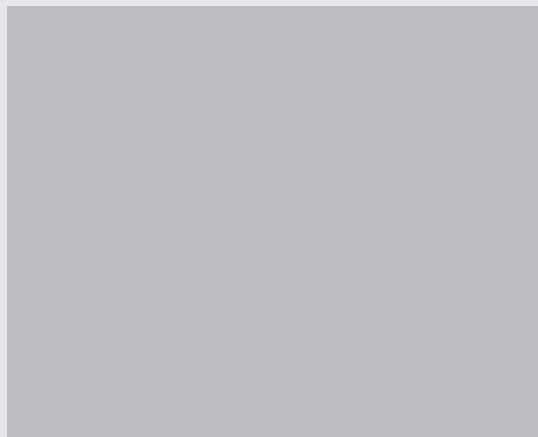


2008 Crop Protection Guide for Tree Fruits in Washington

EB0419



Campylomma adult



Pear psylla nymph



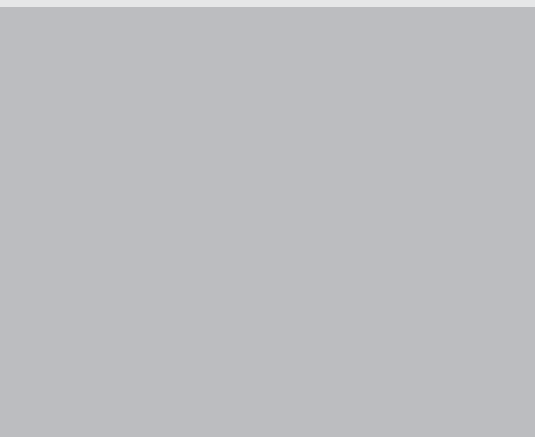
Earwig



Codling moth larva



Deraeocoris nymph



Cherry fruit fly larva

Important Phone Numbers

Poison Emergency	National Capitol Poison Center	1-800-222-1222
Toxic/Hazardous Waste Spills	Washington State Patrol	911
WSU Extension, Tree Fruits	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 (Mike Bush and Jim Olmstead)	509-574-1600
	South Central Washington (Gwen-Alyn Hoheisel)	509-786-5609
	Okanogan County (Norman Suverly)	509-422-7245
	Tree Fruit Research & Extension Center—Wenatchee	509-663-8181
	WSU Irrigated Agriculture Research & Extension Center—Prosser	509-786-2226
	Northwestern Washington Research & Extension Center—Mount Vernon (Gary Moulton)	360-848-6131
Pesticide Licensing, Registration, Compliance, & Public Safety	WSDA Pesticide Management Division (PMD), statewide	1-877-301-4555
	WSDA pesticide licensing and recertification	
	Western Washington	360-902-1937
	Eastern Washington	509-225-2639
	WSDA Registration Services Program	360-902-2030
	WSDA Compliance Program (Olympia)	360-902-2040
	WSDA Organic Food Program	360-902-1805
	Washington State Dept. of Health	1-888-586-9427
	Washington Public Health Laboratory	206-361-2898
	WSDA Pesticide Disposal Program	360-902-2056
	Northwest Ag Plastics Inc. (container recycling)	509-457-3850
Pesticide Disposal	Department of Labor and Industries	1-800-547-8367
Pesticide Container Disposal	Adams County	509-488-2862
	Benton County	509-786-5609
Worker Protection Standards	Franklin County	509-545-3580
	Chelan-Douglas Counties	509-667-6677
Horticultural Pest and Disease Boards	Grant County	509-754-2011 ext. 411
	Kittitas County	509-962-7507
	Klickitat County	509-773-5817
	Okanogan County	509-322-1286
	Skagit County	360-428-4270
	Walla Walla County	509-527-3206
	Whatcom County	360-398-9187
	Yakima County	509-225-6966
Bee Registration	Olympia	360-902-2070

STOP

This guide replaces earlier editions. Do not use after 2008.

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. PST,
EXtOXNET (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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Cover photos, from left to right: top row—*Campylomma* adult, Pear psylla nymph;
middle row—Earwig, Codling moth larva, *Deraeocoris* nymph; bottom row—Cherry fruit fly larva.

Tree Fruit Information on the Internet

Tree Fruit Crop Protection Guide Online

<http://jenny.tfrec.wsu.edu/eb0419/>

Orchard Pest Management Online

<http://jenny.tfrec.wsu.edu/opm>

WSU Tree Fruit in Washington

www.treefruit.wsu.edu

WSU Wenatchee Tree Fruit Research & Extension Center

www.tfrec.wsu.edu

WSU Extension North Central Washington

www.ncw.wsu.edu/treefruit/

WSU Extension Yakima County

treefruit.yakima.wsu.edu

WSU Tree Fruit Pathology

fruit.wsu.edu and
nrsp5.prosser.wsu.edu/nrspviru.html

WSU Grant-Adams Extension

grant-adams.wsu.edu/agriculture/index.htm

WSU Postharvest

postharvest.tfrec.wsu.edu

WSU Prosser IAREC

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 2009 Crop Protection Guide for Tree Fruit in Washington in February 2009. The next printed edition will be available approximately February 15, 2009. We will post the latest edition on our web page as soon as all changes have been entered.

Please visit the Extension Communications and Educational Support Web site anytime; click on publications at <http://pubs.wsu.edu>

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

Phone: 1-800-723-1763

E-mail: bulletin@wsu.edu

ECES Publishing and Printing
Washington State University Extension
P.O. Box 645912
Pullman, WA 99164-5912

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CROP PROTECTION GUIDE FOR TREE FRUITS IN WASHINGTON

NEW DEVELOPMENTS FOR 2008

1. Azinphos methyl phase-out

On November 16, 2006 the U.S. Environmental Protection Agency finalized details of its proposed phase-out of azinphos methyl (Guthion) on apples, pears, and cherries. Changes go into effect this year, 2008. Under this decision azinphos methyl applications will be prohibited on apples, cherries, and pears after September 30, 2012. The phase-out of azinphos methyl is being implemented through a reduction in the amount of active ingredient allowed per season. These reductions are outlined below for each crop. In addition to the active ingredient reductions there are buffer restrictions on the use of azinphos methyl around buildings occupied by humans (60 feet) and water bodies or aquatic habitats (60 feet).

Apple and Pear azinphos methyl use limitations

2008-2009: maximum application of 3.0 lbs. active ingredient per acre.

2010: maximum application of 2.0 lbs. active ingredient per acre.

2011-2012: maximum application of 1.5 lbs. active ingredient per acre.

Cherry azinphos methyl use limitations

2008-2009: maximum application of 1.5 lbs. active ingredient per acre.

2010-2012: maximum application of 0.75 lbs. active ingredient per acre.

The Environmental Protection Agency has agreed to form a transition working group under the umbrella of the existing Pesticide Program Dialogue Committee (PPDC) to evaluate the effectiveness of azinphos methyl alternatives and progress towards establishing MRLs in export markets.

2. Closed cab restrictions on endosulfan

Airblast applications of endosulfan in apple, pear, cherry, and stone fruit orchards require closed cabs. There is an exception to this requirement only in apple and pear orchards when closed cabs are not feasible to use. Applicators are permitted to use open cab airblast equipment provided they are wearing chemical resistant headgear and maximum PPE clothing (i.e., baseline clothing plus organic vapor respirator, coveralls over long sleeved shirt and long pants, chemical resistant gloves, chemical resistant shoes plus socks, and goggles or face shield).

3. Voluntary Notification Program

As directed by the 2007 legislature, WSDA is starting a 2-year Voluntary Notification Study Project concerning

the application of "Danger/Poison" (e.g., azinphos methyl, deltamethrin, endosulfan, formetanate hydrochloride, methidathion, methomyl, oxamyl, paraquat) pesticides near schools, hospitals, nursing homes, and adult and child daycares.

This project will collect data from October 1, 2007 to October 1, 2009 to determine if notification is a significant factor in reducing pesticide exposures when agricultural "Danger/Poison" pesticides are applied by aerial or airblast application methods near these facilities in Chelan, Kittitas, and Yakima Counties. For more information, go to <http://agr.wa.gov/PestFert/Pesticides/VoluntaryNotificationProject/>

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/PestFert/Pesticides/default.htm> or can be obtained from one of the locations below, or call toll-free, 1-877-301-4555.

WSDA Pesticide Management Division —Olympia
Natural Resources Bldg., 2nd floor
1111 Washington Street S.E.
P.O. Box 42589
Olympia, WA 98504-2589
Fax 360-902-2093

WSDA Pesticide Management Division —Spokane Branch
222 North Havana, Suite 203
Spokane, WA 99202-4776
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.

Synthetic pyrethroid pesticides. Contact with skin may result in irritation such as stinging, itching, burning, and tingling.

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 a person is not breathing, call 911 or ambulance, then give artificial respiration by mouth-to-mouth, if possible.
2. Call a poison control center or doctor for further treatment advice. If you know which pesticide may be involved, provide this information to the doctor.
3. Decontamination is extremely important. If the pesticide has come in contact with skin or clothing, immediately remove contaminated clothing and rinse skin immediately with plenty of water for 15-20 minutes. Those who give first aid should avoid direct contact with contaminated clothing and body areas.
4. If in eyes, hold eyes open and rinse slowly and gently with water for 15-20 minutes.
5. Do not 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 respon-

sibilities, 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 and Surveillance Section, P.O. Box 47820, Olympia, WA, 98504, phone 360-236-3360. Reports from growers, while not required, are helpful.

Investigations of pesticide misuse. In the event of misuse of a pesticide notify the nearest WSDA office or branch. When you speak with an individual, please be prepared to provide as much information as possible concerning the incident. If you do not speak directly to an individual, please leave a voice message and your call will be returned. 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 at <http://agr.wa.gov/PestFert/Pesticides/docs/InvestigEnforcmntBroch.pdf> or Spanish at <http://agr.wa.gov/PestFert/Pesticides/docs/InvestigEnforcmntBrochSpanish.pdf>.

Storage or transportation accidents. In the event of a significant accidental pesticide spill or release due to leaks, floods, fires, and the like, notify the appropriate Ecology regional office found at <http://www.ecy.wa.gov/programs/spills/other/reportaspill.htm>.

Transportation of Hazardous Materials

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

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, 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, agricultural 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 non-emergency 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 Toxic Substances, Pesticide Section, P.O. Box 47846, Olympia WA 98504, 1-888-586-9427; Dr. Allan Felsot, WSU Tri-Cities, Food and Environmental Quality Laboratory, 509-372-7365; or the Extension Toxicology Network (EXTOXNET [EXTension TOXicology NETwork] at <http://extoxnet.orst.edu>). 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; 206-418-5400.

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. Growers are responsible for carefully reading, understanding, and following these label requirements 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 re-entry 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 e-mail at 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.

Numerous other training and certification events are provided by both private companies and public educators. Contact your local Extension office for local meeting information.

Enclosed Cab

An enclosed cab, according to EPA regulation, has a nonporous barrier which totally surrounds the occupant(s) of the cab and prevents contact with pesticides outside of the cab. Enclosed cabs must meet Department of Labor and Industry requirements (L & I: 1-800-547-8367). The Washington State Department of Agriculture has implemented an enclosed cab policy, which allows an applicator to wear less personal protective equipment (PPE) than what may be required for outside or open cab applications. Exceptions to personal protective equipment specified on the product labeling for that handling activity are permitted as provided in (e)(i) through (iv) of WAC 16-233-245 at <http://apps.leg.wa.gov/WAC/default.aspx?cite=16-233-245>.

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

WSDA's Waste Pesticide Identification and Disposal Program, in cooperation with local agencies, regularly collects unusable agricultural and commercial grade pesticides. Participants are not charged a disposal fee. Several collections are held throughout the state each year.

Advance registration is required to participate. Participants can sign up or request to be notified of the next disposal event by sending their name, phone number, and complete mailing address to WSDA, Pesticide Disposal Program. After pre-registering, participants are given an inventory sheet and instructions, which are available on the internet at <http://agr.wa.gov/PestFert/Pesticides/WastePesticide.htm>.

Additional information, such as a schedule of pesticide collection dates, can be obtained by calling 1-877-301-4555 (toll free) or by e-mailing WastePesticide@agr.wa.gov.

Pesticide Container Disposal

Northwest Ag Plastics, Inc. is contracted by the Agricultural Container Recycling Council (ACRC) to operate the plastic recycling program in Washington, Oregon, and Idaho. This program recycles plastic containers that held pesticides, micro-nutrients, adjuvants, or cleaners. Container recycling is provided at no charge and is supported by the chemical

manufacturers. Triple rinse or pressure rinse empty pesticide containers, drain, dry, and remove slip-on labels, label booklets, or hard plastic lids. Follow all 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 or by e-mail steve@nwagplastics.com. You may also visit the Northwest Ag Plastics, Inc. web site at <http://www.nwagplastics.com> or the WSU Extension Pesticide Education program at <http://pep.wsu.edu/resources.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.

Section 2(ee) of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and General Pesticide Rule WAC 16-228-1225 allow that a pesticide, under certain limited conditions that are not specified on a pesticide label, may be:

- Applied at any dosage, concentration, or frequency less than that specified on the label (unless the label specifically prohibits such an application).
- Applied against any target pest not specified on the label (unless EPA has required that the pesticide may be used only for the specified pests).
- Applied by any method not prohibited by the label (unless the label specifically states the pesticide may be applied only by the methods specified on the label). Examples of methods include aerial, ground, and airblast.
- Mixed with another pesticide or a fertilizer (if not prohibited by the label).

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; or 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 may be used in orchards include simazine, diuron, and 2,4-D (except salt formulations distributed in quantities of one gallon or less; dry formulations labeled and intended only for home and garden use or for turf). The state of Washington has declared certain pesticides restricted for the protection of groundwater; they are footnoted in the Signal Word 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 statements must appear at the top of the first page of 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. The pest board may then investigate and document the situation, inform the offending pest source of action that must be taken to stop the spread of the pest, and may enforce action through the county prosecutors office if the offender fails to take effective action. As all USA citizens have legal constitutional protection of their property, no direct action can be forced upon the landowner without direction by the county court system, after the land

Signal Word (Precautionary Language) for Tree Fruit Pesticides

The signal word provides the applicator with important information about the toxicity, irritation, and sensitization hazards associated with use of that pesticide. Word category is determined by the results of six acute toxicity studies submitted by the pesticide registrant (ingestion, inhalation, dermal absorption, eye effect, and skin irritation tests). Danger/Poison products are the most toxic, followed by products marked Danger, followed by products marked Warning, whereas Caution products are the least toxic (Source 40 CFR 156).

In general, "Danger/Poison" and "Danger" chemicals require a 48 hr REI (72 hours for organophosphates used in areas with less than 25 inches of annual precipitation)." Warning" chemicals, in general, require a 24 hr REI, and "Caution" chemicals usually require a 12 hr REI. **Note:** Product specific re-entry requirements are set by the chemical's registrant. Read all labels carefully to determine the right re-entry period for the product being used.

FUNGICIDES AND BACTERICIDES

Common Name	Trade Name	Signal Word
captan	Captan	Danger
chlorothalonil	Bravo	Danger
copper hydroxide	Kocide	Danger
dodine	Syllit	Danger
ziram	Ziram	Danger
fenarimol	Rubigan	Warning
fixed copper		Warning
myclobutanil	Rally	Warning
propiconazole	Orbit	Warning
tebuconazole	Elite	Warning
terramycin	Mycoshield, Flameout	Warning
A-506 Pseudomonas fluorescens	BlightBan	Caution
Bacillus pumilus strain QST 2808	Sonata	Caution
Bacillus subtilis strain QST 713	Serenade	Caution
azoxystrobin	Abound	Caution
cyprodinil	Vanguard	Caution
fenbuconazole	Indar	Caution
flowable/micronized sulfur	Sulfur	Caution
iprodione	Rovral	Caution
kresoxim-methyl	Sovran	Caution
mancozeb	Dithane	Caution
metiram	Polyram	Caution
potassium bicarbonate	Kaligreen	Caution
pyraclostrobin	Cabrio	Caution
pyraclostrobin +boscalid	Pristine	Caution
quinoxifen	Quintec	Caution
streptomycin sulfate	Agri-mycin	Caution
thiram	Thiram	Caution
triadimefon	Bayleton	Caution
trifloxystrobin	Flint	Caution
triflumizole	Procure	Caution

HERBICIDES

Common Name	Trade Name	Signal Word
paraquat	several trade names	Danger/Poison
2,4-D	several trade names	Danger
glufosinate-ammonium	Rely	Warning
glyphosate	Roundup	Warning
oxyfluorfen	several trade names	Warning
sethoxydim	Poast	Warning
carfentrazone-ethyl	Aim	Caution
clopyralid	Stinger	Caution
dichlobenil	Casoron	Caution
diuron ¹	several trade names ¹	Caution
fluazifop	Fusilade	Caution
isoxaben	Gallery	Caution
isoxaben+trifluralin	Snapshot	Caution

HERBICIDES (Continued)

Common Name	Trade Name	Signal Word
napropamide	Devrinol	Caution
norflurazon	Solicam	Caution
oryzalin	several trade names	Caution
oxyfluorfen	GoalTender	Caution
pendimethalin	Prowl	Caution
pronamide	Kerb	Caution
pyraflufen-ethyl	Venue	Caution
rimsulfuron	Matrix	Caution
simazine ¹	several trade names	Caution
terbacil	Sinbar	Caution

INSECTICIDES AND MITICIDES

Common Name	Trade Name	Signal Word
azinphos methyl	Guthion	Danger/Poison
endosulfan	Thionex	Danger/Poison
fenbutatin oxide	Vendex	Danger/Poison
formetanate hydrochloride	Carzol	Danger/Poison
methidathion	Supracide 2E	Danger/Poison
methomyl	Lannate	Danger/Poison
oxamyl ¹	Vydate ¹	Danger/Poison
calcium polysulfide	Sulforix	Danger
deltamethrin	Battalion	Danger
dicofol	Kelthane	Danger
lime sulfur	Rex	Danger
propargite	Omite	Danger
CM pheromone dispensers		Warning
PTB pheromone	Isomate-P	Warning
abamectin	several trade names	Warning
azadirachtin	Neemix 4.5 IGR	Warning
carbaryl	Sevin 80S	Warning
chlorpyrifos	Lorsban	Warning
dimethoate	Dimethoate	Warning
esfenvalerate	Asana	Warning
fenpropathrin	Danitol	Warning
fenpyroximate	FujiMite	Warning
lambda-cyhalothrin	Warrior	Warning
malathion	Malathion 8EC	Warning
methidathion	Supracide 25W	Warning
novaluron	Rimon	Warning
permethrin	Ambush 25W	Warning
phosmet	Imidan	Warning
potassium salts of fatty acids	M-Pede	Warning
pyrethrins	PyGanic EC 5.0	Warning
pyridaben	several trade names	Warning
thiacloprid	Calypso	Warning
<i>Bacillus thuringiensis</i>		Caution
CM granulosis virus		Caution
OFM pheromone dispensers	several trade names	Caution

¹ 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.

INSECTICIDES AND MITICIDES (Continued)

Common Name	Trade Name	Signal Word	Common Name	Trade Name	Signal Word
acequinocyl	Kanemite	Caution	imidacloprid	several trade names	Caution
acetamiprid	several trade names	Caution	indoxacarb	Avaunt	Caution
azadirachtin	Aza-Direct	Caution	kaolin clay	Surround	Caution
bifenazate	Acramite	Caution	malathion	Malathion ULV	Caution
buprofezin	Centaur	Caution	methoxyfenozide	Intrepid	Caution
carbaryl	Sevin 4F	Caution	permethrin	Pounce 3.2EC	Caution
carbaryl	Sevin XLR Plus	Caution	petroleum oil		Caution
clofentezine	Apollo	Caution	pyrethrins	PyGanic EC 1.4	Caution
clothianidin	Clutch	Caution	pyriproxyfen	Esteem	Caution
diazinon	Diazinon	Caution	rosemary/peppermint oil	Ecotrol	Caution
diflubenzuron	Dimilin	Caution	spinetoram	Delegate	Caution
emamectin benzoate	Proclaim	Caution	spinosad	several trade names	Caution
etoxazole	Zeal	Caution	spirodiclofen	Envidor	Caution
flonicamid	Beleaf	Caution	sulfur, wettable	Sulfur	Caution
gamma-cyhalothrin	Proaxis	Caution	tebufenozide	Confirm	Caution
hexythiazox	several trade names	Caution	thiamethoxam	Actara	Caution
horticultural mineral oil		Caution			

owner and the pest board have had an opportunity to explain the situation to a judge.

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 the most restrictive requirements 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 incompatibility, crop injury, or reduced performance. 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 carefully read and follow all use restrictions on the label.** 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. 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 applying 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), 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 in cover crops and around tree trunks or as a cherry fruit fly control. They are less hazardous to the general environment than many sprays and dusts. Birds and other animals, however, do feed occasionally on some 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.

Be careful when using 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 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.

Defoaming agent, when added in the spray tank, breaks down or prevents the formation of foam.

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

Surfactant, spreader, and 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. **Note:** 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.

WSDA requires registration of spray adjuvants that are distributed in Washington. For a list of adjuvants registered in Washington visit the PICOL web site at <http://wsprs.wsu.edu>.

Dilutions For Wettable Powder and Liquid Products

Type of Material	Quantities of Material For Indicated Quantities of Water ¹			
	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
	0.75 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

¹The 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.

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. Lesser gallonages on smaller trees may wet the trees to a level similar to the definitions above.

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 effects 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 Beecomist 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 when fungicides that may be redistributed by rain are used 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 and iprodione (Rovral) are exceptions, since they are harmful to 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. Weather conditions can greatly influence spray effect.

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 increased 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.**

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 anti-foaming 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

Toxicity of Pesticides to Bees

See PNW0591, *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 evening except during high temperatures ^{1,2,3}	Not hazardous if applied in late evening or early morning except during high temperatures ^{1,2,4}	Not hazardous to bees at any time on blooming crops
abamectin (Epi-Mek 0.15EC) azinphos methyl (Guthion) captan (Captan) carbaryl (Sevin) chlorpyrifos (Lorsban) clothianidin (Clutch) diazinon (Diazinon) dimethoate (Dimethoate) esfenvalerate (Asana) fenpropathrin (Danitol) imidacloprid iprodione (Rovral) lambda-cyhalothrin (Warrior) malathion (Malathion ULV) methidathion (Supracide) novaluron (Rimon) permethrin phosmet (Imidan) spirodiclofen (Envidor) thiamethoxam (Actara)	abamectin (Agri-Mek 0.15EC) endosulfan (Thionex) formetanate hydrochloride (Carzol) malathion (Malathion 8EC) oxamyl (Vydate) tebufenozide (Confirm)	NAA (K-Salt Fruit Fix 200) acetamiprid azadirachtin bifenazate (Acramite) deltamethrin (Battalion) emamectin benzoate (Proclaim) horticultural mineral oil indoxacarb (Avaunt) methomyl (Lannate) pyrethrins (PyGanic) pyridaben spinosad thiacloprid (Calypso)	<i>Bacillus thuringiensis</i> NAA acequinocyl (Kanemite) ammonium thiosulfate, liquid, 12%N, 25%S buprofezin (Centaur) clofentezine (Apollo) dicofol (Kelthane) diflubenzuron (Dimilin) dodine (Syllit) ethephon (Ethrel) etoxazole (Zeal) fenarimol (Rubigan) fenbutatin oxide (Vendex) fenpyroximate (FujiMite) flonicamid (Beleaf) flowable/micronized sulfur (Sulfur) hexythiazox kaolin clay (Surround) lime sulfur (Rex) methoxyfenozide (Intrepid) myclobutanil (Rally) petroleum oil potassium salts of fatty acids (M-Pede) propargite (Omite) pyriproxyfen (Esteem) sulfur, wettable (Sulfur) triadimefon (Bayleton)

¹If temperature is less than 45°F, spray any time.

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

³For early morning spray, stop at 7 a.m.

⁴toxic if direct contact on bee.

and surfactants, and the injury observed following their use (See also herbicides in Chemical Weed Control):

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 pre-pink 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 pre-pink 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 (Thionex)—May damage all deciduous fruits as a foliage spray.

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

Oil plus wettable sulfur—Either of these products applied within 14 days of one another may mark light colored cherries.

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

Phosmet (Imidan)—Causes injury to cherry foliage.

Pyraclostrobin + boscalid (Pristine)—damage to fruit and foliage reported when applied to pears at petal fall, especially when mixed with horticultural mineral oils. Asian pears seem especially sensitive.

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 causing 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. Resistance may be managed 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 growth,

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 ²)
	Light (hours ¹)	Moderate (hours ¹)	Heavy (hours ¹)	
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	

¹Hours 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.

²Number 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).

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 relatively 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 lifetime 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 outperform 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:

As supplies are limited, this product is not likely to be available over the next few years.

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 recom-

mended. 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 200 to 400 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 reasonably smooth orchard surface prior to application.

Chloropicrin + DCP (Telone C) mixtures:

Chloropicrin was the first soil fumigant found to effectively control replant disease. It is most effective controlling soil fungi, and much less effective on nematodes and insects. 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. The 1,3-D and chloropicrin treatments have controlled orchard replant disease as well or better than methyl bromide.

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, K-Pam, 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. Over-application of water will over-dilute 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. Shank 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. Non-toxic, but unpleasant sulfurous odors may remain in the soil for several weeks after treatment. **Note:** Application variables often lead to variation in disease counted.

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 Spray Oils to Control Orchard Pests*, a Pacific Northwest Extension Publication (PNW0328, 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 subfreez-

ing 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 mineral 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 mineral 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 non-crop 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 orchards. 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.

The apple maggot is found near some commercial apple production areas in Washington where it is infesting host trees in residential areas and parks or in wild host trees. The WSDA coordinates apple maggot control activities in urban areas. The purpose of these activities is to achieve local eradication of apple maggot populations or suppress them to the point where they are not a threat to commercial apple orchards. The first table in this section gives products that can be used to control apple maggot on hosts in residential areas.

Commercial apple orchards that are in an area designated as under a quarantine for apple maggot must abide by rules for protecting apples from infestation by this pest. Most orchards in a quarantine area do not come under a designation of “threatened with infestation”, however, it is possible that some may fall into this class. The “threatened with infestation” designation is applied to any orchard that is within one-half mile of the detection of any life stage of the apple maggot, usually the adult fly. Any orchard or production site that is infested or threatened with infestation by apple maggot must be inspected by the department following accepted agency standards.

Any threatened orchard should either be monitored for apple maggot or have insecticide applied to protect the fruit from infestation. If orchards are monitored, and an apple maggot fly is detected in them, then insecticide applications must be applied to protect fruit from infestation. The Apple Maggot fly begins emerging in late June and continues emerging and active through September. Products that can be used in commercial apple orchards are shown in the regular recommendation section in the period Late Spring and Summer and the Pre-harvest period.

