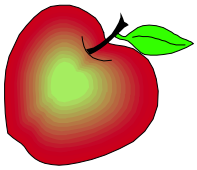
Reducing Food Safety Risks in Apples



A Self-Assessment Workbook for Producers of Apples, Juice and Cider

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Why Should You Take Action?

As a food producer, you can make important contributions to a safe food supply by following good practices in producing and processing apples. Outbreaks of food-borne illness from fresh fruits and vegetables, and unpasteurized cider have steadily increased in recent years (7,10,15). New guidelines aimed at reducing food safety risks are being developed for all groups involved in our food system. Although it is not possible to guarantee complete elimination of harmful pathogens, improved practices *can* greatly reduce potential contamination from bacteria (*Escherichia coli (E. coli)* 0157:H7, *Listeria*, and *Salmonella, etc.*), viruses (hepatitis A and Norwalk), parasites (*Cryptosporidium* and *Cyclospora*) and other microorganisms. Growers can also help insure food safety by following good pest management practices to prevent potential pesticide residues. Whether you sell fresh fruit or make cider, this checklist will help you reduce food safety risks.

Microbial contamination of fresh fruit may occur during *any* part of the production process from field operations to transport to market. Many sources of harmful microorganisms may be hidden or overlooked in your operation. Be alert for potential contamination from your irrigation and processing water, manure and compost fertilizers, animal feces, dropped or decayed fruit, unclean containers and equipment, inadequate worker hygiene or nearby livestock operations. While pathogens can live on the surface of the apples, they may also enter the fruit and survive in the core.

With a food safety assessment under your belt, you will have taken an important step in understanding if your operation has a “High” or “Low” risk for microbial or pesticide contamination. Build on this assessment by periodically reviewing your operation to discover further opportunities to improve your management. By taking voluntary action, you will provide assurance to regulators, retailers and consumers that you are serious about food safety, and reducing risks can help avoid legal problems (2,11).

How can you use this checklist to make improvements?

The checklist will help:

- Identify food safety risks in your operation related to microbial contamination or pesticide management.
- Identify actions to reduce risks and plan to make changes.

How you use it

- Answer the questions in each section that apply to your operation. For questions with a "yes" answer, pat yourself on the back for doing a good job. If you answer questions "no," you should consider actions to reduce risks.
- Read the "Action" information provided for each set of questions.
- Make a list of the questions you answered "no." Develop an action plan using the “Action” guidelines, numbered references, and additional resources listed on the last page. You may also contact your local Extension agent for assistance.

Pre-Harvest

1. Sources of Contamination from Manure/Feces

Yes	No	
☐	☐	If you fertilize with manure, is the manure adequately composted or treated to kill pathogens?
☐	☐	If you fertilize with manure, is it incorporated into the soil at least 120 days prior to harvest?
☐	☐	Do you clean equipment (including tires) used to handle manure before use in orchards or processing areas?
☐	☐	Are livestock excluded from orchards during the growing season?
☐	☐	Do you take steps to keep wildlife from entering orchards?
☐	☐	Is your orchard or packing area located more than 100 feet from where manure is spread or stored or from a facility where livestock are housed?
☐	☐	Are portable toilets serviced regularly and safely to prevent any drainage into the orchard or water sources?

Actions to Reduce Fecal Contamination

Animal manures generally contain harmful pathogens that can contaminate fruit. If possible, avoid using raw manure in orchards. If organic amendments are needed, choose a non-manure based material or an actively composted manure that has met the time/temperature requirements for pathogen reduction (6,10,14,15). Check with the compost vendor for information on methods used, temperature records, and pathogen test results. Alkaline stabilization also reduces pathogens in manure. If using raw manure, incorporate into the soil and allow a minimum of 120 days between application and harvest. Do not top-dress with fresh manure. If feasible, incorporate any manure-based product into the soil to further reduce contamination potential. Keep records of application and harvest dates.

