IPM Elements for Wine Grapes in Virginia and North Carolina

Growers should use this document and its sub-headings as a checklist of possible Integrated Pest Management (IPM) practices that they could implement. Growers should count only the activities they perform in their wine grape pest management practices and aim to be compliant with at least 80% of the activities listed. This is not a requirement, but only a suggested level of compliance.

This document is intended to help wine grape growers identify areas in their operations that possess strong IPM qualities and also point out areas for improvement. Growers should attempt to incorporate the majority of these specific techniques into their usual production and maintenance practices, especially in areas where they fall short of the 80% goal.

Pests and Diseases of Wine Grapes in Virginia and North Carolina			
Arthropods	*Diseases*	*Vertebrates*	*Weeds*
Aerial phylloxera Climbing cutworms European red mite Grape berry moth Grape cane borer Grape cane gallmaker Grape cane girdler Grape curculio Grape flea beetle Grape leafhopper Grape root borer Grape rootworm Grape tumid gallmaker Grapevine looper Japanese beetle Mealybugs Redbanded leafroller Sharpshooters Stinkbugs Wasps	Anthracnose Bitter Rot Black rot Botryosphaeria canker Botrytis bunch rot Crown gall Downy mildew ESCA or Petri diseases (Young vine decline) Eutypa dieback Grapevine yellows Leafroll virus Phomopsis cane and leaf spot Pierce's disease Powdery mildew Ripe rot Sour rot (non-specific fruit rot) Tomato/Tobacco ringspot virus	Bears Birds Deer Geese Groundhogs Moles Raccoons Turkeys Voles	Annual broadleaf weeds Annual grasses Perennial grasses Perennial broadleaf weeds, including Woody perennials Yellow nutsedge

		Check if done
	I. SITE SELECTION/MAINTENANCE, ROOTSTOCK, CULTIVARS, AND PLANTING SYSTEMS:	
1	Vineyard site was selected, in part, for relatively high elevation to afford good cold air drainage out of vineyard to minimize risk of frost and winter cold damage and minimize disease pressure. Site has good wind and air movement to help with disease management.	
2	Vineyard site was selected, in part, on basis of low to moderate soil fertility and good soil structure that demonstrates rapid internal soil water drainage, and relatively low water-holding capacity.	

3	Vineyard site was selected, in part, due to its isolation from adjacent, abandoned vineyards or wooded areas that harbor wild grapevines, either of which can serve as reservoirs for pests and pathogens of grape. Turf and pasture sites can harbor diseases and pests, as well.	
4	Select a site with enough available water (pond, well, etc.) to meet spray water needs and irrigation needs, if necessary.	
5	Remove abandoned vineyard blocks to reduce the potential for spread of diseases and pests.	
6	Refrain from planting vines immediately after removing old vines. Rotate out of grapes for at least one year (three years is better), then plant and/or incorporate a cover crop into the soil to improve the organic content and minimize plant problems.	
7	Use certified plant material.	
8	Use rootstocks appropriate for the variety to ensure trellis fill but avoid over-vigorous growth.	
9	Design groundcover management plan and vineyard layout with a goal of minimizing erosion potential.	
10	Select site with a 100-yard, or greater, if possible, buffer zone between vineyard and wooded areas that contain wild grapevines and other reservoir hosts of pathogens such as *Xylella fastidiosa* (the cause of Pierce's disease).	
11	Use soil erosion barriers while installing vineyard and developing road systems.	
12	Consult wine grape specialists for advice on clearing virgin land for vineyard establishment.	
13	Understand that it may be more difficult to establish vineyards on certain sites due to what was previously established there. For example, it may be hard to plant grapevines on land once covered with black walnut trees due to juglone toxicity. In addition, oak root rot fungus may hinder the establishment of vineyards on particular sites.	
	II. SOIL MANAGEMENT, FERTILIZATION, AND IRRIGATION:	
1	Complete soil analysis of vineyard site prior to planting. Take a soil sample for a nematode assay.	
2	Make soil amendments (and incorporate if necessary) before planting and trellis installation.	
3	Create management blocks and sample/amend nutrients based upon these management blocks.	
4	Make nutrient amendments based upon visual cues and or soil/petiole nutrient test reports.	
5	Apply nitrogen fertilizer around grapevine bloom to maximize uptake. In the case of a large application (> 30 lbs of actual N per acre), split application into two applications before and after bloom.	
6	Fertilizer application uses a calibrated spreader or other methodology that ensures only the appropriate amount is uniformly applied.	
7	Add organic matter to soil to improve structure, drainage, fertility, and	