Pest or disease to be controlled	Use any one of the listed materials or combinations	Amount per acre	Amount per 100 gallons (dilute sprays)	Re-entry interval	Preharvest interval
Management recommendations for host trees in residential areas or public parks.					
Apple maggot (urban sites)	1. acetamiprid (TriStar 30 SG)	4-8 oz	1-2 oz	12 h	7 d
	2. acetamiprid (TriStar 70WSP)	1.7-3.4 oz	1.7-3.4 oz	12 h	7 d
<p>acetamiprid—In accordance with Special Local Needs labels for Washington applications of acetamiprid (TriStar 30SG and TriStar 70 WSP) against apple maggot should be started within 10 days of when the first flies have begun emerging from the soil or when they are detected in traps. In Washington this usually occurs in late June or early July. Applications should be repeated every 14 days as long as flies are detected in traps. Do not make more than 4 applications/year or exceed 8.7 oz ai/acre/year.</p>					

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) without required PPE. Consult the label for exceptions and proper personal protection equipment for early entry.

FUNGICIDES AND BACTERICIDES			MITICIDES			INSECTICIDES		
Chemical Name	Trade Name	REI (days)	Chemical Name	Trade Name	REI (days)	Chemical Name	Trade Name	REI (days)
A-506 Pseudomonas fluorescens	BlightBan	4 h	acequinocyl	Kanemite	12 h	abamectin	Agri-mek	12 h
azoxystrobin	Abound	4 h	bifenazate	Acramite	12 h	acetamiprid	Assail	12 h
Bacillus pumilus strain QST 2808	Sonata	4 h	clofentezine	Apollo	12 h	azadirachtin	Aza-Direct, Neemix	12 h*
Bacillus subtilis strain QST 713	Serenade	4 h	dicofol	Kelthane	48 h	azinphos methyl	Guthion	15 d**
captan	Captan	varies by label*	etoxazole	Zeal	12 h	<i>Bacillus thuringiensis</i>		4 h
chlorothalonil	Bravo	12 h*	fenbutatin oxide	Vandex	48 h+	buprofezin	Centaur	12 h
copper hydroxide	Kocide	24 h	hexythiazox	Onager, Savey	12 h	calcium polysulfide	Sulforix	48 h
cyprodinil	Vanguard	12 h	propargite	Omite	7 d	carbaryl	Sevin	12 h
dodine	Syllit	48 h	spirodiclofen	Envidor	12 h	chlorpyrifos	Lorsban	4 d
fenarimol	Rubigan	12 h	sulfur, wettable	Sulfur	24 h	clothianidin	Clutch	12 h
fenbuconazole	Indar	12 h				CM granulosis virus		4 h
fixed copper		24 h				CM pheromone dispensers		none listed
flowable/micronized sulfur	Sulfur	24 h				deltamethrin	Battalion	12 h
iprodione	Rovral	24 h				diazinon	Diazinon	4 d
kresoxim-methyl	Sovran	12 h				diflubenzuron	Dimilin	12 h
mancozeb	Dithane	24 h				dimethoate	Dimethoate	48 h
metiram	Polyram	24 h				emamectin benzoate	Proclaim	48 h
myclobutanil	Rally	24 h				endosulfan	Thionex	24 h
potassium bicarbonate	Kaligreen	4 h				esfenvalerate	Asana	12 h
propiconazole	Orbit	24 h				fenpropathrin	Danitol	24 h
pyraclostrobin	Cabrio	12 h				fenpyroximate	FujiMite	12 h
pyraclostrobin+ boscalid	Pristine	12 h				flonicamid	Beleaf	12 h
quinoxifen	Quintec	12 h				formetanate hydrochloride	Carzol	5 d
streptomycin sulfate	Agri mycin	12 h				gamma-cyhalothrin	Proaxis	24 h
tebuconazole	Elite	12 h				horticultural mineral oil		4 h
terramycin	FlameOut, Mycoshield	12 h				imidacloprid	Admire, Provado	12 h
thiram	Thiram	24 h				indoxacarb	Avaunt	12 h
triadimefon	Bayleton	12 h				kaolin clay	Surround	4 h
trifloxystrobin	Flint	12 h				lambda-cyhalothrin	Warrior	24 h
triflumizole	Procure	12 h				lime sulfur	Rex	28 h
ziram	Ziram	48 h				malathion	Malathion	12 h
						methidathion	Supracide	48 h–14 d (see label)
						methomyl	Lannate	4 d++
						methoxyfenozide	Intrepid	4 h
						novaluron	Rimon	12 h
						OFM pheromone dispensers	Checkmate, Isomate-M100	none listed
						oxamyl	Vydate	48 h
						permethrin	Ambush, Pounce	12 h
						petroleum oil		4 h*
						phosmet	Imidan	5 d
						potassium salts of fatty acids	M-Pede	12 h
						PTB pheromone	Isomate-P	none listed
						pyrethrins	PyGanic	12 h
						pyridaben	Nexter, Pyramite	12 h
						pyriproxyfen	Esteem	12 h
						rosemary/peppermint oil	Ecotrol	0 h
						spinetoram	Delegate	4 h
						spinosad	Entrust, GF-120, Success	4 h
						tebufenozide	Confirm	4 h
						thiacloprid	Calypso	12 h
						thiamethoxam	Actara	12 h

*REI varies by label.

+REI varies by orchard activity.

**REI for apples & pears—14 days. REI for cherries—15 days.

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

PREHARVEST INTERVAL (PHI) CHART FOR TREE FRUIT PESTICIDES

FUNGICIDES

Chemical name	apple	pear	sweet cherry	tart cherry	peach	nectarine	apricot	plum/prune
A-506 Pseudomonas fluorescens (BlightBan)	none listed	none listed	--	--	--	--	--	--
azoxystrobin (Abound)	--	--	0 d ^e	0 d ^e	0 d ^e	0 d ^e	0 d ^e	--
Bacillus pumilus strain QST 2808 (Sonata)	0 d	0 d	0 d	0 d	0 d	0 d	0 d	--
Bacillus subtilis strain QST 713 (Serenade)	0 d ^e	0 d ^e	0 d ^e	0 d ^e	0 d	0 d	d	--
captan (Captan)	0 d ^e	--	0 d ^e	0 d ^e	0 d ^e	0 d ^e	0 d ^e	--
chlorothalonil (Bravo)	--	--	0 d ^d	0 d ^d	0 d ^d	0 d ^d	0 d ^d	--
copper hydroxide (Kocide)	none listed	none listed	none listed	none listed	none listed	none listed	none listed	--
cyprodinil (Vangard)	72 d	72 d	--	2 d ^{b,e}	2 d ^e	2 d ^e	2 d ^e	--
dodine (Syllit)	7 d	7 d	none listed	none listed	15 d	--	--	--
fenarimol (Rubigan)	30 d	30 d	0 d ^e	0 d ^e	--	--	--	--
fenbuconazole (Indar)	--	--	0 d	0 d	0 d	0 d	0 d	--
fixed copper	0 d	0 d	0 d	0 d	0 d	0 d	0 d	--
flowable/micronized sulfur (Sulfur)	none listed	none listed	none listed	none listed	none listed	none listed	--	--
iprodione (Rovral)	--	--	none listed	none listed	none listed	none listed	none listed	--
kresoxim-methyl (Sovran)	30 d	30 d	--	--	--	--	--	--
mancozeb (Dithane)	none listed ^c	none listed ^c	--	--	--	--	--	--
metiram (Polyram)	77 d	--	--	--	--	--	--	--
myclobutanil (Rally)	14 d ^e	--	0 d ^e	0 d ^e	0 d ^e	0 d ^e	0 d ^e	--
potassium bicarbonate (Kaligreen)	1 d	1 d	1 d	1 d	1 d	1 d	1 d	--
propiconazole (Orbit)	--	--	0 d ^e	0 d ^e	0 d ^e	0 d ^e	0 d ^e	--
pyraclostrobin (Cabrio)	--	--	0 d ^e	0 d ^e	--	--	--	--
pyraclostrobin+boscalid (Pristine)	0 d ^e	0 d ^e	0 d ^e	0 d ^e	0 d ^e	0 d ^e	0 d ^e	--
quinoxifen (Quintec)	--	--	7 d	7 d	--	--	--	--
registered antibiotic	--	--	--	--	--	--	--	--
streptomycin sulfate (Agri-mycin)	50 d	30 d	--	--	--	--	--	--
tebuconazole (Elite)	--	--	0 d ^e	0 d ^e	0 d ^e	0 d ^e	--	--
terramycin (Mycoshield, FlameOut)	--	60 d	--	--	21 d	21 d	--	--
thiram (Thiram)	--	--	--	--	7 d	--	--	--
triadimefon (Bayleton)	45 d	45 d	--	--	--	--	--	--
trifloxystrobin (Flint)	14 d	14 d	--	--	--	--	--	--
triflumizole (Procur)	14 d	14 d	1 d	1 d	--	--	--	--
ziram (Ziram)	14 d	5 d	30 d	30 d	30 d	30 d	30 d	--

INSECTICIDES AND MITICIDES

Chemical name	apple	pear	sweet cherry	tart cherry	peach	nectarine	apricot	plum/prune
abamectin (Agri-Mek, Epi-Mek)	28 d	28 d	--	--	--	--	--	--
acequinocyl (Kanemite)	14 d	14 d	--	--	--	--	--	--
acetamiprid (Assail, TriStar)	7 d	7 d	--	--	--	--	--	--
azadirachtin (Aza-Direct, Neemix)	none listed	none listed	none listed	none listed	none listed	none listed	none listed	--
azinphos methyl (Guthion)	14/21 d	14/21 d	15 d	15 d	--	--	--	--
Bacillus thuringiensis	0 d ⁱ	0 d ⁱ	0 d ⁱ	0 d ⁱ	0 d ⁱ	0 d ⁱ	0 d ⁱ	--
bifenazate (Acramite)	7 d	7 d	3 d	3 d	3 d	3 d	3 d	--
buprofezin (Centaur)	14 d	14 d	--	--	14 d	--	--	--
calcium polysulfide (Sulforix)	none listed	none listed	none listed	none listed	none listed	none listed	--	--
carbaryl (Sevin)	3 d ^e	3 d ^e	3 d	3 d	3 d	3 d	3 d	--
chlorpyrifos (Lorsban)	none listed	none listed	21 d	21 d	14 d	14 d	--	--
clofentezine (Apollo)	45 d	21 d	21 d	21 d	21 d	21 d	21 d	--
clothianidin (Clutch)	7 d	7 d	--	--	--	--	--	--
CM granulosus virus	0 d	0 d	--	--	--	--	--	--
CM pheromone dispensers	none listed	none listed	--	--	none listed	none listed	--	--
deltamethrin (Battalion)	21 d	21 d	--	--	--	--	--	--
diazinon (Diazinon)	21 d	21 d	21 d	21 d	21 d	21 d	21 d	--
dicofol (Kelthane)	7 d	7 d	--	--	--	--	--	--
diflubenzuron (Dimilin)	--	14 d	--	--	not after PF	not after PF	not after PF	--
dimethoate (Dimethoate)	--	28 d	21 d ^m	21 d ^m	--	--	--	--

PREHARVEST INTERVAL CHART FOR TREE FRUIT PESTICIDES (Continued)

INSECTICIDES AND MITICIDES

Chemical name	apple	pear	sweet cherry	tart cherry	peach	nectarine	apricot	plum/ prune
emamectin benzoate (Proclaim)	14 d	14 d	--	--	--	--	--	--
endosulfan (Thionex)	21 d	7 d	21 d	21 d	21/30 d	21/30 d	21/30 d	--
esfenvalerate (Asana)	21 d	28 d	14 d	14 d	14 d	14 d	14 d	--
etoxazole (Zeal)	28 d	28 d	--	--	--	--	--	--
fenbutatin oxide (Vendex)	14 d	14 d	14 d	14 d	14 d	14 d	--	--
fenpropathrin (Danitol)	14 d	14 d	--	--	--	--	--	--
fenpyroximate (FujiMite)	14 d	14 d	--	--	--	--	--	--
flonicamid (Beleaf)	21 d	21 d	14 d	14 d	14 d	14 d	14 d	--
formetanate hydrochloride (Carzol)	none listed	none listed	--	--	none listed	none listed	--	--
gamma-cyhalothrin (Proaxis)	21 d	21 d	14 d	14 d	14 d	14 d	14 d	--
hexythiazox (Onager, Savey)	28 d	28 d	28 d	28 d	28 d	28 d	28 d	--
horticultural mineral oil	none listed	none listed	none listed	none listed	none listed	none listed	none listed	--
imidacloprid (Provado, Admire)	21 d	21 d	21 d	21 d	21 d	21 d	21 d	--
indoxacarb (Avaunt)	14 d	28 d	--	--	--	--	--	--
kaolin clay (Surround)	0 d ^f	0 d ^f	0 d ^f	0 d ^f	0 d ^f	0 d ^f	0 d ^f	--
lambda-cyhalothrin (Warrior)	21 d	21 d	14 d	14 d	14 d	14 d	14 d	--
lime sulfur (Rex)	none listed	none listed	none listed	none listed	none listed	none listed	--	--
malathion (Malathion)	--	--	3 d ^m	3 d ^m	7 d	7 d	7 d	--
methidathion (Supracide)	none listed	none listed	none listed	none listed	none listed	none listed	none listed	--
methomyl (Lannate)	14 d	--	--	--	4 d	--	--	--
methoxyfenozide (Intrepid)	14 d	14 d	7 d	7 d	7 d	7 d	--	--
novaluron (Rimon)	14 d	14 d	--	--	--	--	--	--
OFM pheromone dispensers (Isomate-M100, Checkmate)	none listed	none listed	none listed	none listed	none listed	none listed	none listed	--
oxamyI (Vydate)	14 d ^f	14 d ^f	--	--	--	--	--	--
permethrin (Ambush, Pounce)	none listed	none listed	3 d	3 d	14 d	14 d	--	--
petroleum oil	none listed	none listed	none listed	none listed	none listed	none listed	none listed	--
phosmet (Imidan)	7 d	7 d	--	7 d	14 d	14 d	14 d	--
potassium salts of fatty acids (M-Pede)	0 d ⁱ	0 d ⁱ	0 d ⁱ	0 d ⁱ	0 d ⁱ	0 d ⁱ	0 d ⁱ	--
propargite (Omite)	--	--	none listed	none listed	--	14 d	--	--
PTB pheromone (Isomate-P)	--	--	none listed	none listed	none listed	none listed	none listed	--
pyrethrins (PyGanic)	0 d	0 d	0 d	0 d	0 d	0 d	0 d	--
pyridaben (Nexter, Pyramite)	25 d	7 d	300 d	300 d	7 d	7 d	300 d	--
pyriproxyfen (Esteem)	45 d	45 d	14 d	14 d	14 d	14 d	14 d	--
rosemary/peppermint oil (Ecotrol)	0 d	0 d	0 d	0 d	0 d	0 d	0 d	--
spinetoram (Delegate)	7 d	7 d	7 d	7 d	7 d	7 d	7 d	--
spinosad (Success, Entrust, GF-120)	none listed ^d	none listed ^d	none listed ^d	none listed ^d	none listed ^d	none listed ^d	none listed ^d	--
spirodiclofen (Envidor)	7 d	7 d	7 d	7 d	7 d	7 d	7 d	--
sulfur, wettable (Sulfur)	none listed	none listed	none listed	none listed	none listed	none listed	--	--
tebufenozide (Confirm)	14 d	14 d	--	--	--	--	--	--
thiacloprid (Calypso)	30 d	30 d	--	--	--	--	--	--
thiamethoxam (Actara)	14/35 d	14/35 d ^e	14 d	14 d	14 d	14 d	14 d	--

^aDo not apply after early cover period.

^bVanguard not registered on sweet cherries.

^cRegulations vary according to rates used. Read the label carefully.

^dDo not apply after shuck split and before harvest.

^eDefaults to restricted entry period.

^fDo not apply Vydate within 30 days after full bloom to avoid fruit thinning.

^gApplication within 30 days of full bloom may cause fruit thinning.

^hCherries: 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.

ⁱPeaches and nectarines: Only one application allowed during the season.

^jPHI defaults to restricted entry interval, see product label.

^kRates exceeding 2.75 oz/acre have 35 day PHI; rates less than or equal to 2.75 oz/acre have a 14 day PHI.

^lExempt from tolerance; may be used up to and including day of harvest.

^mLabels 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	WPM ²	ARM ³	Relative impact rating ¹			
				<i>Colpoclypeus florus</i> ⁴	<i>Pnigalio flavipes</i> ⁴	<i>Coccinellids</i> ⁵	Lacewing
abamectin	Agri-Mek	H ⁶	H ⁶	M ⁶	L	M ⁶	—
acetamiprid	Assail	¹⁰	L	—	—	—	M
azadirachtin	Ecozin, Aza-Direct	—	—	L	—	L	—
azinphos methyl	Guthion	L	L	H	L	H	—
<i>Bacillus thuringiensis</i> (Bt)	DiPel, Javelin, Crymax, Biobit	L	L	L	L	L	—
bifenazate	Acramite	L	—	—	—	—	—
carbaryl	Sevin	M-H	L-M	H	L	H	L
chlorpyrifos	Lorsban	L-M	L	H	H	H	L
clofentezine	Apollo	L	L	—	—	—	—
diazinon	Diazinon	L	L	H	—	H	—
diflubenzuron	Dimilin	—	—	L	—	L	—
dimethoate	Dimethoate	L-M	L	H	—	H	—
endosulfan	Thionex, Endosulfan	L	M-H	M	M	M-H	L
esfenvalerate	Asana	H	L	M	M-H	—	L
fenbutatin-oxide	Vendex	M	H	L	—	L	—
fenpropathrin	Danitol	H	—	—	—	—	—
fenpyroximate	FujiMite	—	M	—	—	—	—
formetanate hydrochloride	Carzol	M-H	M-H	H	—	L	—
hexythiazox	Savey	L	L	—	—	—	—
imidacloprid	Provado	L ⁸	L ⁸	M-H ⁶	—	M	M-H
indoxacarb	Avaunt	L ⁹	L ⁹	—	—	—	—
kaolin	Surround	M-H	—	—	M	M-H ⁵	—
lime-sulfur	Rex	M-H	H	—	—	—	—
methomyl	Lannate	H	L	—	—	—	—
methoxyfenozide	Intrepid	L	L	L	L	—	L
novaluron	Rimon	¹⁰	—	¹¹	—	—	¹²
oxamyl	Vydate	M-H	—	H	L-M	M	L
petroleum oil		M ^{6,7}	L ⁶	L	L	—	—
permethrin	Ambush, Pounce	H	L	M	—	—	—
phosmet	Imidan	L	L	H	L	H	L
potassium salts of fatty acids	M-Pede	M ⁶	M ⁶	—	—	L	L
pyridaben	Pyramite, Nexter	M	H	M-H	—	—	—
pyriproxyfen	Esteem	—	—	M	—	—	L
spinosad	Success	L	—	M-H	H	L	L
thiacloprid	Calypso	¹⁰	L	—	—	—	—
thiamethoxam	Actara	L ⁸	L ⁸	—	—	—	—

¹Rating system: L = low impact, M = moderate impact, H = high impact, — = no data available.

²WPM = western predatory mite, *Typhlodromus occidentalis*.

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

⁴*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.

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

⁶Overall negative impact is reduced due to short residual activity.

⁷Spray volume may be important in determining toxicity.

⁸Preliminary data; based on field trials of 4 cover sprays.

⁹Preliminary data; based on field trials with a single application.

¹⁰The use of these materials has been associated with mite problems, although the effect is inconsistent, and the mechanism is unknown.

¹¹100% mortality/sterility was caused by exposure to novaluron.

¹²Novaluron has little or no acute toxicity to lacewing eggs, larvae, or adults; however, this material caused a near-complete shutdown of egg hatch from exposed adults.

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.

Common name	Trade name	Rate/ acre	Pests																	
			C M	P L	O B L	W T L	W A L	G A A	R A A	W A A	W F T	E R M	A R M	T S M	S J S	L E P	L A C	C A M	S B	
			PREBLOOM																	
<i>Bacillus thuringiensis</i>	DiPel DF, Javelin, Crymax, Biobit	1–2 pounds	—	3 ^d	3 ^d	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
chlorpyrifos	Lorsban 4EC	4 pt	—	3-4	3-4	1	—	2	x	—	—	—	—	3	4	—	3	—	—	
chlorpyrifos	Lorsban 50W	3 pounds	—	3-4	3-4	1	—	—	—	—	—	—	—	—	4	—	3	4	—	
clofentezine	Apollo SC	4–8 fl oz	—	—	—	—	—	—	—	—	2-4 ^e	1	—	—	—	—	—	—	—	
endosulfan	Thionex 50W	4 pounds	—	2	x	2	—	3	2-3	—	—	—	—	1	4	—	3	—	—	
fenbutatin oxide	Vendex 50WP	1 pound	—	—	—	—	—	—	—	—	x	3-4	—	—	—	—	—	—	—	
formetanate hydrochloride	Carzol 92SP	1 pound	—	—	—	1	4	—	—	—	3	3	3	2	x	x	x	3	4	3-4
hexythiazox	Savey 50DF	3–6 oz	—	—	—	—	—	—	—	—	2-4 ^e	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	oil + Lorsban 4EC	1% vol: vol + 2 quarts	—	3-4	3-4	1	—	3	2-3	—	3-4	—	—	4	4	—	3	—	—	
			POSTBLOOM																	
abamectin	Agri-Mek 0.15EC	10–20 fl oz	x	1	1	4	2	x	x	x	3 ^f	4	3 ^f	x	x	x	x	x	—	
acetamiprid	Assail 70WP	3.4 oz	3-4	1	1	—	4	3-4	3-4	2-3 ^h	2-3	—	—	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	—	
azinphos methyl	Guthion Solupak	2 pounds	4	2 ^c	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 ^d	3 ^d	—	—	—	—	—	—	—	—	—	—	x	—	—	—	
bifenazate	Acramite 50WS	0.75–1 pound	—	—	—	—	—	—	—	—	3-4	x	4	—	—	—	—	—	—	
carbaryl	Sevin 4F	0.5–3 quarts	2	x	x	x	4	2	x	1	—	—	2	—	2	x	x	1	2	
clothianidin	Clutch 50WDG	2–5 oz	2	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
diazinon	Diazinon 50W	4 pounds	2	1	1	1	2	2	3	4	x	—	—	3	x	x	3	3	—	
emamectin benzoate	Proclaim 5SG	3.2–4.8 oz	—	4	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
endosulfan	Thionex 50W	3 pounds	1	1	1	1	3-4	2-3	2-3	4	2	—	2-3	—	x	3-4	3-4	3	2-3	
extoxazole	Zeal 72WSP	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	
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	Avant 30WDG	6 oz	1-2	3	1-2	2-3	3-4	x	x	x	2-3	—	—	x	x	4	x	1	x	
kaolin	Surround WP	50 pounds	2	3	3	—	—	—	—	—	—	—	—	—	—	3-4	—	—	x	
lambda-cyhalothrin	Warrior 1CS	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 ^b	2-4 ^b	x	4	3	x	x	x	—	—	x	3-4 ^a	x	3	x	—	
methoxyfenozide	Intrepid 2F	16 fl oz	3	3-4	3-4	—	—	—	—	—	—	—	—	—	—	3-4	—	—	—	
novaluron	Rimon 0.83EC	30–50 fl oz	4	4	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
oxamyl	Vydate L	2 pt	x	1	1	4	3	2	x	x	2	2	3	2-3	x	x	x	x	—	
petroleum oil		1.5% vol:vol	3	1	1	—	3	2-3	—	2-3	—	2-3	2-3	—	—	—	—	—	—	
phosmet	Imidan 70W	3-5.33 pounds	3-4	—	x	x	1-2	2	1	2	x	—	—	2	x	x	x	x	—	
potassium salts of fatty salts	M-Pede	1–2% vol:vol	—	—	—	—	2-3	2-3	—	—	—	—	—	—	—	x	—	2-3	—	
pyridaben	Pyramite, Nexter	4.4–8.8 oz	—	—	—	—	x	x	x	x	4	4	2-3	x	x	x	x	x	—	
pyriproxyfen	Esteem 35WP	4–5 oz	3	4	4	—	—	—	—	—	—	—	—	3-4	—	—	—	—	—	
spinosad	Success 2L	6–10 fl oz	2-3	4	4	3-4	x	x	x	x	x	x	x	x	x	3-4	x	x	—	
spirodiclofen	Envidor 2SC	16–18 fl oz	—	—	—	—	—	—	—	—	—	3-4	x	3-4	—	—	—	—	—	
tebufenozide	Confirm 2F	20 fl oz	2-3	3-4	3-4	3	—	—	—	—	—	—	—	—	—	3-4	—	—	—	
thiacloprid	Calypso 4F	4–8 fl oz	4	1	1	x	4	x	3-4	x	—	—	—	—	—	1	—	2-3	1	

^a Rate per 100 gallons, for trunk spray only.

^b Not recommended for this use because of detrimental effects on predatory mites.

^c Effective when directed against adult moth, not effective against larvae.

^d Not effective against adults, use only against larval stage.

^e Stages present and initial population level are critical to degree of control.

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

^g Activity by contact only. No control from residues.

^h Suppression only; better activity will be obtained with higher gallonages or the addition of oil.

See rating under chlorpyrifos+oil at DD; likely most of the activity is due to the chlorpyrifos.

