A Sustainable Practices Workbook for Wine Grape Growing in Maryland

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Photography credit: Bruce Perrygo, MGGA member

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Introduction

For many, the Chesapeake Bay defines the state of Maryland. There is keen interest in preserving and protecting the waters of the Bay and the fish, crabs, oysters, and other creatures that dwell there. Millions of dollars have been spent by local and state governments as well as the federal government to restore this amazing resource and to protect it for future generations.

Maryland's farmers are major participants in these efforts. Wine grape growing is one of the fastest growing agricultural sectors in the state with new vineyards being planted each year. Vineyards can now be found in every county. Wine grape farmers are eager to do their part to "Save the Bay".

Several members of the Maryland Grape Growers Association expressed interest in applying sustainable viticulture practices to grape growing. Due to that interest, Dr. Timothy Martinson, Senior Extension Associate in Viticulture, Cornell University was asked to make a presentation at the Maryland Grape Growers Association sponsored wine/grape industry, Annual Conference and Seminars.

Dr. Martinson's presentation, **Sustainable Viticulture: Promotion and Practices** was enthusiastically received. Many members of MGGA requested that the Association provide more guidance in sustainable practices for their Maryland Vineyards.

Maryland Grape Grower Association leadership organized a group of members to pursue ways of promoting sustainable viticulture practices, especially for Maryland wine grape growers. It was decided that the best way to reach that goal was to adapt the **New York Guide to Sustainable Viticulture Practice** for use in Maryland.

A Specialty Crop Block Grant from the United States Department of Agriculture was applied for through the Maryland Department of Agriculture. That grant was awarded to the Maryland Growers Association.

Soon thereafter, members of the grant committee were struck with major health issues and other life changing challenges and were not able to proceed with the program. Upon becoming MGGA president, Bob White was able to reorganize the grant committee. Now after some setbacks and more time than anticipated, a workbook designed specifically for Maryland is now available, **A Sustainable Practices Workbook for Wine Grape Growing in Maryland.**

The Maryland Grape Growers Association hopes that this workbook will provide information, and resources to aid Maryland's wine grape growers to farm in a sustainable manner. MGGA encourages all wine grape growers to make use of the information supplied here to become better stewards of our land and the Chesapeake Bay.

Preface

This workbook is intended to help producers meet the increasing environmental and social challenges facing the wine/grape industry. There is a growing awareness of the effects the actions of each of us has on the Chesapeake Bay. This natural resource is a living, "protein factory" that in many ways defines the state of Maryland. The general public is demanding that steps be taken to protect this treasure.

As the concept of sustainable agriculture has grown, the agricultural community has agreed that practices must be developed that are economically, environmentally, and socially sustainable.

This workbook is designed to allow wine grape growers to assess their vineyard's position regarding sustainability. To help producers improve practices, it is important that this workbook serve as a measurement, as well as an educational, tool. It is to aid the individual grower. Its purpose is not to compare one grower's practices with another.

As time goes on there will be new and evolving sustainable practices. It is important that growers keenly keep aware of these new developments and incorporate them into their vineyard practices and routines. As we become good stewards of our resources, we can be profitable today and leave a legacy for generations to come.

Bruce Perrygo
Coordinator
Maryland Grape Growers Association

How to Use This Workbook

This workbook contains questions in 8 sections. The questions address issues or practices that are important to good vineyard management. Each question is followed by four (4) options ordered on a sustainable scale, with "1" being the most desired (i.e. most sustainable) option and "4" being the least. The questions are designed to help you evaluate all areas of your current management practices, with each chapter covering a different production area. A sample question is presented on page 7.

Questions are often followed by a short sidebar designed to further explain the rationale behind the promoted practices and provide additional resources related to the topics. When reading through the possible answer options, we recommend starting at option #4 and moving toward option #1, choosing the option that your current practice fully encompasses. If you find that your present practice comprises part, but not all, of an answer, choose the higher score. For instance, if you presently perform only two of the three practices necessary to assess yourself a score of "2" on a certain question, score yourself a "3" on that question. Your scores will provide a baseline from which to develop an action plan and assess improvement after implementation of your plan. It is important to note that this is not a test and there are no "wrong" answers. Simply choose the answer that best describes what you do. In answering the questions, it may be helpful to think of a particular vineyard block rather than a range of different blocks and varieties. We recognize that different varieties may require different management approaches.

Some of the questions in the workbook may not be applicable to your farm, so you can skip the questions that do not apply to you and mark "NA" on the score sheet. Canopy management questions applicable to *vinifera* grapes, for example, will not be applicable to Concord production. Similarly, if you do not use irrigation, you can skip the irrigation section.

Action Plan. Once you have completed the workbook, the next step is to develop an action plan based on the results of your self-assessment that will address the practices that you believe you can effectively modify within the financial and management capacity of your farm. Concentrate on the issues where you scored three or four, with the goal of modifying your practices to reach the more sustainable one or two rating. The action plan is yours, and only you will know what is practical and possible on your farm.

Please note that this workbook is not a production guide. Managing vineyards is a complex enterprise involving numerous site and variety-specific practices and weather conditions, along with skill and experience in making decisions. Not all questions will apply to your vineyard, nor are the options listed for management the only possible solutions. ***You*** *are the person most familiar with your site and most suited to deciding what is applicable to your situation.*

Example:

Nitrogen (N) Management Practices					
	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
When is N fertilizer soil-applied in spring?	N is applied during the period of maximum uptake - budbreak to fruit set. **AND** Split applications are used with 30-50% of the N applied prebloom and the remainder applied postbloom.	All N is applied during the period of maximum uptake - budbreak to fruit set. **AND** Split applications are not used.	N is applied up to 2 weeks prior to budbreak when vines are still dormant. **OR** All N is applied in the period between fruit set and veraison.	N is applied >2 weeks prior to budbreak.	**2**
There is little absorption of N by roots prior to budbreak. The soil is cold and roots are inactive. Early vine growth depends almost entirely on N stored in the woody parts of the vine. It is unclear whether pre-budbreak application release organic fertilizers confers an advantage in terms of N availability to the plant.					

Example:

Our grower applies nitrogen in the spring in one application about 1 ½ weeks before bloom. Based on this practice, the grower selects "2". Self-assessment scores can be recorded in the "YOUR RANK" column following each question and/or on the Workbook Scoresheet included with this workbook. In deciding whether or not to modify current practice to reach the "1" level, the grower will have to consider whether the benefits (e.g. increased efficiency in timing and rates of nitrogen fertilizer application and the associated potential savings) outweigh the drawbacks (e.g. increased labor, tractor use and other potential costs).

I. Soil Management

Vineyard sites in Maryland vary in slope, soil texture, depth, parent materials, pH, and elevation. There are three main geomorphic regions in the state, each with its own types of soils and climates.

