PEST MANAGEMENT

HOW DO I MANAGE PESTS (INSECTS AND MITES OR ARTHROPODS, DISEASES, WEEDS, NEMATODES, AND VERTEBRATES) IN A SUSTAINABLE WAY THAT MINIMIZES ECONOMIC, HEALTH, AND ENVIRONMENTAL CONCERNS?

CHECKLIST OF QUESTIONS TO ANSWER:

1. Is integrated pest management (IPM) part of my grape production program?

IPM, which plays an integral role in grape production, is a cost-effective, long-term approach to managing pests. IPM combines biological, cultural, and chemical tools to minimize economic, health, and environmental issues. It involves a broad-based strategy and takes a systems approach to pest management.

2. What are the components of IPM?

- Crop growth
  - Do I understand the basic growth stages of the crop?
  - Do I understand the relationship between plant health and vigor and pests?
  - Do I understand the impacts between canopy management and irrigation systems and pest populations?
- Pests and natural enemies
  - Do I understand the basic interactions of pests and their natural enemies and control?
  - Do I understand the environmental impacts on pests and natural controls?
  - Do I understand the critical growth stages of both pests and natural controls, and know what causes pest populations to change?
  - What is the pest's weak link that I can use to help control pests?
- Monitoring program
  - Have I instituted a pest monitoring program to assess pest population levels in the field on a regular basis?
  - Am I monitoring for natural predators or biological controls to know if insect enemies are present and at what level?
- Economic thresholds
  - Am I making pest control decisions based on established or unofficial economic thresholds? Economic thresholds are levels of pest populations that can cause economic loss if no action is taken to control or reduce pest numbers.
  - Am I aware that I may need to develop my own economic thresholds for my particular situation and market?
  - Am I considering all costs involved with pest control (paperwork, work interruptions from pesticide worker re-entry waiting periods, and potential secondary outbreaks) when establishing economic thresholds?
- Evaluation of control techniques
  - Am I considering all available control techniques (chemical, cultural, biological, behavioral and genetic control) and their effects on the environment, pests, predators, and worker safety before choosing the method most appropriate for my particular situation?
  - Am I watching for the cause and effect of my pest control activities and other vineyard operations?
  - Am I pursuing IPM with the understanding that it doesn't offer a cookbook approach to farming, but is a process to identify and solve problems by continually refining strategies?

3. Pest Management – Insects and Mites

There are several insects and mites or arthropods in the Pacific Northwest that can reach detrimental levels and cause economic impact.

- Clean material
  - Have I obtained planting material that is free of pests? A strong defense against insects is a good offense. Clean material can prevent the introduction of exotic pests, which is why there are state pest quarantine regulations for grape planting material from out-of-state sources.
- Identification
  - Can I identify the insects and mites that exist in my vineyard? Do I know their overwintering sites? Do I know their susceptible growth stages? A pest control consultant should be used if I am unfamiliar with insect and mite identification and their growth stages.
  - Can I identify beneficial predators?
  - Am I aware of neighboring crops and their potential to harbor insects detrimental to grapes? (i.e. field corn)
  - Key insect and mite pests in Washington State (not a complete list)
    - Western grape leafhopper, Virginia creeper leafhopper
    - Grape mealybug
    - Cutworms (spotted, redbacked, and other species)
    - Mites (McDaniel, two-spotted spider, bud, grape leaf rust, brown)
    - Western flower thrips, grape thrips
  - Minor or occasional insects of Washington State
    - Black vine weevil
    - Cottony maple scale
    - Phylloxera (isolated locations)
    - Sharpshooters (can vector devastating diseases but generally don't in Washington)
    - Ten-line June beetle
    - Multi-colored Asian ladybug beetle
- Monitoring
  - Monitoring equipment should include a hand lens with a 10x magnification.
    - Am I scouting for insects, mites, and beneficial predators on a weekly basis?
    - Do I have a record keeping program in place to record numbers, track populations over time, and evaluate pest damage?
    - Am I sampling leaves to look for pests and beneficials?
    - Am I sampling for insects and mites in hotspots and in locations where they will most likely be found?
- Determine thresholds and damage levels for pests
  - Have I established economic thresholds and economic damage levels for the insects found in my vineyard?
    - Researchers are developing thresholds for Washington growers, though numbers have not yet been published. In the absence of published economic thresholds, growers should develop their own thresholds by evaluating monitoring data and damage levels at the end of each season and comparing historical data with new information.
- Unofficial economic thresholds for Washington grape growers:
  - Early season (shoots are six inches in length or less):
    - Cutworms - Monitor at night 90 minutes to 2 hours after sunset. If two strikes per vine are found, spot treat where necessary.
    - Grape mealybug - A nuisance pest unless grape leafroll virus is present. If mealybug is present, vines should be tested for virus. If virus is found, close attention must be paid to mealybug to avoid spreading the virus. Consider spot treatment when taking action to control mealybug.