Rating System: 4 = excellent control 2 = suppression activity only



3 = acceptable in low pressure situations 1 = poor control

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	1.5% v/v	1.5% v/v	See text—Special Programs. (Horticultural Mineral Oils)
	STAGES 2–3 (Delayed-Dormant)			
Apple mildew	1. myclobutanil (Rally) 40W 2. triflumizole (Procure) 480SC 3. lime sulfur 4. fenarimol (Rubigan) 1EC 5. kresoxim-methyl (Sovran) 50WG 6. flowable/micronized sulfur 7. trifloxystrobin (Flint) 50W	5 oz 8–16 fl oz See label 12 fl oz 4–6.4 oz See label 2.0–2.5 oz	1.25 oz 2–4 oz See label 3 fl oz 1.0–1.6 oz See label 0.5–0.63 oz	Place myclobutanil into solution before adding oil. Apply no sooner than half-inch green. See remarks under Apple scab.
Apple scab	1. lime-sulfur 2. captan (Captan) 50WP 3. cyprodinil (Vanguard) 75 WG 4. fenarimol (Rubigan) 1EC 5. kresoxim-methyl (Sovran) 50WG 6. mancozeb (Dithane M-45) (pre-bloom schedule) 7. flowable/micronized sulfur 8. myclobutanil (Rally) 40W 9. trifloxystrobin (Flint) 50W 10. triflumizole (Procure) 50WS (protective schedule) 11. ziram (Ziram) 76DF 12. metiram (Polyram) 80DF	See label 6 lbs 5 oz 12 fl oz 4–6.4 oz 6 lbs See label 5 oz 2.0–2.5 oz 8–16 fl oz See label See label	See label 1.5 lbs 1.25 oz 3 fl oz 1.0–1.6 oz See label 1.25 oz 0.5–0.63 oz 2–4 fl oz See label See label	

Flint and Sovran: To limit the potential for development of fungicide resistance, do not make more than four applications of strobilurin fungicides per season. Do not make more than two sequential applications of strobilurin fungicides. This limitation is inclusive to all strobilurin fungicides labeled for use on pome fruits.

captan – Do not use captan on pink through blossom stages.

cyprodinil – Vanguard rate may be reduced to 3 oz/A when tank-mixed with other effective fungicides.

mancozeb – Do not apply after bloom. See label for restrictions.

myclobutanil – Place Rally into solution before adding oil.

metiram – Begin applications at 1/4 to 1/2 inch green and continue on a 7- to 10-day schedule through bloom.

triflumizole – Rates vary with postinfective schedule; see 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; restrictions, remarks
Cutworms	1. endosulfan (Thionex) 50W 2. endosulfan (Thionex) 3EC 3. chlorpyrifos (Lorsban) 75WG 4. chlorpyrifos (Lorsban) 4EC 5. indoxacarb (Avaunt) 30DG 6. methoxyfenozide (Intrepid) 2F	See label See label See label See label See label See label	1 lb 0.67 qt 0.67 lb 0.5–1.0 pt 1.5 oz 4 fl oz	Apply thoroughly to lower trunk and base of tree.
European red mite (overwintering eggs)	1. horticultural mineral oil	1.5% v/v	1.5% v/v	Oil is indispensable for an integrated mite control program. See information in Special Programs—Horticultural Mineral Oils, Dormant or Delayed Dormant Use.
Grape mealybug	horticultural mineral oil + one of the following: 1. diazinon (Diazinon) 50W 2. chlorpyrifos (Lorsban) 4EC 3. azinphos methyl (Guthion Solupak) 50WP	1-1.5% v/v 4 lbs 4 pt 2–3 lbs	1-1.5% v/v 1 lb 1 pt 0.5–0.75 lbs	horticultural mineral oil – See information in Special Programs, Horticultural Mineral Oils, Dormant or Delayed Use.
Aphid eggs, woolly apple aphid	1. horticultural mineral oil + chlorpyrifos (Lorsban) 4EC	1.5% v/v 4 pt	1.5% v/v 1 pt	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 (Thionex) 50W 2. endosulfan (Thionex) 3EC 3. chlorpyrifos (Lorsban) 75WG 4. chlorpyrifos (Lorsban) 4EC	4 lbs 2.67 qts 2.67 lbs 4 pt	1 lb 0.67 qt 0.67 lb 1 pt	Endosulfan: If using with oil, a liquid formulation is preferred.
Pandemis leafroller	1. chlorpyrifos (Lorsban) 75WG 2. chlorpyrifos (Lorsban) 4EC	1.33-2.67 lbs 3–4 pt	0.33–0.67 lb 0.75–1.0 pt	Apply chlorpyrifos at 1/2 inch green. If using with oil, liquid formulations are preferred.
San Jose scale	horticultural mineral oil + one of the following: 1. chlorpyrifos (Lorsban) 4EC 2. methidathion (Supracide) 2E 3. pyriproxyfen (Esteem) 35WP	1-1.5% v/v 4 pt 3 qts 4–5 oz	1-1.5% v/v 1 pt 1.5 pt 1–1.25 oz	See information in Special Programs—Horticultural Mineral Oils, Dormant or Delayed Dormant Use. Liquid formulations are preferred for use with oil.



STAGES 3–4
(Pre-pink)

Apply insecticides early in pre-pink if stone fruit orchards are adjacent to minimize effect on bees.

Apple mildew	1. lime-sulfur 2. calcium polysulfide (Sulfurix) 27.5 3. myclobutanil (Rally) 40W 4. fenarimol (Rubigan) 1EC 5. kresoxim-methyl (Sovran) 50WG 6. trifloxystrobin (Flint) 50W 7. triflumizole (Procure) 480SC 8. <i>Bacillus pumilis</i> (strain QST 2808) (Sonata)	See label 2 gals 5 oz 12 fl oz 4.0–6.4 oz 2.0–2.5 oz 8–16 oz 2–4 qts	See label 2 qts 1.25 oz 3 fl oz 1.0–1.6 oz 0.5–0.63 oz 2–4 oz 0.5–1 qt	Flint and Sovran: To limit the potential for development of fungicide resistance, do not make more than four applications of strobilurin fungicides per season. Do not make more than two sequential applications of strobilurin fungicides. This limitation is inclusive to all strobilurin fungicides labeled for use on pome fruits. 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 – Toxic to both pest and predatory mites, and may predispose the orchard to later mite problems.
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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 Delayed Dormant.
Cutworms	See stages 2–3			
Grape mealybug	1. buprofezin (Centaur IGR) 2. chlorpyrifos (Lorsban) 75WG 3. azinphos methyl (Guthion Solupak) 50WP 4. thiacloprid (Calypso) 4F 5. acetamiprid (Assail) 70WP 6. clothianidin (Clutch) 50WDG	34.5 oz 2.67 lbs 2–3 lbs 8 oz 3.4 oz 6 oz	See label 0.67 lb 0.5–0.75 lb See label See label See label	Azinphos methyl: see comments under stages 2–3.
Green apple aphid, rosy apple aphid, apple grain aphid	1. endosulfan (Thionex) 50WP 2. acetamiprid (Assail) 70WP	4 lbs 1.7 oz	1 lb 0.4 oz	
Green fruitworm	1. azinphos methyl (Guthion Solupak) 50WP	2 lbs	0.5 lb	
Lygus bugs, stink bugs	1. endosulfan (Thionex) 50W 2. diazinon (Diazinon) 50W	4 lbs 4 lbs	1 lb 1 lb	
Pandemis leafroller	1. chlorpyrifos (Lorsban) 75WG 2. <i>Bacillus thuringiensis</i> (Bt)	2.67 lbs 1–2 lbs	0.67 lb See label	

This timing is too early for control of obliquebanded leafrollers.
Bacillus thuringiensis – 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, above 65 degrees, for 3 or more days.
chlorpyrifos – To minimize the effect on bees in adjacent cherry orchards it is best to apply chlorpyrifos at delayed dormant.



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 2. spirodiclofen (Envidor) 25C	1–1.5 lbs 18 oz	4–6 oz See label	Apply only where a problem exists on Golden Delicious.
Apple scab	See stages 2–3 EXCEPTION: Captan should not be used at this stage.			

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	1 lb	0.25 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. Minimize bee hazard by spraying before bees are placed in the orchard. Formetanate hydrochloride is toxic to predatory mites. Acetamiprid: Use higher rates for high population numbers.
	2. chlorpyrifos (Lorsban) 75WG	2.67 lbs	0.67 lb	
	3. acetamiprid (Assail) 70WP	1.7–3.4 oz		
Codling moth	1. CM pheromone dispensers	See label		
<p>Pheromone treatments typically need to be supplemented with insecticides to achieve acceptable levels of control. Any insecticide recommended for control of codling moth can be used as a supplement to pheromone treatments. Timing of different insecticides for codling moth control depends on the stages they impact, eggs or larvae. Refer to the Petal-fall, 14-28 days after Full Bloom, and Late Spring and Summer timing periods for specific recommendations.</p> <p>CM pheromone dispensers – The number of dispensers per acre will depend on the product used and pest pressure. Hand-applied pheromone dispensers must be in place before the first moth flight, that is prior to bloom. Dispensers should be placed within the top 2 feet of the tree canopy. It is strongly recommended that full label rate of any hand-applied pheromone dispenser be used. Reducing the rate of dispensers per acre will reduce efficacy and result in more damage from codling moth or require the use of more insecticides to achieve acceptable control. 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.</p>				
Lygus bugs	1. endosulfan (Thionex) 50W	4 lbs	1 lb	Endosulfan: There is a 3 lb per acre ai limit per year. Plan ahead for potential use later in the season.
Pandemis leafroller, obliquebanded leafroller	1. <i>Bacillus thuringiensis</i>	See label	See label	Bacillus thuringiensis – 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, above 65 degrees, for 3 or more days. chlorpyrifos – This timing is better for control of overwintering obliquebanded leafroller larvae than the delayed dormant timing. Chlorpyrifos is hazardous to bees so caution should be taken when applying it in apple orchards adjacent to cherry orchards that are in bloom.
	2. chlorpyrifos (Lorsban) 75WG	2.67 lbs	0.67 lb	
Rosy apple aphid	1. acetamiprid (Assail) 70WP	1.7 oz	See 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; restrictions, remarks
	Stage: 7 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.		
Campylocoma	1. formetanate hydrochloride (Carzol) 92SP 2. acetamiprid (Assail) 70WP	1 lb 1.7–3.4 oz	0.25 lb See label	Formetanate hydrochloride: See Bee Hazard information Acetamiprid: Use higher rates for high populations.
Fire blight	1. A-506 <i>Pseudomonas fluorescens</i> (BlightBan) 2. registered antibiotic	See label	See label	Most effective fire blight control requires a combination of methods and materials. There is a risk of fire blight infection any time there are flowers on the tree, the weather is warm, and wetting occurs. A-506 <i>Pseudomonas fluorescens</i> – Apply A-506 or other biologicals when blossoms are open, starting 2-3 days before predicted warm weather (predicted high risk on Smith FB model). These products may help prevent the build-up of blight bacteria, but do little good when applied after flowers are fully infested. Repeat applications during a sustained infection period may be beneficial. registered antibiotic – If an infection event occurs, apply an effective registered antibiotic as soon as possible, but within 24 hours. Repeated antibiotic sprays may be necessary during extended high or extreme risk periods. Best results obtained when applied within 24-hour window before flower wetting. Often beneficial if applied as soon as possible, but 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 highly recommended. Application of antibiotics by aircraft is not recommended.
Pandemis leafroller, obliquebanded leafroller	1. <i>Bacillus thuringiensis</i> (Bt) 2. methoxyfenozide (Intrepid) 2F	1–2 lbs 16 fl oz	4–8 oz 4 fl oz	
Codling moth	1. CM pheromone dispenser	See label		

Pheromone treatments typically need to be supplemented with insecticides to achieve acceptable levels of control. Any insecticide recommended for control of codling moth can be used as a supplement to pheromone treatments. Timing of different insecticides for codling moth control depends on the stages they impact, eggs or larvae. Refer to the Petal-fall, 14-28 days after Full Bloom, and Late Spring and Summer timing periods for specific recommendations.

CM pheromone dispensers – The number of dispensers per acre will depend on the product used and pest pressure. Hand-applied pheromone dispensers must be in place before the first moth flight, that is prior to bloom. Dispensers should be placed within the top 2 feet of the tree canopy. It is strongly recommended that full label rate of any hand-applied pheromone dispenser be used. Reducing the rate of dispensers per acre will reduce efficacy and result in increased damage from codling moth or require the use of more insecticides to achieve acceptable control. 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.

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"> 1. fenarimol (Rubigan) 1EC 2. kresoxim-methyl (Sovran) 50WG 3. lime-sulfur 4. flowable/micronized sulfur 80W 5. myclobutanil (Rally) 40W 6. trifloxystrobin (Flint) 50W 7. triflumizole (Procure) 480SC 8. <i>Bacillus pumilis</i> (strain QST 2808) (Sonata) 	12 fl oz 4.0–6.4 oz See label See label 5 oz 2.0–2.5 oz 8–16 fl oz 2–4 qts	3 fl oz 1.0–1.6 oz See label See label 1.25 oz 0.5–0.63 oz 2–4 fl oz 0.5–1 qt	Do not apply lime-sulfur if temperatures will exceed 75°F within 3 days of application.
Apple scab	See stages 2–3			
Bull's eye rot	<ol style="list-style-type: none"> 1. captan (Captan) 50WP 2. ziram (Ziram) 	6 lbs See label	1.5 lbs See label	Use one of these materials only if scab spray is NOT used.
Codling moth	<ol style="list-style-type: none"> 1. methoxyfenozide (Intrepid) 2F 2. pyriproxyfen (Esteem) 35WP 3. novaluron (Rimon) 0.83EC 	16 fl oz 4–5 oz 30–50 fl oz	4 fl oz See label See label	These products act as ovicides (kill eggs) against codling moth. They should be first applied 75-100 degree-days after Biofix, which is about petal fall (see the new codling moth model on the IPM Decision Aids System web site— http://das.wsu.edu/). When these products are used at this time they will also control leafroller larvae (see specific recommendations under leafroller).
Rosy apple aphid	<ol style="list-style-type: none"> 1. imidacloprid (Provado) 1.6F 2. acetamiprid (Assail) 70WP 	4–8 fl oz 1.7 oz	1–2 fl oz See label	Sprays become progressively less effective as the season advances and leaves curl.
Spider mites	<ol style="list-style-type: none"> 1. hexythiazox (Savey) 50DF 2. clofentezine (Apollo) SC 3. bifenazate (Acramite) 50WS 4. etoxazole (Zeal) 72WSP 5. pyridaben (Nexter) 75WP 6. spiroticlofen (Envidor) 2SC 7. fenpyroximate (FujiMite) 5EC 	4–6 oz 6–8 fl oz 0.75–1 lb 2–3 oz 4.4–8.8 oz 16–18 fl oz 1–2 pt	1–1.5 oz 1.5–2 fl oz 3–4 oz 0.5–0.75 oz 1.1–2.2 oz 4–4.5 fl oz See label	Hexythiazox is most effective on the egg stage. When mite populations are high and leaf bronzing has already occurred, a miticide effective on the adult stage may be used in combination.
Grape mealybug	<ol style="list-style-type: none"> 1. azinphos methyl (Guthion Solupak) 50WP 2. imidacloprid (Provado) 1.6F 3. acetamiprid (Assail) 70WP 4. clothianidin (Clutch) 50WDG 5. thiacloprid (Calypso) 4F 6. buprofezin (Centaur IGR) 	2–3 lbs 8 fl oz 3.4 oz 6 oz 8 fl oz 34.5 oz	0.5–0.75 lb 2 fl oz See label See label See label See label	
Lygus bugs	<ol style="list-style-type: none"> 1. endosulfan (Thionex) 50W 	4 lbs	1 lb	

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
Pandemis leafroller, obliquebanded leafroller	1. <i>Bacillus thuringiensis</i> (Bt) 2. methoxyfenozide (Intrepid) 2F 3. pyriproxyfen (Esteem) 35WP 4. spinosad (Success) 2L 5. novaluron (Rimon) 0.83EC 6. emamectin benzoate (Proclaim) 5SG	1–2 lbs 16 fl oz 4–5 oz 6–10 fl oz 30–50 fl oz 3.2–4.8 oz	See label 4 fl oz See label 2–3.3 fl oz See label See label	
<p>All products listed are stomach poisons so complete coverage is very important for efficacy. Repeat application of any product should be based on the size of the leafroller population and the efficacy of initial treatments based on samples.</p> <p><i>Bacillus thuringiensis</i> – Applications of Bt products should be made when daily high temperatures are expected to be 65 degrees or more for three consecutive days. Two or three applications of Bt products are usually required to achieve acceptable control.</p> <p>methoxyfenozide – Some leafroller populations have developed resistance to Intrepid and use of this product in these situations will result in reduced control.</p> <p>pyriproxyfen – Should be applied when last stage larvae are present but before pupation has begun.</p> <p>spinosad – Some leafroller populations have developed resistance to Success so use of this product in this situation may result in reduced control.</p>				
Western tentiform leafminer	1. abamectin (Agri-Mek) 0.15EC 2. spinosad (Success) 2L	10 fl oz 6 fl oz	2.5 fl oz 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 (Thionex) 50W 2. formetanate hydrochloride (Carzol) 92SP 3. imidacloprid (Provado) 1.6F 4. indoxacarb (Avaunt) 30WDG 5. kaolin clay (Surround) WP	2–3 lbs 1 lb 4–8 fl oz 6 oz See label	0.5–0.75 lb 0.25 lb 1–2 fl oz 1.5 oz 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.
Western flower thrips	1. formetanate hydrochloride (Carzol SP) 2. spinosad (Success)	1 lb 6–8 fl oz	0.25 lb 1.5–2 fl oz	

14–28 DAYS AFTER FULL BLOOM

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

Apple mildew	1. fenarimol (Rubigan) 1EC	12 fl oz	3 fl oz
	2. kresoxim-methyl (Sovran) 50WG	4.0–6.4 oz	1.0–1.6 oz
	3. myclobutanil (Rally) 40W	5 oz	1.25 oz
	4. trifloxystrobin (Flint) 50W	2.0–2.5 oz	0.5–0.63 oz
	5. triflumizole (Procure) 480SC	8–16 fl oz	2–4 fl oz
	6. <i>Bacillus pumilis</i> (strain QST 2808) (Sonata)	2–4 qts	0.5–1 qt

Flint and Sovran: To limit the potential for development of fungicide resistance, do not make more than four applications of strobilurin fungicides per season. Do not make more than two sequential applications of strobilurin fungicides. This limitation is inclusive to all strobilurin fungicides labeled for use on pome fruits.

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
Apple scab	1. captan (Captan) 50WP	6 lbs	1.5 lbs	Triflumizole: Rates vary with postinfective schedule; see label.
	2. cyprodinil (Vanguard) 75WG	See label	See label	
	3. fenarimol (Rubigan) 1EC	12 fl oz	3 fl oz	
	4. kresoxim-methyl (Sovran) 50WG	4.0–6.4 oz	1.0–1.6 oz	
	5. metiram (Polyram) 80DF	See label	See label	
	6. myclobutanil (Rally) 40W	5 oz	1.25 oz	
	7. trifloxystrobin (Flint) 50W	2.0–2.5 oz	0.5–0.63 oz	
	8. triflumizole (Procure) 480SC	8–16 fl oz	2–4 fl oz	
	9. ziram (Ziram)	See label	See label	

Flint and Sovran: To limit the potential for development of fungicide resistance, do not make more than four applications of strobilurin fungicides per season. Do not make more than two sequential applications of strobilurin fungicides. This limitation is inclusive to all strobilurin fungicides labeled for use on pome fruits.

cyprodinil – Apply in tank mix combination with the recommended rate of a registered protectant fungicide. See label for the tank mixture instruction.

triflumizole – Rates vary with postinfective schedule; see label.

Codling moth	1. azinphos methyl (Guthion Solupak) 50WP	3 lbs	0.75 lbs
	2. acetamiprid (Assail) 70WP + horticultural mineral oil	3.4 oz + 0.25–1% conc.	See label
	3. phosmet (Imidan) 70W	5.33 lbs	1 lb
	4. thiacloprid (Calypto) 4F	4–8 fl oz	See label
	5. petroleum oil	1% v/v	1% v/v
	6. methoxyfenozide (Intrepid) 2F	16 fl oz	4 fl oz
	7. codling moth granulosis virus	See label	See label

Some orchards are experiencing lower levels of control of codling moth with organophosphate insecticides. Alternative products and strategies, including mating disruption, should be used in these situations to improve control. To minimize the development of codling moth resistance, any class of insecticide should be used against only one generation per year.

The first larvicide application for codling moth should be applied by 250 degree days after Biofix, however, if an ovicide was applied at petal fall the first larvicide application can be delayed until 350 degree days after Biofix (see the new codling moth model on the IPM Decision Aids System web site—<http://das.wsu.edu/>).

azinphos methyl – PHI depends on rate used.

acetamiprid – Use of Assail may cause increased problems with spider mites. It is best to restrict use to two times per year.

CM granulosis virus – Codling moth granulosis virus is a highly specific control that should always be used as a component of a multi-tactic pest management program. The residual activity lasts only about 7 days. The effect of the virus is most often seen in a suppression of the pest's densities over time. Applying virus one or more times per codling moth generation at the end of the residual period of another insecticide to extend the protection period is a logical use of this technology.

methoxyfenozide – Intrepid 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 Intrepid at 250 degree days and follow with additional applications at 14 day intervals for a total of 3 sprays. Intrepid can also be used in the second generation (if not used in the first 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 fl oz).

petroleum oil – Apply horticultural mineral oil as a 1% concentration in water at 200 degree days after model biofix. If a horticultural mineral oil control program is being followed repeat applications should be made at 400 and 600 degree days. High pest pressure orchards should reduce intervals of repeat applications to 150 degree days with four treatments needed the first generation. 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. WARNING: Use of large amounts of oil year after year may cause reduced tree vigor and in some cases fruit size.

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
White apple leafhopper	1. petroleum oil	1% v/v	1% v/v	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. Imidacloprid: Do not use until pollination is complete and bees have been removed from the orchard and neighboring orchards. Oil: Thorough coverage is necessary for this contact material. Apply after eggs finish hatching.
	2. imidacloprid (Provado) 1.6F	4–8 fl oz	1–2 fl oz	
	3. indoxacarb (Avaunt) 30WDG	6 oz	1.5 oz	
	4. kaolin clay (Surround) WP	See label	See label	
	5. potassium salts of fatty acids (soap) (M-Pede)	1% v/v	1% v/v	
	6. thiacloprid (Calypto) 4F	4 fl oz	1 fl oz	
Rosy apple aphid	1. acetamiprid (Assail) 70WP	1.7 oz	See label	Acetamiprid: 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.
	2. imidacloprid (Provado) 1.6F	4–8 fl oz	1–2 fl oz	

LATE SPRING AND SUMMER

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

Apple scab	1. captan (Captan) 50WP	8 lbs	2 lbs	0	Procure: Rates vary with postinfective schedule; see label. Sovran and Flint: To limit the potential for development of fungicide resistance, do not make more than four applications of strobilurin fungicides per season. Do not make more than two sequential applications of strobilurin fungicides. This limitation is inclusive to all strobilurin fungicides labeled for use on pome fruits.
	2. cyprodinil (Vangard) 75WG	See label	See label	72	
	3. fenarimol (Rubigan) 1EC	12 oz	3 oz	30	
	4. kresoxim-methyl (Sovran) 50WG	4.0–6.4 oz	1.0–1.6 oz	30	
	5. myclobutanil (Rally) 40W	5 oz	1.25 oz	14	
	6. trifloxystrobin (Flint) 50W	2.0–2.5 oz	0.5–0.63 oz	14	
	7. triflumizole (Procure) 480SC (protective schedule)	8–16 fl oz	2–4 fl oz	14	
Apple rust mite	1. endosulfan (Thionex) 50W	2–4 lbs	0.5–1 lb	21	In an integrated program, do not reduce apple rust mite populations unless very high.
Codling moth	1. azinphos methyl (Guthion Solupak) 50WP	3 lbs	0.75 lb	14/21	
	2. acetamiprid (Assail) 70WP + horticultural mineral oil	3.4 oz + 0.25–1% v/v	See label	7	
	3. phosmet (Imidan) 70W	5 lbs	1 lb	7	
	4. thiacloprid (Calypto) 4F	4–8 fl oz	1 fl oz	30	
	5. novaluron (Rimon) 0.83EC	30–50 fl oz	See label	14	
	6. petroleum oil	1% v/v	1% v/v		
	7. methoxyfenozide (Intrepid) 2F	16 fl oz	4 fl oz	14	
	8. codling moth granulosis virus	See label	See label	0	

Some orchards are experiencing lower levels of control of codling moth with organophosphate insecticides. Alternative products and strategies, including mating disruption, should be used in these situations to improve control. To minimize the development of codling moth resistance, any class of insecticide should be used against only one generation per year.

azinphos methyl – PHI depends on rate used.

acetamiprid – Use of Assail may cause increased problems with spider mites.

CM granulosis virus – Codling moth granulosis virus is a highly specific control that should always be used as a component of a multi-tactic pest management program. The residual activity lasts at most 7 days. The affect of the virus is most often seen in a suppression of the pest's densities over time. Applying virus one or more times per codling moth generation at the end of the residual period of another insecticide to extend the protection period is a logical use of this technology.

methoxyfenozide – 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 1250 degree days and follow with additional applications at 14 day intervals for a total of 3 or 4 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 fl oz).

novaluron – If Rimon is used in the second generation it should be applied starting at the predicted egg laying period based on the model, 1000 degree-days after Biofix of the first generation.