The Coastal Plain is the area that surrounds the Chesapeake from the Atlantic Ocean to the Potomac River and the Fall Line. On the Eastern Shore the land is nearly flat. The Western Shore tends to be somewhat higher with small, rolling hills. Streams meander and are slow moving. Soils in this area are made up of Gravel, Sand, Silt, and Clay.

The Piedmont Region lies to the west and north of the Coastal Plain and extends west to the Blue Ridge. The diverse topography of the region includes rolling hills, plateaus, and ridges. There are narrow valleys with swift, rapidly moving streams. Soils contain schist, gneiss, metabasalt, and phyllite.

The Appalachian Region runs from the Blue Ridge, west to the state's borders. There are mountains and broad plateaus. In the far west, there are mountain ridges nearing 3,000 feet in elevation. Streams run in steep walled, narrow valleys. Much of the region is dominated by limestone, sandstone, shale, and siltstone**.**

Hillside vineyards are subject to erosion and runoff. Surface runoff carries sediment, nutrients, and pesticides into ponds and streams. Eventually, these make their way into the Chesapeake Bay causing serious degradation to Bay waters, as well as, to the animal and plant life that inhabit it.

Careful management of soils, starting before vines are planted and continuing through the life of the vineyard, is crucial for maintaining vineyard productivity and minimizing runoff of nutrients and pesticides. Questions in this section address runoff and leaching potential, pre-plant vineyard design, soil amendments, soil compaction, soil erosion, the use of cover crops and mulch to manage erosion, and water use in your vineyard. [1]

Photography credits: Bruce Perrygo, MGGA member, Dr. Joe Fiola UMD Ext.

[1] *Natural Soil Groups of Maryland* Maryland Dept. of State Planning 1973

Site Characteristics: Determination of Soil Leaching and Runoff Potential

Background

1. Compare the relative risk of ground and surface water contamination among different vineyard blocks on your farm.

2. Identify the vineyard blocks on which you may want to consider using more extensive water protection practices.

3. Set priorities for adopting vineyard floor management practices, constructing soil conservation structures, and making changes to nutrient or pesticide management practices.

4. Be applicable for both established vineyards and pre-plant situations.

Pages 10-13 will allow you to enumerate and classify the risk potential for each vineyard block. If the assessment shows a high or moderate risk of sedimentation or ground or surface water contamination, you will want to consider possible ways to modify that risk.

If you already know the leaching potential of your soil, you may want to skip to page 14.

Vineyard Site Characteristics Worksheets - Instructions

1. If you know your vineyard's leaching and runoff potential, you may skip this section.
2. Use a County Soil Survey of your property to identify soils and slopes present on your land, or ask for assistance from your local Soil and Water Conservation District to obtain a computer-generated map of your property with soils and slopes identified.
3. Identify major vineyard blocks or natural divisions with similar soils and slopes. Mark the location of each area on the map. Identify the predominant soil type and average slope in each area.
4. From the county soil survey, use information on each soil group to fill out the following table for each vineyard block. This will identify if a block has a high potential to leach pesticides or fertilizers into groundwater or a high potential for surface runoff that may carry fertilizers or pesticides into surface waters.

Soil Hydrologic Group	Description
A	Low runoff potential - high leaching potential.
	Mostly deep coarse-textured soils such as sandy loams, gravels, coarse gravelly loams.
B	Moderately low runoff potential - moderately high leaching potential.
	Mostly permeable loams.
C	Moderately high runoff potential - moderately low leaching potential.
	Mostly fine-to-medium textured soils and/or those with imperfect drainage.
D	High runoff potential - low leaching potential.
	Mostly very fine-textured soils and/or those with poor drainage.

Rating of Runoff/Leaching Potential of Vineyard Blocks

Soil Hydrologic Group	Rating	Average Block Slope	Rating
A	1	< 3%	1
B	2	3 – 6%	2
C	3	7 – 12%	3
D	4	< 12%	4

Vineyard Block ID	Hydrologic Soil Group Rating	Average Block Slope Rating	Addition of Rating Numbers
1			
2			
3			
4			
5			
6			
Addition of Numbers - Results			

2 – 3 = High Leaching Potential. Use caution when making ground-directed herbicide or fertilizer applications especially when heavy rainfall is expected. Split applications of nitrogen fertilizers are recommended.

4 – 5 = Intermediate Conditions. The site may be intermediate in both the risk of runoff and leaching potential. For example, a flat site on heavy clay would likely have less runoff and more leaching than a hillside vineyard. Similarly, a well-drained, gravelly soil on steep slopes may be subject to both runoff and leaching.

6 – 8 = High Runoff Potential. Installation of filter strips around vineyards is highly recommended. Delay application of pre-emergence herbicides and fertilizers when >1" of rainfall is forecast.

MANAGEMENT CONSIDERATIONS FOR SITES WITH HIGH LEACHING OR RUNOFF POTENTIAL

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
If vineyard has a high leaching potential, is a plan in place to minimize this risk?	A management plan is in place to reduce the use of pesticides and fertilizers with high leaching potential, and appropriate herbicide application rates are used to limit movement. **AND** Nitrogen rates are adjusted by using split applications or fertigation, and applications of ground-directed fertilizers and herbicides are delayed when heavy rains are expected.			Herbicide, insecticide, fungicide, and fertilizer applications are made on a cost and need only basis with no consideration to leaching potential. **OR** No knowledge of which inputs are most prone to leaching, and herbicide rates are not adjusted according to soil texture. **OR** No plan is in place to address leaching.	

MANAGEMENT CONSIDERATIONS FOR SITES WITH HIGH LEACHING OR RUNOFF POTENTIAL

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
If vineyard has a high runoff potential, is a plan in place to mitigate the runoff?	A conservation plan is in place that addresses runoff with appropriate soil conservation structures (e.g. diversions, filter strips, drainage) and vineyard floor management options. **AND** Application of herbicides, fungicides, insecticides, and fertilizers is delayed if rainfall is forecasted within the drying time of the application.			Soil conservation practices are not considered in vineyard layout and management. **AND** Weather conditions and runoff are not considered prior to application of pesticides and fertilizers. (i.e. No management plan exists for reducing erosion and runoff.)	

PREPLANT CONSIDERATIONS

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Are complete soil nutrient analyses done?	Soil analyses are done on all distinct portions of the site, the slope is sampled separately from the flat area and different soil types are sampled separately.	More than one soil analysis is done, but the site is not thoroughly sampled.	Only one complete soil analysis is done.	Only pH is tested: a complete soil analysis is not done. **OR** No soil analyses are done.	
Are soil samples sent for nematode analysis? *(Not applicable for Labrusca growers.)*	Prior to planting, samples are collected according to laboratory instructions and sent for nematode analysis.			Nematode analysis is not done.	