	water-holding capacity, if necessary.	
8	Record all nutrient addition amendments.	
9	Know the nutrient leaching/surface run-off potential for your soil/vineyard and correct nutrient application methods as necessary.	
	III. VINE TRAINING AND CROP/CANOPY MANAGEMENT:	
1	Understand the vine vigor potential, or vine capacity, of your site. Quantify vine size though pruning weights.	
2	Train vines to promote canopy light penetration, air circulation, optimal spray coverage, and rapid drying of canopy.	
3	Chip and recycle prunings in vineyard middles with a flail mower, or bury, compost, or burn as appropriate. Pay attention to burning restrictions.	
4	Remove diseased tissue from the vineyard and bury or burn it.	
5	Use shoot-thinning or fruit-thinning techniques to regulate crop size and avoid over-cropping. Remove dropped clusters from the vineyard.	
6	Conduct an annual survey to assess vineyard conditions and identify potential problems, e.g., prevalence of leafroll viruses, drought-prone sections of the vineyard, etc.	
7	For varieties susceptible to bunch rot and powdery mildew, leaf pulling should be practiced to thin the canopy and expose the fruiting zone.	
8	Use canopy management as the foundation of an effective disease management program.	
	IV. PEST MONITORING, FORECASTING, AND GENERAL MANAGEMENT:	
1	Monitor weather conditions and understand risk of disease. For example, pay attention to winter minimum temperatures to determine the potential for Pierce's disease.	
2	Know fungal disease risk based on vineyard history.	
3	Monitor pest (arthropods, weeds, vertebrates) populations and disease prevalence on a regular basis using visual assessments, sticky traps, pheromones, etc. However, for some pests (e.g., grape root borer), monitoring may not necessarily be very effective at predicting population levels.	
4	Assess damage levels and determine if controls need to be initiated using recommended thresholds. Keep in mind that thresholds are not established for all pests (e.g., grape root borer).	
5	Keep written records of monitoring efforts, sampling dates, damage levels, trap catch numbers, injury thresholds used, etc.	
6	Use only pesticides registered in your state and approved for use on the target pest and crop. Consult the most current Pest Management Guides for Virginia and/or North Carolina (see the links in the "Recommended Information" section at the end of this document).	

7	Consider hiring a vineyard consultant if time does not permit you to complete the aforementioned tasks.	
8	Understand how to time pesticide applications in order to avoid impacting honeybees and native pollinators (i.e., spray in the very early morning, evening, or at night).	
	V. GROUNDCOVER AND WEED MANAGEMENT IN ESTABLISHED VINEYARDS:	
1	Employ groundcover management techniques that will reduce soil erosion, nutrient runoff, and herbicide use.	
2	Perennial, inter-row cover crops are used to minimize soil erosion, reduce soil compaction, allow machinery movement sooner after rains, and to minimize establishment of perennial weeds in the vineyard.	
3	Be knowledgeable of what weeds are present in your vineyards and what threats or benefits these plants offer. Minimize broadleaf weeds such as clover and oxalis where Pierce's disease is a threat.	
4	Conduct weed surveys and use these observations to guide herbicide selection and application rates, or to choose non-herbicidal management strategies.	
5	Weeds are suppressed or eliminated in a 2 to 4-foot wide strip under the trellis (intra-row) with a strategy of regulating vine size and vigor. A wider strip may be needed in non-irrigated vineyards or to increase vine size and trellis fill. In established plantings, reducing the width of the bare strip below the vines will suppress vegetative growth of grape vines.	
6	Keep written records of weed location and identity of hard-to-manage weeds, as well as species that have escaped annual weed management programs.	
7	Control aggressive perennials with spot treatments. Periodically monitor weed size, vigor, and species composition to optimize weed management strategies. Consider soil conservation as well as how to control weeds.	
8	Mulches (black plastic, landscape fabrics, newspapers, pine bark, untreated grass clippings), while not typically used in commercial operations, may be used to control weeds, if economical. Closely monitor pest populations (e.g., climbing cutworms) that may proliferate if mulches (e.g., untreated grass clippings) are used.	
9	Sow cover crops to help control nematodes, when possible.	
	VI. DISEASE MANAGEMENT: Be sure to correctly identify and regularly monitor disease development in order to develop appropriate and effective chemical control strategies.	
1	Be able to recognize and identify wine grape diseases (see the links in the "Recommended Information" section at the end of this document).	
2	Be able to recognize and identify weather that favors disease development and pressure (see the links in the "Recommended Information" section at the	