        - Thrips- Consider treatment or spot treatment when 10 to 20 thrips per slap are found (shoot tips are slapped against dark paper and thrips are counted).
    - Mid season
        - Leafhoppers- Monitor nymph numbers during first brood. Treatment should be considered if 15-20 nymphs per leaf are found or 100 percent of leaves are infested in the second generation. Monitor for presence of *Anagrus* wasps during the first and second leafhopper generations. If low to medium levels of parasitism occur in the first and second leafhopper generations, there is good potential to control mid to late summer leafhopper populations.
        - Mealybug – Consider treatment or spot treatment if virus is present.
    - Mid to late season
        - Spider mites – Treatment should be considered if 15 to 25 mites per leaf are found during sampling.
        - Mealybug – Consider treatment if honeydew secretion will be a problem.
- Choice of control methods

  Conservation and biological control is the preferred method of insect and mite control. *Always read and follow the label carefully before using any insecticide or miticide to note timing, volume, nozzle size, rate, worker reentry and days to harvest intervals and any restrictions. Avoid drift.*
    - Am I considering predatory mites and beneficial insects when I make my chemical control choices?
        - Predatory mites, when present in sufficient numbers, are capable of reducing pest mite numbers to below the economic threshold.
    - Use materials that preserve beneficial insects and mites. Broad spectrum pesticides kill non-target insects and mites. Also, some fungicides are harmful to predatory mites.
    - Consider leaving a small check area for borderline applications to evaluate efficacy and assess if insect population levels are truly problems. Use information when making control decisions in the future.
- Adopt cultural practices to help control insects
    - Sound cultural practices (canopy management, dust control, nutrition and irrigation) that reduce canopy congestion and temper vine growth can help minimize pest problems.
    - Proper site selection helps assure early ripening and healthy vine growth and can help prevent insect damage.
    - Cover crops, insect refuges, riparian habitat, and even adjacent crops can help attract beneficial insects. For more information, see Soil Surface Management for cover crop discussion.

4. Pest Management - Diseases

Diseases are the most damaging of pests in Washington to fruit quality. Grape powdery mildew, *Botrytis* bunch rot, sour rot, grapevine leafroll virus, and crown gall are widespread diseases that can be problematic for growers.

- Some varieties are more susceptible to powdery mildew. Chardonnay, Chenin Blanc, and Cabernet Sauvignon are highly susceptible, while White Riesling and Merlot are moderately susceptible.
- Varieties with tight-bunched, thin-skinned clusters are susceptible to bunch rot; crown gall can be a problem after vines have sustained winter injury or mechanical damage.

Grapevine leafroll virus affects the long-term health of the vineyard and causes quality problems by delaying maturity. Prevention is the only control option because there is no cure once vines become infected with viruses.

- Clean material
    - Have I obtained planting material certified to be free of viruses (leafroll, fanleaf, corky bark) and phylloxera? If certified stock is not available, planting material can be indexed or tested to be sure that it is virus-free.
    - Did I visit the nursery to see first hand the health status of the planting stock?
    - Did I start my vineyard with healthy, vigorous stock?
    - Am I controlling insects in my vineyard that can vector viruses, such as grape mealybug?
- Site history
    - Does the site have a history of viruses or diseases from previously grown crops?

