounds active ingredient/A<br>2.0 to 8.0 pints product/A<br>2.0 to 8.0 pints product/A<br>2.0 to 8.0 pints product/A<br><br>Apply to trash-free soil as a directed spray towards the base of dormant trees to control susceptible broadleaf weeds. Rate depends on weed species to be controlled and whether applied preemergence or postemergence to the weeds. Apply only to healthy trees. Do not apply after tree buds start to swell or when foliage or fruits are present. Often tank-mixed with other materials to control grass weeds.  |
| 9. <b>isoxaben</b><br>Gallery 75DF<br>(nonbearing orchards only)    | 0.5 to 1.0 pound active ingredient/A<br>0.66 to 1.33 pounds product/A<br><br>Isoxaben is registered for use in nonbearing orchards. Controls annual broadleaf weeds only. Apply to weed- and debris-free soil in late summer or early fall or in early spring prior to germination of targeted weeds or immediately after cultivation. One-half inch or more moisture (rainfall or sprinkler irrigation) needed to activate. Delay application on newly planted trees until ground has settled by packing and irrigation or rainfall and no cracks are present. Isoxaben + trifluralin (Snapshot 2.5G) will control grasses.   |
| 10. <b>flumioxazin</b><br>Chateau WDG<br>(nonbearing orchards only) | 0.19 to 0.38 pound active ingredient/A<br>6.0 to 12.0 ounces product/A<br><br>Flumioxazin is registered for use in nonbearing orchards that will not be harvested within one year. Controls broadleaf weeds primarily. Rate depends on soil type, soil organic matter, weeds to be controlled and age of trees. Apply to weed free soil or with glyphosate or paraquat. Must be incorporated into soil with overhead moisture for residual control. Flumioxazin has some postemergence activity to small weeds. Do not apply to trees established less than one year unless protected from spray contact by nonporous wraps, grow tubes or waxed containers. Do not apply over 0.19 lb ai/A (6 oz product/A) to trees established less than 3 years of age if growing on soil that has a sand plus gravel content of over 80%. Do not make a sequential application within 30 days of the first application. |

### TANK MIXES FOR STONE FRUITS

| Herbicide  | Rate*, Application and Remarks   | Herbicide  | Rate*, Application and Remarks  |
|--|--|--|---|
| 10. <b>paraquat</b><br>Gramoxone Max<br>+<br>nonionic surfactant<br>+<br><b>oryzalin</b><br>or<br><b>norflurazon</b><br>or<br><b>norflurazon</b><br>+<br><b>oryzalin</b><br>or<br><b>oxyfluorfen</b> | 0.66 to 1.0 pound active ingredient/A<br>1.75 to 2.7 pints product/A<br><br>1.0 pint/100 gal spray solution<br><br>2.0 to 6.0 pounds active ingredient/A<br><br>2.0 to 4.0 pounds active ingredient/A<br><br>2.0 to 4.0 pounds active ingredient/A<br><br>2.0 to 4.0 pounds active ingredient/A<br><br>0.5 to 2.0 pounds active ingredient/A | 12. <b>oxyfluorfen</b><br>Goal 2XL<br>or<br>Galigan 2E<br>+<br><b>oryzalin</b><br>or<br><b>norflurazon</b> | 0.5 to 2.0 pounds active ingredient/A<br>2.0 to 8.0 pints product/A<br><br>2.0 to 8.0 pints product/A<br><br>2.0 to 6.0 pounds active ingredient/A<br><br>2.0 to 4.0 pounds active ingredient/A |
| 11. <b>glyphosate</b><br>+<br><b>oryzalin</b><br>or<br><b>norflurazon</b><br>or<br><b>norflurazon</b><br>+<br><b>oryzalin</b><br>or<br><b>oxyfluorfen</b>  | 0.75 to 3.75 pounds acid equivalent/A<br><br>2.0 to 6.0 pounds active ingredient/A<br><br>2.0 to 4.0 pounds active ingredient/A<br><br>2.0 to 4.0 pounds active ingredient/A<br><br>2.0 to 4.0 pounds active ingredient/A<br><br>0.5 to 2.0 pounds active ingredient/A   |  |   |

