	end of this document).	
3	Utilize cultural practices (e.g., canopy management) and variety/cultivar selection as primary pest control practices and use agricultural chemicals to supplement control of pests.	
4	Remove infected plant tissues from the vineyard. For example, black rot, bitter rot, and ripe rot pathogens can survive in infected mummies over winter and cause disease in the following year.	
5	Follow the recommendations of the Pest Management Guides for Virginia and/or North Carolina and other documents written by wine grape specialists when monitoring and managing diseases.	
6	Scouting on foot should be conducted weekly by the same person, if possible, and more often at times of high potential disease pressure. The observations should be recorded and maintained for future reference.	
7	Use disease development and forecast models to help manage diseases, especially powdery mildew, downy mildew, black rot, and Botrytis.	
8	Be cognizant that beneficial predatory mites can be protected by using EBDC fungicides (e.g., mancozeb) prior to bloom ONLY, or not at all.	
9	At harvest time, sample fruit from different blocks in order to assess and record disease levels. This will help to optimize future disease management protocols.	
10	If possible, select and plant varieties/cultivars that are less susceptible to major diseases such as powdery mildew, downy mildew, black rot, Phomopsis, and Botrytis.	
11	Select sites for better disease management. Well air-drained sunny vineyards tend to have less disease risks than vineyards in the shade. Moreover, cold damage can increase the chance of Botryosphaeria and crown gall infection.	
12	Remove wild grapevines within 100 to 200 yards of your vineyards and from nearby habitats, if possible. Wild grapes can be hosts for many pathogens, including grapevine yellows.	
13	Know that the timing of fungicide application depends not only on the presence of the target disease, but also the grape's physiological stages. Please refer to the Virginia and/or North Carolina Pest Management Guides for detailed information.	
14	Understand that the risk of fungicide resistance will increase based on the history of fungicide applications in your vineyard(s), so keep good records.	
15	Be aware that different products may not necessarily have different modes of action (i.e., Fungicide Resistance Action Committee code). When rotating fungicides, rotate the mode of action, as well. Please refer to the fungicide label and follow the instructions.	
16	Obtain certified grapevines from reputable sources in order to minimize the risk of graft-transmitted diseases such as leafroll virus, Petri disease, etc.	
17	Be aware of the history of disease(s) in your vineyard(s). Create a map of hot spots, if possible, because this information can influence your disease management strategies.	
18	Understand that some own-rooted hybrids are susceptible to soil borne disease such as tomato or tobacco ringspot virus.	

