# PEAR PEST MANAGEMENT IN THE PACIFIC NORTHWEST

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## INTRODUCTION

The United States is the second largest pear producing country in the world, with the Pacific Northwest (PNW) states producing 66% of the national pear crop. In Oregon and Washington, pears are produced in arid, interior valleys on 45,000 acres by 1,600 growers on an average orchard of 28 acres in size. The four major pear-growing districts are the Wenatchee-Okanogan area in north-central Washington, the Yakima Valley in south-central Washington, the Mid-Columbia region straddling the Columbia River along the Oregon/Washington border, and the Rogue River Valley in southern Oregon.

'Bartlett', 'Anjou' (d'Anjou) and 'Bosc' are the most important varieties (Table 1). Other fresh market varieties are red strains of 'Bartlett', 'Starkrimson', 'Forelle', 'Seckel', and 'Comice'. In the previous 5 years, an average of 16 million cartons of pears (42 lb./carton) were produced for fresh consumption and 155,138 tons for processed use annually.

**Table 1**. Pear production by variety and growing region.

| Variety | Wenatchee-Okanogan | Yakima | Mid-Columbia | Medford | Total acreage |
|---|---|---|---|---|---|
| **Bartlett** | 3,195 | 8,295 | 3,425 | 1,965 | 16,880 |
| **Anjou** | 7,100 | 2,540 | 5,320 | 1,210 | 16,170 |
| **Bosc** | 480 | 845 | 1,020 | 2,610 | 4,955 |
| **Red Bartlett** | 420 | 400 | 470 | 500 | 1,790 |
| **Other** | 285 | 170 | 350 | 2,335 | 3,140 |

## KEY MITE AND INSECT PESTS

The primary insect and mite pests of pear are codling moth, pear psylla, mites, and grape mealybug (Table 2). Over the last 20 years, insect damage and the cost of control have risen substantially. Pear growers currently spend as much as $14 million annually on insecticides. Increasing costs associated with pest control including increased pesticide resistance, reduced pest management options and increased chemical costs have made pear production more challenging.

The evolution of pesticide resistance has disrupted control programs of codling moth, pear psylla, and spider mites. Increased problems with grape mealybug and leafrollers may also be due to resistance. For various biological and economic reasons, including low tolerance for damage, and lack of effective natural enemies, control is dependent on the availability of suitable pesticides. Unfortunately, biological control is presently not an effective option. Current pest control programs are largely based on nonselective insecticides, such as organophosphates (OPs) that kill beneficial insects as well as pests. The 1996 Food Quality Protection Act (FQPA)

specifically regulates these pesticides. It is prudent to expect that the use of these products will be limited in the future.

**Table 2**. Pear insect problems in the Pacific Northwest.

| Insects and Mites | Type of damage | Loss w/o pesticides |
|---|---|---|
| Codling moth | Larval stage (worm) feeds directly on the fruit | Severe |
| Pear psylla | Nymphs (immature stages) feed on leaves and produce a sticky substance (honeydew) resulting in fruit marking. Heavy damage affects subsequent years' yield. | Severe |
| European red mite, two-spotted mite, McDaniel mite, yellow mite, and pear rust mite | All life stages feed on leaves causing damage ranging from partial loss of leaf function to defoliation. Pear rust mites also feed directly on fruit resulting in fruit russeting. | Moderate to severe, depending on pear variety |
| Leafrollers | Larval stage feeds on leaves and fruit | Moderate |
| Box elder bugs, lygus bugs and stink bugs | All life stages feed on fruit | Minor to moderate |
| San Jose scale | All life stages feed on branches, leaves and fruit. Presence of pest on fruit prevents exportation. | Minor to severe |
| Grape mealybug | All life stages feed on leaves, branches and fruit, producing honeydew on the fruit. | Minor to severe, depending on region |

To obtain a long-term stable pest management, it is necessary to develop alternatives to existing programs. Components such as selective pest control, safer pesticides, mating disruption, and cultural tactics must be crafted into a consistently effective integrated program.

Substantial resources are focused on developing and implementing resistance management strategies and tactics that preserve the useful life of currently registered pesticides, fit into integrated programs and optimize the utility of new control tools as they become available. Resistance management programs integrate biological and cultural control programs along with chemical control.