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## WEED CONTROL PROGRAM FOR STONE FRUITS (CONTINUED)

| Herbicide  | Rates*, Application and Remarks  |
|--|--|
| TEMPORARY CONTROL—Broadleaf weeds  |  |
| 1. <b>2,4-D</b><br>Formula 40<br>Orchard Master<br>Weedar 64<br>Opti-Amine<br>Weedestroy Am-40<br>Saber<br>Amine 4 2,4-D | 1.425 pounds acid equivalent/A<br>1.5 quarts product/A<br>1.5 quarts product/A (not on apricots or nectarines)<br>1.5 quarts product/A<br>1.5 quarts product/A<br>1.5 quarts product/A<br>1.5 quarts product/A<br>1.5 quarts product/A   |
|  | Kills most annual and many perennial broadleaf weeds. Apply as directed spray to weeds. Avoid contact with foliage, limbs and trunk. Do not apply during windy periods. May be used at any time except during bloom but most effective when weeds are small and growing actively. Can be absorbed by tree roots and cause serious injury. Best results are obtained when applied within 2 days following an irrigation and the weeds are growing actively. In sprinkler-irrigated orchards, apply only after irrigation and never to dry or bare ground. Do not apply to trees established in orchard for less than 1 year. Do not make more than 2 applications per year. Do not harvest within 40 days of application. |
| 2. <b>clopyralid</b><br>Stinger  | 0.125 to 0.25 pounds acid equivalent/A<br>0.33 to 0.67 pint product/A  |
|  | Controls many weeds in the sunflower, buckwheat or knotweed, nightshade and legume families. Apply to actively growing weeds in a minimum of 10 gallons of water per acre. Apply to Canada thistle after a majority of basal leaves have emerged, but prior to bud stage. Up to four applications may be made during the crop year, but do not exceed a total of 2/3 pint of product per sprayed acre per year. Do not apply within 30 days of harvest.  |
| TEMPORARY CONTROL—Grass weeds  |  |
| 1. <b>fluazifop</b><br>Fusilade DX   | 0.09 to 0.25 pound active ingredient/A<br>0.375 to 1.0 pints product/A   |
|  | Apply to actively growing grasses. Use with either a crop oil concentrate or nonionic surfactant. Annual grasses should be treated when they are 2–8 inches tall, before tillering and/or head formation. Perennial grasses should be treated according to size indicated on the label. Will control most annual and perennial grasses except for annual bluegrass and fine fescues. Do not tank-mix with other pesticides. Do not apply within 14 days of harvest.  |
| 2. <b>sethoxydim</b><br>Poast<br>(not on bearing<br>plums or prunes)   | 0.28 to 0.47 pound active ingredient/A<br>1.5 to 2.5 pints product/A   |
|  | Apply to actively growing grasses. Use with a crop oil concentrate. Annual grasses should be treated when they are less than 12 inches tall. Rate applied will depend on grass size. Perennial grasses should be treated according to size indicated on the label. Will control many annual and perennial grasses, but will not control annual bluegrass and fine fescues. Do not tank-mix with other pesticides. Do not apply within 25 days of harvest for apricots, cherries, peaches and nectarines. Do not apply within 1 year of harvest for plums and prunes.   |
| TEMPORARY CONTROL—Grass and broadleaf weeds  |  |
| 1. <b>paraquat</b><br>Gramoxone Max<br>+<br>nonionic surfactant  | 0.66 to 1.0 pound active ingredient/A<br>1.75 to 2.7 pints product/A<br>1.0 pint/100 gal spray solution  |
|  | Apply as a directed spray. May be used at any time, but most effective when weeds are no more than 4–6 inches tall and growing actively. Keep off tree foliage, fruit, and green bark. Often tank-mixed with soil residual herbicides to control established weeds. Use a full face shield, gloves and apron when filling and mixing. Do not ingest or inhale spray mist when spraying.  |
| 2. <b>glyphosate</b><br>(numerous products)  | 0.75 to 3.75 pounds acid equivalent/A<br>See label for rate.   |
|  | Apply as a directed spray. Rate depends on formulation and weed species to be controlled. Do not apply within 17 days of harvest. Keep off tree foliage, root suckers, fruit, and green bark. Plants do not readily metabolize glyphosate; if a tree is inadvertently sprayed, the chemical may persist and cause injury the following year. Often tank-mixed with soil residual herbicides to control later germinating weeds. Do not use in galvanized or mild steel tanks because of chemical reaction. Follow label directions on addition of wetting agents.  |

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# BUD DEVELOPMENT CHART

| STAGE | APPLE   | PEAR  | PEACH/APRICOT  | CHERRY/PLUM   |
|-------|---|---|--|---|
| 0     |    |    |   |    |
| 1     |    |    |   |    |
| 2     |    |    |   |    |
| 3     |    |    |    |    |
| 4     |   |  |  |  |
| 5     |  |  |  |  |
| 6     |  |  |  |  |
| 7     |  |  |  |  |

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