        - Some diseases, like crown gall *(Agrobacterium vitis)*, can persist in living grape roots for years after vineyards have been removed. Vineyards with cold temperature pockets are more susceptible to winter kill, which can lead to crown gall.
    - If the site has previous virus or disease history, remove as much rooting material as possible and consider fallowing land to allow time for roots to decay.
    - Do I know what previous pesticides were used on the site?
    - Is fumigation avoidable?
        - Virgin ground is usually not fumigated, but pre-plant fumigation is considered in sites that grew tree fruit or crops that harbor grape viruses and nematodes. Fumigation may not eradicate bacteria but will kill roots from previously infected vines to the depth of fumigation.
    - Are diseases like powdery mildew or leafroll virus present in adjacent or surrounding vineyards?
    - Is adjacent vegetative material a host for insects or diseases?
- Identification and Understanding
    - Can I identify virus and disease symptoms?
    - Do I know the vectors of grape diseases?
    - Do I know when the risk/pressure is high for disease incidence to occur?
- Common Viruses and Diseases in Washington State
    - Viruses:
        - Grapevine leafroll virus
        - Rugose wood disease complex
        - (Rupestris stem pitting, corky bark)
        - Grapevine fanleaf virus
    - Diseases:
        - Grape powdery mildew
        - *Botrytis* bunch rot
        - Sour rot
        - Crown gall
        - Phytophera (root rot)
- Monitoring
    - Am I scouting weekly for disease symptoms, especially in high pressure situations?
    - Do I keep written records of my vineyard monitoring?
- Controls

  Always read and follow the label carefully before using any fungicide to note timing, volume, nozzle size, rate, worker reentry and days to harvest intervals, and any restrictions. Avoid drift.
    - Do I implement cultural techniques to help prevent disease incidence and break disease cycles?
        - Examples of cultural practices include using trellis, training systems, and management practices that allow good air movement and prevent excess shading, removing leaves or shoots, using irrigation scheduling and judicious fertilization to control canopy growth and allow penetration of chemical sprays, and following vineyard sanitation practices (sweeping berms, chopping prunings, or removing infected prunings from vineyard).
    - Am I using weather data and a predictive model to indicate the level of powdery mildew disease risk and to schedule appropriate spray intervals for the correct material instead of spraying by the calendar?
        - Do I follow resistance management practices (rotating fungicides with different modes of action and avoid using any one fungicide class more than three times in a growing season) to preserve available fungicides?
        - Visit http://www.fruit.wsu.edu/Diseases/Stewardship.htm to learn more about fungicide resistance management.
        - Do I consider using reduced-risk fungicides?

- Do I understand potential problems from using reduced-risk fungicides (i.e., sulfur and light oils) that can exacerbate mite problems and cause leaf burn?
- Do I follow field sanitation practices involving workers, equipment, plants, stakes, etc., to prevent spread of insects that vector viruses?

5. Pest Management - Nematodes

Nematodes are plant parasitic, unsegmented worms that feed on plant roots. The microscopic worms reduce water and nutrient uptake by the plant, impacting vigor and yield, and they can transmit viruses and assist fungi in entering roots. Five nematode species are present in the Northwest, with the root knot nematode and dagger nematode the most problematic in Washington State.

- Monitoring
  - Cropping history is very important when considering potential nematode problems and is particularly important when previous crops included mint, potatoes, tree fruit, alfalfa, and corn.
  - Soils should be sampled to monitor nematode populations at pre-plant, generally from February through mid-March, and at the end of the growing season in October and November in established vineyards. Sampling should be done when the soil is moist and soil temperature is above 50° F.
  - Samples of soil and roots from within the row should be assayed for nematodes. Take samples about a foot from the trunk and a foot deep after removing the top few inches of topsoil.
  - Economic thresholds for nematodes have not been set yet for Washington, but yield loss has been associated with populations of 10 to 25 or more dagger nematodes per 250 cubic centimeters of soil if viruses are present and 200 to 300 root knot nematodes per 250 cubic centimeters of soil.