Pathogens from domestic and wild animals in and around the orchard can also contaminate fruit by direct contact (e.g. bird droppings, soil contact), cross-contamination (e.g. unclean containers, pickers' hands from ladder rungs), and indirect sources (e.g. wind-blown dust from nearby feedlots or pastures). Minimize opportunities for feces to contact the fruit. Risks can be reduced by improving manure management in nearby livestock yards including routine cleaning, prevention of runoff and drift, and incorporating manure into the soil after spreading. Where possible, exclude livestock and wildlife from the orchard and processing areas. If birds are a pest problem, discourage them with repellents, noise cannons, flash tape, scare balloons, or netting to reduce crop damage, the incidence of droppings and potential fruit contamination in wounds.

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2. Sources of Waterborne Contamination

If you use well water for spray irrigation, mixing pesticides, cooling fruit, or washing fruit, is your well at least 100 feet from a:

Yes	No	
☐	☐	manure storage facility,
☐	☐	livestock area,
☐	☐	septic system drainage field, or
☐	☐	discharge area for milk house wastewater?
☐	☐	Do you test your well water sources for fecal coliform microbes at least once per year?
☐	☐	Have you installed a backflow prevention device or other system to prevent contamination of clean water supplies by potentially contaminated water?
☐	☐	Have you formally evaluated pollution risks to your well using Farm*A*Syst worksheets? (See reference 17)

If you use surface water for irrigation and cooling:

Yes	No	
☐	☐	Do you use drip, under-tree, or low volume spray irrigation to reduce water contact with fruit?
☐	☐	If you use overhead irrigation or evaporative cooling, do you test your irrigation water for fecal coliform concentrations during the growing season?
☐	☐	If livestock operations are located nearby the irrigation source, are animals excluded?
☐	☐	Do you use only potable water to apply foliar applications including pesticides, nutrients, and growth regulators?

Actions to Reduce Waterborne Contamination

In the orchard, water comes into direct contact with fruit during irrigation, foliar application of fertilizer, pesticides, and growth regulators, and overhead cooling. Water can carry *Escherichia coli (E. coli), Salmonella* spp., *Cryptosporidium, Giardia,* and the Norwalk and hepatitis A viruses, etc. that may contaminate fruits and vegetables (10,15). Even in small amounts, these microorganisms can cause food-borne illness. Pathogens can survive both on the surface of apples and within the core if absorbed. Take care to insure the quality of your water source used for these practices.

If you use municipal water or potable well water there is little risk of contamination. Maintain your well in good working condition, making sure the casing is intact. Protect the well from potential contamination by excluding livestock, manure storage, and septic tanks from well recharge zones. (15,17) Simple actions such as installing a backflow prevention device enable you to reduce risks. Test your well water for fecal coliforms (*E.co1i*) 1-2 times annually, and pay special attention to tests if you have pollution sources near your well. If a well tests positive for *E. coli*, be sure to treat before use. Annual testing of private water sources may be a requirement if you are processing foods, e.g. cider, sauces and jam. If you have irrigation district

water, *and* a well or municipal water source, be certain there is no cross connection between your lines.

Surface water is a major source of irrigation in orchards. Be aware that there may be a significant risk of contamination when surface water comes in direct contact with fruit. To reduce the risk, limit water contact with fruit by using under-tree irrigation, and use potable or treated water for any foliar applications of materials that will contact fruit. Try to maximize the time between the last overhead irrigation and harvest; exposure to ultra-violet light may help to reduce concentrations of pathogens. Test your water for the presence of *E. coli* as an indicator of contamination risk. This is especially important when using overhead sprinklers for irrigation or cooling because pathogens may come into direct contact with the fruit, or even be absorbed into the core. Since surface water quality is so variable, tests should be made 3-4 times during the growing season. Field kits are available to test for presence of fecal coliforms and require an incubation time of only 24-48 hours (3)[1]. If your water is *E. coli* positive, have a certified lab analyze a sample for the population density of *E. coli* and for presence of any other harmful organisms . Unfortunately, it is not clear what level of *E. coli* is safe for irrigation water (10). Be sure that fruit for market is washed only with potable water, not irrigation water.