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
Cutworms	1. endosulfan (Thionex) 50W	4 lbs	1 lb	21
Spider mites	1. bifentazate (Acramite) 50WS 2. etoxazole (Zeal) 72WSP 3. hexythiazox (Savey) 50DF 4. pyridaben (Nexter) 75WP 5. spiroticlofen (Envidor) 2SC 6. fenpyroximate (FujiMite) 5EC	12–16 oz 2–3 oz 4–6 oz 4.4–8.8 oz 16–18 fl oz 1–2 pt	3–4 oz 0.5–0.75 oz 1–1.5 oz 1.1–2.2 oz 4–4.5 fl oz See label	7 28 28 25 7 14 Pyridaben: 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 Solupak) 50WP 2. imidacloprid (Provado) 1.6F 3. phosmet (Imidan) 70W 4. acetamiprid (Assail) 70WP 5. buprofezin (Centaur IGR) 6. clothianidin (Clutch) 50WDG 7. thiacloprid (Calypso) 4F	2 lbs 8 fl oz 4.5 lbs 3.4 oz 34.5 oz 6 oz 8 fl oz	0.5 lb 2 fl oz 1 lb See label See label See label See label	14/21 7 7 7 7 7 7 Azinphos methyl: PHI depends on rate used.
Grasshoppers	1. carbaryl (Sevin) 4F	2 pt	8 fl oz	3 See text: Special Programs—Grasshoppers
Green apple aphid	1. imidacloprid (Provado) 1.6F 2. acetamiprid (Assail) 70WP 3. endosulfan (Thionex) 50W	4–8 fl. oz 1.7 oz 4–5 lbs	1–2 fl. oz See label 1 lb	7 7 21 Imidacloprid: Aerial application may result in slower activity or reduced control.
Lacanobia fruitworm	1. endosulfan (Thionex) 50W 2. indoxacarb (Avaunt) 30DG 3. kaolin clay (Surround) WP 4. methoxyfenozide (Intrepid) 2F 5. spinosad (Success) 2L	3 lbs 4–6 oz 50 lbs 16 fl oz 6–10 fl oz	0.75 lb 1–1.5 oz See label 4 fl oz 2–3.3 fl oz	21 14 0 14 7 Spinosad: use only against young larvae and NOT after larvae have changed color from green to brown.
Pandemis leafroller, obliquebanded leafroller	1. <i>Bacillus thuringiensis</i> 2. methoxyfenozide (Intrepid) 2F 3. spinosad (Success) 2L 4. novaluron (Rimon) 0.83EC 5. emamectin benzoate (Proclaim) 5SG	1–2 lbs 16 fl oz 6–10 fl oz 30–50 fl oz 3.2–4.8 oz	 4 fl oz 2–3.3 oz See label See label	0 14 7 14 14
<p>If you used one of these products to control overwintering leafroller larvae (petal-fall or later in spring) it should not be used again at this time in order to minimize the development of resistance. Intrepid, Rimon, Proclaim, or Bt products should target young leafroller larvae in late June or early July. Consult new leafroller models available over the IPM Decision Aids System web site at http://das.wsu.edu/. All these products are primarily stomach poisons, so complete coverage of foliage is very important for efficacy.</p> <p><i>Bacillus thuringiensis</i> – Two or three Bt applications are usually required to achieve acceptable control. Time the first application to coincide with leafroller egg hatch. A repeat application might be required if leafroller populations are high.</p> <p>methoxyfenozide – Some leafroller populations have developed resistance to Intrepid and its use could result in reduced levels of control.</p> <p>spinosad – Some leafroller populations have developed resistance to spinosad and its use could result in reduced levels of control.</p>				
San Jose scale	1. diazinon (Diazinon) 50W	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 (Thionex) 50W	4 lbs	1 lb	21
Stink bugs	1. endosulfan (Thionex) 50W 2. fenprothrin (Danitol) 2.4EC 3. lambda-cyhalothrin (Warrior) 1CS	4–5 lbs 20 fl oz 2.5–5 fl oz	1 lb 5 fl oz See label	21 14 21
<p>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.</p>				

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
Western tentiform leafminer	1. abamectin (Agri-Mek) 0.15EC 2. spinosad (Success) 2L	10 fl oz 6–10 fl oz	2.5 fl oz 2–3.3 fl oz	28 7 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).
White apple leafhopper	1. carbaryl (Sevin) 4F 2. endosulfan (Thionex) 50W 3. petroleum oil 4. imidacloprid (Provado) 1.6F 5. indoxacarb (Avaunt) 30WDG 6. kaolin (Surround) WP	1–2 pt 3 lbs 1% v/v 4–8 fl oz 4–6 oz See label	4–8 fl oz 0.75 lb 1% v/v 1–2 fl oz 1–1.5 oz See label	3 21 7 14 0 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. Imidacloprid: Aerial application may result 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 (Thionex) 50W 2. diazinon (Diazinon) 50W 3. petroleum oil	3–4 lbs 4 lbs 1–1.5% v/v	0.75–1 lb 1 lb 1–1.5% v/v	21 21 Oil will suppress woolly apple aphid. Multiple applications and/or high spray volumes will help.
PREHARVEST				
Apple scab	1. captan (Captan) 50WP 2. ziram (Ziram) 76DF	6 lbs See label	1.5 lbs See label	0 14
Bull's eye rot	1. captan (Captan) 50WP 2. ziram (Ziram) 76DF	6 lbs See label	1.5 lbs See label	0 14
Storage rots	1. pyraclostrobin + boscalid (Pristine) 2. ziram (Ziram, Granuflo)	14.5–18.5 oz 8 lbs	3.6–4.6 oz 2 lbs	0 14 A ground applied, dilute application leading to excellent fruit coverage is essential for control of storage rots. Pristine: To limit the potential for development of fungicide resistance, do not make more than four applications of strobilurin fungicides per season. Do not make more than two sequential applications of strobilurin fungicides. This limitation is inclusive to all strobilurin fungicides labeled for use on pome fruits.
Apple maggot	1. phosmet (Imidan) 70W 2. acetamiprid (Assail) 70WP	5.33 lb 3.4 oz	See label See label	7 7
Codling moth	1. carbaryl (Sevin) 4F 2. acetamiprid (Assail) 70WP + petroleum oil	2 pt 3.4 oz 0.25% v/v	0.5 pt See label 0.25% v/v	3 7 Use carbaryl or acetamiprid near harvest or on late-maturing varieties to prevent fruit damage from codling moth where pressure is high.
Pandemis leafroller, obliquebanded leafroller	1. <i>Bacillus thuringiensis</i>	1–2 lbs	See label	0 Bts are stomach poisons so complete coverage is very important for control. Two or three applications are usually required.

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 ^d												
			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
PREBLOOM															
acetamiprid	Assail 70WP	2.3–3.4 ounces	4	–	3-4	x	–	–	–	–	–	–	x	x	–
azadirachtin	several		2-3	–	1	–	x	–	–	–	–	x	–	–	–
azinphos methyl	Guthion Solupak	2–3 pounds	–	–	3-4	x	x	–	–	–	–	4	x	x	–
chlorpyrifos	Lorsban 4EC	4 pt	–	–	3-4	x	x	–	–	–	–	4	x	x	3-4
endosulfan	Endosulfan 3EC	3 quarts	3-4	–	–	–	1	–	4	–	x	3-4 ^b	2-3	2-3	2
esfenvalerate	Asana XL ^a	1 pt	1-4 ^f	–	–	–	–	–	–	–	–	x	4	4	x
horticultural mineral oil		4–6 gals	2-3	–	–	3	–	3-4 ^b	x	–	–	–	–	–	x
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 50W	6 gal + 4 pounds	2-3	–	3	4	3	3	2	–	2	2	2-3	2-3	x
oxamyl	Vydate L	3–4 quarts	–	–	–	–	–	2	x	2-3	x	–	–	–	x
permethrin	Pounce 3.2EC	12 ounces	1-4	–	–	–	–	–	–	–	–	4	4	4	x
pyridaben	Pyramite 60WSB	8.8–13.2 ounces	3-4	–	1-2	–	–	4	3-4	2-4	x	–	x	x	–
pyriproxyfen	Esteem 35WP	4–5 ounces	3	–	–	3-4	–	–	–	–	–	–	–	–	x
thiacloprid	Calypso 4F	6–8 fl ounces	4	–	3-4	x	x	–	–	–	–	–	x	x	–
thiamethoxam	Actara 25WDG	5.5 ounces	4	–	3-4	x	x	–	–	–	–	–	x	x	–
POSTBLOOM															
abamectin	Agri-Mek 0.15EC	10–20 fl ounces	3-4	–	–	–	–	4	4	3-4	–	–	–	–	–
acetamiprid	Assail 70WP	3.4 ounces	4	4	3-4	x	x	–	–	–	–	–	x	x	–
azadirachtin	several		2-3	1	1	–	x	–	–	–	–	x	–	–	–
azinphos methyl	Guthion Solupak	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 4L	0.5–3 quarts	–	2	x	1	1	–	3	–	x	x	1	1	–
clofentezine ^e	Apollo SC	4–8 ounces	–	–	–	–	–	2-4	1	2-4	–	–	–	–	–
clothianidin	Clutch 50 WDG	4–6 ounces	4	–	3-4	x	x	–	–	–	–	–	x	x	–
diazinon	Diazinon 50W	4 pounds	–	2	3-4	3	2-3	–	–	–	–	x	3	3	–
dimethoate	Dimethoate 2.67EC	4 pt	–	2	x	x	2-3	–	–	–	–	x	3-4	3-4	–
emamectin benzoate	Proclaim 5SG	3.2–4.8 oz	–	–	–	–	–	–	–	–	–	–	–	–	4
endosulfan	Thionex 50W	3 pounds	1	1	–	1	2	–	1-3	–	x	3-4	2-3	2-3	–
etoxazole	Zeal 72WSP	3 ounces	–	–	–	–	–	4	x	4	x	–	–	–	–
fenbutatin-oxide	Vendex 50WP	1.5–2 pounds	–	–	–	–	–	1-4	2-4	2-4	x	–	–	–	–
fenproprathrin	Danitol 2.4EC	20 fl ounces	x	x	x	x	x	x	x	x	x	x	4	x	x
fenpyroximate	FujiMite 5EC	1–2 pt	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 50DF	4–6 ounces	–	–	–	–	–	2-4 ^a	1	2-4	x	–	–	–	–
imidacloprid	Provado 1.6F	15–20 fl 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 70W	3–5.33 pounds	1-3	3-4	3	2	2	–	–	–	–	x	x	x	–
pyridaben	Pyramite 60WSB	4.4–13.2 ounces	3-4	–	x	–	–	4	3	2-3	x	–	–	–	–
pyriproxyfen	Esteem 35WP	5 ounces	2-3	2-3	1	x	–	–	–	–	–	x	–	–	2-4
spinosad	Success 2L	6–10 fl ounces	1	2-3	–	–	–	–	–	–	–	4	–	–	4
spiroticlofen	Envior 2SC	16–18 fl ounces	–	–	–	–	–	4	4	4	x	–	–	–	–
thiacloprid	Calypso 4F	6–8 fl ounces	4	3-4	3-4	x	x	–	–	–	–	–	x	x	–
thiamethoxam	Actara 25WDG	5.5 ounces	4	–	3-4	x	x	–	–	–	–	–	x	x	–

^aRecommended for prebloom use

^bRate per 100 gallons (cutworm spray), use as a trunk spray

^cFor use only on 'Bartlett' pears intended for processing

^dSee Relative Efficacy Guide—Apple, for information on pests not listed here

^eStages present and initial population level are critical to degree of control

^fResistance 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 18s) 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: 1. endosulfan (Thionex) 3EC 2. esfenvalerate (Asana XL) 3. lime sulfur 4. flowable/micronized sulfur 5. kaolin clay (Surround) WP 6. permethrin (Ambush) 25W 7. permethrin (Pounce) 3.2EC 8. lambda-cyhalothrin (Warrior) 1CS 9. gamma-cyhalothrin (Proaxis)	1–1.5% v/v 3 qts 1 pt 11 gals See label 25–50 lbs 12.8–25.6 oz 12 fl oz 2.5–5 fl oz 5.12 fl oz	1–1.5% v/v 0.67 qt 4 fl oz See label See label See label 12 fl oz 0.63–1.25 fl oz See label	Do not use esfenvalerate and permethrin more than 2 times per season. Pyrethroid (numbers 2, 6, 7, 8, and 9) resistance is present in many areas and may severely reduce efficacy. Kaolin clay: 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 2. endosulfan (Thionex) 50W 3. endosulfan (Thionex) 3EC	See label 4 lbs 2 qts	0.5–1 pt 1 lb 0.67 qt	Apply thoroughly to lower trunk and cover crop with a handgun.
European red mite	1. horticultural mineral oil	1.5% v/v	1.5% v/v	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: 1. chlorpyrifos (Lorsban) 4EC 2. diazinon (Diazinon) 50W	1.5% v/v 4 pt 4 lbs	1.5% v/v 1 pt 1 lb	
Lygus bugs, stink bugs	1. dimethoate (Dimethoate) 2.67EC 2. endosulfan (Thionex) 3EC	4 pt 3 qts	1 pt 0.67 qt	Lygus bugs and stink bugs will be controlled by pyrethroids if they are used at this time.
Pear psylla	horticultural mineral oil + one of the following: 1. calcium polysulfide (Sulforix) 2. endosulfan (Thionex) 3EC 3. esfenvalerate (Asana XL) 4. kaolin clay (Surround) WP 5. lime sulfur 6. flowable/micronized sulfur 7. permethrin (Pounce) 3.2EC 8. acetamiprid (Assail) 70WP 9. pyriproxyfen (Esteem) 35WP 10. diflubenzuron (Dimilin) 2L 11. lambda-cyhalothrin (Warrior) 1CS 12. gamma-cyhalothrin (Proaxis)	1–1.5% v/v 2 gals 3 qts 1 pt 25–50 lbs 11 gals See label 12 fl oz 2.3–3.4 oz 5 oz 40–48 fl oz 2.5–5 fl oz 5.12 fl oz	1–1.5% v/v 2 qts 0.67 qt 4 fl oz See label See label See label 3 fl oz See label See label 10–12 fl oz 0.63–1.25 fl oz See label	Pyrethroid (e.g., Asana, Pounce, Ambush, Proaxis, Warrior) resistance is present in many areas and may severely reduce efficacy. Kaolin clay: 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.

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 + 1. carbaryl (Sevin) 4F 2. lime sulfur 3. flowable/micronized sulfur 4. calcium polysulfide (Sulforix) 5. endosulfan (Thionex) 3EC	1–1.5% v/v 4 pt 11 gals See label 2 gals 3 qts	1–1.5% v/v 1pt See label See label 2 qts 0.67 qt	See remarks pertaining to oil under European red mite.
San Jose scale	horticultural mineral oil + one of the following: 1. chlorpyrifos (Lorsban) 4EC 2. methidathion (Supracide) 25WP or without oil: 3. pyriproxyfen (Esteem) 35WP	1–1.5% v/v 4 pt 6 lbs 4–5 oz	1–1.5% v/v 1 pt 1.5 lbs See label	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.
	STAGES 3–4 (Pre-pink, clusterbud to popcorn)	Avoid killing bees on blooming cover crops. See Hazards to Bees.		
European red mite	1. horticultural mineral oil	1% v/v	1% v/v	
Grape mealybug	1. diazinon (Diazinon) 50W 2. azinphos methyl (Guthion Solupak) 50WP 3. phosmet (Imidan) 70W 4. thiamethoxam (Actara) 25WDG 5. acetamiprid (Assail) 70WP 6. thiacloprid (Calypso) 4F 7. buprofezin (Centaur IGR)	4 lbs 2–3 lbs 5–7 lbs 5.5 oz 2.3–3.4 oz 6–8 fl oz 34.5 oz	1 lb 0.5–0.75 lb 0.75–1 lb See label See label 1.5–2 fl oz See label	Use a dilute spray for full coverage. azinphos methyl and thiamethoxam: PHI depends on rate used.
Lygus bugs, stink bugs, green fruitworm	1. endosulfan (Thionex) 50W 2. dimethoate (Dimethoate) 4EC 3. diazinon (Diazinon) 50W	4 lbs 2.67 pt 4 lbs	1 lb 0.67 pt 1 lb	
Pear psylla	1. esfenvalerate (Asana XL) 2. permethrin (Pounce) 3.2EC 3. pyriproxyfen (Esteem) 35WP 4. thiamethoxam (Actara) 25WDG 5. acetamiprid (Assail) 70WP 6. thiacloprid (Calypso) 4F 7. buprofezin (Centaur IGR) 8. pyridaben (Nexter) 75WP 9. clothianidin (Clutch) WDG	1 pt 12 fl oz 5 oz 5.5 oz 2.3–3.4 oz 6–8 fl oz 34.5 oz 10.67 oz 4–6 oz	4 fl oz 3 fl oz See label See label See label 1.5–2 fl oz See label See label See label	
Pear rust mite, brown mite	1. formetanate hydrochloride (Carzol) 92SP 2. pyridaben (Nexter) 75WP	1 lb 6.6–10.67 oz	0.25 lb See label	
San Jose scale	1. pyriproxyfen (Esteem) 35WP	4–5 oz	See label	

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 (Pink, fingerbud to first white)	Avoid killing bees on blooming cover crops. See Hazards to Bees.		
Pandemis leafroller	1. <i>Bacillus thuringiensis</i>	See label		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. This timing is too early for control of obliquebanded leafroller.
Pear mildew (Anjou)	1. kresoxim-methyl (Sovran) 50WG 2. triadimefon (Bayleton) 50DF 3. trifloxystrobin (Flint) 50W 4. triflumizole (Procure) 480SC	4.0–6.4 oz 6–8 oz 2.0–2.5 oz 8–16 fl oz	1.0–1.6 oz 1.5–2 oz 0.5–0.63 oz 2–4 fl oz	Flint and Sovran: To limit the potential for development of fungicide resistance, do not make more than four applications of strobilurin fungicides per season. Do not make more than two sequential applications of strobilurin fungicides. This limitation is inclusive to all strobilurin fungicides labeled for use on pome fruits. DO NOT use lime sulfur or flowable micronized sulfur on Anjou.
Pear mildew (other varieties)	1. kresoxim-methyl (Sovran) 50WG 2. lime-sulfur 3. flowable/micronized sulfur 4. triadimefon (Bayleton) 50DF 5. trifloxystrobin (Flint) 50W 6. triflumizole (Procure) 480SC	4.0–6.4 oz 8 gals See label 6–8 oz 2.0–2.5 oz 8–16 fl oz	1.0–1.6 oz 2 gals See label 1.5–2 oz 0.5–0.63 oz 2–4 fl oz	Flint and Sovran: Do not apply more than two sequential or exceed 4 total applications of strobilurin fungicides per season. cyprodinil: Do not apply Vanguard alone to pears. 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 strobilurin fungicides per acre per season. DO NOT use lime-sulfur on Anjou. Mancozeb: Do not apply after bloom. Procure: Rate varies when used in eradicant (postinfective) schedules.
Pear scab	1. cyprodinil (Vanguard) 75 WG 2. kresoxim-methyl (Sovran) 50WG 3. lime-sulfur 4. mancozeb (Dithane) M-45 (pre-bloom schedule) 5. triflumizole (Procure) 480SC (protective schedule)	See label 4.0–6.4 oz 8 gals 6 lbs 8–16 fl oz	See label 1.0–1.6 oz 2 gals 2–4 fl oz	
	STAGE 7 (First bloom to late bloom)	Avoid killing bees on blooming cover crops. See Hazards to Bees.		
Codling moth	1. CM pheromone dispensers	See label		See remarks in the apple section, Stage 7.
Fire blight (Anjou)	1. terramycin (Mycoshield, FlameOut)	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.

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) 3. <i>Bacillus subtilis</i> (QST 713 strain) (Serenade Max)	See label 2–3 lbs	See label 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. 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) 2. fixed copper 3. copper hydroxide (Kocide DF) 4. A-506 <i>Pseudomonas fluorescens</i> (BlightBan) 5. <i>Bacillus subtilis</i> (QST 713 strain) (Serenade Max)	16 oz 2 lbs 1 lb See label 2–3 lbs	16 oz 0.5 lb See label See label See label	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. 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.
Pandemis leafroller	1. <i>Bacillus thuringiensis</i>	See label	See label	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. This timing is too early for control of obliquebanded leafroller.
Pear mildew	1. kresoxim-methyl (Sovran) 50WG 2. triadimefon (Bayleton) 50DF 3. trifloxystrobin (Flint) 50W 4. triflumizole (Procure) 50WS	4–6.4 oz 6–8 oz 2–2.5 oz 8–16 oz	1–1.6 oz 1.5–2 oz 0.5–0.63 oz 2–4 oz	
Pear scab	1. cyprodinil (Vanguard) WG 2. dodine (Syllit) FL 3. kresoxim-methyl (Sovran) 50WG 4. lime sulfur 5. mancozeb (Dithane) M-45 6. triflumizole (Procure) 50WS	See label 4.5 pt 4–6.4 oz See label 6 lbs 8–16 oz	See label See label 1–1.6 oz See label See label 2–4 oz	
PETAL-FALL—Avoid killing bees on blooming cover crops. See Hazards to Bees.				
Bull's eye rot	1. ziram (Ziram) 76DF	See label	See label	Apply while pear calyx is still upright.
Codling moth	See Stage 7			
Fire blight	See Stage 7			Watch for warm weather followed by wetting whenever secondary bloom or rat-tail blossoms are present. Full bloom through late petal fall is the most dangerous period, but infection during this stage is uncommon. Petal fall through 30 days postbloom is the time when most infection occurs.

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 Solupak) 50WP	2–3 lbs	0.5–0.75 lb	See Hazards to Bees in text. Imidacloprid: Efficacy may be increased by adding 0.25% horticultural oil.	
	2. diazinon (Diazinon) 50W	4 lbs	1 lb		
	3. imidacloprid (Provado) 1.6F	16–20 fl oz	4–5 fl oz		
	4. phosmet (Imidan) 70W	5.33 lbs	1 lb		
	5. acetamiprid (Assail) 70WP	2.3–3.4 oz	See label		
	6. thiamethoxam (Actara) 25WDG	4.5–5.5 oz	See label		
	7. thiacloprid (Calypso) 4F	6–8 fl oz	See label		
	8. clothianidin (Clutch) 50WDG	4–6 oz	See label		
	9. buprofezin (Centaur) 70W	34.5 oz	See label		
Lygus bugs	1. dimethoate (Dimethoate) 4EC	2.67 pt	0.67 pt	<p>Each product listed for leafroller control must be consumed by larvae in order to be effective. Therefore good spray coverage of the foliage is critical to achieving good control with these products.</p> <p>Bacillus thuringiensis – Bt products should be timed to coincide with periods of warm weather when high temperatures are expected to reach 65 degrees for three consecutive days. Multiple applications are typically required to control high populations.</p> <p>methoxyfenozide – Some leafroller populations have developed resistance to Intrepid and its use could result in reduced levels of control.</p> <p>pyriproxyfen – Esteem should be applied when last stage larvae are present but before pupation has begun.</p> <p>spinosad – Some leafroller populations have developed resistance to spinosad and its use could result in reduced levels of control.</p>	
	2. endosulfan (Thionex) 50W	3 lbs	0.75 lb		
Pandemis leafroller, obliquebanded leafroller	1. <i>Bacillus thuringiensis</i>	See label	See label		
	2. methoxyfenozide (Intrepid) 2F	16 fl oz	4 fl oz		
	3. pyriproxyfen (Esteem) 35WP	4–5 oz	1–1.25 oz		
	4. spinosad (Success) 2L	6–10 fl oz	See label		
	5. emamectin benzoate (Proclaim) 5SG	3.2–4.8 oz	See label		
Pear mildew	1. kresoxim-methyl (Sovran) 50WG	4.0–6.4 oz	1.0–1.6 oz		Sovran: See remarks under stages 5–6.
	2. triadimefon (Bayleton) 50DF	6–8 oz	1.5–2 oz		
	3. triflumizole (Procure) 480SC	8–16 fl oz	2–4 fl oz		
Pear psylla	1. abamectin (Agri-Mek) 0.15EC + horticultural mineral oil	16–20 fl oz	4–5 fl oz		
	2. imidacloprid (Provado) 1.6F	0.25% v/v	0.25% v/v		
	3. thiamethoxam (Actara) 25WDG	15–20 fl oz	3.75–5 fl oz		
	4. acetamiprid (Assail) 70WP	5.5 oz	See label		
	5. thiacloprid (Calypso) 4F	2.3–3.4oz	See label		
	6. pyriproxyfen (Esteem) 35WP	6–8 fl oz	1.5–2 fl oz		
	7. fenpyroximate (FujiMite) 5EC	5 oz	See label		
	8. clothianidin (Clutch) 50WDG	1–2 pt	See label		
	9. buprofezin (Centaur) 70W	4–6 oz	See label		
	10. pyridaben (Nexter) 75WP	34.5 oz	See label		
Pear rust mite	1. dicofol (Kelthane) 50WSP	6.6–10.67 oz	See label		
	2. fenbutatin-oxide (Vendex) 50WP	4 lbs	1 lb		
	3. spirodiclofen (Envidor) 2SC	1–1.5 lbs	4–6 oz		
	4. fenpyroximate (FujiMite) 5EC	16–18 fl oz	See label		
	5. pyridaben (Nexter) 75WP	2 pt	See label		
Pear scab	1. cyprodinil (Vanguard) WG	6.6–10.67 oz	See label		
	2. kresoxim-methyl (Sovran) 50WG	4 lbs	1 lb		
	3. lime sulfur	4–6.4 oz	1–1.6 oz		
	4. triflumizole (Procure) 480SC	See label	See label		

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	
14–32 DAYS AFTER FULL BLOOM (Traditional "First Cover")					
Codling moth	1. azinphos methyl (Guthion Solupak) 50WP	3 lbs	0.75 lb		
	2. acetamiprid (Assail) 70WP	3.4 oz	See label		
	3. phosmet (Imidan) 70W	5.33 lbs	1 lb		
	4. methoxyfenozide (Intrepid) 2F	16 fl oz	4 oz		
	5. thiacloprid (Calypso) 4F	6–8 fl oz	1.5–2 fl oz		
LATE SPRING AND SUMMER (May to August)—Avoid killing bees on blooming cover crops. See Hazards to Bees.					
Codling moth	1. azinphos methyl (Guthion Solupak) 50WP	1–3 lbs	0.25–0.75 lb	14/21	Some orchards are experiencing lower levels of control with organophosphate insecticides. Alternative products should be used in these situations to improve control. To minimize the development of codling moth resistance to new insecticides you should use a class of insecticide against only one generation per year. azinphos methyl – PHI depends on rate used. methoxyfenozide – Methoxyfenozide is a stomach poison, so complete coverage is essential for adequate control.
	2. phosmet (Imidan) 70W	3–5.33 lbs	0.75–1 lb	7	
	3. methoxyfenozide (Intrepid) 2F	16 fl oz	4 fl oz	14	
	4. acetamiprid (Assail) 70WP	3.4 oz	See label	7	
	5. pyriproxyfen (Esteem) 35WP	5 oz	1.25 oz	45	
	6. thiacloprid (Calypso) 4F	6–8 fl oz	1.5–2 fl oz	30	
Fire blight	See stage 7 (Blossom)				
Grape mealybug	1. azinphos methyl (Guthion Solupak) 50WP	2 lbs	0.5 lb	14/21	Imidacloprid: Efficacy may be increased by adding 0.25% horticultural oil. azinphos methyl and thiamethoxam – PHI depends on rate used.
	2. imidacloprid (Provado) 1.6F	16–20 fl oz	4–5 fl oz	7	
	3. phosmet (Imidan) 70W	4.5 lbs	1 lb	7	
	4. thiamethoxam (Actara) 25 WDG	5.5 oz	See label	14/35	
	5. acetamiprid (Assail) 70WP	3.4 oz	See label	7	
	6. thiacloprid (Calypso) 4F	6–8 fl oz	1.5–2 fl oz	30	
	7. clothianidin (Clutch) 50WDG	4–6 oz	See label	7	
	8. buprofezin (Centaur) 70W	34.5 oz	See label	14	
Grasshoppers	1. carbaryl (Sevin) 4F	2 pt	8 fl oz	3	See text: Special Programs—Grasshoppers
Green apple aphid	1. endosulfan (Thionex) 50W	2 lbs	0.5 lb	7	Dimethoate may cause russetting of Anjou. Actara: See above for PHI explanation.
	2. dimethoate (Dimethoate) 2.67EC	4 pt	1 pt	28	
	3. thiamethoxam (Actara) 25WDG	4.5–5.5 oz	See label	14/35	
Lygus bugs, stink bugs	1. endosulfan (Thionex) 50W	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 1 gal	2.5–5 fl oz 1 qt	28	Clofentezine and hexythiazox are ovicides. When initial mite populations are high, use in combination with an adulticide. Pyridaben: Use 4.4–5.2 oz/A for ERM, use 6.6–10.67 oz/A for Twospotted and McDaniel spider mites.
	2. clofentezine (Apollo) SC	4–8 oz	1–2 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) 50DF	4–6 oz	1–1.5 oz	28	
	6. bifenazate (Acramite) 50WS	12–16 oz	3–4 oz	7	
	7. etoxazole (Zeal) 72 WSP	3 oz	See label	28	
	8. fenpyroximate (FujiMite) 5EC	1–2 pt	See label	14	
	9. spiroticlofen (Envidor) 2SC	16–18 fl oz	See label	7	
	10. pyridaben (Nexter) 75WP	4.4–10.67 oz	See label	7	
	11. acequinocyl (Kanemite) 15SC	21–31 fl oz	See label	14	