**Codling moth** management has required one to four azinphosmethyl (an OP pesticide) applications depending on pest densities and number of generations. Because there currently are no effective natural enemies of codling moth, pesticides have been necessary to maintain populations below an economic threshold. Pheromone-based mating disruption is used effectively in some orchards in the region. However, the cost of mating disruption exceeds the cost of conventional control programs, thus limiting its adoption.

Two new strategies in addition to mating disruption are being explored. A class of selective insecticides referred to as insect growth regulators (IGRs) show promise as replacements for OP, but none have yet been registered for this use on pears. Through foreign exploration, funded by

the pear industry and USDA, two novel species of natural enemies have been imported and released in limited field tests to evaluate their potential in suppressing codling moth.

**Pear psylla** is being managed during the prebloom with one or two applications of IGRs, available under Section 18 Emergency Use registrations granted by EPA. Summer control of pear psylla is maintained by one or two applications of abamectin, pyridaben, imidacloprid, or amitraz. A complex of predators can provide biological control of pear psylla in certain situations. However, the presence of this complex is dependent on the availability of ecological refugia, alternate prey for these predators, and alternatives to insecticides used against other pests but are toxic to natural enemies. Because of these limitations, reliance on biological control is moving slowly.

***Pear psylla injury.***

**Spider mites** (two-spotted, McDaniel, yellow mite, and European red mite) can be controlled by the application of insecticides, several of which are used against pear psylla. Biological control of spider mites is possible, although the economic damage threshold is very low on some pear varieties, such as Anjou. Pear rust mite can be very damaging in specific orchards and is managed through careful monitoring and application of acaricides when necessary.

**San Jose scale**, grape mealybug, a complex of leafrollers, and sucking bugs are pests of a sporadic nature and/or regional significance. San Jose scale is managed with prophylactic applications of horticultural mineral oil and OP insecticides during the prebloom period and OPs alone during the postbloom period. Current research is aimed at identifying alternatives for scale control, such as IGRs. An increase in research effort is required to identify conditions under which biological control can be effective.

**Grape mealybug** is a serious pest of pear in the Wenatchee-Okanogan district and is the key pest in some orchards. Like pear psylla, grape mealybug produces sugary exudates that can drip on the fruit making it commercially worthless. It is not understood why grape mealybug is such a serious pest in certain regions. Where it is a problem growers rely on two or more OP applications for control. Naturally occurring biological control agents are being studied to determine if they play a role in grape mealybug control. Several 'soft' pesticide alternatives are being evaluated to conserve natural enemies.

**Pandemis and oblique-banded leafrollers** have recently caused increasing amounts of fruit damage leading to additional pesticide applications directed specifically at these pests. Pear growers have turned to prebloom applications of the OP insecticide chlorpyrifos supplemented by summer *Bacillus thuringiensis* (Bt) applications for control. Research directions include developing more effective spray timing, treatment thresholds based on monitoring, mating disruption, biological insecticides and selective IGRs.

**Sucking bugs, including stink bugs, box elder bugs and lygus bugs**, are a regionally sporadic but serious problem. Sucking bugs are particularly troublesome in the Wenatchee River valley and in southern Oregon, particularly in orchards where mating disruption is being used. Growers have limited tools available to control these pests. Research is being conducted to improve sampling methods, predict stink bug development, and determine the potential for biological control.

## PREHARVEST DISEASES

The major preharvest diseases of pear fruit are fire blight, pear scab and powdery mildew.

**Fire blight** is the single most important preharvest disease of pears in the PNW (Table 3). It is perennially present in the primary pear production areas and is occasionally devastating when unseasonably warm temperatures coincide with bloom. Control of fire blight is accomplished through both cultural and chemical tactics. Fire blight strikes are removed as they become visible. Prevention of blossom infection is carried out using sprays of copper compounds and antibiotics (oxytetracycline or streptomycin). Special formulations of beneficial bacteria have been shown to provide partial biological control of fire blight, but must be used with antibiotics under conditions of high disease pressure. Research is focused on finding more effective biological controls and improvement of weather-driven fire blight prediction systems.