Keep records of all test results, and dates of irrigation, foliar applications and harvest.

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[1] Mention of brand or firm name does not constitute an endorsement by WSU Cooperative Extension.

1. Harvest Practices

Yes	No	
☐	☐	Do you encourage workers to pick only marketable fruit, and provide training on ways to reduce fruit bruising and damage during harvest?
☐	☐	Do you collect and properly handle dropped apples which should only be used for pasteurized or cooked products?
☐	☐	Do you avoid cross-contamination from dropped apples by using separate containers to collect them and by washing hands after contact?
☐	☐	Do you properly cull and dispose of decayed, damaged, or wormy fruit?
☐	☐	Are totes, bins, and other storage containers cleaned and sanitized before use in the field?

☐ ☐ Do you inspect and repair or discard containers that are damaged?

☐ ☐ Do you use plastic bins or plastic bin liners?

☐ ☐ When you stack containers, are apples in the lower container free from contact with the bottom of the upper container?

☐ ☐ When climbing ladders, do individuals place their hands on the side rails when possible?

☐ ☐ Do you clean and disinfect storage facilities before harvest?

2. Worker Hygiene

Yes	No	
☐	☐	Are workers instructed to wash their hands before starting work, after handling dropped apples, and after using the toilet?
☐	☐	Are workers instructed to wash their hands before and after eating and smoking?
☐	☐	Do workers and others who pick apples have convenient access to properly equipped hand washing stations and clean restrooms in the field and near the processing area?
☐	☐	Do you provide workers training about basic sanitation and good hygiene?
☐	☐	Do you provide instruction in languages other than English if necessary?
☐	☐	Do you exclude workers who have symptoms of infectious illness, or reassign them to jobs that do not involve direct contact with food?
☐	☐	Do you require workers to cover open wounds with water-proof bandages and provide disposable gloves to prevent food contamination?

Actions to Reduce Contamination Risks During Harvest

During harvest, apples may become contaminated with microbes from contact with the ground, decayed fruit, containers, and workers with poor hygiene or infectious diseases. Your goal is to reduce the chance that apples will come in contact with sources of contamination.

Train your workers to pick apples carefully, to reduce bruising and damage, and to pick only marketable fruit. Picking apples one at a time, gently placing each into the picking bag and avoiding pressing apples between the picker and ladder or branches while reaching to pick will help reduce damage (4,8). Apples bruise more easily when picked wet or near-frozen. Dropped apples may pick up microbes from feces on the ground, and damaged or decayed fruit can support the growth and reproduction of dangerous microbes. Do not use dropped, damaged or decayed fruit for fresh market or cider production. Instruct your workers to place such fruit into designated bins to prevent contamination of marketable fruit.

Harvest containers can harbor microbes. Your best protection is to wash and sanitize all containers thoroughly each day. Prevent workers from standing in bins during harvest. Stacking open or damaged containers allows contamination to pass from apples in one container to those in another, particularly if fruit is touching the container above them. Bins and totes should be covered during storage to prevent access by rodents and birds. Ladders should be placed upright against walls or buildings when not in use. Ladder rungs may pick up contamination from boots and should be cleaned regularly. Encourage workers to use only the side rails for hand holds to help prevent spreading microorganisms to the fruit. Storage facilities should be cleaned and sanitized before harvest. Transport bins to covered storage as soon as possible.