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	
Pandemis leafroller, obliquebanded leafroller	1. <i>Bacillus thuringiensis</i>	See label	See label	0	
	2. methoxyfenozide (Intrepid) 2F	16 fl oz	4 fl oz	14	
	3. spinosad (Success) 2L	6–10 fl oz	See label	7	
	4. emamectin benzoate (Proclaim) 5SG	3.2–4.8 oz	See label	14	
<p>Each product listed for leafroller control must be consumed by larvae in order to be effective. Therefore good spray coverage of the foliage is critical to achieving good control with these products.</p> <p><i>Bacillus thuringiensis</i> – Two or three applications are usually required. Apply when forecasts predict a warm weather pattern for 3 or more days.</p> <p>methoxyfenozide – Some leafroller populations have developed resistance to methoxyfenozide and its use could result in reduced levels of control.</p> <p>spinosad – Some leafroller populations have developed resistance to spinosad and its use could result in reduced levels of control.</p>					
Pearleaf blister mite	1. carbaryl (Sevin) 4F	4–6 pt	1–1.5 pt	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. abamectin (Agri-Mek) 0.15EC + petroleum oil	16 fl oz 0.25% v/v	4 fl oz 0.25% v/v	28	
Pear psylla	1. abamectin (Agri-Mek) 0.15EC + petroleum oil	16–20 fl oz 1 gal	4–5 fl oz 1 qt	28	Imidacloprid: Efficacy may be increased by adding 0.25% horticultural oil. Azadirachtin: These products have relatively short residues; reapplication may be necessary for control. Thiamethoxam: PHI depends on rate used.
	2. imidacloprid (Provado) 1.6F	16–20 fl oz	4–5 fl oz	7	
	3. thiamethoxam (Actara) 25WDG	5.5 oz	See label	14/35	
	4. acetamiprid (Assail) 70WP	2.3–3.4 oz	See label	7	
	5. azadirachtin (several)	See label	See label	0	
	6. thiacloprid (Calypso) 4F	6–8 fl oz	1.5–2 fl oz	30	
	7. fenpyroximate (FujiMite) 5EC	1–2 pt	See label	14	
	8. clothianidin (Clutch) 50WDG	4–6 oz	See label	7	
	9. buprofezin (Centaur) 70W	34.5 oz	See label	14	
	10. pyridaben (Nexter)	6.6–10.67 oz	See label	7	
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 (Nexter) 75WP	10.67 oz	See label	7	
	4. spiroticlofen (Envidor) 2SC	16–18 fl oz	See label	7	
	5. fenpyroximate (FujiMite) 5EC	2 pt	See label	14	
Pear sawfly	1. azinphos methyl (Guthion Solupak) 50WP	1–2 lbs	0.25–0.5 lb	14/21	PHI depends on rate used.
Pear scab	1. kresoxim-methyl (Sovran) 50WG	4.0–6.4 oz	1.0–1.6 oz	30	Apply every 12 days until dry weather. Flint and Sovran: Do not apply more than 2 sequential, or exceed 4 total applications of strobiluron fungicides per acre per season.
	2. trifloxystrobin (Flint) 50W	2.0–2.5 oz	0.5–0.63 oz	14	
San Jose scale	1. diazinon (Diazinon) 50W	4 lbs	1 lb	21	



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
PREHARVEST				
Bull's eye rot	1. ziram (Ziram) 76DF	8 lbs	2 lbs	5 Because of visible residues, do not use ziram on Asian pears.
Storage rots	1. ziram (Ziram) 76DF	8 lbs	2 lbs	5 A ground applied, dilute application leading to excellent coverage is essential for the control of storage rots. Pristine: To limit the potential for development of fungicide resistance, do not make more than four applications of strobilurin fungicides per season. Do not make more than two sequential applications of strobilurin fungicides. This limitation is inclusive to all strobilurin fungicides labeled for use on pome fruits.
	2. pyraclostrobin + boscalid (Pristine)	14.5–18.5 oz	3.6–4.6 oz	
POSTHARVEST—Avoid killing bees on blooming cover crops. See Hazards to Bees.				
Pearleaf blister mite, pear rust mite	1. carbaryl (Sevin) 4F	4–6 pt	1–1.5 pt	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.
	2. endosulfan (Thionex) 50W	3 lbs	0.75 lb	
	3. lime-sulfur + petroleum oil	See label	See label	
	4. flowable/micronized sulfur	0.75% v/v	0.75% v/v	
Pear psylla	1. lime-sulfur + petroleum oil	See label	See label	Lime-sulfur: Follow label directions regarding apple interplants and orchard borders. See text—Potential Fruit & Leaf Injury.
	2. flowable/micronized sulfur	0.75% v/v	0.75% v/v	
	3. calcium polysulfide (Sulforix)	See label	See label	
		2 gals	2 qts	



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) 2. fixed copper	See label See label	See label 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	1–1.5% v/v	1–1.5% v/v	
Coryneum blight	1. chlorothalonil (Bravo Ultrex)	See label	See label	
Cutworms	1. endosulfan (Thionex) 50W 2. endosulfan (Thionex) 3EC 3. chlorpyrifos (Lorsban) 4EC	See label See label See label	1 lb 0.67 quart 0.5–1 pt	Apply thoroughly to lower trunk and cover crop with a handgun.
European red mite	1. horticultural mineral oil 2. clofentezine (Apollo) SC 3. hexythiazox (Savey) 50DF	1–1.5% v/v 4–8 fl oz 4–6 oz	1–1.5% v/v 1–2 fl oz 1–1.5 oz	Adequate agitation is required.
Twospotted spider mite	1. fenbutatin-oxide (Vendex) 50WP	1–2 lbs	0.25–0.5 lb	
San Jose scale, lecanium scale	horticultural mineral oil + one of the following: 1. chlorpyrifos (Lorsban) 4EC 2. methidathion (Supracide) 25WP	1–1.5% v/v 4 pt 6 lbs	1–1.5% v/v 1 pt 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	1. endosulfan (Thionex) 50W 2. endosulfan (Thionex) 3EC	See label See label	1 lb 0.67 quart	Adults are active when daily high temperatures exceed 65°F. Spray to control active adults.

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 (Thionex) 50W 2. diazinon (Diazinon) 50W	4 lbs 4 lbs	1 lb 1 lb	Endosulfan: Note use restrictions near waterways.
Coryneum blight (shothole)	1. azoxystrobin (Abound) 2. pyraclostrobin + boscalid (Pristine) 3. copper hydroxide (Kocide) DF + ziram (Ziram) Granuflo 4. copper hydroxide (Kocide) DF	11–15 fl oz 10.5–14.5 oz 8–12 lbs 4–6 lbs 8–12 lbs	2.75–3.75 fl oz 2.6–3.6 oz	Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label.
Cherry rust mite	1. endosulfan (Thionex) 50W	4 lbs	1 lb	
Cutworms	1. endosulfan (Thionex) 50W	See label	1 lb	Apply thoroughly to lower trunk and cover crop with a handgun.
Pandemis leafroller	1. <i>Bacillus thuringiensis</i> 2. spinosad (Success) 2L	See label 4–8 fl oz	See label 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. This spray timing is too early to control obliquebanded leafroller. Pandemis may build up if oil/chlorpyrifos sprays have not been applied in recent years, especially when cherry orchard is near apple and pear orchards.
				
STAGES 6–7 (Bloom)				
Brown rot (blossom blight)	1. fenbuconazole (Indar) 75WSP 2. iprodione (Rovral) 50W 3. flowable/micronized sulfur 4. myclobutanil (Rally) 40W	2 oz 1–2 lbs See label 5 oz	0.5 oz 0.25–0.5 lb See label 1.25 oz	Myclobutanil: Make a second application at petal fall if disease-conducive weather occurs. 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. Fenbuconazole: Do not apply more than 0.75 pound ai per acre per season. Many fungicide materials are effective on both brown rot and powdery mildew. Powdery mildew requires more sprays, and resistance is always a risk. Use the above products on brown rot, as they are effective, and mildew sprays are not effective at this stage of tree growth. Neither iprodione nor fenbuconazole are first-rate powdery mildew materials.
Coryneum blight	1. azoxystrobin (Abound) 2. pyraclostrobin + boscalid (Pristine)	11–15 fl oz 10.5–14.5 oz	2.75–3.75 fl oz 2.6–3.6 oz	

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 2. azoxystrobin (Abound) 3. trifloxystrobin (Gem) 4. triflumizole (Procure) 50WS 5. potassium bicarbonate 6. pyraclostrobin (Cabrio) 7. pyraclostrobin + boscalid (Pristine) 8. quinoxyfen (Quintec)	5 oz 11–15.4 fl oz 4–8 oz 10–16 oz Rates vary 9.5 oz 10.5–14.5 oz 7 fl oz	1.25 oz 2.75–3.85 fl oz 1–2 oz 2.5–4 oz See label See label 2.6–3.6 oz 1.75 fl oz	Place into solution before adding oil. Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 2.88 quarts product per acre per season.
PETAL-FALL (100% petal fall)—See Hazards to Bees.				
Black cherry aphid	1. imidacloprid (Provado) 1.6F	4–8 fl oz	2 fl oz	
Brown rot (blossom blight)	1. azoxystrobin (Abound) 2. captan (Captan) 50WP 3. fenbuconazole (Indar) 75WSP 4. iprodione (Rovral) 50W 5. flowable/micronized sulfur 6. myclobutanil (Rally) 40W 7. propiconazole (Orbit) 8. triflumizole (Procure) 50WS 9. pyraclostrobin (Cabrio EG) 10. pyraclostrobin+boscalid (Pristine)	12–15.5 fl oz 4 lb 2 oz 1–2 lb See label 5 oz 4 fl oz 12–16 oz 9.5 oz 10.5–14.5 oz	3–3.9 fl oz 1 lb 0.5 oz 0.25–0.5 lb See label 1.25 oz See label 3–4 oz See label 2.6–3.6 oz	
Fruitree leafroller	1. endosulfan (Thionex) 50W	4 lbs	1 lb	
Pandemis leafroller, obliquebanded leafroller	1. <i>Bacillus thuringiensis</i> 2. spinosad (Success) 2L 3. methoxyfenozide (Intrepid) 2F	See label 4–8 fl oz 8–16 fl oz	See label 1–2 fl oz See label	Each product listed for leafroller control must be consumed by larvae in order to be effective. Therefore good spray coverage of the foliage is critical to achieving good control with these products. <i>Bacillus thuringiensis</i> – 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. methoxyfenozide – Some leafroller populations have developed resistance to Intrepid and its use could result in reduced levels of control. spinosad – Some leafroller populations have developed resistance to Success and its use could result in reduced levels of control.
Powdery mildew	1. fenarimol (Rubigan) 1EC 2. azoxystrobin (Abound) 3. triflumizole (Procure) 50WS 4. potassium bicarbonate (Kaligreen) 5. pyraclostrobin + boscalid (Pristine) 6. quinoxyfen (Quintec)	6–12 fl oz 11–15.4 fl oz 10–16 oz See label 10.5–14.5 oz 7 fl oz	1.5–3 fl oz 2.75–3.85 fl oz 2.5–4 oz See label 2.6–3.6 oz 1.75 fl oz	Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label. Quintec: Do not apply more than 35 fl oz product per acre 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	1. imidacloprid (Provado) 1.6F	4–8 fl oz	2 fl oz	
Brown rot	See Petal Fall EXCEPTION: Do not use iprodione at this stage.			

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
Coryneum blight (shothole)	1. captan (Captan) 50WP 2. azoxystrobin (Abound) 3. pyraclostrobin + boscalid (Pristine)	4 lbs 11–15 fl oz 10.5–14.5 oz	1 lb 2.75–3.75 fl oz 2.6–3.6 oz	Azoxystrobin: See remarks under powdery mildew at petal fall.
Pandemis leafroller, fruittree leafroller, obliquebanded leafroller	1. <i>Bacillus thuringiensis</i> 2. spinosad (Success) 2L 3. pyriproxyfen (Esteem) 35WP 4. methoxyfenozide (Intrepid) 2F	See label 6–8 fl oz 4–5 oz 8–16 fl oz	See label 1.5–2 fl oz See label See label	Each product listed for leafroller control must be consumed by larvae in order to be effective. Therefore good spray coverage of the foliage is critical to achieving good control with these products. <i>Bacillus thuringiensis</i> – Two or three applications are usually required. Apply when forecasts predict a warm weather pattern for 3 or more days. methoxyfenozide – Some leafroller populations have developed resistance to Intrepid and its use could result in reduced levels of control. pyriproxyfen – Time pyriproxyfen to coincide with the presence of the last larval stage but before pupae are present. spinosad – Some leafroller populations have developed resistance to Success and its use could result in reduced levels of control.
Powdery mildew	1. fenarimol (Rubigan) 1EC 2. myclobutanil (Rally) 40W 3. tebuconazole (Elite) 45DF 4. flowable/micronized sulfur 5. azoxystrobin (Abound) 6. petroleum oil 7. triflumizole (Procure) 50WS 8. potassium bicarbonate (Kaligreen) 9. pyraclostrobin (Cabrio) 10. pyraclostrobin + boscalid (Pristine) 11. quinoxyfen (Quintec)	6–12 fl oz 5 oz 8 oz See label 11–15 fl oz 0.5–1% v/v 10–16 oz See label 9.5 oz 10.5–14.5 oz 7 fl oz	1.5–3 fl oz 1.25 oz 2 oz See label 2.75–3.75 fl oz 0.5–1% v.v 2.5–4 oz See label See label 2.6–3.6 oz 1.75 fl oz	Myclobutanil: Place into solution before adding oil. Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label. 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. Oil and sulfur may mark light colored varieties when applied together or within 14 days of each other.
White apple leafhopper	1. carbaryl (Sevin) 4F 2. endosulfan (Thionex) 50W	1–2 pt 4 lbs	4–8 fl oz 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. imidacloprid (Provado) 1.6F	4–8 fl oz	1–2 fl oz	7 Imidacloprid: Best control timing is petal fall.
Brown rot (fruit rot)	1. flowable/micronized sulfur 2. captan (Captan) 50WP 3. fenbuconazole (Indar) 75WSP 4. propiconazole (Orbit) 5. triflumizole (Procure) 50WS 6. pyraclostrobin + boscalid (Pristine)	See label 4 lbs 2 oz 4 fl oz 12–16 oz 10.5–14.5 oz	See label 1 lb 0.5 oz See label 3–4 oz 2.6–3.6 oz	* Sulfur: See text—Potential Fruit & Leaf Injury. Fenbuconazole: Begin applications 2 to 3 weeks before harvest and continue at 7- to 10-day intervals.
Cherry rust mite	1. flowable/micronized sulfur 2. endosulfan (Thionex) 50W 3. fenbutatin-oxide (Vendex) 50WP	See label 2 lbs 1–2 lbs	See label 0.5 lb 0.25–0.5 lb	* Sulfur: See text—Potential Fruit & Leaf Injury.

*None listed

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
Pandemis leafroller, obliquebanded leafroller	1. <i>Bacillus thuringiensis</i> 2. spinosad (Success) 2L 3. pyriproxyfen (Esteem) 35WP 4. methoxyfenozide (Intrepid) 2F	See label 4–8 fl oz 4–5 oz 8–16 fl oz	See label 1–2 fl oz See label See label	0 7 14 7 Each product listed for leafroller control must be consumed by larvae in order to be effective. Therefore good spray coverage of the foliage is critical to achieving good control with these products. <i>Bacillus thuringiensis</i> – Two or three applications are usually required to achieve acceptable control of high populations. methoxyfenozide – Some leafroller populations have developed resistance to Intrepid and its use could result in reduced levels of control. pyriproxyfen – Time pyriproxyfen to coincide with the presence of the last larvae stage but before pupae appear. spinosad – Some leafroller populations have developed resistance to Success and its use could result in reduced levels of control.
Powdery mildew	1. azoxystrobin (Abound) 2. fenarimol (Rubigan) 1EC 3. flowable/micronized sulfur 4. myclobutanil (Rally) 40W 5. petroleum oil 6. triflumizole (Procuire) 50WS 7. potassium bicarbonate (Kaligreen) 8. pyraclostrobin (Cabrio) 9. pyraclostrobin + boscalid (Pristine) 10. quinoxifen (Quintec)	11–15.4 fl oz 6–12 fl oz See label 5 oz 0.5–1% v/v 10–16 oz See label 9.5 oz 10.5–14.5 oz 7 fl oz	2.75–3.85 fl oz 1.5–3 fl oz See label 1.25 oz 0.5–1% v/v 2.5–4 oz See label See label 2.6–3.6 oz 1.75 fl oz	0 0 * 0 0 1 1 0 0 7 Sulfur: See text—Potential Fruit & Leaf Injury. Do not apply more than 48 fluid ounces of fenarimol prior to harvest. Myclobutanil: Place into solution before adding oil. Calcium polysulfide: Do not apply at temperatures above 84°F. Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label. 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.
San Jose scale, Lecanium scale	1. pyriproxyfen (Esteem) 35WP	4–5 oz	See label	14 Pyriproxyfen: Timing for leafrollers should also provide control of scale.
Shothole borer	1. endosulfan (Thionex) 50W	4 lbs	1 lb	21 Good sanitation (removing large wood pruning and wood piles from the orchard) is the best management tactic. Insecticides are only effective against adults. Beetles begin flying in late April and are active through May. The second generation flight begins in late July or early August. Yellow sticky traps placed on orchard borders will detect activity of the adult beetles. Spraying the border trees (rows) with high water volumes will protect the remainder of the orchard in many situations where external sources are the primary problem.
Twospotted spider mites	1. fenbutatin-oxide (Vendex) 50WP	1–2 lbs	0.25–0.5 lb	14 Apply sprays in early May.
Stink bugs	1. endosulfan (Thionex) 50W	4 lbs	1 lb	21 Wettable powder formulations may leave visible residues when applied near harvest.

*None listed

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
Western cherry fruit fly	1. azinphos methyl (Guthion Solupak) 50WP	1.5 lbs	0.375 lb	15 WARNING: multiple applications of carbaryl may cause mite problems. Apply malathion ULV by air only (see text—Aerial Application). Malathion may cause leaf injury. Azinphos methyl may induce leaf drop in sensitive varieties if oil was applied within 21 days.
	2. carbaryl (Sevin XLR Plus)	4 pt	1 pt	3
	3. malathion (Malathion) 8EC	3 pt	12 fl oz	3
	4. malathion (Malathion ULV)	16 fl oz	See label	1
	5. spinosad (Success) 2L	4–6 fl oz	2 fl oz	7
	6. spinosad (Entrust) 80WP	1.5–1.88 oz	0.38–0.47 oz	7
	7. imidacloprid (Provado) 1.6F	4–6 fl oz	2 fl oz	7
	8. spinosad (GF-120 NF Bait)	20 fl oz	See label	* 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 www.ncw.wsu.edu/treefruit/index.html . Spray interval is important. More than 7–10 days between applications is risky. Shorten intervals after significant rain.
PREHARVEST AND HARVEST				
Brown rot (fruit rot)	1. flowable/micronized sulfur	See label	See label	* Apply 20 and 10 days before harvest, and at picking time. See text—Potential Fruit & Leaf Injury. See General Recommendations. Fenbuconazole: Begin applications 2 to 3 weeks before harvest and continue at 7- to 10-day intervals.
	2. fenbuconazole (Indar) 75WSP	2 oz	0.5 oz	0
	3. propiconazole (Orbit)	4 fl oz	See label	0
	4. triflumizole (Procure) 50WS	12-16 oz	3-4 oz	1
	5. pyraclostrobin (Cabrio EG)	9.5 oz	See label	0
	6. pyraclostrobin + boscalid (Pristine)	10.5–14.5 oz	2.6–3.6 oz	0
Grasshoppers, Mormon crickets	See text—Special Programs—Grasshoppers			
Powdery mildew	1. fenarimol (Rubigan) 1EC	6–12 fl oz	1.5–3 fl oz	0 Myclobutanil: Place into solution before adding oil. See remarks in shuck fall section.
	2. myclobutanil (Rally) 40W	5 oz	1.25 oz	0
	3. tebuconazole (Elite) 45DF	8 oz	2 oz	0
	4. flowable/micronized sulfur	See label	See label	*
	5. azoxystrobin (Abound)	11–15.4 fl oz	2.75–3.85 fl oz	0
	6. triflumizole (Procure) 50WS	10–16 oz	2.5–4 oz	1
	7. potassium bicarbonate	See label	See label	1
	8. pyraclostrobin (Cabrio)	9.5 oz	See label	0
	9. pyraclostrobin + boscalid (Pristine)	10.5–14.5 oz	2.6–3.6 oz	0
	10. quinoxyfen (Quintec)	7 fl oz	1.75 fl oz	7
Western cherry fruit fly	1. carbaryl (Sevin) 4F	4 pt	1 pt	3 Apply malathion ULV by air only. See text—Aerial Application. Carbaryl may cause mite flare-ups, especially with multiple applications. 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 www.ncw.wsu.edu/treefruit/index.html
	2. malathion (Malathion ULV)	16 fl oz		1
	3. spinosad (Success) 2L	4–6 fl oz	1–1.5 fl oz	7
	4. spinosad (Entrust) 80WP	1.25–1.9 oz	See label	7
	5. imidacloprid (Provado) 1.6F	4–6 fl oz	1–1.5 fl oz	7
	6. spinosad (GF-120 NF Bait)	20 fl oz	See label	*
POSTHARVEST				
Pandemis leafroller, obliquebanded leafroller	1. <i>Bacillus thuringiensis</i>	See label	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. petroleum oil 2. calcium polysulfide (Sulforix)	1–1.5% v/v 2 gals	1–1.5% v/v 2 qts	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.



*None listed

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 bore	1. endosulfan (Thionex) 50W	4 lbs	1 lb	Good sanitation (removing large wood pruning and wood piles from the orchard) is the best management tactic. Insecticides are only effective against adults. The second generation flight begins in late July or early August. Yellow sticky traps placed on orchard borders will detect activity of the adult beetles. Spraying the border trees (rows) with high water volumes will protect the remainder of the orchard in many situations where external sources are the primary problem.
Spider mites	1. fenbutatin-oxide (Vendex) 50WP 2. propargite (Omite) CR or 30WS 3. petroleum oil	1–2 lbs 6 lbs 1–1.5% v/v	0.25–0.5 lb 1.5 lbs 1–1.5% v/v	
Western cherry fruit fly	1. dimethoate (Dimethoate) 267 2. imidacloprid (Provado) 1.6F	4 pt 8 fl oz	1 pt 2 fl oz	Dimethoate and Provado are the only products that will control larvae inside of the fruit. Use higher volumes of water when applying these products. Dimethoate is limited to one application per season; postharvest is it's best use.
FALL				
Coryneum blight, bacterial gummosis	1. copper hydroxide (Kocide DF) 2. fixed copper	See label See label	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.
Powdery mildew	1. lime sulfur (Rex 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)	<ol style="list-style-type: none"> fixed copper copper hydroxide (Kocide DF) chlorothalonil (Bravo Ultrex) ziram (Ziram Granuflo) 	See label See label See label 6–8 lbs	See label See label See label 1.5–2 lbs	Rates vary according to manufacturer. Convert copper formulations so that there are 2.5 lbs. metallic copper per 100 gals. Apply Bravo no later than shuck split.
Peach leaf curl	<ol style="list-style-type: none"> chlorothalonil (Bravo Ultrex) fixed copper thiram (Thiram Granuflo) ziram (Ziram) 76DF 	See label 20 lbs 3.9–5.1 lbs See label	See label 5 lbs 1.3–1.7 lbs 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	<ol style="list-style-type: none"> endosulfan (Thionex) 50W endosulfan (Endosulfan) 3EC 	See label See label	1 lb 1.3 pt	Apply thoroughly to lower trunk and cover crop with a handgun.
European red mite (overwintering eggs)	<ol style="list-style-type: none"> horticultural mineral oil 	1–1.25% v/v	1–1.25% v/v	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	<ol style="list-style-type: none"> horticultural mineral oil + esfenvalerate (Asana XL) 0.66EC 	1–1.25% v/v 6–8 fl oz	1–1.25% v/v 1.5–2 fl oz	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.
San Jose scale, Lecanium scale	horticultural mineral oil + one of the following: <ol style="list-style-type: none"> chlorpyrifos (Lorsban) 4EC methidathion (Supracide) 2E pyriproxyfen (Esteem) 35WP 	1–1.25% v/v 4 pt 8 pt 4–5 oz	1–1.25% v/v 1 pt 2 pt 1–1.25 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.