**Table 3**. Pear disease problems in the Pacific Northwest.

| Diseases | Type of damage | Loss w/o pesticides |
|---|---|---|
| ***Pre-harvest diseases:*** | | |
| Fire blight | A bacterial disease capable of killing portions or all of the tree | Severe |
| Pear scab | Fungal disease of leaves, shoots, and fruit. | Severe in certain environmental conditions |
| Powdery mildew | Fungal disease that attacks leaves, shoots and fruit. | Severe on clear- skinned varieties |
| Bull's-eye rot | Fungal disease occurring on fruit and branches. | Minor to moderate |
| Phytophthora fruit rot | Fungal disease of fruit and branches | Minor to moderate |
| ***Postharvest diseases:*** | | |
| Gray mold, blue mold, side rot, Mucor rot and Alternaria rot | Fungal diseases that cause fruit to rot in storage | Minor to severe depending on disease |

**Pear scab** attacks fruit and foliage. It is most severe in the higher rainfall areas, where it is controlled by fungicide applications using predictive models based on observations of precipitation, leaf wetness and air temperature.

**Powdery mildew** is most troublesome to Anjou and Comice fruit. Sterol inhibitor (SI) fungicides are used to protect against pear scab and powdery mildew until the period of susceptibility passes. Serious concerns exist about the potential development of resistance to SIs by these organisms. A biological control agent (AQIO, a fungal parasite) is being tested for control of powdery mildew.

***Pear scab injury.***

Diseases such as bull's-eye rot and Phytophthora fruit rot are more sporadic in nature and are controlled by preventive sprays and/or sanitation. Research is underway to understand environmental and host conditions necessary for these diseases to occur in fruit.

## POSTHARVEST DISEASES AND DISORDERS

In a survey of the 1990-1993 crop years, Pacific Northwest pear packinghouse managers reported losses of $1.5 to $2.5 million annually due to postharvest diseases and disorders. These losses are caused by a complex of diseases including: gray mold, blue mold, Mucor rot, Phialaphora side rot, Alternaria rot, bull's-eye rot and others. The fungi can initiate and spread in stored boxes of packed fruit, necessitating costly repacking in addition to direct fruit loss. While stored pears are held under stringent temperature and controlled atmosphere regimes, and are treated with a fungicide, crop size necessitates that a portion of the crop be stored 10 months or longer, increasing the likelihood of decay. The withdrawal of benomyl registration for postharvest use on pears has precipitated a greater incidence of postharvest decay.

Research into biological controls for these diseases has resulted in registration of some products. While these do not offer the necessary level of control, this approach is promising. Currently the pear industry's ability to effectively manage postharvest decay is limited to the use of the fungicides: sodium orthophenylphenate (SOPP), thiabendazole (TBZ), and Captan. Captan, when used in combination with TBZ, is the most effective treatment for postharvest storage decay. Unfortunately, Captan residues are not permitted in some major export markets, limiting its usefulness. TBZ is the most widely used fungicide, but control of the major decay organisms with this product appears to be breaking down. Research is underway to study the biology of how and when these diseases infect fruit. Recent IPM research has led to a greater understanding of preharvest causes of postharvest losses and, in some cases, management options in the orchard that can reduce the likelihood of infection.

Superficial scald, a postharvest physiological disorder of Anjou fruit, has been a major cause of stored fruit losses. Ethoxyquin, an antioxidant, is currently the only effective chemical to manage this disorder. The pear industry is supporting re-registration of ethoxyquin to maintain its use.

The pear industry of Washington and Oregon is currently dependent on very few tools for the control of postharvest diseases and disorders. Because there are no effective alternatives to manage postharvest diseases, the loss of any fungicide or antioxidant without adequate replacement would mean devastating losses to the fruit industry.

## INDUSTRY COMMITMENT TO IPM RESEARCH

The PNW pear industry invests over $365,000 in pear pest management research each year to develop new IPM strategies and tactics critical to the long-term success of the industry. Despite increasing needs and industry support, the availability of research personnel has declined at both state and federal levels in recent years. Current industry-supported research projects, which serve as cornerstones for future IPM programs, are listed below:

### *Grower Funded IPM Insect and Mite Control Projects*

- Development and evaluation of soft pesticide programs
- Codling moth mating disruption
- Particle films for pest control
- Horticultural oils for pest control

- Managing regional pear psylla and spider mite resistance
- Integrated control of grape mealybug
- Pear psylla biology and management
- Biological control of pear psylla using ice nucleating bacteria
- Host cues and oviposition deterrents and codling moth management
- Using sterile insect release (SIR) to manage codling moth
- Monitoring leafrollers with pheromone traps using modified lures
- Thrips management in Hood River
- IPM for stinkbugs

***Grower Funded IPM Disease Control Projects***

- Epidemiology and management of fire blight
- Biological control of fire blight using beneficial bacteria
- Control of gray mold decay in pears
- Pear decay control in stored pears
- Managing superficial scald

## INDUSTRY GOALS FOR PEAR IPM

The Northwest pear industry wishes to develop economical and sustainable pest management programs while delivering a high quality product to the consumers. To reach this objective, the industry has identified a series of goals for its IPM programs:

- Develop and register selective and effective pest control tactics
- Develop and implement pesticide resistance management strategies
- Increase our understanding of pest biology and ecology
- Improve monitoring and prediction systems
- Enhance information and technology transfer.