For more information on soil sampling, testing, and interpretation, go to:
http://go.umd.edu/SoilTissueNematodeTesting

High nematode populations have been found in some areas of former tobacco cultivation. The dagger nematode Xiphenema index has been found to vector ringspot viruses, a disease of concern for hybrid varieties. Consequently, assessing the soil nematode populations may help to address a later problem. One of the best defenses against nematode injury is excellent early care of the vineyard, as healthy vines are better able to tolerate an infestation than compromised vines.
For more information on nematodes, sampling, and biorenovation, go to: **http://go.umd.edu/Biorenovation**

PREPLANT CONSIDERATIONS

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is preplant soil compaction addressed?	Soil compaction is directly evaluated. **AND** If soils have impermeable layers or hard pans, subsoiling is performed the year prior to planting. **OR** Soils are gravelly with no perched water tables or clay layers requiring subsoiling.	Soil compaction is not directly evaluated. **BUT** Subsoiling is done the year prior to planting.	Soil compaction is not directly evaluated. **AND** Preplant subsoiling is Not done. **AND** Soils are well-drained gravels or gravelly loams in hydrologic classes A and B, which are less prone to compaction.	Soil compaction is not directly evaluated. **AND** Preplant subsoiling is not done. **AND** Soils have silt or clay layers, and/or perched water tables. **OR** Soils are in hydrologic classes C and D, which are prone to compaction.	

The need for subsoiling should be judged based on local experience and/or the use of a penetrometer, a device that measures soil compaction. The need for subsoiling should be assessed in consultation with a vineyard consultant, University of Maryland Extension and/or Natural Resources Conservation Service. While preplant subsoiling is not a standard practice, it may be of help on sites with poor drainage.

PREPLANT CONSIDERATIONS

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Are soil pits dug to evaluate the soil profile?	If soils are variable, soil pits are dug in a grid pattern. **AND** Drainage, topsoil depth, and texture are evaluated in each block.	Soil pits are dug at several distinct sites on a potential property. **BUT** Drainage, topsoil depth, and texture are evaluated.	One soil pit is dug at the potential vineyard property.	No soil pits are dug prior to planting. **AND** No evaluation of soil physical properties is made.	

Soil pits allow evaluation of the soil profile in order to better gauge appropriate scion/rootstock choices, spacing, irrigation, trellis design, etc. Preferably all distinct areas on a site will have a pit. They should be done according to recommendations from a vineyard consultant or a University of Maryland Extension and/or Natural Resources Conservation Service district representative. Pits are typically 5-6 ft long x 3-4 ft wide x 4-5 ft deep.

PREPLANT CONSIDERATIONS

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Are drainage problems addressed?	Soils are well drained to excessively well drained and no tiling is required. **OR** Pattern tiling is established, with tile lines parallel to rows at an adequate density for the soil texture. **AND** Tile spacing is appropriate for variety type.	Soils are evaluated and drainage requirements are determined preplant. **AND** Tile drainage is designed and installed on poorly drained areas or in heavy soils, with tile spacing appropriate for variety type (vinifera may need more than natives to be productive).	No preplant design or evaluation for tiling is done. **BUT** Tile lines installed in observably wet areas.	Soil drainage is not considered preplant. **AND** Soils are poorly drained, no tile drainage present even in wet spots and low areas. **AND** Standing water persists after rainfall.	

PREPLANT CONSIDERATIONS

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
If necessary, is soil pH adjusted?	In the year prior to planting, soil pH is adjusted with lime so the top 16" of soil is approximately 6.5 for *V. vinifera,* 6.0 for hybrids, and 5.5 for natives. **AND** If the total amount recommended is >6 tons per acre, the lime is split between two applications in the year prior to planting.	In the year prior to planting, soil pH is adjusted with lime so the top 16" of soil is approximately 6.5 for *V. vinifera,* 6.0 for hybrids, and 5.5 for natives. **AND** Lime applications are not split if >6 tons per acre is required.	In the spring just before planting, soil pH is adjusted with lime so the top 16" of soil is approximately 6.5 for *V. vinifera,* 6.0 for hybrids, and 5.5 for natives. **OR** Less than 3 tons per acre of lime is applied after planting.	Soil pH is not adjusted before planting. **OR** Soil pH is not known. **OR** More than 3 tons per acre of lime is applied after planting.	

Three major types of grapevines are grown in Maryland: natives, hybrids, and *V. vinifera* types. Native labrusca types are adapted to acid soils, with optimum pH around 5.5. *V. vinifera* grapevines are more adapted to neutral soil pH (6.5-7.0) and can exhibit nutrient deficiencies in acid soils. Interspecific hybrid varieties are hybrids of American (often acid-adapted) *Vitis* spp. and *V. vinifera,* so are thought to have an adaptation to intermediate soil pH (6.0) somewhere between the European and American parents. Although this idea has not been rigorously tested for every hybrid, these guidelines seem to work reasonably well in practice.

Application of lime should be done in the year prior to planting. Additions of large amounts of lime just before planting can induce manganese, potassium, or magnesium deficiencies in vines. Also, lime applied immediately preplant may not have time to react with soil particles.

PREPLANT CONSIDERATIONS

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
For sites with low soil organic matter (< 3% for Coastal, < 2% for Piedmont and Appalachian regions), is additional matter added?	Organic matter is supplied through one of the following methods: Cover crops (particularly with sorghum/sudan hybrids); Compost; or Manure, preferably composted.			Organic matter is not added, particularly on sandy sites.	
How are vineyard rows oriented with respect to slopes?	Vineyard rows run perpendicular to the slope (across slope). **OR** Slope along rows is < 3%; hill slope is < 12%. **AND** Direction of slope is uniform.	Vineyard rows run perpendicular to the slope. **AND** Slope along rows is < 6%; hill slope is < 12%. **AND** Some side slopes present.	Vineyard rows are perpendicular to the main slope. **AND** Substantial side slopes are present (slope direction is not uniform).	Vineyard rows run up and down the slope. **AND** Slopes are >6%.	

Vineyard rows can reduce the effective slope by channeling water across it. Such protection is less effective when the slope ***along vineyard rows*** exceeds 3%, when slope direction is not uniform (side hills present), or when the main slope exceeds 12%.

ESTABLISHED VINEYARD CONSIDERATIONS

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is pH adjusted if necessary?	Lime is added according to soil test recommendations if topsoil pH is less than 6.5 for *V. vinifera,* 6.0 for hybrids, or 5.5 for natives. **AND** No more than 2-3 tons per acre is applied per year. No more than 1 ton is applied at one time and lime is never applied at the same time as Nitrogen.		Lime is added according to soil test recommendations. **AND** More than 3 tons per acre is applied in one application.	Soil tests are never taken, and lime is added systematically, or not at all.	

ESTABLISHED VINEYARD CONSIDERATIONS

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
How is soil compaction addressed, if evident?	Equipment is chosen or modified to minimize compaction (e.g. lightest equipment possible, wider or larger diameter tires, tire pressure is as low as possible). **AND** In compacted areas, subsoiling is completed every other year in the tire tracks, or deep-rooting cover crops are planted to help restore soil structure. **AND** Equipment use is avoided when soils are saturated.	In compacted areas, subsoiling is completed every 2 to 3 years. **AND** Equipment use is usually avoided when soils are saturated.	Compaction status is not known. **AND** Equipment is sometimes used when soil is saturated.	Compaction status is not known. **AND** Equipment is regularly used when soil is saturated.	