	VII. PEST MANAGEMENT: Be sure to correctly identify and regularly monitor pest development or pressure in order to develop appropriate and effective chemical control strategies.	
	a. Arthropod Management:	
1	Prune or remove pests by hand, if possible.	
2	Follow monitoring protocols and pest management techniques recommended by reputable, established sources such as the Virginia and/or North Carolina Pest Management Guides (see the links in the "Recommended Information" section at the end of this document).	
3	Scouting should be done on a weekly basis by the same person, if possible. Record and maintain results for future reference.	
4	Employ pheromone traps, degree-day models, and risk assessment protocols to make informed management decisions for pests such as grape berry moth and grape leafhopper.	
5	Use mating disruption as a control option, where available.	
6	Time pesticide application to least impact beneficial arthropods and to help prevent secondary pest problems.	
7	Conserve naturally occurring biological control organisms (e.g., parasitic wasps, mites, flies, etc.) by using selective, NOT broad-spectrum, pesticides. Participate in biocontrol release programs, if possible.	
8	At harvest time, sample fruit from different blocks in order to assess and record damage levels. This will help to optimize future pest management protocols.	
9	Utilize spot or perimeter applications of insecticides when feasible.	
	b. Vertebrate Management:	
1	Install fencing to keep out deer and small animals.	
2	Use repellents, baits, physical barriers, traps, and other deterrents to repel and/or control vertebrate pests. Combining practices increases success.	
3	Moles, rabbits, and ground hogs are more problematic where vegetation is thick, so practice good ground cover management.	
4	Trap or hunt vertebrates (where legal) making sure to follow all local regulations.	
5	Protect and enhance natural predator (e.g., owls, foxes, hawks) populations by providing attractive habitats for them.	
6	Reduce bird damage with noise (e.g., bangers), visual tactics (e.g., scare eyes), or exclusion methods (e.g., netting).	
	VIII. PESTICIDE SAFETY AND EFFICACY:	
1	Correctly identify and regularly monitor pest populations or disease pressure BEFORE attempting chemical controls.	
2	When pesticides are to be utilized, choose a chemical based on efficacy, reasonable cost, and safety to applicators, native pollinators, natural enemies,	

	and the environment. This is critical with certain pests (e.g., mealybugs vector plant pathogens but the use of pyrethroids to control them can cause secondary pests to proliferate).	
3	Purchase chemicals from a reputable dealer and utilize only those that are registered for treating vineyards.	
4	Follow all pesticide labeling explicitly, including use of appropriate personal protective equipment (PPE). Vineyard owners and workers should all be aware of the proper use of PPE.	
5	Clearly post re-entry interval (REI) information and confirm that workers and handlers understand how to determine if/when a vineyard is safe to enter. Use this information as a guide for restricting others from entering treated areas.	
6	Monitor weather conditions to allow proper drying time and to avoid drift due to windy conditions. Spray only when wind, temperature, and humidity conditions are suitable for applying chemicals unless the sprayer is modified to reduce drift (e.g., hooded boom, deflectors, low drift nozzles, shielded applicator).	
7	Understand pesticide resistance and manage use of agricultural chemicals to reduce risk of resistance development (see the links in the "Recommended Information" section at the end of this document).	
8	Maintain accurate and complete pesticide application records. Record pesticide applications, including date, time, weather, operator, sprayer details (e.g., nozzle specifications, pressure, forward speed, application rate), field identification, targeted pest, pesticide name and EPA number, formulation, REI, pre-harvest interval (PHI), and number of acres treated.	
9	Make sure equipment is inspected and properly calibrated at least once a year, or more often as necessary. Be sure all workers know how to use various types of sprayer equipment. Clean equipment after each use, or between applications of different products.	
10	Discuss with a local Extension agent your legal obligations as they pertain to pesticide usage. Become a certified applicator and maintain certification.	
11	Utilize drift-reducing sprayers (tunnel, sensor, tower) or sprayers that have been modified (towers, deflectors, angled fans, side battle plate, air induction nozzles) to direct the chemicals to the appropriate spot.	
12	Select nozzles that optimize droplet size and avoid those that produce fine droplets (<150 microns). Nozzles must point toward the target canopy.	
13	Grow windbreaks or hedgerows to minimize spray drift out of the vineyard.	
14	Use generous buffer zones when applying pesticides near water, neighboring crops, private and public properties, schools, roadways, and other sensitive locations.	
15	Implement a Worker Protection Standards (WPS) compliance program.	
	IX. PESTICIDE MIXING AND STORAGE:	
1	Mix agricultural chemicals away from surface water, waterways, and water wells.	