Workers who handle fruit can transmit diseases such as *Salmonella, E.coli 0157:H7*, Shigella and hepatitis A. Prevention starts with clean hands. Supply soap, fresh water and single-use disposal towels for hand washing. Providing worker hygiene training, adequate toilet facilities and instructions on the importance of hand washing can help prevent the spread of diseases (10,13,15). Develop a sanitation training program for all your employees. Become familiar with signs of infectious illnesses and exclude sick workers or reassign them to jobs that do not require coming in contact with the fruit. Instruct workers to report any illness before beginning duties. Keep water-proof bandages and gloves on hand, and provide them to workers when needed for covering open wounds. If you run a U-pick operation, ask customers to wash hands before and after picking the fruit.

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1. Facility and Worker Sanitation

Yes	No	
☐	☐	Do you wash and disinfect floors, and packing and processing facilities each day?
☐	☐	Do you wash and sanitize all brushes, lines, belts and other equipment that come in contact with fruit at the end of each day?
☐	☐	Do you have a pest control system to minimize rodents, insects and other pests in the processing and storage areas?
☐	☐	Do you prevent pets, livestock or wildlife from coming within 25 feet of areas where apples are processed or stored?
☐	☐	Are worker hygiene guidelines being promoted?
☐	☐	Do field workers change footwear and clothing before entering packing and processing facilities?

2. Processing Sanitation

Yes	No	
☐	☐	Before washing, are apples inspected, and damaged or decaying fruit discarded?
☐	☐	Do you use only potable water to wash, or treat fruit?
☐	☐	Are dump tanks, flumes and wash tanks cleaned and sanitized before use?
☐	☐	Do you use chlorine in your wash water?
☐	☐	If so, do you monitor the wash water to maintain an adequate level of chlorine and water pH of 6.5 – 7.5?
☐	☐	Do you change the water in the primary dump tank whenever water is dirty?
☐	☐	Do you maintain water temperature close to the apple temperature to prevent absorption into the core and to maintain fruit quality?
☐	☐	Do you provide a final wash for apples with potable water to remove any sanitizer residue?
☐	☐	Is fruit refrigerated and stored in a clean facility?

Actions to Reduce Contamination Risks During Processing

Good management practices and sanitation can significantly reduce the risks of microbial contamination when packing and processing apples. Regular maintenance of the packing shed and processing facilities is important (8,10,13,15). Keep washing and packing areas clean; wash and sanitize floors, walls, lines, belts and all equipment each day. Pay special attention to surfaces that come in direct contact with fruit. Prevent animals or pests from entering the processing area. Use screening as necessary. These guidelines are intended to complement the Food and Drug Administration requirements (21CFR110) for food processors (13). Be sure to be familiar with all federal and state requirements.

Promote worker hygiene guidelines as described in the Harvest section. Adequate toilet and hand washing facilities are essential. Fieldworkers should change footwear and clothing, and wash their hands before entering post-harvest facilities. No worker should be permitted to handle fruit if they have an infectious illness or uncovered wound. Instruct workers not to eat or smoke in any packing or processing areas.

Water for washing and processing should meet drinking water standards. Using chlorine in wash water helps to minimize the introduction or spread of pathogens. Effective washing can reduce pathogen numbers by 10-100 fold but will not guarantee complete elimination (15). Chlorine (e.g. sodium or calcium hypochlorite) may be added to wash water for apples at a concentration of 50-100 parts per million of total chlorine (5,10,15). Monitor wash water several times a day, using a chlorine test kit, and maintain free residual chlorine concentration from 25–50 ppm (8;

D. Dougherty, personal communication). Water pH should be in the 6.5-7.5 range to keep chlorine active. Water in the primary dumptank quickly becomes loaded with soil and plant debris and should be changed whenever it gets dirty to maintain the effectiveness of the chlorine wash.

Give fruit a final rinse with potable water to remove any residue from sanitizing chemicals used for processing or cleaning equipment. Apples should be refrigerated at approximately 34 ^{o}F to suppress the growth of human pathogens and maintain fruit quality. Check with state regulators, or your local health department, for more information on your options.