Common implements used for subsoiling include the chisel plow, spader, and paratill. A chisel plow typically has two shanks that ride in the tire tracks. It is more effective with drier soil and can extend to a depth of 18". The spader, a series of rotary shovels, loosens topsoil and fractures subsoil. It reportedly works in both dry and wet soils to a depth of about 14". The advantage to a spader is that it incorporates green cover. The paratill consists of a pair of coulters that slice the soil followed by 2 angled legs, each with a foot and riser plate on the bottom. It typically reaches depths of 12-18". It lifts and partially shatters the soil profile with maximum shatter occurring with drier soils. It does not mix top and subsoils, nor create clods, or large trenches. Note that it is not unusual for the chisel plow and paratill to sever vine roots in established vineyards.

VINEYARD MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
How is soil erosion addressed?	Permanent cover crops are established in vine row middles and maintained throughout the year. **AND** Where erosion is evident corrective measures are taken (e.g. grass waterway, diversions, filter strips). **AND** Buffer/filter strips are established around all water bodies, wetlands, and outlet ends of concentrated flow areas. **AND** Straw mulch is applied to row middles where available.		Winter annual cover crops are established in vine row middles. **AND** Where erosion is evident, corrective measures are taken (e.g. grass waterway, diversions, filter strips), but some erosion is still evident. **AND/OR** No buffer/filter strips are established around any water bodies, wetlands, or outlet ends of concentrated flow areas.	No cover crop is established. **AND/OR** **E**rosion is evident and no corrective measures are taken.	

The services of the Natural Resources Conservation Service (NRCS) and the Soil and Water Conservation District (SWCD) can be utilized to design and install appropriate erosion control methods.

ROW MIDDLE MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
If cultivation is used in row middles, what practices are used?	Slope is < 3% for heavy soils or < 6% for medium to coarse-textured soils. **AND** Shallow or trashy cultivation is practiced every other year or less.	Slope is < 3% for heavy soils or < 6% for medium to coarse-textured soils. **AND** Row middles are clean-cultivated no more than one time per season. **OR** Slope is 6-12% and row middles are shallow cultivated no more than once per year.	Slope is 3-9% for heavy soils or 6-12% for coarse-textured soils. **AND** Shallow cultivation is practiced 1-3 times per season.	Row middles are clean cultivated every year. **AND** Slopes are >12% for coarse-textured soils or >9% for heavy soils.	

Cultivation, whether in the row middle or under the trellis, can have negative consequences particularly if done in excess. It renders soils more prone to erosion, destroys soil organic matter and can alter the quantity and diversity of soil microbial populations. Row middle tillage can, and should, be done to periodically renovate row middles (reduces weed populations such as dandelions) and as a vine management tool in dry years (reduces competition for water).

ROW MIDDLE MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What type of seeded cover crop is used?	Permanent cover crop is established.	Annual cover crops are fall-seeded with a no-till drill every year. **AND** Cover is established most of the year.	Cover crops are seeded into cultivated row middles. **AND** Cover is established from late fall through bloom.	Annual cover crops are established following cultivation only on slopes >12%.	
If permanent cover is used in row middles, how is it managed?	Vegetation covers more than 2/3 of the vineyard floor. **AND** Vegetation is uniformly dense within the 2/3 cover. **AND** A no-till seeder is used when renovating cover crops.	Vegetation covers more than 2/3 of the vineyard floor. **AND** Occasional bare spots occur on less than 10% of the vineyard. **AND** Cultivation is practiced only when renovating cover crops.	Vegetation covers less than 1/2 of the vineyard floor. **OR** Bare spots occur on eroded knolls on more than 20% of the vineyard.	Vegetation is difficult to establish and frequent gaps in vegetation cover are present.	
Drip line irrigation reduces the vines' soil moisture competition with sod and therefore the need to suppress its growth with herbicides.					

ROW MIDDLE MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What is the frequency of mowing?	Monthly from bloom to veraison, and only thereafter for worker comfort and safety.	Vineyard is mowed monthly from bloom to harvest.	Vineyard is mowed more than monthly during entire season.	Vineyard is mowed weekly.	
In regions where Lyme disease is a concern, more frequent mowing is warranted as a safety measure for workers. Mowing should be restricted to the amount necessary to allow normal vineyard operations, worker safety, or other carefully considered vineyard objectives. Mowing does not reduce water use during droughts and excessive mowing wastes fuel, tractor time, and management time better devoted to other tasks. Of course, vineyard blocks next to tasting rooms may be justifiably manicured as a marketing practice. By the same token, sustainable vineyard management can be a marketing strategy and mowing less can provide an opportunity for tasting room staff to demonstrate this to customers directly.					
If mulch is used in row middles for erosion control, how is it managed?	Mulch is applied to every row middle on eroded areas as needed. **OR** Mulch is applied to all vineyard blocks with slopes >12%.	Mulch is applied to alternate row middles in vineyard blocks with >12% slope.		Row middles are never mulched. **AND** Slopes are >12%, and permanent sod is not well established. **OR** Soils are eroded or low in organic matter.	

Application of straw mulch to row middles is a highly beneficial practice, particularly on eroded hillside vineyards. It conserves moisture, adds organic matter to the soil, and is highly effective in reducing erosion and runoff. It is commonly applied to alternate row middles, and often applied in the fall after harvest. Straw mulch can supply significant amounts of potassium to soils. It is most cost effective to use when growers bale the straw themselves and have open land that they can devote to producing it. Round bales are most often rolled out using self-fabricated tractor-mounted equipment to unroll the bales.

ESTABLISHED VINEYARD CONSIDERATIONS

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is ephemeral (small rills that concentrate into channels) or gully erosion occurring on the farm?	No gully or ephemeral erosion is evident.	There is ephemeral erosion occurring in some blocks. **AND** There is no gully erosion. **AND** Sod prevents sediment from entering watercourses.	Both ephemeral and minor gully erosion is present. The erosion forms a distinct, narrow channel through which water runs during a storm or when ice and snow melt. Channels remain after tillage operations.	Both ephemeral and gully erosion are present.	

ESTABLISHED VINEYARD CONSIDERATIONS

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Are filter strips (grass borders along watercourses) used?	Vegetative buffers are at least 20 ft wide and meet Natural Resources Conservation Service Standard. Filter strips surround all watercourses and vineyard borders.	Filter strips are present along most vineyard borders. **AND** No sediment is entering a major watercourse.	Filter strips are present along some vineyard borders.	Sediment directly enters a watercourse. **AND/OR** No filter strips are in place.	
Are drainage problems addressed?	Pattern tiling is established with tile lines parallel to rows at an adequate density for the soil texture. **AND** Tile spacing is appropriate for variety type (Vinifera may need more tiling than natives to be productive).	Soils are well drained to excessively well drained. **OR** Tile drainage is installed on poorly drained low areas or heavy soils. **AND** Tile spacing is appropriate for variety type (Vinifera may need more tiling than natives to be productive).	Soils are moderately drained to poorly drained. **AND** Tile lines extend only to observably wet areas.	Soils are poorly drained, and no tile drainage is utilized even in wet spots and low areas. **AND** Standing water persists after rain events.	