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 (Prebloom)			Avoid killing bees on blooming cover crops. See Hazards to Bees.
Brown rot (blossom blight)	1. iprodione (Rovral) 50W 2. myclobutanil (Rally) 40W 3. fenbuconazole (Indar) 75WSP 4. azoxystrobin (Abound) 5. pyraclostrobin + boscalid (Pristine)	1–2 lbs 5 oz 2 oz 12–15.5 fl oz 10.5–14.5 oz	0.25–0.5 lb 1.25 oz 0.5 oz 3–3.9 fl oz 2.6–3.6 oz	Rovral: Apply at 5% bloom. Apply again at full bloom or at petal fall if disease-conducive weather occurs. Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 2.88 quarts product per acre per season.
Coryneum blight (shothole)	1. azoxystrobin (Abound) 2. captan (Captan) 50WP 3. chlorothalonil (Bravo Ultrex) 4. myclobutanil (Rally) 40W 5. pyraclostrobin + boscalid (Pristine)	11–15 fl oz 8 lbs See label 5 oz 10.5–14.5 oz	2.75–3.75 fl oz 2 lbs See label 1.25 oz 2.6–3.6 oz	Rally: See label for specific use recommendations. Place into solution before adding oil.
Cutworms	1. endosulfan (Thionex) 50W 2. endosulfan (Thionex) 3EC	See label See label	1 lb 1.3 pt	Apply thoroughly to lower trunk and cover crop with a handgun.
Lecanium scale	1. malathion (Malathion) 8EC 2. diazinon (Diazinon) 50W 3. pyriproxyfen (Esteem) 35WP	5 pt 4 lbs 4–5 oz	20 fl oz 1 lb 1–1.25 oz	
Lygus bugs, stink bugs	1. endosulfan (Thionex) 50W 2. lambda-cyhalothrin (Warrior) ICS	4 lbs 2.5–5 fl oz	1 lb 0.6–1.25 fl oz	
Oriental fruit moth	1. OFM pheromone dispensers	See label		Dispensers must be in place before the first oriental fruit moth adult flight.
Peach silver mite	1. propargite (Omite) 30WS 2. endosulfan (Thionex) 50W	5 lbs 2 lbs	1.25 lbs 0.5 lb	Propargite: Use on nectarines only.
Peach twig borer	1. endosulfan (Thionex) 50W 2. <i>Bacillus thuringiensis</i> 3. esfenvalerate (Asana XL) 0.66EC 4. spinosad (Success) 2L 5. spinetoram (Delegate) WG	4 lbs See label 6–8 fl oz 4–8 fl oz 3–7 oz	1 lb See label 1.5–2 fl oz 1–2 fl oz 0.75–1.75 oz	Bts must be ingested by the 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).
Shothole borer	1. endosulfan (Thionex) 50W	4 lbs	1 lb	
Western flower thrips	1. endosulfan (Thionex) 50W	4 lbs	1 lb	

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 (Bloom)			Avoid killing bees on blooming cover crops. See Hazards to Bees.
Brown rot (blossom blight)	<ol style="list-style-type: none"> 1. azoxystrobin (Abound) 2. captan (Captan) 50WP 3. fenbuconazole (Indar) 75WSP 4. iprodione (Rovral) 50W 5. flowable/micronized sulfur 6. propiconazole (Orbit) 7. tebuconazole (Elite) 45DF 8. thiram (Thiram Granuflo) 9. wettable sulfur 10. pyraclostrobin+boscalid (Pristine) 	12–15.5 fl oz 8 lbs 2 oz 1–2 lbs See label 4 fl oz 4–8 oz 3.9–5.1 lbs 10–12 lbs 10.5–14.5 oz	3–3.9 fl oz 2 lbs 0.5 oz 0.25–0.5 lb See label 2 oz 1.3–1.7 lbs 2.5–3 lbs 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. Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label.
Leafrollers	<ol style="list-style-type: none"> 1. <i>Bacillus thuringiensis</i> 2. methoxyfenozide (Intrepid) 2F 3. spinosad (Success) 2L 	See label 8–16 fl oz 4–8 fl oz	See label 2–4 fl oz 1–2 fl oz	Each product listed for leafroller control must be consumed by larvae in order to be effective. Therefore good spray coverage of the foliage is critical to achieving good control with these products. <i>Bacillus thuringiensis</i> – 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"> 1. azoxystrobin (Abound) 2. fenbuconazole (Indar) 75WSP 3. iprodione (Rovral) 50W 4. myclobutanil (Rally) 40W 5. tebuconazole (Elite) 45DF 6. pyraclostrobin+boscalid (Pristine) 	12–15.5 fl oz 2 oz 1–2 lbs 5 oz 4–8 oz 10.5–14.5 oz	3–3.9 fl oz 0.5 oz 0.25–0.5 lb 1.25 oz 2 oz 2.6–3.6 oz	Myclobutanil: See label for specific use recommendations. Place into solution before adding oil.
Coryneum blight (shothole)	<ol style="list-style-type: none"> 1. chlorothalonil (Bravo Ultrex) 2. azoxystrobin (Abound) 3. pyraclostrobin+boscalid (Pristine) 	See label 11–15 fl oz 10.5–14.5 oz	See label 2.75–3.75 fl oz 2.6–3.6 oz	Apply Bravo no later than shuck split. Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label.
Powdery mildew	<ol style="list-style-type: none"> 1. flowable/micronized sulfur 2. myclobutanil (Rally) 40W 3. propiconazole (Orbit) 4. azoxystrobin (Abound) 5. petroleum oil 	See label 5 oz 4 fl oz 11–15 fl oz 0.5–1% v/v	See label 1.25 oz See label 2.75–3.75 fl oz 0.5–1% v/v	Do not apply oil within 14 days of a sulfur application.
Leafrollers	<ol style="list-style-type: none"> 1. <i>Bacillus thuringiensis</i> 2. methoxyfenozide (Intrepid) 2F 3. spinosad (Success) 2L 	See label 8–16 fl oz 4–8 fl oz	See label 2–4 fl oz 1–2 fl oz	See remarks for Leafrollers, Stages 6–7
Lygus bugs, stink bugs	See stages 2–5 (Prebloom)			

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
Oriental fruit moth	1. phosmet (Imidan) 70W 2. spinosad (Success) 2L	4 lbs 4–8 fl oz	1 lb 1–2 fl oz	
Peach twig borer	1. <i>Bacillus thuringiensis</i> 2. endosulfan (Thionex) 50W 3. phosmet (Imidan) 70W 4. spinosad (Success) 2L 5. spinetoram (Delegate WG)	See label 4 lbs 4 lbs 4–8 fl oz 4.5–7 oz	See label 1 lb 1 lb 1–2 fl oz 1.13–1.75 oz	
Green peach aphid	1. imidacloprid (Provado) 1.6F	4–8 fl oz	1–2 fl oz	Imidacloprid: Do not apply during prebloom, bloom or when bees are actively foraging.
Western flower thrips	1. spinosad (Success) 2L	4–8 fl oz	1–2 fl oz	
SHUCK FALL		Avoid killing bees on blooming cover crops. See Hazards to Bees.		
Brown rot	1. azoxystrobin (Abound) 2. captan (Captan) 50WP 3. flowable/micronized sulfur 4. pyraclostrobin + boscalid (Pristine)	12–15.5 fl oz 8 lbs See label 10.5–14.5 oz	3–3.9 fl oz 2 lbs See label 2.6–3.6 oz	Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 2.88 quarts product per acre per season.
Coryneum blight (Shothole)	1. azoxystrobin (Abound) 2. captan (Captan) 50WP 3. ziram (Ziram Granuflo) 4. pyraclostrobin + boscalid (Pristine)	11–15 fl oz 6 lbs 6 lbs 10.5–14.5 oz	2.75–3.75 fl oz 1.5 lbs See label 2.6–3.6 oz	
Leafrollers	1. <i>Bacillus thuringiensis</i> 2. methoxyfenozide (Intrepid) 2F 3. spinosad (Success) 2L	See label 8–16 fl oz 4–8 fl oz	See label 2–4 fl oz 1–2 fl oz	Each product listed for leafroller control must be consumed by larvae in order to be effective. Therefore good spray coverage of the foliage is critical to achieving good control with these products. <i>Bacillus thuringiensis</i> – 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) 2. calcium polysulfide (Sulforix) 3. flowable/micronized sulfur 4. myclobutanil (Rally) 40W 5. propiconazole (Orbit) 6. petroleum oil	11–15.4 fl oz 2 gals See label 5 oz 4 fl oz 0.5–1% v/v	2.75–3.85 fl oz 2 qts See label 1.25 oz 0.5–1% v/v	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. Do not apply oil within 14 days of a sulfur application. Excellent spray coverage of fruitlets is essential for control. Repeat applications at 10–14 day intervals will be necessary in high pressure situations and with varieties especially susceptible to mildew.
SUMMER		Avoid killing bees on blooming cover crops. See Hazards to Bees.		
Brown rot (fruit rot)	1. azoxystrobin (Abound) 2. captan (Captan) 50WP 3. fenbuconazole (Indar) 75WSP 4. propiconazole (Orbit) 5. tebuconazole (Elite) 45DF 6. thiram (Thiram Granuflo) 7. flowable/micronized sulfur 8. pyraclostrobin + boscalid (Pristine)	12–15.5 fl oz 5 lbs 2 oz 4 fl oz 4–8 oz 3.9–5.1 lbs See label 10.5–14.5 oz	3-3.9 fl oz 1.25 lbs 0.5 oz See label 2 oz 1.3–1.7 lbs See label 2.6–3.6 oz	0 Fenbuconazole: Begin applications 2 to 3 weeks before harvest and continue at 7- to 10-day intervals. Apply tebuconazole 21, 0 14, and 7 days before harvest. 0 Thiram: Not for use on nectarines. 7 * 0

*None listed

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
Powdery mildew	1. flowable/micronized sulfur 2. myclobutanil (Rally) 40W 3. calcium polysulfide (Sulforix) 4. propiconazole (Orbit) 5. azoxystrobin (Abound) 6. petroleum oil	See label 5 oz 2 gals 4 fl oz 11–15 fl oz 0.5–1% v/v	See label 1.25 oz 2 qts See label 2.75–3.75 fl oz 0.5–1% v/v	* Sulfur: Apply 2–3 weeks after shuck fall. 0 Myclobutanil: See label for specific use * recommendations. Place into solution before 0 adding oil. Calcium polysulfide: Do not apply 0 at temperatures above 84°F. Allow 30 days to elapse between Sulforix and oil sprays. Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label. Do not apply oil within 14 days of a sulfur application.
Cutworms	1. endosulfan (Thionex) 50W	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.
Earwigs	1. carbaryl (Sevin) 80S 2. carbaryl (Sevin) 4F	2.5–3.75 lbs 2–3 qts	0.6–0.9 lb 0.5–0.75 qt	3 Apply around bases of trees and on trunks. 3 Do not apply carbaryl on blooming cover crops because of hazard to bees.
Grasshoppers, Mormon crickets	1. carbaryl (Sevin) 4F	2–3 qts	See label	3 See text: Special Programs—Grasshoppers
McDaniel spider mite, twospotted spider mite, European red mite	1. clofentezine (Apollo) SC 2. fenbutatin-oxide (Vendex) 50WP 3. hexythiazox (Savey) 50DF 4. propargite (Omite) 30WS 5. bifenazate (Acramite) 50WS	4–8 fl oz 1–2 lbs 3–6 oz 5–6 lbs 0.75–1 lb	1–2 fl oz 4–8 oz 0.75–1.5 oz 1.25–1.5 lbs 3–4 oz	21 Apollo and Savey: Both products are most effective on the egg stage and are not effective on the adult stage. Propargite: Use higher rate on European red mite. Use on nectarines only. 14 28 14 3
Oriental fruit moth	1. phosmet (Imidan) 70WP 2. spinosad (Success) 2L	3–4.25 lbs 4–8 fl oz	0.75–1 lb 1–2 fl oz	14 14
Leafrollers	1. <i>Bacillus thuringiensis</i> 2. spinosad (Success) 2L 3. methoxyfenozide (Intrepid) 2F	See label 4–8 fl oz 8–16 fl oz	See label 1–2 fl oz 2–4 fl oz	0 Each product listed for leafroller control must be consumed by larvae in order to be effective. 14 7 Therefore good spray coverage of the foliage is critical to achieving good control with these products. <i>Bacillus thuringiensis</i> – 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 2. endosulfan (Thionex) 50W 3. propargite (Omite) 30WS	See label 4 lbs 5 lbs	See label 1 lb 1.25 lbs	0 Propargite: Use on nectarines only. 30 Endosulfan: PHI depends on whether applied as a trunk spray or a cover spray. 14
Peachtree borer	1. endosulfan (Thionex) 50W 2. chlorpyrifos (Lorsban) 4EC	See label See label	1 lb 3 qts	21/30 Spray trunks, crotches, and ground around trees with a handgun. Chlorpyrifos: Do not allow spray to contact fruit. 14
Peach twig borer	1. endosulfan (Thionex) 50W 2. phosmet (Imidan) 70W 3. spinosad (Success) 2L 4. spinetoram (Delegate WG)	4 lbs 4 lbs 4–8 fl oz 4.5–7 oz	1 lb 1 lb 1–2 fl oz 1.13–1.75 oz	30 Use model for proper timing of spray. 14 14 14/1
San Jose scale	1. diazinon (Diazinon) 50W	4 lbs	1 lb	21

*None listed





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
Shothole borer, ambrosia beetle	1. endosulfan (Thionex) 50W	4 lbs	1 lb	21/30 Good sanitation (removing large wood pruning and wood piles from the orchard) is the best management tactic. Insecticides are only effective against adults. The second generation flight begins in late July or early August. Yellow sticky traps placed on orchard borders will detect activity of the adult beetles. Spraying the border trees (rows) with high water volumes will protect the remainder of the orchard in many situations where external sources are the primary problem.
PREHARVEST AND HARVEST				
Brown rot	1. azoxystrobin (Abound)	12–15.5 fl oz	3–3.9 fl oz	0 Fenbuconazole: Begin applications 2 to 3
	2. captan (Captan) 50WP	6 lbs	1.5 lbs	0 weeks before harvest and continue at 7- to
	3. fenbuconazole (Indar) 75WSP	2 oz	0.5 oz	0 10-day intervals. Apply tebuconazole 21,
	4. flowable/micronized sulfur	See label	See label	* 14, and 7 days before harvest.
	5. propiconazole (Orbit)	4 fl oz	See label	0 Thiram: Not for use on nectarines.
	6. tebuconazole (Elite) 45DF	4–8 oz	2 oz	0
	7. thiram (Thiram Granuflor)	3.9–5.1 lbs	1.3–1.7 lbs	7
	8. pyraclostrobin + boscalid (Pristine)	10.5–14.5 oz	2.6–3.6 oz	0
Powdery mildew	1. azoxystrobin (Abound)	11–15 fl oz	2.75–3.75 fl oz	0 Calcium polysulfide: Do not apply at tempera-
	2. calcium polysulfide (Sulforix)	2 gals	2 quarts	* tures above 84°F. Allow 30 days to elapse
	3. propiconazole (Orbit)	4 fl oz	See label	0 between Sulforix and oil sprays. Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label.
Oriental fruit moth, peach twig borer	1. carbaryl (Sevin) 80S	2.5-3.75 lbs	0.6–0.9 lb	3
	2. carbaryl (Sevin) 4F	2–3 qts	0.5–0.75 qt	3
	3. spinosad (Success) 2L	4–8 fl oz	1–2 fl oz	14
	4. spinetoram (Delegate WG)	4.5–7 oz	1.13–1.75 oz	14/1
POSTHARVEST				
Coryneum blight (shothole)	1. captan (Captan) 50WP	6 lbs	1.5 lbs	Apply before autumn rains.
	2. chlorothalonil (Bravo Ultrex)	See label	See label	
	3. ziram (Ziram Granuflor)	6 lbs	1.5 lbs	
Peach leaf curl, bacterial gummosis, Coryneum blight	1. copper hydroxide (Kocide DF)	See label	See label	Rates vary according to manufacturer. Do not use copper materials before October 1. Leaves have to have fallen. Convert so there are 2.5 pounds metallic copper per 100 gallons.
	2. fixed copper	See label	See label	
Peach silver mite	1. propargite (Omite) 30WS	5 lbs	1.25 lbs	Propargite: Use on nectarines only and no more than 2 applications per season.
	2. flowable/micronized sulfur	See label	See label	
Shothole borer	1. endosulfan (Thionex) 50W	4 lbs	1 lb	Good sanitation (removing large wood pruning and wood piles from the orchard) is the best management tactic. Insecticides are only effective against adults. The second generation flight begins in late July or early August. Yellow sticky traps placed on orchard borders will detect activity of the adult beetles. Spraying the border trees (rows) with high water volumes will protect the remainder of the orchard in many situations where external sources are the primary problem.
Spider mites	1. fenbutatin-oxide (Vendex) 50WP	1–2 lbs	4–8 oz	Propargite: Use on nectarines only.
	2. propargite (Omite) 30WS	5 lbs	1.25 lb	


*None listed

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 2. copper hydroxide (Kocide DF) 3. chlorothalonil (Bravo Ultrex)	See label See label See label	See label See label 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) 50W 2. endosulfan (Thionex) 3EC	See label See label	1 lb 1.3 pt	Apply thoroughly to lower trunk and cover crop with a handgun.
European red mite (overwintering eggs)	1. horticultural mineral oil	1–1.25% v/v	1–1.25% v/v	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 + 1. methidathion (Supracide) 2E 2. pyriproxyfen (Esteem) 35WP	1–1.25% v/v 4–8 pt 4–5 oz	1–1.25% v/v 1–2 pt 1–1.25 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.
 	STAGES 2–5 (Prebloom)	Avoid killing bees on blooming cover crops. See Hazards to Bees.		
Brown rot (blossom blight)	1. iprodione (Rovral) 50W 2. myclobutanil (Rally) 40W 3. fenbuconazole (Indar) 75WSP 4. azoxystrobin (Abound) 5. pyraclostrobin + boscalid (Pristine)	1–2 lbs 5 oz 2 oz 12–15.5 fl oz 10.5–14.5 oz	0.25–0.5 lb 1.25 oz 0.5 oz 3–3.9 fl oz 2.6–3.6 oz	Iprodione: Apply at 5% bloom. Apply again at full bloom or petal fall if disease-conducive weather occurs. Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label.
Coryneum blight	1. captan (Captan) 50WP 2. chlorothalonil (Bravo Ultrex) 3. myclobutanil (Rally) 40W 4. pyraclostrobin + boscalid (Pristine)	5 lbs See label 5 oz 10.5–14.5 oz	1.25 lbs See label 1.25 oz 2.6–3.6 oz	Myclobutanil: See label for specific use recommendations. Place into solution before adding oil.

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) 50W 2. endosulfan (Thionex) 3EC	See label See label	1 lb 1.3 pt	Apply thoroughly to lower trunk and cover crop with a handgun.
Grape mealybug, aphids	1. diazinon (Diazinon) 50W 2. endosulfan (Thionex) 50W	4 lbs 4 lbs	1 lb 1 lb	
Lecanium scale	1. malathion (Malathion) 8EC 2. pyriproxyfen (Esteem) 35WP	4 pt 4–5 oz	1 pt 1–1.25 oz	
Lygus bugs, stink bugs	1. endosulfan (Thionex) 50W 2. lambda-cyhalothrin (Warrior) 1CS	4 lbs 2.5–5 fl oz	1 lb 0.6–1.25 fl oz	
Oriental fruit moth	1. CheckMate-OFM	See label		Dispensers must be in place before the first oriental fruit moth adult flight.
Peach silver mite	1. endosulfan (Thionex) 50W	4 lbs	1 lb	
Peach twig borer	1. <i>Bacillus thuringiensis</i> 2. endosulfan (Thionex) 50W 3. esfenvalerate (Asana XL) 0.66EC 4. spinosad (Success) 2L 5. spinetoram (Delegate WG)	See label 4 lbs 6–8 fl oz 4–8 fl oz 3–7 oz	See label 1 lb 1.5–2 fl oz 1–2 fl oz 0.75–1.75 oz	Bts must be ingested by the 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.
Western flower thrips	1. endosulfan (Thionex) 50W	4 lbs	1 lb	
 STAGES 6–7 (Bloom)				Avoid killing bees on blooming cover crops. See Hazards to Bees.
Brown rot (blossom blight)	1. azoxystrobin (Abound) 2. captan (Captan) 50WP 3. fenbuconazole (Indar) 75WSP 4. iprodione (Rovral) 4F 5. propiconazole (Orbit) 6. pyraclostrobin + boscalid (Pristine)	12–15.5 fl oz 5 lbs 2 oz 1–2 pt 4 fl oz 10.5–14.5 oz	3–3.9 fl oz 1.25 lbs 0.5 oz 0.25–0.5 pt See label 2.6–3.6 oz	Propiconazole: Apply at 5–10% and 80–100% bloom. Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label. Iprodione: Apply at 5% bloom. Apply again at full bloom or petal fall if disease-conducive weather occurs.

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>	See label	See label	Bts must be ingested by the 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) 4F 2. myclobutanil (Rally) 40W 3. fenbuconazole (Indar) 75WSP 4. azoxystrobin (Abound) 5. pyraclostrobin + boscalid (Pristine)	1–2 pt 5 oz 2 oz 12–15.5 fl oz 10.5–14.5 oz	0.25–0.5 pt 1.25 oz 0.5 oz 3–3.9 fl oz 2.6–3.6 oz	Rally: See label for specific use recommendations. Place into solution before adding oil. Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label.
Coryneum blight (shothole)	1. chlorothalonil (Bravo Ultrex) 2. azoxystrobin (Abound) 3. pyraclostrobin + boscalid (Pristine)	See label 11–15.4 fl oz 10.5–14.5 oz	See label 2.75–3.85 fl oz 2.6–3.6 oz	
Powdery mildew (Perfection spot)	1. myclobutanil (Rally) 40W 2. propiconazole (Orbit) 3. azoxystrobin (Abound)	5 oz 4 fl oz 11–15 fl oz	1.25 oz See label 2.75–3.75 fl oz	
Grape mealybug, aphids	1. diazinon (Diazinon) 50W 2. endosulfan (Thionex) 50W 3. imidacloprid (Provado) 1.6F	4 lbs 4 lbs 4–8 fl oz	1 lb 1 lb 1–2 fl oz	Imidacloprid: Do not apply during prebloom, bloom, or when bees are actively foraging.
Leafrollers	1. <i>Bacillus thuringiensis</i> 2. spinosad (Success) 2L	See label 4–8 fl oz	See label 1–2 fl oz	Bts must be ingested by the 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) 70W	4 lbs	1 lb	
Peach twig borer	1. <i>Bacillus thuringiensis</i> 2. endosulfan (Thionex) 50W 3. phosmet (Imidan) 70W 4. spinosad (Success) 2L 5. spinetoram (Delegate WG)	See label 4 lbs 3–4.25 lbs 4–8 fl oz 4.5–7 oz	See label 1 lb 0.75–1 lb 1–2 fl oz 1.13–1.75 oz	

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	5 lbs	1.25 lbs	Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label. Do not apply more than 2.88 quarts product per acre per season.
	2. azoxystrobin (Abound)	12–15.5 fl oz	3–3.9 fl oz	
	3. pyraclostrobin + boscalid (Pristine)	10.5–14.5 oz	2.6–3.6 oz	
Coryneum blight (Shothole)	1. azoxystrobin (Abound)	11–15 fl oz	2.75–3.75 fl oz	Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label.
	2. captan (Captan) 50WP	5 lbs	1.25 lbs	
	3. ziram (Ziram) 76DF	6 lbs	1.5 lbs	
	4. pyraclostrobin + boscalid (Pristine)	10.5–14.5 oz	2.6–3.6 oz	
Powdery mildew (Perfection spot)	1. azoxystrobin (Abound)	11–15 fl oz	2.75–3.75 fl oz	Rally: See label for specific use recommendations. Place into solution before adding oil.
	2. myclobutanil (Rally) 40W	5 oz	1.25 oz	
	3. propiconazole (Orbit)	4 fl oz	See label	
Leafrollers	1. <i>Bacillus thuringiensis</i>	See label	See label	Bts must be ingested by the 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.
	2. spinosad (Success) 2L	4–8 fl oz	1–2 fl oz	
SUMMER		Avoid killing bees on blooming cover crops. See Hazards to Bees.		
Brown rot (fruit rot)	1. azoxystrobin (Abound)	12–15.5 fl oz	3–3.9 fl oz	0 Indar: Begin applications 2 to 3 weeks before harvest and continue at 7- to 10-day intervals. 0 Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label.
	2. captan (Captan) 50WP	5 lbs	1.25 lbs	
	3. fenbuconazole (Indar) 75WSP	2 oz	0.5 oz	
	4. propiconazole (Orbit)	4 fl oz	See label	
	5. pyraclostrobin + boscalid (Pristine)	10.5–14.5 oz	2.6–3.6 oz	
Powdery mildew	1. myclobutanil (Rally) 40W	5 oz	1.25 oz	0 Myclobutanil: See label for specific use recommendations. Place into solution before adding oil.
	2. propiconazole (Orbit)	4 fl oz	See label	
Cutworms	1. endosulfan (Thionex) 50W	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 and no more than two applications.

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) 80S	2.5–3.75 lbs	0.6–0.9 lb	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	1. carbaryl (Sevin) 4F	2–3 qts	See label	3 See text: Special Programs—Grasshoppers
Oriental fruit moth	1. phosmet (Imidan) 70W	3–4.25 lbs	0.75–1 lb	14
	2. spinosad (Success) 2L	4–8 fl oz	1–2 fl oz	14
Pandemis leafroller, obliquebanded leafroller	1. <i>Bacillus thuringiensis</i>	See label	See label	0 Bts are stomach poisons so complete coverage is very important for control. Two or three applications are usually required.
	2. spinosad (Success) 2L	4–8 fl oz	1–2 fl oz	14
Peach silver mite	1. endosulfan (Thionex) 50W	4 lbs	1 lb	21/30 PHI depends on whether applied as a trunk spray or a cover spray.
Peachtree borer	1. endosulfan (Thionex) 3EC 2. PTB pheromone (Isomate-P)	See label 100 dispensers	1 quart	21/30 Spray trunks, crotches, and ground around trees with a handgun. Endosulfan PHI 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) 50W	4 lbs	1 lb	21/30 Use temperature model to time application
	2. phosmet (Imidan) 70W	4 lbs	1 lb	14 in late May or early June. The PHI for endo-
	3. spinosad (Success) 2L	4–8 fl oz	1–2 fl oz	14 sulfan is 21 days when applied as a trunk
	4. spinetoram (Delegate WG)	4.5–7 oz	1.13–1.75 oz	14 spray, 30 days if applied as a cover spray.
San Jose scale	1. diazinon (Diazinon) 50W	4 lbs	1 lb	21
Shothole borer	1. endosulfan (Thionex) 50W	4 lbs	1 lb	21/30 Good sanitation (removing large wood pruning and wood piles from the orchard) is the best management tactic. Insecticides are only effective against adults. The second generation flight begins in late July or early August. Yellow sticky traps placed on orchard borders will detect activity of the adult beetles. Spraying the border trees (rows) with high water volumes will protect the remainder of the orchard in many situations where external sources are the primary problem.

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
PREHARVEST AND HARVEST				
Brown rot	1. captan (Captan) 50WP	5 lbs	1.25 lbs	0 Fenbuconazole: Begin applications 2 to 3 weeks before harvest and continue at 7- to 10-day intervals. 0 Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label.
	2. propiconazole (Orbit)	4 fl oz	See label	
	3. fenbuconazole (Indar) 75WSP	2 oz	0.5 oz	
	4. azoxystrobin (Abound)	12–15.5 fl oz	3–3.9 fl oz	
	5. pyraclostrobin + boscalid (Pristine)	10.5–14.5 oz	2.6–3.6 oz	
Powdery mildew	1. propiconazole (Orbit)	4 fl oz	See label	0
	2. azoxystrobin (Abound)	11–15 fl oz	2.75–3.75 fl oz	0
Oriental fruit moth, peach twig borer	1. carbaryl (Sevin) 80S	2.5–3.75 lbs	0.6–0.9 lb	3
	2. carbaryl (Sevin) 4F	4 pt	1 pt	3
POSTHARVEST				
Coryneum blight (shothole)	1. captan (Captan) 50WP	5 lbs	1.25 lbs	Apply before autumn rains.
	2. ziram (Ziram Granuflo)	See label	See label	
	3. chlorothalonil (Bravo Ultrex)	See label	See label	
Bacterial gummosis, Coryneum blight	1. copper hydroxide (Kocide DF)	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	See label	See label	
Shothole borer	1. endosulfan (Thionex) 50W	4 lbs	1 lb	Good sanitation (removing large wood pruning and wood piles from the orchard) is the best management tactic. Insecticides are only effective against adults. The second generation flight begins in late July or early August. Yellow sticky traps placed on orchard borders will detect activity of the adult beetles. Spraying the border trees (rows) with high water volumes will protect the remainder of the orchard in many situations where external sources are the primary problem.