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3. Cider and Juice Pressing

Yes	No	
☐	☐	Does your cider pressing facility meet state requirements for food processing?
☐	☐	Are apples held in cold storage until pressing?
☐	☐	Do all apples used for cider meet the standards for “U.S. Cider Grade”?
☐	☐	Do you only use filter cloths specifically designed for cider pressing and replace them as needed?
☐	☐	Do you use press racks made of food-grade plastic or wood properly protected by a food-approved coating?
☐	☐	Is the press rack and other equipment kept off the floor at all times?
☐	☐	Between runs, do you place filter clothes over a clean line or in a clean container?
☐	☐	Do you use pumps and tubing that are approved for food use?
☐	☐	Do you use continuous tubing and limit couplings to as few as possible?
☐	☐	After each day's use, do you adequately clean all equipment to remove fruit particles and film and then sanitize?
☐	☐	After each day's use, do you clean and sanitize press filter cloths, rack and tubing?
☐	☐	Do you test sanitizing solution to ensure proper concentrations?
☐	☐	Do you enforce sanitation rules such as hand washing and hair nets or caps for workers?

☐ ☐ Do you follow precautions and restrictions when using pesticides to prevent the contamination of food or packaging materials with illegal residues?

☐ ☐ Do you clean and sanitize surfaces that come in contact with food after pesticide spraying and before food processing?

☐ ☐ Do you use new containers to package your cider or juice?

☐ ☐ If you do not pasteurize your cider or juice, does label information contain an FDA required warning?

☐ ☐ Do you keep records for each container that enable you to identify the press date, apple source, and where the container was marketed?

☐ ☐ Do you have a system to insure that the oldest product is sold first?

☐ ☐ Do you have a procedure in place to respond to food safety complaints?

☐ ☐ Is waste water drained properly into the sewer or a septic system separate from the toilet system?

☐ ☐ Do you promptly remove and properly dispose of pressed pomace?

Actions to Reduce Risks in Cider and Juice Processing

Cider producers face significant safety concerns and responsibilities. Make every practical effort to ensure the quality of your product and prevent any outbreak of food-borne illness. Microorganisms that can contaminate cider or juice may come from (1) fresh fruit, especially if it is picked from the ground, or is decayed or damaged, (2) the facility, equipment, and water, or (3) people involved in making cider.

Safe cider guidelines build on the basic concepts for washing and packing: maintain clean and sanitary conditions, ensure worker hygiene, and reduce opportunities for contamination from contact with the ground, pests or animals. *Do not use dropped fruit for unpasteurized cider*. Keep your operation in line with state and federal requirements for food processors and have your facility inspected and licensed prior to operation (8,10,15,16,17).

In January 2001, the Food and Drug Administration released a final ruling to improve the safety of fruit and vegetable juices (16). The ruling requires producers to use Hazard Analysis and Critical Control Point (HACCP) practices and achieve a 5-log kill of pathogens by pasteurizing or treating the juice/cider. Businesses who *only sell directly to consumers* are exempt from this ruling but must continue to use the following warning label that has been in effect since 1999 for untreated cider or juice (12):

> **WARNING:** This product has not been pasteurized and therefore may contain harmful bacteria that cause serious illness in children, the elderly, or persons with weakened immune systems.

The label must have the word **WARNING** set in bold capitalized letters and a type size no less than one-sixteenth of an inch in height. The warning label must be set off in a 'hairline' box from the rest of the label information. Point-of-purchase signs can have a type size no smaller than

one-quarter (1/4) inch in height. Processed food product labels are also required to list the following information :

- Product name
- Ingredients
- Net quantity
- Name, address, and zip code of the manufacturer, packer, or distributor
- Pack, open, pull, freshness, or expiration dates
- Keep Refrigerated
- "Fresh Unpasteurized" bottle and cap labels

See Reference 12 for complete label specifications.

Cider should be cooled quickly and stored at 32-36^{o} F. Establish a record keeping and traceback system to document all phases of production including the grower, processor, packer and market for each lot of cider. Records should identify the product by name, size and lot number and should include sanitation measures, and operating and monitoring procedures. Develop a system to sell oldest product first.