ESTABLISHED VINEYARD CONSIDERATIONS

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
If a nitrogen (N) supplying cover crop is used (e.g. a legume), are its N contributions factored into the vines' N requirements?	If your vineyard has a N requirement and a component of your cover crop fixes N (e.g. legumes such as clover and vetch), the fixed N is taken into account when calculating the application rate of additional N.		If your vineyard requires additional N, a component of the cover crop fixes N. **BUT** Total N supplied by the cover crop is not calculated. **AND** Vines show balanced growth, no excess vigor.	Although N is required, no legumes are used to fix N (i.e. all N is purchased and applied). **OR** A component of the cover crop fixes N, but the total N supplied by the cover crop is not calculated. **AND** Vines show excess vigor.	

A general equation used to calculate nitrogen contributions from cover crops is found on page 29.

ESTIMATING AVAILABLE NITROGEN SUPPLIED BY COVER CROPS

To estimate the amount of nitrogen in your cover crop, you must assess the total yield of the cover crop and the percentage of nitrogen in the plants just before they die.

There are two ways to estimate yield. The most accurate way is to take cuttings from several places (of known surface area) in the vineyard, then dry, and weigh them. Clip the plants at ground level within the known area. Dry them out in the sun for a few days and use the following formula to determine the per acre yield of dry matter.

$$\textbf{Yield (lbs/acre)} = \frac{\textbf{Total wt of dried samples (lbs)}}{\textbf{ft}^2\textbf{ sampled}} \times \frac{\textbf{43,560 ft}^2}{\textbf{1 acre}}$$

An easier but less accurate method is to estimate your yield from the height of the cover crop and its percent cover. At 100% cover and 6" height, most grass legume cover crops will contain roughly 2000 lbs/acre of dry matter. For each additional inch, add 150 lbs. For example, a typical fescue, perennial ryegrass, or white clover vineyard cover crop that is 8" tall will yield 2000 lbs/acre of dry matter plus an additional 150 lbs for each additional inch for a total of 2300 lbs of dry matter per acre. If the strand is less than 100 percent, multiply by the percent cover. In this example, for an 80% cover you would obtain: 2300 lbs x 0.80 = 1840 lbs dry matter/acre.

To convert the yield to total nitrogen, use the following guideline: cover crop grass legume mixtures contain 2-3% N before flowering and 1.5-2.5% after flowering. Therefore, total nitrogen in the cover crop = yield (lbs/acre) x % N/100.
To estimate the nitrogen available to the vines, divide the total nitrogen by 4 for cover crop material left on the surface in a no-till system.

So, in our example, if you mowed the vineyard three (3) times during the season when the cover reached a 6" height you would have 6000 lbs/acre of dry matter.

Total nitrogen = 2000 lbs/acre x 3 cuttings = 6000 lbs

$$\textbf{6000 lbs/acre} \times \frac{\textbf{2.5*}}{\textbf{100}} = \textbf{150 lbs}$$

*Average nitrogen percentage before flowering.

$$\textbf{Nitrogen available to vines} = \frac{\textbf{150 lbs}}{\textbf{4}} = \textbf{37.5 lbs/acre}$$

This procedure provides a gross estimate of available nitrogen in the soil from cover crops. To obtain a more accurate estimate you would have to send plant samples to a lab for analysis.

Organic matter decomposition in the soil also produces nitrogen. Each 1% of organic matter supplies 15-20 lbs/acre/year of nitrogen (Dr. Terry Bates, Cornell University, Fredonia Vineyard Laboratory).

Modified from: Sustainable Agriculture Network (1998).

THE BENEFITS OF USING COVER CROPS IN VINEYARDS

Cover crops do not need to be worked into the soil. Cultivation, whether in the row middle or under the trellis, can have negative consequences, particularly if done in excess. It renders soils more prone to erosion, burns off soil organic matter, and can alter the quantity and diversity of soil microbial populations. Row middle tillage generally negates the benefits of a row middle crop (no net increase in organic matter as it burned off roughly as fast as it is added). However, row middle tillage can and should be done to periodically renovate row middles (reduces weed populations such as dandelions) and as a vine management tool in dry years (reduces competition for water). In regard to mowing, more organic matter is preserved by mowing and letting the residue lie on the surface versus cultivation of any kind (roots contribute to organic matter as well).

From Ohmart and Matthiasson (2000):

- Permanent cover crops are the most practical and cost effective means of supplying the organic matter needed to maintain and improve the soil.
- Cultivation decreases organic matter.
- As the cover crop decays, it provides nutrients for the grapevines.
- Grass cover crops usually require some added nitrogen (20-40 lbs per acre), whereas legumes may require phosphorus and sulfur and should not receive any nitrogen, otherwise they become weedy.
- Different types of cover crops can either reduce or enhance vine growth.
- Cover crops tend to use more water than clean cultivation. Increased infiltration of rainfall may offset this loss in some years.

ESTABLISHED VINEYARD CONSIDERATIONS

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
For soils with low organic matter (< 2 for Coastal Plain, and <3% for Piedmont and Appalachian regions), is additional organic matter added?	Organic matter, such as compost or composted pomace, is banded to the soil under the vine row annually, or as needed. Compost is analyzed for nutritional composition as well as contaminants. **AND** Vine prunings are chopped and remain in vineyard.*	Organic matter, such as compost or composted pomace, is banded to the soil under the vine row occasionally. Compost is not analyzed. **AND** Vine prunings are chopped and remain in vineyard.*	No organic matter is added to the soil. **BUT** Vine prunings are chopped and remain in vineyard.*	No organic matter is added to the soil. **AND** Vine prunings are removed from vineyard.*	

It is most practical to apply compost to a swath under the trellis rather than a broadcast application. Reasons include limited availability of high quality compost, the fact that large quantities are needed, and the expense involved. Dr. Ian Merwin, of Cornell University's Department of Horticulture, has documented that compost application increases soil microbial activity (CO_2 evolution), CEC (Cation Exchange Capacity), and available P, Ca, and K. Compost application can also result in shifts in microbial community structure. Caution – Compost/organic matter may add desirable components to the soil, however excessive application may lead to long term increases in vine vigor (especially for *vinifera)* which may have deleterious effect on fruit quality.

*Chopping the prunings may aid movement through the vineyard rows, removal of vine prunings may be warranted to reduce fungal disease infestations.