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) 50W 2. endosulfan (Thionex) 3EC 3. chlorpyrifos (Lorsban) 4EC	See label See label See label	1 lb 1.3 pt 0.5–1 pt	Apply thoroughly with handgun to lower trunk and to cover crop at base of tree. Chlorpyrifos: Apply only as dormant or delayed dormant spray.
European red mite (overwintering eggs)	1. horticultural mineral oil	1–1.25% v/v	1–1.25% v/v	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: 1. chlorpyrifos (Lorsban) 4EC 2. methidathion (Supracide) 2E 3. pyriproxyfen (Esteem) 35WP	1–1.25% v/v 4 pt 4–8 pt 4–5 oz	1–1.25% v/v 1 pt 1–2 pt 1–1.25 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) See Hazards to Bees.				
Cutworms	1. endosulfan (Thionex) 50W 2. endosulfan (Thionex) 3EC	See label See label	1 lb 1.3 pt	Endosulfan: Apply thoroughly to lower trunk and to cover crop at base of tree with handgun.
Grape mealybug, Mealy plum aphid, leaf curl plum aphid	1. phosmet (Imidan) 70W 2. diazinon (Diazinon) 50W 3. endosulfan (Thionex) 50W	4 lbs 4 lbs 4 lbs	1 lb 1 lb 1 lb	
Lecanium scale	1. diazinon (Diazinon) 50W	4 lbs	1 lb	
Lygus bugs, stink bugs	1. endosulfan (Thionex) 50W	4 lbs	1 lb	
Pandemis leafroller, obliquebanded leafroller	1. <i>Bacillus thuringiensis</i> 2. spinosad (Success) 2L	See label 4–8 fl oz	See label 1–2 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.
Peach twig borer	1. endosulfan (Thionex) 50W 2. spinosad (Success) 2L 3. <i>Bacillus thuringiensis</i> 4. spinetoram (Delegate WG)	4 lbs 4–8 fl oz See label 3–7 oz	1 lb 1–2 fl oz See label 0.75–1.75 oz	
Plum rust mite	1. endosulfan (Thionex) 50W	4 lbs	1 lb	

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 (Bloom)			See Hazards to Bees.
Brown rot	1. azoxystrobin (Abound) 2. captan (Captan) 50WP 3. propiconazole (Orbit) 4. flowable/micronized sulfur 5. pyraclostrobin + boscalid (Pristine)	12–15.5 fl oz 6 lbs 4 fl oz See label 10.5–14.5 oz	3–3.9 fl oz 1.5 lbs See label See label 2.6–3.6 oz	Propiconazole: Do not use on Stanley-type plums earlier than 21 days prior to harvest. Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label.
PETAL-FALL (100% petal fall)—See Hazards to Bees				
Brown rot	See stages 6–7 (Bloom)			
Grape mealybug, mealy plum aphid, leaf curl plum aphid	1. imidacloprid (Provado) 1.6F 2. phosmet (Imidan) 70W 3. diazinon (Diazinon) 50W 4. endosulfan (Thionex) 50W	4–8 fl oz 4 lbs 4 lbs 4 lbs	1–2 fl oz 1 lb 1 lb 1 lb	Imidacloprid: Do not apply prebloom, bloom or when bees are actively foraging. Diazinon: Limited to one in-season foliar application per season.
Pandemis leafroller, obliquebanded leafroller	1. <i>Bacillus thuringiensis</i> 2. spinosad (Success) 2L 3. methoxyfenozide (Intrepid) 2F	See label 4–8 fl oz 8–16 fl oz	See label 1–2 fl oz 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) 50W	4 lbs	1 lb	
SHUCK FALL			Avoid killing bees on blooming cover crops. See Hazards to Bees.	
Brown rot	1. wettable sulfur 2. captan (Captan) 50WP	10–12 lbs 6 lbs	2.5–3 lbs 1.5 lbs	
LATE SPRING AND SUMMER			Avoid killing bees on blooming cover crops. See Hazards to Bees.	
Brown rot	1. flowable/micronized sulfur 2. captan (Captan) 50WP 3. azoxystrobin (Abound) 4. pyraclostrobin + boscalid (Pristine)	See label 6 lbs 12–15.5 fl oz 10.5–14.5 oz	See label 1.5 lbs 3–3.9 fl oz 2.6–3.6 oz	* 0 0 0 Abound is extremely phytotoxic to certain apple varieties. See Application Directions, Resistance Management, and Attention information on label.

* None listed

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
Earwigs	1. carbaryl (Sevin) 80S 2. carbaryl (Sevin) 4F	See remarks See remarks	0.6–0.9 lb 0.5–0.75 qt	3 Apply thoroughly to trunks and soil around base of trees. 3
Grasshoppers Mormon crickets	1. carbaryl (Sevin) 4F	2–3 qts	See label	3 See text: Special Programs—Grasshoppers
McDaniel spider mite, twospotted spider mite, European red mite	1. fenbutatin-oxide (Vendex) 50WP 2. hexythiazox (Savey) 50DF 3. bifentazate (Acramite) 50WS	1–2 lbs 3–6 oz 0.75–1 lb	4–8 oz 0.75–1.5 oz 3–4 oz	14 28 Hexythiazox: most effective on the egg stage, does not control adult mites. 3
Grape mealybug	1. endosulfan (Thionex) 50W 2. imidacloprid (Provado) 1.6F	4 lbs 4–8 fl oz	1 lb 1–2 fl oz	7 7
Pandemis leafroller, obliquebanded leafroller	1. <i>Bacillus thuringiensis</i> 2. spinosad (Success) 2L	See label 4–8 fl oz	See label 1–2 fl oz	0 Apply June 10–20 (or 1st brood peak moth flight). Apply again August 15–25 (or 2nd brood peak moth flight) if problem persists. Spinosad: Do not apply more than 0.45 pound ai per acre per year. 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.
Peachtree borer	1. endosulfan (Thionex) 50W	See label	1 lb	7 Apply thoroughly to trunk and soil around base of trees.
Peach twig borer	1. endosulfan (Thionex) 50W 2. spinosad (Success) 2L 3. spinetoram (Delegate WG)	4 lbs 4–8 fl oz 4.5–7 oz	1 lb 1–2 fl oz 1.13–1.75 oz	7 Apply when traps show significant adult presence and models indicate proper spray timing. This usually occurs in early to mid-June. 7
Plum rust mite	1. endosulfan (Thionex) 50W 2. flowable/micronized sulfur	4 lbs See label	1 lb See label	7 *

*None listed

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
Shothole borer	1. endosulfan (Thionex) 50W	4 lbs	1 lb	7 Good sanitation (removing large wood pruning and wood piles from the orchard) is the best management tactic. Insecticides are only effective against adults. The second generation flight begins in late July or early August. Yellow sticky traps placed on orchard borders will detect activity of the adult beetles. Spraying the border trees (rows) with high water volumes will protect the remainder of the orchard in many situations where external sources are the primary problem.
White apple leafhopper	1. endosulfan (Thionex) 50W 2. carbaryl (Sevin XLR Plus)	4 lbs 2–3 pt	1 lb 0.5–0.75 pt	7 3

POSTHARVEST

Bacterial gummosis	1. fixed copper	See label	See label	Apply most materials after October 1.
Shothole borer	1. endosulfan (Thionex) 50W	4 lbs	1 lb	Good sanitation (removing large wood pruning and wood piles from the orchard) is the best management tactic. Insecticides are only effective against adults. The second generation flight begins in late July or early August. Yellow sticky traps placed on orchard borders will detect activity of the adult beetles. Spraying the border trees (rows) with high water volumes will protect the remainder of the orchard in many situations where external sources are the primary problem.
Plum aphids	1. phosmet (Imidan) 70W 2. diazinon (Diazinon) 50W	4 lbs 4 lbs	1 lb 1 lb	Fall applied (October) aphicides provide excellent aphid control for the following year.

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 at 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: Indiscriminate 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 applica-

tions 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 10-20 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
DORMANT AND DELAYED DORMANT				
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) 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.
PRE-PINK OR PINK				
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 pt	
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	
BLOOM				
Nitrogen and sulfur maintenance	1. ammonium thiosulfate, liquid, 12% N, 25% 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.
FOLIAGE—After bloom and before harvest.				
Boron maintenance	1. sodium borate, dry, 16.5–20.5% B	2.5–3 lbs	0.75 lb	All products—Pre-pink 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 pt	
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 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. Indiscriminant use of potassium sprays can increase the incidence of bitter pit in apples and cork spot in pears.
Magnesium deficiency	1. magnesium nitrate, dry, 13.5% Mg 2. magnesium nitrate 0.4LC 3. magnesium chelate or organic complex	20–40 lbs 6–12 gals See label	5–10 lbs 1.5–3 gals	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 2. zinc sulfate, liquid, 10–12% Zn 3. basic zinc sulfate, dry, 50–52% Zn 4. basic zinc sulfate, liquid, 20–25% Zn 5. zinc chelate or organic complex	6–12 lbs 2–4 gals 6–12 lbs	1.5–3 lbs 0.5–1.5 gal 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 2. boric acid, dry, 17% B 3. boric acid liquid, 10% B	2.5–3 lbs 3 lbs 2 qts	0.75 lb 0.75 lb 1 pt	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 2. boric acid, dry, 17% B 3. boric acid liquid, 10% B	5–6 lbs 6 lbs 1 gal	1.25–1.5 lbs 1.5 lbs 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 2. zinc sulfate, liquid, 10–12% Zn 3. basic zinc sulfate, dry, 50–52% Zn 4. basic zinc sulfate, liquid, 20–25% Zn 5. zinc chelate or organic complex	6–12 lbs 2–4 gals 6–12 lbs	1.5–3 lbs 0.5–1 gal 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 2. zinc sulfate, liquid, 10–12% Zn 3. basic zinc sulfate, dry, 50–52% Zn 4. basic zinc sulfate, liquid, 20–25% Zn 5. zinc chelate or organic complex	10–12 lbs 7 gals 14 lbs	2.5–3 lbs 1.75 gals 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 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

Bioregulators can induce many diverse responses in fruit trees; for example, the auxin analog naphthaleneacetic acid (NAA) reduces fruit set in apple when applied shortly after petal fall, increases return bloom when applied during the middle of the growing season, and also reduces fruit abscission when applied shortly before harvest. In addition, many bioregulators have side effects beyond their intended uses and it is important that growers understand all potential outcomes of application of any growth regulator to trees or fruit of a specific cultivar at a given developmental stage.

As with other materials, spray efficacy is a function of the relative absorption of the bioregulator by the plant tissue. Slow-drying conditions (cool temperatures, dense canopies, no wind) tend to amplify the effects of the material, while fast-drying conditions (hot temperatures, open canopies, wind) can diminish its efficacy. Abundant surface area of young, healthy leaves tends to increase material absorption and trees in this state may exhibit greater responses than trees with fewer, smaller, and/or older leaves. Typically, bioregulators are most effective with thorough coverage and wetting, but do not require excessive drenching; many materials are not translocated within the plant, so direct application to target tissues (leaves, flower clusters, fruit, etc.) is often critical to achieving desired responses. Many bioregulators are sensitive to pH and label directions should be carefully followed regarding spray tank acidity.

Elevated response or injury may be observed from applications of bioregulators under the following conditions:

- high temperatures
- low-vigor / weak trees
- high concentration of active ingredient in spray tank
- use of surfactants

Caution should be exercised when one or more of these conditions are present.

Apple Chemical Thinning

Apple chemical bloom and postbloom thinning programs are intended to reduce the current season's crop load in pursuit of three fundamental goals: 1) inhibit fruit set to minimize green fruitlet hand thinning; 2) improve size and quality of surviving fruit; and 3) promote return bloom to encourage annual cropping. Successful chemical thinning usually requires comprehensive programs employing multiple chemistries during the bloom and postbloom period. Bloom thinners (applied when flowers are open and viable) reduce fruit set by damaging flower parts and/or inducing plant stress. Postbloom thinners (applied after petal fall) typically mimic the effect of plant hormones to elicit a specific physiological response (i.e., increased ethylene evolution, which triggers fruitlet abortion) to achieve reductions in crop load.

Fertilized flowers become more difficult to thin with each

passing day, making early, aggressive thinning strategies more successful than those which rely primarily on chemical applications after 10 mm fruitlet size. Research indicates that early thinning results in not only higher chemical efficacy, but greater impact on fruit size, fruit quality, and return bloom. Even if they employ more aggressive rates, applications of postbloom chemical thinners after 15 mm fruitlet size are usually of marginal benefit. Timings based on crop developmental stage (i.e., mean fruitlet diameter) are generally more reliable and accurate than those based on the calendar (i.e., days after full bloom).

Chemical thinning efficacy is a function of many factors, including apple cultivar and strain, rootstock, tree condition, pollen strength and density, bee activity, weather, product chemistry, rate, application method, timing, and coverage. Therefore, thinning programs should be customized to individual blocks. Select materials, timings, and rates accordingly and observe label recommendations and restrictions. Spring frosts can induce significant fruitlet abortion in lower parts of the tree, but upper parts of the canopy may still be over-cropped; in these cases, thinning sprays targeted to tree tops are often advisable to keep the trees in balance and discourage alternate bearing.

Response to chemical thinners can vary relative to weather conditions before, during, and after application, especially in the case of postbloom materials. Caution should be exercised when applying thinning materials in temperatures above 80°F, as fruitlet abortion may become excessive in some cases. Thinner efficacy may be diminished below 60°F, but low temperatures can also temporarily mask the symptoms of a significant thinning response; growers dissatisfied with the performance of thinning sprays during cool conditions may be well advised to wait for a few days of warm temperatures to reassess fruit set before applying additional thinners. See individual product labels for additional guidance.

Effective chemical thinning is more difficult in some apple cultivars; Fuji, Golden Delicious, and Cameo generally require more aggressive tactics (e.g., more applications and/or higher rates) than do Red Delicious, Gala, Cripps Pink (Pink Lady®), Granny Smith, Honeycrisp, Jonagold, or Braeburn to achieve comparable results. Spur-type Red Delicious are often more difficult to thin than non-spur Red Delicious. Ineffective thinning can result in over-cropping and induce alternate (biennial) bearing in many apple cultivars, especially Fuji, Golden Delicious, Cameo, and Honeycrisp. Unfortunately, alternate bearing cycles are easy to establish and difficult to break and can dramatically hurt orchard profitability over time. Early, aggressive chemical thinning programs should be the first defense against over-cropping, but consistent annual bearing may also be managed with effective use of bioregulators; please refer to the section "Other Programs for Apple—To Promote Bloom" for more information.

Apple Bloom Thinning

Research has shown that materials which damage sensitive flower parts (stigmas, styles, pollen) and/or induce whole-tree stress can reduce fruit set. Programs which have shown

promise in experimental settings include caustic salts, weak acids, lime sulfur, and combinations of spray oils and lime sulfur. Lime sulfur programs not only damage floral anatomy but temporarily depress plant photosynthesis, inducing apple trees to abort some fruitlets which may have already been fertilized. Because their success is not solely reliant on damaging recently exposed organs in unpollinated flowers, lime sulfur-based thinning programs have shown more of a “kickback” effect than caustic salts in research studies. Sequential applications of lime sulfur or oil + lime sulfur can have a cumulative effect on plant stress and typically increase levels of thinning.

Lime-sulfur/Oil Products

Lime sulfur (Rex Lime Sulfur Solution) is registered for use as a bloom thinner either alone or in combination with horticultural oil products on Red Delicious, Golden Delicious, Gala, Fuji, Braeburn, Cameo, Cripps Pink (Pink Lady®), Granny Smith, Jonagold, or Pacific Rose. Oils tend to increase the penetration and efficacy of lime sulfur, requiring lower concentrations of lime sulfur when combined with oils to achieve desirable results. If using oil with lime sulfur, consult the oil label for specific use guidelines. Multiple applications can be made during bloom according to the needs of the individual block.

Rex Lime Sulfur is labeled under a 24C Special Local Needs provision in Washington. The registrant, Pest Management Northwest, Inc., requires that **users must sign a special conditions and use waiver** prior to obtaining this product. Be sure to follow all label instructions carefully. **Lime sulfur and oil products are currently approved by the Washington State Department of Agriculture for bloom thinning in Washington organic apple orchards.**

Apple Postbloom Thinning

NAA (K-Salt Fruit Fix 200, K-Salt Fruit Fix 800, Fruitone). Naphthaleneacetic acid (NAA) is an auxin analog which can be applied from petal fall to 30 days past full bloom, with best results occurring from applications between 5–10 mm. Use higher concentrations of NAA if applied without a surfactant; see product label for more guidance. To increase thinning, tank mix NAA with carbaryl (see section on carbaryl). For other uses of NAA, please refer to the section “Other Programs for Apple.”

NAD (Amid-Thin W). Naphthaleneacetamide (NAD) is chemically similar to NAA and can be used on varieties other than Red Delicious, where it may cause abnormally small (pygmy) fruit. Apply from petal fall to 14 days past full bloom. 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. Use higher concentrations of NAD if applied without a surfactant; see product label for more guidance. To increase thinning, tank mix NAD with carbaryl (see section on carbaryl).

Carbaryl (Sevin 4F, Sevin XLR Plus). Carbaryl is a

carbamate-class insecticide that also mimics the action of auxins and can be applied to apple as a chemical thinner any time from 80% petal fall to 16 mm fruit size. Results from carbaryl depend on temperature, chemical rates, variety, and pollination. Other factors to consider include potential toxicity to bees in or near the orchard and possible impacts on mite management. Please check the product label for additional guidance. Carbaryl may be applied with NAA or NAD; their use in combination is more effective than when used separately. For optimal response, apply the combination of carbaryl + NAD or NAA at 3–10 mm fruit diameter. Excessive thinning may occur if daytime temperatures are above 85°F.

Caution: Sevin 80WSP and Sevin 80S are highly toxic to bees; use Sevin XLR Plus or Sevin 4F, which are less hazardous. If open bloom is present, apply when bees are not foraging. Before using any carbaryl formulation, it is advisable to eliminate flowers in the cover crop (e.g., by mowing) to minimize bee kill. Caution should be exercised with Sevin XLR Plus as it may contribute to fruit deformities under some conditions, especially in Red Delicious — see the product label for more details.

Carbaryl can also 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 little resistance has developed. Reduce the hazard of injury to mites by directing sprays towards tree tops, applying early in the season, and limiting the total number of applications.

Ethephon (Ethrel). Ethephon is a synthetic precursor of ethylene and may be applied with carbaryl, NAA, and/or NAD to increase fruit thinning and promote return bloom. Applications for thinning are most effective 10–20 days after full bloom.

Caution: High rates of ethephon may reduce fruit size; Red Delicious fruit shape may also be affected by inhibiting calyx-end development when applied earlier than 3 weeks after bloom. Please refer to the product label for more guidance and section “Other Programs for Apple” for more information on other uses of ethephon.

6-BA, BA (MaxCel, Exilis Plus, RiteWay): 6-benzyladenine (BA) is a cytokinin analog which has the ability to thin fruitlets as well as enhancing cell division in developing fruit, ultimately resulting in larger fruit size. Combination sprays of BA and NAA may increase the occurrence of pygmy fruits, especially with Red Delicious and Fuji; label recommendations should be followed carefully.

For thinning, use one to two applications of BA when king-bloom fruit are 5–10 mm fruit diameter according to specific recommendations of the product label. Best results are obtained when BA is combined with carbaryl and temperatures greater than 65°F occur during and for a period of several days following application.

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. MaxCel, Exilis Plus and RiteWay have a specific preharvest interval (PHI) of 86 days.

Pear Chemical Thinning

Like apple, chemical thinning in pear is intended to reduce the current season's crop load in pursuit of three fundamental goals: 1) inhibit fruit set to minimize green fruitlet hand thinning; 2) improve size and quality of surviving fruit; and 3) promote return bloom to encourage annual cropping. While most pear trees largely self-regulate their crops without chemical intervention, well-managed chemical and hand thinning programs can increase the long term profitability of many varieties, especially Bartlett. Some pear blocks can struggle to set commercially adequate levels of fruit and it may be advisable to clearly assess pear set before applying chemical thinners, especially when conditions have been cool and/or wet during bloom.

BA (MaxCel, RiteWay) may be applied when pears are 5–15 mm in diameter to reduce fruit set, increase fruit size, and promote return bloom. **NAD (Amid-Thin W)** may be applied to reduce pear fruit set 5–7 days after petal fall. **NAA (K-Salt Fruit Fix 200, K-Salt Fruit Fix 800, Fruitone) can be used to thin pears 15–28 days after full bloom. For best results, apply NAA products with a surfactant (wetting agent) when temperatures are between 70 and 75 F. Please refer to individual product labels for more detailed information.** No chemical bloom thinners are registered for use in pear at this time.

Promotions of Apple and Pear Fruit Sizes

When used in a chemical thinning program, **BA (MaxCel, Exilis Plus, RiteWay)** may increase fruit size beyond the effect of reduced crop load; cytokinins often increase cell division, and BA-treated fruit may have higher cell numbers per fruit, resulting in larger fruit size. This effect may be achieved in apples with minimal fruit thinning by using sequential applications of BA at concentrations lower than those used for standard thinning programs. To promote apple fruit size while still maximizing fruit set, apply 2–4 sprays of BA at 3–10 day intervals, starting at petal fall; please refer to product labels for appropriate concentrations for this purpose. Be warned, **even at lower rates, BA may induce fruitlet abortion;** growers should exercise caution when using these programs if additional thinning is not desirable.

Other Programs for Apple

To Suppress Apple Shoot Growth. 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. 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 (4–6 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. For best results, the first application should be made early when newly-forming terminal shoots are no more than about 1 inch 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 6–12 ounces per 100 gallons spray volume (200–300 gallons applied per acre). 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 inter-

val; 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.

Note: Applications of 12 ounces/100 gallons at pink and repeated within 14 days provide the greatest effect. Being late with the application(s) will reduce the result.

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 not 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 Improve Fruit Shape and Size. Three products that contain mixtures of gibberellic acids (GA_{4+7}) 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_{4+7} + 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_{4+7} + BA is applied to young trees just coming into full bearing. Do not apply more than once per season. Applications of GA_{4+7} + BA products may improve fruit size. The products Exilis Plus and RiteSize are also registered for fruit size improvement in apple.

To Control Russetting of Golden Delicious. GA_{4+7} (ProVide, 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_{4+7} (ProVide, 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_{4+7} are normally recommended, but two sprays 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_{4+7} at the higher rate should be accompanied by an aggressive chemical thinning program to avoid reductions in return bloom.

Note: ProVide 10SG has received OMRI certification and is registered for use on organic as well as conventional apples.

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_{4+7} + 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 1–3 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 latex paint should not contain mildewcides or other chemicals potentially harmful to trees.

For stimulation of lateral branching, apply 0.25–1 pint GA_{4+7} + 6BA containing products per 5 gallons water to nursery or orchard apple trees or 0.5–2 pints GA_{4+7} + 6BA containing products per 5 gallons water to nursery or non-bearing orchard pear trees when trees have reached the height where branching is desired. For non-bearing sweet cherry trees in the nursery only, apply 0.5–2 pints GA_{4+7} + 6BA containing products per 5 gallons water when trees reach the desired height for branch development.

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. NAA (Fruitone N) may be applied as a single application at 3–5 ppm (1.2–2.1 oz/100 gallons) five to six weeks after bloom to induce flowering the following year. If results are unsatisfactory after the first year, 1–2 applications may be required the next year at 7–10 day intervals to stimulate flowering.

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 6 weeks after bloom (after the beginning of June drop) to avoid excessive fruit thinning. NAA (Fruitone N) may be applied as a single application at 3–5 ppm (1.2–2.1 oz/100 gallons) five to six weeks after bloom to induce flowering the following year. If results are unsatisfactory after the first year, 1–2 applications may be required the next year at 7–10 day intervals to stimulate flowering.

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 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. NAA (Fruitone N) may also be applied as a single application at 3–5 ppm (1.2–2.1 oz/100 gallons) five to six weeks after bloom to induce flowering the following year.

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 7–21 days before expected harvest, depending on cultivar and season of fruit maturity. Follow label instructions carefully. Applications to advance maturity 3–5 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 7–14 days prior to harvest, but no closer than 2–5 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 3–4 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 0.25–0.5 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 can be used to adjust harvest timing and control fruit drops. 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 7 days before harvest. The manufacturer recommends that for a single-pick harvest program, ReTain be applied once **4 weeks before the anticipated beginning of normal harvest for that season** based on appropriate maturity indices of untreated fruit. If fruit will be harvested using a multiple-pick schedule, ReTain should be applied once at **1–2 weeks before the start of normal harvest of untreated fruit.** 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 maxi-

mum). 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 6–7 days prior to harvest, but no closer than 2 days before harvest.

NAA becomes effective 3–4 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.

The PHI for ReTain in pears is 7 days.

Programs for Stone Fruits

To Extend Harvest—Sweet Cherries. [The normal harvest period for sweet cherries can be extended by use of GA₃ (ProGibb, Falgro, GibGro, N-Large).]

Three formulations of ProGibb are now registered for use on sweet cherry: 1) ProGibb 4% solution, 2) ProGibb 40% water-soluble granules, and 3) ProGibb plus 2X soluble powder. Falgro 4L, Falgro 20SP, GibGro 20SP, GibGro 5% Powder, GibGro 4LS, and N-Large 4L are also registered for use on sweet cherries. The Falgro, Gibgro, or N-Large products should be applied only as a single spray of 16–48 grams active ingredient per acre when fruit is light green to straw colored. Any of the ProGibb formulations may be applied once or twice prior to harvest. If applying twice, make the first application when the fruit are translucent green and the second 3–7 days later when the fruit reach straw color. Apply approximately 1/3 to 1/2 of the total allowed amount of 16-48 grams active ingredient in the first application and the remainder in the second application. The application of GA₃ delays fruit maturity from three to seven days and gives larger and much firmer fruit, bright green stems, and much longer storage life. Rates of GA₃ can be reduced on lightly cropped trees. Complete coverage of the tree is important for uniform fruit maturity.

GA₃ can reduce soluble solids and slightly reduce fruit bud set the following year. If reduction in return bloom is observed and not wanted, reduce the amount of GA₃ applied per acre in subsequent years.

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
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 Cameo, Fuji, Golden Delicious, Pacific Rose	4–10 gallons Rex Lime Sulfur alone 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. Note: Lime-sulfur is toxic to rust mites and predatory mites. Use of this material may predispose the orchard to mite outbreak.