It is important to recognize that each pear district in Washington and Oregon has distinctly different pear varieties and climatic conditions that require site-specific pest management approaches. Research has shown that there is no single IPM program that can be implemented throughout the Northwest. Instead, IPM programs and supporting research must be tailored to specific regions.

## IMPLEMENTING PEAR IPM GOALS

Specific IPM demonstration and educational activities have been initiated to incorporate these goals into model IPM projects. The largest are included here as examples of the pear industry's commitment to stewardship. All of these projects began as the result of local grower interest in new approaches to pear IPM and each seeks to enhance IPM use.

## MEDFORD CODLING MOTH AREAWIDE MANAGEMENT PROGRAM (CAMP)

This project began in 1995 as a demonstration of the use of codling moth mating disruption, soft pesticides use and intensive orchard monitoring. Project objectives are to minimize negative effects of pesticides, maximize effects of natural control agents and maintain acceptable levels of crop production and quality.

In 1998, the demonstration site grew to 500 acres and included six growers. Sixteen educational meetings were conducted. As a result of this activity, growers in this project were able to reduce synthetic pesticide applications by 79% and lower the overall cost of orchard IPM activities. While damage from perennial pear pests such as codling moth, pear psylla and leafroller was reduced, damage from sucking bugs increased as compared to orchards managed with conventional programs. Each year an extensive report on the impacts of the program is published. Medford CAMP is expected to increase in acreage in the coming years as well as change to meet new IPM challenges.

## HOOD RIVER DISTRICT INTEGRATED FRUIT PRODUCTION (IFP).

In 1994, the Hood River Grower Shipper Association (HRGSA), agricultural chemical companies, independent orchard consultants, and Oregon State University launched an Integrated Fruit Production (IFP) program in the Hood River District. Its goal is economically producing high quality pear and apple fruit using ecologically sound growing practices. Project funding has been provided by local, state and federal sources. This program has been a partner in EPA's Pesticide Environmental Stewardship Program (PESP) since 1996.

The program provides growers with intensive education in all aspects of pome fruit production. Activities include irrigation scheduling using soil moisture monitoring, a district-wide computerized pesticide use recording system, on-farm demonstrations of selective codling moth control with mating disruption, weather station system establishment, use of pest phenology models, orchard monitoring/scouting classes in English and Spanish, grower educational meetings and newsletters/newspaper articles on subjects related to IFP. Preferred IFP production practices are summarized in annually updated IFP guidelines.

## YAKIMA VALLEY PEAR IPM PROJECT

In 1998, Yakima Valley growers, packers, canners, Washington State Horticultural Association and Washington State University initiated a regional IPM project. This project is funded by 3-year, $490,000 grant from the US EPA and the Pew Charitable Trust.

The goal of this project is to implement an environmentally stable and economically feasible pear pest management system to address regulatory concerns of FQPA, and the changing biology of target pests to increase the use of IPM systems that lead to reduction in pesticide risk and improve resistance management. The project will build new capacity within the industry to deliver, monitor and evaluate management systems. The project included 500 acres in 1998which increased to 2,000 acres in 1999.The goal is to increase involvement to 50% of total pear acreage by the year 2000.

## WENATCHEE RIVER VALLEY PEAR IPM PROJECT

In 1999, Wenatchee River Valley growers initiated a regional IPM project in conjunction with Washington State University, Washington State Horticultural Association and EPA Region X.

This project is designed to further existing IPM programs in the Wenatchee River Valley and increase implementation of codling moth mating disruption. In 1999 the project enrolled 16 orchards.

## ASSESSING IPM ADOPTION

These programs are specific examples of broad-based stewardship strategies pursued by the pear industries of Washington and Oregon on a regional basis. Progress toward biologically sound and cost-effective pear IPM systems will be measured by adoption of new practices within each project as evaluated by project participants. Further reductions in the use of the most toxic pesticides along with changes in IPM practices will be monitored through the use of NASS (National Agricultural Statistics Service) pear pesticide use survey data.

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