- Common nematodes in the Northwest
  - Root knot nematode
  - Dagger nematode
  - Ring nematode
  - Root lesion nematode
  - Citrus nematode

- Controls
  - If nematodes are present in sampling, fumigation of soil before planting is effective. Control with nematicides after vines are established is more difficult. Chemicals must be incorporated into the plants' root zone through drip irrigation or ground application. Information on fumigation can be found in the *Pest Management Guide for Grapes in Washington*.
  - Research is studying alternative nematode treatments, including green manures, cover crops, and bionematicides.

6. Pest Management - Weeds

Weeds compete with vines for water, nutrients, and sunlight, harbor insects, and can reduce vine growth and yields. Weeds interfere with management objectives for a given area of land at a given point in time, but they can be beneficial. Weed control is especially important in young plantings under three years old that are still developing their root systems. In mature, established vineyards, competition from weeds is greatest under drip irrigation zones. Weeds can also interfere with harvest operations, pesticide spray operations, and contaminate mechanically harvested grapes with MOG (material other than grapes).

- Benefits
  - Are there benefits to the presence of some weeds in my vineyard?

        - Weeds can:
            - provide food for cutworms, thereby reducing canopy damage;
            - help control erosion;
            - help reduce dust, especially along roadsides;
            - improve soil structure and water infiltration;
            - reduce reflected light from the vineyard floor in areas of intense sun light where sunburn is a problem;
            - provide a sugar source for many beneficial predators;
            - help deplete excessive soil moisture. (See Soil Surface Management for cover crop issues)
        - Can I tolerate some weeds?
- Monitoring
    - Am I monitoring my vineyard to identify the broad spectrum of annual and perennial weeds, scouting at least bimonthly and keeping records from year to year?
        - Weeds are more easily controlled by cultural or chemical means and lower rates of herbicide are needed if treatment is early and the seedling stage is targeted. Some weeds are also more easily controlled using a pre-emergent herbicide.
    - Am I scouting for the presence of new perennial weeds so I can control them early before widespread infestation?
- Control methods
    - Have I developed a weed management strategy to guide my herbicide choice or cultivation equipment and practices?
    - What methods of control will be part of my weed management plan?
        - Cultural:
            - Tillage can help suppress annual and biennial weeds but can also spread perennial weed seeds and inadvertently prune vine roots.
            - Mulching can also help suppress weeds.
            - When considering a "no-herbicide" program, labor and fuel costs should be balanced against savings in chemicals. More frequent tillage—which can increase soil compaction—may be necessary when reducing herbicide treatments.
            - A variety of implements have been developed for weed suppression, including a hilling disk, cultivation knife, mower or flailer.
            - Flaming (propane burning) can sear small broadleaf weeds but has little impact on grasses and perennial weeds. Use caution if flaming.
        - Chemical:
            - Residual herbicides are applied to the soil to prevent new weed growth. Moisture or mechanical incorporation is needed when using residual herbicides. Knowledge of weed species present is important because herbicides are specific to different species.
            - Contact/systemic herbicides are foliar applied and are nonselective, killing or damaging all green tissue.
            - Properly placed grow tubes on young grapevines can protect foliage from herbicide application damage.
- Considerations when using herbicides

  Read and follow the label carefully before using any herbicide to note timing, temperatures, volume, nozzle size, rate worker reentry and days to harvest intervals, and any restrictions. Avoid drift.
    - Leaching:
        - Herbicide leaching into ground water is an important water quality issue in some areas. Leaching can be a problem with certain herbicides in areas with sandy or gravelly soils, high water tables, and overhead sprinkler irrigation.
    - Timing:
        - Herbicide sprays should be applied at the optimum time when weeds are most susceptible.

- Lower rates of herbicide can be used if annual weeds are sprayed early at the cotyledon to early vegetative stage.
- Spray after irrigating or fertilizing when weed leaves are lush and tender, not stressed, dry, or dusty.

- Spot treatment:
  - Use foliar-applied herbicides to spot treat perennial weed areas when possible and consider using systemic instead of contact herbicides.
  - Use clean water for the spray mixture.
- Replanting:
  - Consider the need for potential replanting when using residual herbicides.