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 and Fruit and Leaf Injury.				
All apple varieties (early thinning)	1. carbaryl (Sevin XLR Plus)	600 ppm	1 pt	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. See Hazards to Bees
Red Delicious, Braeburn	1. carbaryl (Sevin 4F)	600–1200 ppm	1–2 pt	Sevin XLR is the preferred formulation for reduced hazard to bees. If blooms are present in cover crop, apply while bees are not foraging. Note: multiple applications of carbaryl, especially following lime sulfur, may predispose the orchard to mite outbreaks. See product labels for more information on timing, rates, and cautions.
	1. carbaryl (Sevin XLR Plus)	600–1200 ppm	1–2 pt	
	2. NAA (+surfactant)			
	(K-Salt Fruit Fix 200)	2–5 ppm	0.48–1.2 fl oz	
	(K-Salt Fruit Fix 800)	2–5 ppm	0.12–0.3 fl oz	
	Delicious, spur types	1. carbaryl (Sevin XLR Plus) + NAA (K-Salt Fruit Fix 200)	600–1200 ppm 2–5 ppm	1–2 pt 0.48–1.2 fl oz
2. carbaryl (Sevin XLR Plus) + NAA (K-Salt Fruit Fix 800)		150–300 ppm 2–5 ppm	0.25–0.5 pt 0.12–0.3 fl oz	
3. carbaryl (Sevin 4F) + NAA (K-Salt Fruit Fix 200)		600–1200 ppm 2–5 ppm	1–2 pt 0.48–1.2 fl oz	
4. carbaryl (Sevin 4F) + NAA (K-Salt Fruit Fix 800)		600–1200 ppm 2–5 ppm	1–2 pt 0.12–0.3 fl oz	

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)				
Fuji, Cameo, Golden Delicious, Gala, Jonagold, Pink Lady, Granny Smith, (in approximate order of thinning difficulty in pollinated conditions.)	1. carbaryl (Sevin 4F)	1200–1800 ppm	2–3 pt	See bee hazard remarks under Post-bloom—Delicious. Note: multiple applications of carbaryl, especially following lime-sulfur, may predispose the orchard to mite outbreaks. See text or product labels for additional information. Variety Note: Pollination is a major factor in fruit set and thinning response. Lack of cross pollination can create "easy to thin" conditions. 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. NAD plus ethephon gives good thinning and return bloom.
	2. carbaryl (Sevin XLR Plus)	1200–1800 ppm	2–3 pt	
	3. NAA (K-Salt Fruit Fix 200) + surfactant (Regulaid)	3–5 ppm	0.7–1.2 fl oz	
	4. NAA (K-Salt Fruit Fix 800) + surfactant (Regulaid)	3–5 ppm	0.18–0.3 fl oz	
	5. NAD (Amid-Thin W) + surfactant (Regulaid)	25 ppm	4 oz	
	6. carbaryl (Sevin XLR Plus) + NAA (K-Salt Fruit Fix 200)	600–1200 ppm 3 ppm	1–2 pt 0.7 fl oz	
	7. carbaryl (Sevin XLR Plus) + NAA (K-Salt Fruit Fix 800)	600–1200 ppm 3 ppm	1–2 pt 0.18 fl oz	
	8. carbaryl (Sevin XLR Plus) + NAD (Amid-Thin W)	600–1200 ppm 25 ppm	1–2 pt 4 oz	
	9. carbaryl (Sevin 4F) + NAA (K-Salt Fruit Fix 200)	600–1200 ppm 3 ppm	1–2 pt 0.7 fl oz	
	10. carbaryl (Sevin 4F) + NAA (K-Salt Fruit Fix 800)	600–1200 ppm 3 ppm	1–2 pt 0.18 fl oz	
	11. carbaryl (Sevin 4F) + NAD (Amid-Thin W)	600–1200 ppm 25 ppm	1–2 pt 4 oz	
	12. NAD (Amid-Thin W) + ethephon (Ethrel)	25 ppm 300–450 ppm	4 oz 1–1.5 pt	
Apples: thinning	1. 6-BA (MaxCel) + carbaryl (Sevin XLR Plus)	75–200 ppm 600–1800 ppm	48–128 fl oz 1–3 pt	Make 1–2 applications when king-bloom fruit are 5–15 mm in diameter. Apply when temperatures will exceed 65°F for a few days following application. Do not apply within 86 days of harvest. Follow all label instructions. Thinning performance of BA products is increased when combined with carbaryl. BA rates of 75–100 ounces per 100 gallons when combined with carbaryl are suggested for varieties such as Gala.
	2. 6-BA (Exilis Plus) + carbaryl (Sevin XLR Plus)	75–200 ppm 600–1800 ppm	46–122 fl oz 1–3 pt	Make 1–2 applications when king-bloom fruit are 5–10 mm in diameter. Do not apply if temperature is below 60°F.
	3. 6-BA+GA ₄₊₇ (RiteSize)		Per Acre: 10–30 g a.i. (18–53.5 fl oz) /acre per application	Make 1–2 applications in 50–200 gallons/acre between petal-fall and 10-mm average fruit diameter. Apply when temperatures will be 70°F or greater for 2–3 days. Follow all label instructions carefully.

GROWTH REGULATOR PROGRAM FOR APPLES AND PEARS

Fruit Variety	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
POSTBLOOM—(Continued)					
Bartlett	1. NAD (Amid-Thin W) (+surfactant) 2. NAA (K-Salt Fruit Fix 200) (+surfactant)	10–15 ppm 10–15 ppm	1.6–2.4 oz 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—Young, nonbearing trees					
To promote lateral branching (1–3 in terminal growth)	1. GA ₄₊₇ + BA (Promalin, Perlan, Typy)–latex applied 2. GA ₄₊₇ + BA (Promalin, Perlan, Typy)–foliar applied + Surfactant (Regulaid)	5000–7500 ppm 125–500 ppm + 0.2–0.3% v/v	0.2 to 0.33 pt product per pt of latex paint. 0.25–1 pt per 5 gals + 1.6–2.4 pt per 100 gals		Apply in spring when terminal buds begin to swell but before green tissues emerge. Apply the GA ₄₊₇ + 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. 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. 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 return bloom	1. ethephon (Ethrel) + surfactant (Regulaid) 2. NAA (Fruitone N) [suggested for Braeburn, Fuji, Golden Delicious, Jonagold]	300–600 ppm 3–5 ppm	1–2 pt 1.2–2.1 oz		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. Apply 5–6 weeks after full bloom. If results are not sufficient, use two applications at 7-day intervals the next year. Follow label directions.
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
APPLES—Bearing trees					
To promote longer, typy Red Delicious	1. GA ₄₊₇ + BA (Promalin, Perlan, or Typy)	25 ppm	1 pt	(1–2 pt)	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 ₄₊₇ (ProVide, or TypRus)	15–20 ppm	10–13 fl 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 per acre per year. See text.

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	Formulated material per acre (approx.)	Remarks and restrictions
APPLES—Bearing trees (Continued)					
To promote return bloom	1. ethephon (Ethrel) (+ surfactant)	300 ppm	1 pt	(3 pt)	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.
	2. NAA (Fruitone N) [for Braeburn, Fuji, Golden Delicious, Jonagold]	3–5 ppm	1.2–2.1 oz	1.2–2.1 oz	Apply 5–6 weeks after full bloom. If results are not sufficient, use two applications at 7-day intervals. Follow label directions.
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.
Multiple applications (preferred)	1. prohexadione calcium (Apogee)	125 ppm	6 oz	18 oz	Apply starting at 1 inch shoot growth, repeat at 14- to 21-day intervals. Do not apply within 45 days of harvest. Use 300 gal of dilute spray/acre.
To increase fruit size	1. 6-BA (MaxCel)	10–50 ppm	6–32 fl oz		Make 2–4 applications starting at petal-fall and repeating at 3- to 10-day intervals. Apply when temperatures will exceed 65°F for a few days following application. Do not apply within 86 days of harvest. Follow all label instructions.
	2. 6-BA (Exilis Plus)	10–50 ppm	6–30 fl oz		Make 2–4 applications starting at petal-fall and repeating at 3- to 10-day intervals. Do not apply when temperatures are below 60°F. Do not apply within 86 days of harvest. Follow all label instructions.
	3. 6-BA+GA ₄₊₇ (RiteSize)			10–30 g a.i. (18–53.5 fl oz)/acre per application	Make 1–2 applications in 50–200 gallons/acre between petal-fall and 10-mm average fruit diameter. Apply when temperatures will be 70°F or greater for 2–3 days. Thinning may occur with this program. Follow all label instructions.

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
APPLES—Bearing trees (Continued)					
To advance maturity and promote red color on some varieties	1. ethephon (Ethrel) (+surfactant)	300 ppm	1 pt		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)	16–32 ppm	4–8 fl oz	25 to 50 g a.i.	Apply NAA 7 to 14 days prior to harvest, but no closer than 2 to 5 days before harvest, or more than twice as a stop drop treatment. Do not apply more than 2 pt NAA 200 or 0.5 pt NAA 800 per acre. ReTain: Apply either 4 weeks before anticipated start of single pick harvest or 1–2 weeks before start of multiple pick harvest depending on harvest schedule. 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.
	2. NAA (K-Salt Fruit Fix 800)	16–32 ppm	1–2 fl oz	25 to 50 g a.i.	
To decrease preharvest fruit drop, to delay watercore and to improve harvest maturity management	1. AVG (ReTain) + organosilicone surfactant		0.73 pound 0.05–0.1% v/v	50 g a.i. (1 bag)	
PEARS—Spray to run-off (based on 400 gallons/acre for average-sized trees)					
To prevent preharvest fruit drop (Anjou, Bartlett, Bosc)	1. NAA (K-Salt Fruit Fix 200)	8–16 ppm	2–4 fl oz	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.
	2. NAA (K-Salt Fruit Fix 800)	8–16 ppm	0.5–1 fl oz	12.5–25 g a.i.	
	3. AVG (ReTain) [+ organosilicone surfactant]		0.73 pound 0.05–0.1% v/v	50 g a.i. (1 bag)	ReTain: Apply 1–2 weeks before start of normal harvest. Follow label instructions.

GROWTH REGULATOR PROGRAM FOR STONE FRUITS

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
SWEET CHERRY—Spray to run-off					
To delay fruit maturity	1. GA ₃ (ProGibb 4%)	10–30 ppm	0.25–0.75 pt	16 to 48 g a.i.	Apply once or twice according to the product label approximately 3 weeks before expected harvest when fruit is straw colored. Improves fruit firmness and storage life. Delays maturity 3 to 7 days. Follow all label directions carefully.
	2. GA ₃ (ProGibb 40WSG)	10–30 ppm	0.35–1 oz	16 to 48 g a.i.	
	3. GA ₃ (Falgro 4L)	10–30 ppm	0.25–0.75 pt	16 to 48 g a.i.	
	4. GA ₃ (Falgro 20SP)	10–30 ppm	0.7–2 oz	16 to 48 g a.i.	
	5. GA ₃ (GibGro 4LS)	10–30 ppm	0.25–0.75 pt	16 to 48 g a.i.	
	6. GA ₃ (GibGro 20SP)	10–30 ppm	0.7–2 oz	16 to 48 g a.i.	
	7. GA ₃ (GibGro 5% Powder)	10–30 ppm	2.8–8.5 oz	16 to 48 g a.i.	

Note: 20 ppm = 0.50 pt (8 fl oz) ProGibb 4%, Falgro 4L or GibGro 4LS or 2/3 oz ProGibb 40WSG or 1.33 oz Falgro 20SP or GibGro 20% Powder or 5.35 oz GibGro 5% Powder/100 gallons

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 20–35 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.
5. Read label for soil texture and organic matter restrictions.

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 anti-foaming 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. glyphosate (Roundup and numerous alternate trade names)	4.5 to 6.0 ounces acid equivalent/A See label for rate. 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. oryzalin Surflan AS Oryzalin 4AS	2.0 to 6.0 pounds active ingredient/A 2.0 to 6.0 quarts product/A 2.0 to 6.0 quarts product/A 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. napropamide Devrinol 50DF	4.0 pounds pounds active ingredient/A 8.0 pounds product/A 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. dichlobenil Casoron 4G	6.0 pounds active ingredient/A 150.0 pounds product/A 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. diuron Karmex DF Diuron 80 WDG Direx or Diuron 4L	1.6 to 3.2 pounds active ingredient/A 2.0 to 4.0 pounds product/A 2.0 to 4.0 pounds product/A 1.6 to 3.2 quarts product/A 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. Limit initial sprinkler irrigation to 0.5 inch of water. Do not apply in orchards established less than 12 months. Note label restrictions and follow label directions closely. Do not treat apples recently grafted onto full-dwarf rootstocks.
5. simazine Princep 4L Princep Caliber 90 Simazine 4L Sim-Trol 4L Simazine 90DF Sim-Trol 90DF	1.6 to 3.2 pounds active ingredient/A 1.6 to 3.2 quarts product/A 1.8 to 3.6 pounds product/A 1.6 to 3.2 quarts product/A 1.6 to 3.2 quarts product/A 1.8 to 3.6 pounds product/A 1.8 to 3.6 pounds product/A 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. Limit initial sprinkler irrigation to 0.5 inch of water. Do not apply in orchards established less than 12 months. 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. terbacil Sinbar (not on pears)	1.6 pounds active ingredient/A 2.0 pounds product/A 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. Limit initial sprinkler irrigation to 0.5 inch of water. Do not apply in apple orchards established less than 36 months. Note label restrictions and follow label directions closely.
7. norflurazon Sollicam DF	2.0 to 3.9 pounds active ingredient/A 2.5 to 5.0 pounds product/A 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 on label.
8. pronamide Kerb 50-W	1.0 to 3.0 pounds active ingredient/A 2.0 to 6.0 pounds product/A 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. pendimethalin Prowl H ₂ O	1.9 to 3.8 pounds active ingredient/A 2.0 to 4.0 quarts/A Pendimethalin 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. oxyfluorfen Goal 2XL Galigan 2E OxiFlo 2EC GoalTender	0.5 to 2.0 pounds active ingredient/A 2.0 to 8.0 pt product/A 2.0 to 8.0 pt product/A 2.0 to 8.0 pt product/A 1.0 to 4.0 pt product/A 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. isoxaben Gallery 75DF (nonbearing orchards only)	0.5 to 1.0 pound active ingredient/A 0.66 to 1.33 pounds product/A 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) is 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 2.5TG) will control grasses.
12. rimsulfuron (Matrix FNV)	1 ounce active ingredient/A 4 ounces product/A Apply preemergence or early postemergence. For maximum preemergence activity, prior to application, the soil surface should be smooth and relatively free of crop and weed trash. Controls several annual grasses and broadleaf weeds. A repeat application may be made if banded over the tree row. Do not harvest for 7 days. To broaden the weed control spectrum and/or extend the residual effectiveness, rimsulfuron may be tank-mixed with other registered herbicides having a different mode of action.

*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
TANK MIXES FOR APPLES AND PEARS			
13. diuron Karmex DF + terbacil Sinbar (not on pears)	0.8 to 1.6 pounds active ingredient/A 1.0 to 2.0 pounds product/A 0.8 to 1.6 pounds active ingredient/A 1.0 to 2.0 pounds product/A	19. paraquat Gramoxone Max + nonionic surfactant + diuron or simazine or terbacil (not on pears) or diuron + terbacil (not on pears) or oryzalin or norflurazon or simazine + oryzalin or oxyfluorfen	0.64 to 1.0 pound active ingredient/A 1.7 to 2.7 pt product/A 1.0 pt/100 gal spray solution 1.6 to 3.2 pounds active ingredient/A 0.5 to 3.2 pounds active ingredient/A 1.6 pounds active ingredient/A 0.8 to 1.6 pounds active ingredient/A 0.8 to 1.6 pounds active ingredient/A 2.0 to 6.0 pounds active ingredient/A 2.0 to 4.0 pounds active ingredient/A 0.5 to 3.2 pounds active ingredient/A 2.0 to 4.0 pounds active ingredient/A 0.5 to 2.0 pounds active ingredient/A
14. norflurazon Solicam DF + simazine Princep 4L	1.6 pounds active ingredient/A 2.0 pounds product/A 1.0 to 1.6 pounds active ingredient/A 1.0 to 1.6 quarts product/A	20. glyphosate + diuron or simazine or oryzalin or norflurazon or simazine + oryzalin or oxyfluorfen	0.75 to 3.75 pounds acid equivalent/A 1.6 to 3.2 pounds active ingredient/A 0.5 to 3.2 pounds active ingredient/A 2.0 to 4.0 pounds active ingredient/A 2.0 to 4.0 pounds active ingredient/A 0.5 to 3.2 pounds active ingredient/A 2.0 to 4.0 pounds active ingredient/A 0.5 to 2.0 pounds active ingredient/A
15. norflurazon Solicam DF + diuron Karmex DF	1.4 to 2.0 pounds active ingredient/A 1.75 to 2.5 pounds product/A 0.8 to 1.2 pounds active ingredient/A 1.0 to 1.5 pounds product/A		
16. diuron Karmex DF + oryzalin Surflan AS	1.6 to 3.2 pounds active ingredient/A 2.0 to 4.0 pounds product/A 2.0 to 4.0 pounds active ingredient/A 2.0 to 4.0 quarts product/A		
17. simazine Princep 4L + oryzalin Surflan AS	0.5 to 3.2 pounds active ingredient/A 0.5 to 3.2 quarts product/A 2.0 to 4.0 pounds active ingredient/A 2.0 to 4.0 quarts product/A		
18. oxyfluorfen Goal 2XL + oryzalin or norflurazon or diuron or simazine	0.5 to 2.0 pounds active ingredient/A 2.0 to 8.0 pt product/A 2.0 to 6.0 pounds active ingredient/A 2.0 to 4.0 pounds active ingredient/A 0.8 to 1.2 pounds active ingredient/A 0.5 to 3.0 pounds active ingredient/A		

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WEED CONTROL PROGRAM FOR APPLES AND PEARS (CONTINUED)

Herbicide	Rates*, Application and Remarks
TEMPORARY CONTROL—Broadleaf weeds	
1. 2,4-D Orchard Master Weedar 64 Opti-Amine Saber Amine 4 2,4-D	1.425 pounds acid equivalent/A 1.5 quarts product/A 1.5 quarts product/A 1.5 quarts product/A 1.5 quarts product/A 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. Do not apply during bloom.
2. carfentrazone-ethyl Aim EW	0.016 to 0.031 pound active ingredient/A 1.0 to 2.0 fluid ounces product/A Apply alone or as a tank mixture with other labeled herbicides as a directed treatment or as a hooded spray to control emerged and actively growing weeds. Good spray coverage of the weeds is essential for good control. Use with a nonionic surfactant or crop oil concentrate. The lower rates may be used to control small susceptible seeding weeds at the 2- to 3-leaf stage. The higher rate is needed to control weeds up to the 6-leaf stage. Do not make applications less than 14 days apart. Do not exceed 7.9 ounces of Aim EW per season (0.124 lb ai/A). Do not apply within 3 days of harvest. Do not use on seedling or newly transplanted trees or allow spray to contact foliage, fruit, or the green bark on trunks.
3. pyraflufen-ethyl (Venue)	0.44 to 2.51 grams active ingredient/A 0.7 to 4 fluid ounces product/A Use as a directed spray to small emerged broadleaf weeds during the dormant season and prior to bloom. Addition of a crop oil concentrate or non-ionic surfactant will enhance control. Keep off green stems and foliage. Good spray coverage of weed foliage is essential for good control. Up to 3 applications per growing season may be made. Allow a minimum of 30 days between applications. Do not apply more than 6.8 fl oz per acre per growing season. May be tank-mixed with labeled herbicides for broad spectrum control.
TEMPORARY CONTROL—Grass weeds	
1. fluazifop Fusilade DX (nonbearing orchards only)	0.25 to 0.375 pound active ingredient/A 1.0 to 1.5 pt 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. sethoxydim Poast	0.28 to 0.47 pound active ingredient/A 1.5 to 2.5 pt 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. paraquat Gramoxone Max Firestorm + nonionic surfactant	0.64 to 1.0 pound active ingredient/A 1.7 to 2.7 pt product/A 1.7 to 2.7 pt product/A 1.0 pt/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.

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WEED CONTROL PROGRAM FOR APPLES AND PEARS (CONTINUED)

Herbicide	Rates*, Application and Remarks
2. glyphosate (Roundup and numerous alternate trade names)	0.75 to 3.75 pounds acid equivalent/A 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. paraquat (Gramoxone Max) Firestorm + nonionic surfactant + 2,4-D (numerous products)	0.64 to 1.0 pound active ingredient/A 1.7 to 2.7 pt product/A 1.7 to 2.7 pt product/A 1.0 pt/100 gal spray solution 0.95 pound acid equivalent/A 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.
4. glufosinate-ammonium Rely (apples only)	0.75 to 1.5 pounds active ingredient/A 3 to 6 quarts product/A 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. oryzalin Surflan AS Oryzalin 4AS	2.0 to 6.0 pounds active ingredient/A 2.0 to 6.0 quarts product/A 2.0 to 6.0 quarts product/A 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. napropamide Devrinol 50DF	4.0 pounds active ingredient/A 8.0 pounds product/A 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. dichlobenil Casoron 4G (cherries only)	6.0 pounds active ingredient/A 150.0 pounds product/A 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.

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WEED CONTROL PROGRAM FOR STONE FRUITS (CONTINUED)

Herbicide	Rate*, Application and Remarks
4. terbacil Sinbar (peach only)	1.6 pounds active ingredient/A 2.0 pounds product/A 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 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. norflurazon Solicam DF	2.0 to 3.9 pounds active ingredient/A 2.5 to 5.0 pounds product/A 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 on label.
6. pronamide Kerb 50-W	1.0 to 3.0 pounds active ingredient/A 2.0 to 6.0 pounds product/A 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.
7. pendimethalin Prowl H ₂ O	1.9 to 3.8 pounds active ingredient/A 2.0 to 4.0 quarts/A Pendimethalin 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. oxyfluorfen Goal 2XL Galigan 2E OxiFlo 2EC GoalTender	0.5 to 2.0 pounds active ingredient/A 2.0 to 8.0 pt product/A 2.0 to 8.0 pt product/A 2.0 to 8.0 pt product/A 1.0 to 4.0 pt product/A 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. isoxaben Gallery 75DF (nonbearing orchards only)	0.5 to 1.0 pound active ingredient/A 0.66 to 1.33 pounds product/A 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 2.5TG) will control grasses.
10. rimsulfuron (Matrix FNV)	1 ounce active ingredient/A 4 ounces product/A Apply preemergence or early postemergence. For maximum preemergence activity, prior to application, the soil surface should be smooth and relatively free of crop and weed trash. Controls several annuals grasses and broadleaf weeds. A repeat application may be made if banded over the tree row. Do not harvest fruit for 14 days. To broaden the weed control spectrum and/or extend the residual effectiveness rimsulfuron may be tank-mixed with other registered herbicides having a different mode of action.

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WEED CONTROL PROGRAM FOR STONE FRUITS (CONTINUED)

TANK MIXES FOR STONE FRUITS

Herbicide	Rate*, Application and Remarks	Herbicide	Rate*, Application and Remarks
11. paraquat Gramoxone Max + nonionic surfactant + oryzalin or norflurazon or norflurazon + oryzalin or oxyfluorfen	0.64 to 1.0 pound active ingredient/A 1.7 to 2.7 pt product/A 1.0 pt/100 gal spray solution 2.0 to 6.0 pounds active ingredient/A 2.0 to 4.0 pounds active ingredient/A 2.0 to 4.0 pounds active ingredient/A 2.0 to 6.0 pounds active ingredient/A 0.5 to 2.0 pounds active ingredient/A	13. oxyfluorfen Goal 2XL or GoalTender + oryzalin or norflurazon	0.5 to 2.0 pounds active ingredient/A 2.0 to 8.0 pt product/A 1.0 to 4.0 pt product/A 2.0 to 6.0 pounds active ingredient/A 2.0 to 4.0 pounds active ingredient/A
12. glyphosate + oryzalin or norflurazon or norflurazon + oryzalin or oxyfluorfen	0.75 to 3.75 pounds acid equivalent/A 2.0 to 6.0 pounds active ingredient/A 2.0 to 4.0 pounds active ingredient/A 2.0 to 4.0 pounds active ingredient/A 2.0 to 6.0 pounds active ingredient/A 0.5 to 2.0 pounds active ingredient/A		

Herbicide Rates*, Application and Remarks

TEMPORARY CONTROL—Broadleaf weeds

- 2,4-D**
Orchard Master
Weedar 64
Opti-Amine
Saber
Amine 4 2,4-D

1.425 pounds acid equivalent/A
1.5 quarts product/A (not on apricots or nectarines)
1.5 quarts product/A
1.5 quarts product/A
1.5 quarts product/A
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.
- clopyralid**
Stinger

0.125 to 0.25 pound acid equivalent/A
0.33 to 0.67 pt 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 two applications may be made during the crop year, but do not exceed a total of 2/3 pt of product per sprayed acre per year. Do not apply within 30 days of harvest.
- carfentrazone-ethyl**
Aim EW

0.016 to 0.031 pound active ingredient/A
1.0 to 2.0 fluid ounces product/A

Apply alone or as a tank mixture with other labeled herbicides as a directed treatment or as a hooded spray to control emerged and actively growing weeds. Good spray coverage of the weeds is essential for good control. Use with a nonionic surfactant or crop oil concentrate. The lower rates may be used to control small susceptible seeding weeds at the 2- to 3-leaf stage. The higher rate is needed to control weeds up to the 6-leaf stage. Do not make applications less than 14 days apart. Do not exceed 7.9 ounces of Aim EW per season (0.124 lb ai/A). Do not apply within 3 days of harvest. Do not use on seedling or newly transplanted trees or allow spray to contact foliage, fruit, or the green bark on trunks.

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WEED CONTROL PROGRAM FOR STONE FRUITS (CONTINUED)

Herbicide	Rate*, Application and Remarks
TEMPORARY CONTROL—Broadleaf weeds (continued)	
1. pyraflufen-ethyl (Venue)	0.44 to 2.51 grams active ingredient/A 0.7 to fluid ounces product/A Use a directed spray to small emerged broadleaf weeds during the dormant season and prior to bloom. Addition of a crop oil concentrate or non-ionic surfactant will enhance control. Keep off green stems and foliage. Good spray coverage of weed foliage is essential for good control. Up to 3 applications per growing season may be made. Allow a minimum of 30 days between applications. Do not apply more than 6.8 fl oz per acre per growing season. May be tank-mixed with labeled herbicides for broad spectrum control.
TEMPORARY CONTROL—Grass weeds	
1. fluazifop Fusilade DX	0.09 to 0.25 pound active ingredient/A 0.375 to 1.0 pt 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. sethoxydim Poast (not on bearing plums or prunes)	0.28 to 0.47 pound active ingredient/A 1.5 to 2.5 pt 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. paraquat Gramoxone Max Firestorm + nonionic surfactant	0.64 to 1.0 pound active ingredient/A 1.7 to 2.7 pt product/A 1.7 to 2.7 pt product/A 1.0 pt/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. glyphosate (Roundup and numerous alternate trade names)	0.75 to 3.75 pounds acid equivalent/A 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



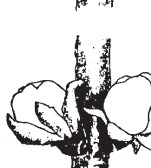
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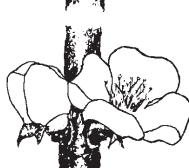
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