Calculating Compost Application on Vine Rows

Examples

Row spacing: 7 ft between rows x 5 ft between vines in row

Rows: 350 ft long; approximately 18 rows per acre

Compost: Have available approximately 5 tons/acre of compost

10,000 lbs/18 rows = 550 lbs/row

To apply compost to a certain depth:

There are 1.5-2 yd^3/ton

350 ft row x 2 ft swath x 0.042 ft (0.5" deep layer of compost) =

29 ft^3 per row x 18 rows/acre = 522 ft^3

522 ft^3/27 ft^3 per yd^3 = 14 yd^3

Summary: The amount of compost needed to apply a 2 ft swath under the trellis 0.5" deep over 1 acre of vines is 14 yd^3 or between 7 and 9 tons of compost. Generally, compost applications should be limited to no more than 10 tons/acre annually to avoid nutrient imbalances.

Benefits of Soil Organic Matter

- Attracts and holds nutrients in an available state, reducing leaching losses.
- Increases soil water-holding capacity.
- Binds soil particles into crumbs (aggregates), producing a granular structure that promotes the penetration of air to roots, the capillary movement of water and the penetration of roots through the soil.
- Transforms into vitamins, hormones, and other substances, which stimulate growth in plants.
- Feeds soil organisms, which in turn feed soil predators that also prey on root pests.

The soil builds up organic matter faster if the organic material is left on the surface than it does if it is worked into the soil. The oxygen introduced by the tillage "burns off" the organic matter. The natural process is for the material to "melt" into the soil over time.

From Ohmart and Matthiasson (2000)

VINEYARD MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is biodiversity of soil microorganisms considered when making soil management decisions?	A conscious effort is made to increase and diversify the soil microbial populations with 4 or 5 of the following methods: • Use of compost or other organic matter • Minimal row middle tillage • Reduction in or elimination of pre-emergence herbicides • Avoiding the overuse of post-emergence herbicides • Increase the diversity of plant material on the vineyard floor	At least 3 of the bulleted points in category 1 are used to benefit soil microbial populations.	1 or 2 of the bulleted points in category 1 are used to benefit soil microbial populations.	No effort is made to improve soil microbiology.	

A diverse soil microbial population has been implicated in nutrient uptake and retention, disease suppression and overall plant health.

VINEYARD MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
How is pomace utilized?	Pomace is composted on site and returned to the vineyard.	Pomace is composted off the farm and returned to the vineyard as mature compost.	Pomace is spread in the vineyard, fresh.	Pomace is not returned to the vineyard.	

Recycling of organic matter back into the vineyard is important to maintain soil organic matter and soil biodiversity. Pomace can be combined with a carbon source - leaves, for example - to create a more nutritionally balanced product that enhances the soil over and above the addition of fresh pomace. Though difficult to totally eliminate, even through proper composting, grapevine seedlings will proliferate from the spreading of fresh pomace. These seedlings are often infected by downy mildew, but are generally controlled through standard weed control practices such as herbicide use, cultivation, or mowing. Caution – Pomace contains large amounts of K which may have undesirable effect on fruit pH. If your vines and soil have high to excess K, do not return pomace to the vineyard.

II. Nutrition Management

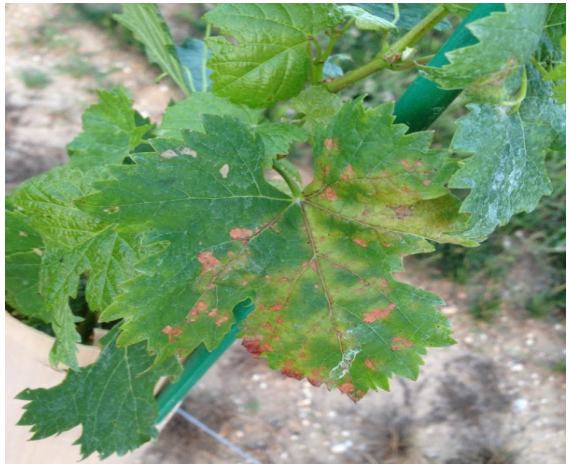
Nutrient management is important to ensure healthy, productive vineyards. It is not only important to have sufficient amounts of each nutrient available to the vine, but also to establish an appropriate balance of the relative amounts of all nutrients. Nutrient excess or deficiency can affect both yield and fruit quality, both for bulk wine and juice grape varieties and premium wine varieties. Nutrient availability is affected by soil texture, moisture, pH, and many other factors. It is important to adapt vine nutrition practices to site-specific vineyard conditions, rather than applying a "one-size-fits-all" approach to all vineyard blocks.

The Maryland Department of Agriculture requires all farms with >$2500 annual income to have a Nutrient management plan produced by a certified advisor. See http://mda.maryland.gov/resource_conservation/pages/nutrient_management.aspx or contact your local UME County Extension Educator or Specialist for more details.
For more details on the UME Nutrient Management Program visit: http://www.extension.umd.edu/anmp
Creating and utilizing an approved Nutrient Management Plan for your vineyard will assure that you are in legal compliance and offer optimal and economical management of nutrients for your vineyard.

Excess fertilizers – notably nitrogen and phosphorus – can also contaminate ground and surface waters. Managing nitrogen fertilization is most important because nitrogen is the most common fertilizer applied to vineyards, it directly affects vine size and quality, and it moves readily through the soil. Phosphorus can trigger excessive growth of organisms in surface water, leading to algal blooms and depletion of oxygen. Grape growers rarely add phosphorus to mature vineyards, except indirectly through application of phosphorus-rich manures, so excess phosphorus is not a common concern.

This section addresses the uses of soil and tissue samples to guide nutrient management decisions and special consideration for using soil characteristics and vine growth as guides for nitrogen management.

Photography credit: Bob White, MGGA member



MONITORING NUTRIENT STATUS

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is tissue analysis done on a regular basis?	Tissue analysis is done in all blocks every 3 years on rotating basis. Results are used in planning future fertilization.	Tissue analysis is done most blocks every 3 years.	Tissue analysis is done only when there is a problem.	Tissue analysis is not done.	
The University of Maryland Extension recommends bloom sampling because in-season correction is possible. See **http://go.umd.edu/TissueTesting** and **http://go.umd.edu/TVitTissueSampling** for more details. The Maryland Department of Agriculture requires all farms with >$2500 annual income to have a Nutrient management plan produced by a certified advisor. See **http://mda.maryland.gov/resource_conservation/pages/nutrient_management.aspx** or contact your local County Extension Educator or Specialist for more details. *For more details on the UME Nutrient Management Program visit:* **http://www.extension.umd.edu/anmp**					
Is soil analysis done on a regular basis?	Soil analysis is done at same time in the same blocks as tissue sampling, more often if problems arise. Results are used in planning fertilization and liming, as well as, organic matter amendments.	Soil analysis is done on most blocks every 3 years.	Soil analysis is done less than every 3 years and/or only in problem areas.	Soil analysis is not done.	