2	Have a spill kit available and fully stocked with back-siphon devices, an eyewash kit, etc.	
3	Have a designated spill containment area for mixing chemicals.	
4	Follow proper storage and disposal guidelines. Store pesticides where they will be protected from the elements, but preferably not in your home. Contact a local Extension agent if you have waste pesticides and are unsure how to safely dispose of them. Confirm what appropriate disposal of pesticide packaging entails and dispose of containers properly.	
5	Maintain a record of the agricultural chemicals stored in your facility.	
6	Store agricultural chemicals off the floor.	
7	Provide a containment area able to contain 125% of the largest container in your pesticide storage area.	
8	Lock storage building.	
9	Clearly label building as a pesticide storage area.	
10	If pesticides are kept over winter, make sure pesticide storage area will not freeze.	
11	Do not store PPE in pesticide storage area.	
12	Make an inspection and emergency plan. Post emergency phone numbers in a central place. Share information and emergency plans with local authorities.	
	X. GROWER/EMPLOYEE EDUCATION:	
1	Earn a pesticide applicator license and regularly attend Pesticide Applicator training offered by Extension and other agencies.	
2	Join local grower association(s) and cultivate relationships with Cooperative Extension personnel.	
3	Obtain current fact sheets and guides for wine grape pest management from your local grower association, Extension specialists, or Extension agents. Vineyard workers should be strongly encouraged to read these.	
4	Participate in local Extension workshops, demonstration plots, and/or short courses on wine grape production, pest identification, and pest management options. Encourage vineyard workers to attend so that they can learn to distinguish harmful pests from harmless arthropods.	
5	Attend local and regional grower meetings each year.	
6	Read online newsletters produced by your local Extension specialists or other unbiased sources.	
7	Implement IPM practices not currently used in your wine grape pest management program on a limited number of vines and gauge their success.	
8	Learn to recognize beneficial insects and/or predators/parasitoids that naturally control pests and be sure workers strive to protect these natural enemies of wine grape pests.	
9	Learn and understand your obligations as an employer under the Worker Protection Standards (WPS), Hazard Communications Standard (HCS), and other labor regulations (i.e., OSHA, etc.). See the links in the "Recommended Information" section at the end of this document.	

RECOMMENDED INFORMATION:

- Alson H. Smith, Jr. Agricultural Research and Extension Center, Winchester, VA, http://www.arec.vaes.vt.edu/alson-h-smith/index.html
- Crop Profile for Grapes in North Carolina, http://www.ipmcenters.org/CropProfiles/docs/ncgrapes.html
- Crop Profile for Grapes in Virginia, http://www.ipmcenters.org/CropProfiles/docs/vagrapes.pdf
  The Mid-Atlantic Wine Grape Grower's Guide, http://www.ces.ncsu.edu/resources/winegrape/
- Fungicide Resistance Action Committee, http://www.frac.info/frac/index.htm
- Laws and Regulations Affecting Pesticide Use in Virginia, http://vtpp.ext.vt.edu/pesticide-safety-education-program/laws-and-regulations-affecting-pesticide-use-in-virginia
- North Carolina Agricultural Chemicals Manual. Chapter VII. Insect and Disease Control of Fruits. http://ipm.ncsu.edu/agchem/7-toc.pdf
- North Carolina Wine Growers Association, http://www.ncwinegrowers.com/
- Pesticide Handling and Storage Practices on the Farm http://www.epa.gov/seahome/farmpest.html
- The Southern Region Small Fruit Consortium Small Fruit Regional Production Guide http://www.smallfruits.org/SmallFruitsRegGuide/
- Virginia Vineyards Association, http://www.virginiavineyardsassociation.com/
- Virginia Tech's Site for Grape IPM & Production, http://www.virginiafruit.ento.vt.edu/VirginiaGrapeSite.html
- Virginia Tech Mid-Atlantic Vineyards Grape IPM, http://www.virginiafruit.ento.vt.edu/grape-fruit-ipm.html
- Virginia 2011 Pest Mangement Guide for Commercial Vineyards (Virginia Coop. Ext. Pub. 456-017), http://pubs.ext.vt.edu/456/456-017/Section-3_Grapes-2.pdf
- Virginia Grape Disease Update, http://grapepathology.blogspot.com/
- Viticulture Notes: http://www.arec.vaes.vt.edu/alson-h-smith/grapes/viticulture/extension/VN_options_index.html
- Worker Protection Standards, http://www.epa.gov/oecaagct/twor.html

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