Consult with your local or state health department about proper disposal of apple pomace or wastewater.

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4. Marketing

Yes	No	
☐	☐	Are trucks cleaned, sanitized and inspected before transporting fruit to market?
☐	☐	Do you only use new or clean containers and load them carefully?
☐	☐	Are apples, cider and juice refrigerated during transport and at market?
☐	☐	Do you educate sales staff to use proper hygiene while at a farmer's market or roadside stand?
☐	☐	Are hand washing facilities available for employees who might be cutting or pouring samples, and for customers to use before picking up a sample?
☐	☐	Does your staff select the produce for the customer?
☐	☐	Do you provide toothpicks as a method for customers to sample without touching other pieces of fruit?
☐	☐	Does your staff remind customers to wash the fruit when they get it home?
☐	☐	Does your staff provide information on storage and refrigeration to customers?
☐	☐	If produce has been handled by the public while at market, do you wash and sort unsold produce before taking it to another market, or restaurant?

Actions to Reduce During Marketing

Trucks should be cleaned and sanitized before transporting fruit to market. Avoid using any vehicles for fruit if they have been used to haul manure, compost or animals. Load fruit carefully to prevent damage or contamination. Use new or clean containers, provide adequate circulation of air, and prevent apples from touching undersides of containers. If possible, keep fresh fruit refrigerated during transport and at market. Cider and juice should be refrigerated at 32-36^{o} or kept frozen. Ensure that each container is labeled properly. Keep adequate records that verify actions taken to ensure the safety of your product.

Train all sales staff to use proper hygiene. If your farmer's market or roadside stand does not have hand washing facilities available, provide a five-gallon container with a spigot, soap and towels, or hand sanitizer. Educate your staff to wash their hands frequently, select fruit for the customers, and to remind the buyers to wash the fruit at home before eating. Sales staff could also offer safety tips on proper storage and refrigeration. Post signs to encourage customers to wash hands before sampling or selecting fruit.

If you sell your remaining produce at another market, consider whether you need to re-wash or sort produce before displaying again. If you are taking the produce to a restaurant, be certain it has been sanitized one last time.

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1. Pesticide Risks

Yes	No	
☐	☐	Do you review current pesticide labels for changes in crop registration, use, pre-harvest interval, and other instructions prior to the pest control season?
☐	☐	Do you have a plan to use new pesticides and other strategies to control pests in response to government-imposed changes in labeled use of pesticides?
☐	☐	At the start of every season, do you review last year's pest management problems, controls used, and develop a pest management plan that anticipates adjustments?
☐	☐	Do you or a qualified consultant monitor your orchard weekly for pests and natural enemies throughout the growing season?
☐	☐	If you monitor your own orchard, do you have sufficient training in the identification and life histories of pests and beneficial insects to be able to make informed pest management decisions?

☐ ☐ Do you receive and maintain records of pest monitoring results, in addition to required pesticide application records (date, field identification, target pest, pesticide name and EPA number, formulation, rate and number of acres treated)?

☐ ☐ Do you apply pest control sprays only when the benefits outweigh the risks of potential crop loss; do you rely upon treatment thresholds for pests when this information is available?

☐ ☐ Do you use pesticides designed to kill specific pests instead of broad-spectrum pesticides that may kill natural predators?

☐ ☐ Do you apply pesticides selectively (e.g. spraying only sections with highest pest densities, or spraying alternating rows?

☐ ☐ If they are available do you rotate use of pesticides with different modes-of-action as part of a pesticide resistance management plan?

☐ ☐ Are you certain you spray pesticides on or before the last date required to meet the "pre-harvest interval"?

☐ ☐ When selecting cultivars and rootstocks to plant do you choose those that have resistance to diseases or insects when available?

☐ ☐ Do you use mating disruption as a tactic to control codling moth?