NITROGEN (N) MANAGEMENT PRACTICES

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What criteria are used to determine the rate of N fertilization?	Soil applied N rates are adjusted based on **at least 6** of the following: • Variety • The previous year's crop level ***(Fruit removes approximately 4 lbs of N/ton of fruit produced.)*** • Vine pruning weights • % soil organic matter • Visual clues of N deficiency or excess • Canopy fill • Vine vigor • Degree of winter injury • Historical records on amount of N used.	Soil applied N rates are adjusted based on 4 or 5 of the criteria.	Soil applied N rates are based on 2 or 3 of the criteria.	N rates are not adjusted for variety, crop level, soil organic matter, winter injury, or any other criteria.	

Nitrogen is the plant nutrient most susceptible to loss by leaching (movement through soil) into groundwater. Specific health problems are associated with nitrate contamination of drinking water supplies. Nitrate levels higher than 10 mg/l (designated the Maximum Contaminant Level by the US EPA) have been found in groundwater, often in association with spring runoff or heavy rainfall events. It is therefore absolutely essential for grape growers to use nitrogen in a thoughtful and sparing manner.

Key Points for N Fertilization:

- If winter injury has occurred, delay N decisions until after fruit set to allow evaluation of vigor level and fruit set.
- N deficiency symptoms: pale green leaves, small leaves, spindly shoots, short internodes, poor fruit set.
- N excess symptoms: dark green, "dinner plate" leaves, bullwood, succulent shoots with long internodes, poor fruit set.
- Vinifera grapes do not require N fertilization in most years. Refer to your Nutrient Management Plan for details.

For more information on Nitrogen nutrition, go to: **http://go.umd.edu/TVitNFertilization**

Nitrogen (N) Management Practices

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What is the total amount of supplemental Nitrogen (N) fertilizer applied from all sources?	Vinifera & Premium Hybrids: All N is derived from soil organic matter and/or cover crops. No supplemental N is necessary. Bulk hybrids & natives: < 30 lbs/acre actual N is applied in a given year.	Vinifera & Premium Hybrids: < 20 lbs/acre actual N is applied in a given year. Bulk hybrids & natives: 30-50 lbs/acre actual N is applied in a given year.	Vinifera & Premium Hybrids: 20-40 lbs/acre total actual N is applied in a given year. Bulk hybrids & natives: 50-70 lbs/acre actual N is applied in a given year.	Vinifera & Premium Hybrids: >40 lbs/acre total actual N is applied in a given year. Bulk hybrids & natives: >100 lbs/acre actual N is applied in a given year.	
Is contribution of Nitrogen (N) from organic sources considered?	N contributions from compost, legumes, mulch, and cover crop residues are estimated to reduce N fertilizer rates.			N contributions from organic sources are not used to reduce N fertilizer rates.	

Nitrogen release from organic matter such as compost and mulch can be calculated from their analysis (if known) and the Carbon to Nitrogen, C:N, ratio. According to Dr. Terry Bates (Cornell University, Fredonia Vineyard Lab), if the N content of the organic matter is >2.5% or the C:N ratio is < 20, N will be released. Materials with a C:N ratio >20 require further decomposition before they can release N, and in fact may lead to N deficiencies as N is sequestered by soil microorganisms.

NITROGEN (N) MANAGEMENT PRACTICES

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Are different rates/timing of N fertilization tried in an effort to reduce overall N use?	Experiments have been/are being conducted on the farm examining a range of N rates and/or timings with the goal of minimizing N fertilizer application.	The timing/rates of N fertilization are based on recommendations from area extension services for the region and varieties grown, but farm-specific experiments have not been done.		The timing/rates of N fertilization are not based upon on-farm research or extension guidelines.	
Are organic fertilizers used?	All fertilizers, foliar and ground applied, are organically acceptable.	A portion of fertilizers used is organically acceptable.	Only synthetic fertilizers are used.		

While organic fertilizers offer potential benefits that synthetic fertilizers may not, increased costs may preclude their use, particularly in bulk production vineyards.

Organic fertilizers are slower to release N, often have an unpredictable rate of release and are more dilute. Some sources report that organic fertilizers can also be high in salts and warn against over-application. On the other hand, if used long-term, they may improve the quantity and quality of soil organic matter, promote soil biodiversity and reduce leaching (through the improved organic matter and slow release of N). Misapplication of any fertilizer – organic or synthetic – can pose a leaching hazard, not to mention a potential headache in the vineyard.

It is more difficult to ascertain the exact rate of organic fertilizer to add given the unpredictable rate of N release. Use of split applications and supplementation with foliar N will allow tweaking of the N rate. Examples of common organic N fertilizers include peanut meal, soybean meal, feather meal, and fish meal.

NITROGEN (N) MANAGEMENT PRACTICES

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
When is N fertilizer soil-applied in spring?	N is applied during the period of maximum uptake – pre-bloom to fruit set. **AND** Split applications are used with 30-50% of the N applied pre-bloom and the remainder applied post-bloom.	All N is applied during the period of maximum uptake – pre-bloom to fruit set. **AND** Split applications are not used.	N is applied up to 2 weeks prior to budbreak when vines are still dormant. **OR** All N is applied in the period between fruit set and veraison.	N is applied >2 weeks prior to budbreak.	
There is little absorption of N by roots prior to budbreak. The soil is cold and roots are inactive. Early vine growth depends almost entirely on N stored in the woody parts of the vine. It is unclear whether pre-budbreak application of slower release organic fertilizers confers an advantage in terms of N availability to the plant. *For more information on Nitrogen nutrition, go to:* **http://go.umd.edu/TVitNFertilization**					
If N fertilizer is soil-applied during the post-harvest period, what criteria are used?	All soil-applied N is applied in spring and summer as per the guideline above.	N is applied in September or after the harvest of earlier varieties such as Chardonnay but not after late-ripening varieties like Merlot or Cabernet Sauvignon; canopy has healthy, functioning leaves when N fertilizer is applied.	N is applied after harvest of late-ripening varieties such as Merlot and Cabernet Sauvignon; canopy has healthy, functioning leaves when N fertilizer is applied.	N is applied after harvest of late-ripening varieties and there is an absence of healthy, functioning leaves when N fertilizer is applied.	

NITROGEN (N) MANAGEMENT PRACTICES

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
In irrigated vineyards, how is N fertilizer applied?	If drip irrigation is installed, fertigation is used to efficiently apply small doses of N to vines.	A combination of fertigation and ground applied N is used.		Only ground or foliar applied N is used.	
If foliar N is used, when is it applied?	Foliar N is used only when necessary or not at all. Use is based on visual cues from vines and/or tissue analyses reporting < 1.0% N in spring.		Foliar N is used several times, its use based on the calendar.	Foliar N is included in most tank mixes automatically.	

Early season foliar N is common in winegrape vineyards and may benefit N deficient vineyards. However, N needs are best addressed through addition of organic matter and/or ground application of N fertilizers.