7. Pest Management - Vertebrates

Birds, rodents, and large mammals like coyotes, deer, and elk are significant pests in Northwest vineyards. Birds and deer feed on grape berries, reducing yields and can cause secondary infections to the cluster and leaves. Rodents, such as gophers, ground squirrels, and meadow voles, can damage young vines by gnawing on the roots and crowns. Coyotes chew on drip irrigation tubing causing havoc to irrigation systems and will feed on low hanging fruit.

- Monitoring
  - Am I scouting for vertebrate pests bimonthly and keeping a written record of pests?
  - Am I watching trees or power lines in the area for signs of birds moving in?
- Habitat management plan
  - Do I have an action plan prepared before birds and animals cause problems?
    - Management plan should include habitat alteration or exclusion strategies to eliminate or reduce habitat that encourages vertebrate or move vertebrate out of the vineyard.
    - Examples would be to use grow tubes around young vines to discourage chewing by rodents; select cover crops that discourage vertebrate establishment; clean areas of brush around vines to discourage vole damage; and clear away brush piles that create mini-sanctuaries for birds.
- Understanding biology for optimum timing of control
  - Do I consider biology of the organism, implementing control measures at the optimum time for best results (i.e., late spring or fall for baiting gophers or voles)?
  - Do I consider non-target organisms that may be impacted by control measures?
    - Am I taking steps to prevent ingestion of anti-coagulant bait by non-target animals?
- Controls
  - Am I targeting problem areas identified through scouting only or am I treating the entire vineyard for vertebrate problems?
    - Birds
      - Do I encourage establishment of avian predators in my vineyard habitat (barn owls, kestrels, hawks, etc.) to help control problem birds?
      - Are trees left in the vineyard or other tall poles erected with perches to encourage predator roosting?
      - Am I providing owl or raptor boxes for nesting?
      - Do I use a combination of controls for pest birds?
        - Controls include visual and sound repellents, trapping, netting, chemical repellents, shooting, and using birds of prey.
        - By using a combination of strategies, techniques like netting, which is the most expensive option but also the most effective, may be needed only on outer rows of the vineyard.
      - If using loud devices, have I considered if the noise will be annoying to neighbors?
      - Am I complying with the Federal Migratory Bird Treaty and targeting only nonprotected birds?
        - Nonprotected birds include European starlings, English sparrows, and pigeons. All other species are protected unless a permit is obtained for their control.

- Rodents
  - Do I encourage predator raptors in the vineyard by providing nesting boxes and perches?
  - Do I use rodent bait stations that prevent other mammals from accidental ingestion of bait?
  - Have I considered a rodentenator (burrow blaster) for extreme gopher or ground squirrel infestations?
- Large animals
  - Is fencing necessary to protect outside rows from deer and elk feeding?
  - Are grow tubes used during the early years of vineyard establishment to protect young vines from deer and elk feeding?

8. Pesticide Safety

When using pesticides, *always read and follow the label carefully, noting timing, temperatures, volume, application method, nozzle size, rate, worker reentry and days to harvest intervals. Avoid drift.*

- Am I complying with all pesticide safety handling and application regulations and training workers in pesticide safety?
- Am I keeping detailed records of pesticide applications for the specified amount of time required by state pesticide regulations?
  - Most wineries require copies of all pesticide records.
- Do I routinely check pesticide sprayers and applicators for maintenance and calibration needs?
- Do I know how to calibrate my sprayer to ensure that proper dosage and coverage is achieved? Am I conducting frequent calibrations? (See sprayer calibration in glossary.)
- Do I follow buffer zone requirements when spraying to ensure that chemicals do not drift on sensitive areas (fish-bearing waterways, homes, roads, etc.)?
- Do I avoid spraying when weather conditions encourage chemical drift to nontarget areas, such as during high wind velocity and inversions?
  - Use an accurate wind gauge to estimate wind velocity.
- Are pesticides stored securely and safely, storing as little material as possible?
- Are chemicals added to the tank in an order that encourages mixing? Am I following the mixing order that is specified on the label? If using additives not on the label, conduct a jar test order that encourages proper mixing.
  - When in doubt, do a jar test and look at the formulation after ten minutes to determine if a compatibility agent is needed in the tank mix. Calculate the proportion of each ingredient when adding to the jar. (See jar test in glossary.)
- Do I have a pesticide emergency response plan posted?
  - Are wash facilities, eye wash, first aid, and clean up equipment available for spills and accidents?
  - Are workers trained in following the emergency response plan?
  - Are workers wearing protective clothing, gear, or equipment?
- Do I need a license to apply these chemicals?