☐ ☐ Do you use pheromone traps to monitor the presence, density, or annual cycle of Lepidopteran pests that occur or might occur in your orchard?

☐ ☐ Do you use degree day models to predict the optimum timing for pesticide applications or monitoring activities?

☐ ☐ Do you use "soft" alternative tactics including *Bacillus thuringiensis (B.t.)* or mating disruption to manage leafrollers in an effort to conserve natural enemies?

☐ ☐ Do you remove diseased or infested branches and leaves from the orchard?

Actions to Reduce Pesticide Residues

The U.S. Environmental Protection Agency has increased its scrutiny of pesticide use in an effort to reduce potential food safety risks, especially risks to children. Consumers are also requesting the use of pest control methods that reduce residues on food and protect the environment. Retailers are seeking products grown using Integrated Pest Management (IPM) to meet consumer demand.

Producers can take positive steps to respond to changes in government policy and consumer preferences. Safe pesticide use depends on your knowledge of the latest and best information. Keep up-to-date on pesticide restrictions and bans imposed under the Food Quality Protection Act (FQPA) as materials are reviewed for their health and safety impacts. Current information is as close as a pesticide's label. Even if you have used a product before, take time every year to

review the current label for changes. For up-to-date information contact the "Pesticide Information Center On-Line" (9) or your Extension office.

Integrated Pest Management (IPM) can help growers reduce potential health and environmental risks related to the control of pests. To implement a successful IPM program:

- Understand pest life cycles
- Gather current information about pest populations and development
- Obtain sufficient knowledge to make informed management decisions
- Use the least-toxic control techniques that will be effective

Prior to taking a pest control action, determine whether the pest is present, and if so, at levels exceeding an action threshold. If action is necessary, first consider non-pesticide options (e.g. mating disruption, predators) or low toxicity pesticides (e.g. oils, *B.t.*, soaps, etc.). Use a selective pesticide in place of a broad-spectrum pesticide if possible, and consider treating problem areas only. Proper pesticide management also includes recordkeeping, sprayer maintenance and calibration, and required notification and re-entry intervals (1,4).

Using these strategies, growers can minimize potential pesticide residue risks. Effective IPM can protect your health, and that of your family and workers. It may also save you money. Excellent IPM resources are available. For examples, review the Additional Resources/Pest Management section at the end of this publication.

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Harvesting, Processing and Cider Making

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Pest Management

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Washington State University Cooperative Extension Bulletins:

- Crop Protection Guide for Tree Fruits in Washington (EB0419)
- Pacific Northwest Insect Control Handbook (MISC 0047)
- Pacific Northwest Disease Control Handbook (MISC0048)
- Pacific Northwest Weed Control Handbook (MISC 0049) *Published by the three Northwest land-grant universities these guides give specific recommendations for pesticide use on crops etc. and are updated annually.*
- Ultrasonic and Subsonic Pest Control Devices. (EB 1663)
- Concepts of Integrated Pest Management in Washington. (EB0753)

WSU Extension publications can be ordered on-line at http://pubs.wsu.edu, by contacting the WSU Cooperative Extension Bulletin Office at 1-800-723-1763 or by e-mail at bulletin@coopext.cahe.wsu.edu

Liability

- Copeland, J. Understanding the Farmers Comprehensive Personal Liability Policy: A Guide for Farmers, Attorneys, and Insurance Agents, Available for $20 from the National Ctr. for Agric. Law Research and Info, 147 Waterman Hall, University of Arkansas, Fayetteville, AR 72701 - http://law.uark.edu/arklaw/aglaw
- Hamilton, N. The Legal Guide for Direct Marketing, available from N. Hamilton for $20 at Drake University Agricultural Law Center, Des Moines, Iowa 50311 http://www.law.drake.edu/lawCenters/agLawCenter/publications.html
- University of Wisconsin. Managing Liability in the Field. http://bluto.uwex.edu:80/farmasyst/slides/liab/liabsli/liabtab.html
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