CHECKLIST: BUILDING MY PEST MANAGEMENT TOOLBOX

- Is IPM part of my daily grape production?
- Am I using clean planting material?
- Have I implemented a monitoring program to scout for grape pests?
- Do I know the grape pests that are common to my vineyard? Can I identify symptoms of grape pests?
- Have I established economic thresholds for pests to help guide my decision making process?
- Am I implementing cultural practices to help discourage pest incidence?
- Am I timing application of chemical controls at the optimum time to maximize their effectiveness and minimize negative effects?
- Do I have a pest management strategy prepared, ready to implement once pest damage is observed?
- Do I apply and store all pesticides in a safe manner, protecting workers and the environment?

RESOURCES

Grape Pest Management – Second Edition. 1992. University of California Publications 3343. University of California, Oakland, California.

O'Neal Coates, S. 2003. Crop profile for wine grapes in Washington. Washington State University publication MISC0371E. Available on the Internet at:
http://www.tricity.wsu.edu/cdaniels/profiles/WineGrapes.pdf.

The following Pacific Northwest Pest Management Handbooks can be accessed on-line at:
http://pnwpest.org.

Pacific Northwest Disease Management Handbook. 2005. Oregon State University Publications.
http://plant-disease.ippc.orst.edu

Pacific Northwest Insect Management Handbook. 2004. Oregon State University Publications.
http://pnwpest.org/pnw/insects.

Pacific Northwest Weed Management Handbook. 2004. Oregon State University Publications.
http://pnwpest.org/pnw/weeds.

Summary of a workshop held May, 2004. Pest Management Strategic Plan for Washington State Wine Grape Production. Funding and support provided by Washington Association of Wine Grape Growers, U.S. Department of Agriculture, and Washington State University.

Washington State University Fungicide Stewardship Web site:
http://www.fruit.wsu.edu/Diseases/Stewardship.htm.

Watson, J. 1999. Growing grapes in eastern Washington. Good Fruit Grower, Yakima, Washington.

Olmstead, M. 2005. Pest Management Guide for Grapes in Washington, Bulletin #0762. Washington State University Extension Publications, Pullman, Washington.

Weeds of the West – Ninth Edition. 2001. Western Society of Weed Science and the Western United States Land Grant Universities Cooperative Extension Services.

GLOSSARY

Calibration of spray equipment is extremely important for economic and crop safety reasons. Pesticides are most cost effective and perform optimally when applied at labeled rates. Too much pesticide can injure crops; too little can give inadequate or unreliable control. Careful calibration is essential to proper sprayer operation and the economic return on the small investment of time can be substantial. To learn how to calibrate sprayer equipment, visit the following:

http://www.weedalert.com/general_application_info/sprayer_calibration.htm
http://berrygrape.oregonstate.edu/fruitgrowing/grapes/boomcal.htm
http://pnwpest.org/24ADJV04.pdf
http://pnwpest.org/24ADJV05.pdf

Inversion is when the layer of air near the earth is cooler than an overlying layer of warmer air. An inversion is an extremely stable layer of the atmosphere, which inhibits upward air motion and mixing of the air layers and traps air contaminants underneath.

Jar test is a valuable tool used to indicate problems that may result from mixing incompatible spray tank additives, such as combining pesticides with liquid fertilizer. Applying a tank mix of different pesticides or pesticides and fertilizer can save time and money, but it can also result in reduced pest control and damage to non-target plants if the materials are incompatible. Instructions for conducting a jar test are found at:
http://scarab.msu.montana.edu/extension/MT_PAT/Info/interactions_compatibility.pdf

This document provided by the Washington Wine Industry Foundation's "Risk Management Education Program for the Northwest Grape Industry" — a USDA-RMA Partnership. For questions about Vinewise, please contact the Washington Association of Wine Grape Growers at 1-877-88WAWGG (1-877-8892994) or email vinewise@wawgg.org.