Clusters have a fairly high N demand around veraison. Foliar-applied urea (or other foliar feeds containing N) applied several times around veraison can increase yeast-assimilable nitrogen (YAN) in musts, particularly when drought has limited N uptake from the soil. In Cornell trials over the last few years, up to 10 lbs urea in 100 gallons (5 lbs actual N) has been used without burning the foliage. This is not a panacea for eliminating Atypical Aging (ATA, a wine defect associated with limited N uptake in drought years in white wines), but has had a secondary role (the more major effect occurring with irrigation) in reducing ATA. It is effective in bumping up the YAN values, which may help winemakers avoid stuck fermentations. It does not appear to prolong or "restart" shoot growth, nor delay wood maturation.

MACRONUTRIENT MANAGEMENT PRACTICES: CALCIUM (CA), MAGNESIUM (MG), POTASSIUM (K)

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
How are macronutrient - P, Ca, Mg, K - levels managed in soil?	Macronutrients are maintained at acceptable ranges based on soil and petiole results. **AND** Vineyard manager can identify deficiency symptoms.	Macronutrients are maintained at acceptable ranges based on soil and petiole results. **BUT** Vineyard manager cannot identify deficiency symptoms.	Macronutrient levels in soil are adjusted only when deficiencies occur.	Fixed amounts of macronutrients are applied annually.	

The application of Ca, Mg, and K as foliar nutrients is not well understood. Use can be based in part on soil/tissue analysis and visual clues. Magnesium deficiency is often addressed through the use of foliar applied Epsom salts. In general, due to the relatively large quantities required by vines, macronutrient nutrition is best addressed through the root system. Potassium is a very critical nutrient in the vineyard and very plentiful in Maryland soils. Excess K can lead to problems with elevated fruit pH during harvest, so applications, if any, should be very judicious. This will be reflected in your Nutrient Management Plan.

Excessive amounts of P in surface water promote the growth of algae and other aquatic organisms, potentially depleting oxygen levels in surrounding water bodies. This can have profound impacts on aquatic life. Because P is less available in acid soils, simply increasing soil pH to 6.0-6.5 will increase P availability. Generally, P fertilization has not been found to benefit vineyards in part due to the immobility of the nutrient.

Macronutrient Management Practices: Calcium (Ca), Magnesium (Mg), Potassium (K)

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is the base saturation ratio in the soil analysis within recommended ranges?	Base saturation percentages are fully within ranges recommended by the soil analysis lab.	Base saturation percentages are slightly imbalanced. Adjustment is addressed in action plan.	Base saturation percentages are grossly imbalanced. Adjustment is addressed in action plan.	Base saturation percentages are grossly imbalanced. Plans for adjustment have not been made.	

Some soil labs provide percent base saturation (% BS), the relative percentage of the cations Ca, Mg, K, Na (sodium) and H (hydrogen) occupying exchange sites on soil particles. The following standards are used: Ca, 65-75%; Mg, 10-15%; K, 3-5%; Na, < 2% (more important for CA growers where high sodium soils can be a problem); and H, depends on pH. BS percentages are useful in choosing a type of lime or fertilizer (e.g. use of high Mg [dolomitic] lime vs. high Ca lime).

Micronutrient Management Practices: Boron (B), Manganese (Mn), Zinc (Zn)

How are micronutrients - B, Mn, Zn - managed?	Micronutrients are maintained at acceptable ranges based on soil and petiole results. **AND** Vineyard manager can identify both deficiency and toxicity symptoms.	Micronutrients are maintained at acceptable ranges based on soil and petiole results. **BUT** Vineyard manager cannot identify all deficiency and toxicity symptoms.	Micronutrient levels in soil are adjusted only when deficiencies occur.	Fixed amount of micronutrients are applied annually.	

MICRONUTRIENT MANAGEMENT PRACTICES: BORON (B), MANGANESE (MN), ZINC (ZN)

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What criteria are used for foliar and ground application of micronutrients?	Micronutrients are used only when necessary; use is based on visual cues from vines and/or petiole and soil analyses.		Micronutrients are used once or twice; use is based on calendar or habit.	Annual applications of micronutrients are made without regard to petiole and soil results.	

There are many types of micronutrient fertilizers. The most commonly applied are boron, manganese, and zinc. Because these elements are required in small quantities and petiole analyses sometimes do not reflect a deficiency (due to time of sampling, type of tissue sampled, dilution effects due to vigorous growth, etc.), it is sometimes necessary to use these fertilizers based on historical knowledge of the vineyard. It is often hard to gauge efficacy of micronutrient fertilizers as they are used in small quantities and the elements are involved in specific enzyme systems and chemical pathways. If possible, leave a section of the vineyard untreated. To judge potential benefits, evaluate subsequent fruit quality and quantity. Examine soil and petiole analyses. Extra diligence in necessary in Maryland's coastal plain (sandy) soils as B is typically low and B added to the soil is prone to leaching, especially when organic matter is low. Pre-bloom foliar sprays are most efficient.

FERTILIZER STORAGE

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What is the storage duration of fertilizers?	No fertilizers are stored at any time.		Fertilizers are stored during the season.	Fertilizers are stored for more than one season.	
What type of storage is used for dry formulations?	Covered storage on impermeable surface such as concrete or asphalt. Spills are collected.	Covered storage on permeable surface (other than sandy soils). Spills are collected.	Partially covered storage on permeable surface (on other than sandy soils). **AND/OR** Spills are not collected.	There is no cover, soils are sandy. **AND/OR** Spills are not collected.	
What is the condition of the containers?	Tanks or bags should be clearly labeled. No holes, tears, weak seams, or leaks unless there is secondary containment.	Labels are missing or hard to read. Bags are old with no holes or tears unless there is secondary containment.		Bags/containers are old and in need of repair. Metal containers show signs of rusting. No labels or secondary containment.	

FERTILIZER STORAGE

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What security measures are taken at the storage area?	Area is fenced or locked and separate from all other activities or valves are locked.	Area is fenced or locked and separate from most other activities.		Area is open to activities that could damage containers or spill fertilizer.	
What is the distance from the fertilizer storage to the nearest surface water body or well?	Greater than 200 ft and storage building is curbed with a concrete pad. **OR** No fertilizer is stored on the farm.	100-200 ft and storage building is curbed with a concrete pad designed to contain 125% of the volume of the stored products.	At least 100 ft and storage building is not curbed with a concrete pad.	There is less than 100 ft between the fertilizer storage and the nearest surface water body or well.	

III. Vineyard Management

In the humid Mid-Atlantic, vineyard management is closely linked to the dual goals of pest management and production of quality fruit. With major challenges inherent in warm climate viticulture, vineyard management practices must be fine-tuned to achieve goals. From vine spacing and training system choices to pruning practices, canopy management practices and winter protection methods, vineyard cultural practices affect profitability and fruit quality, and need to be applied in a flexible manner to confront each season's unique and different challenges. One overall goal is to strike a balance between cropping levels and vegetative growth to ensure achievement of optimum yield of mature, high quality fruit.

This section addresses variety, rootstock, and vine spacing choices, timing and application of winter injury protection, adjustment of cropping levels and shoot density, timely application of canopy management practices, and crop estimation as components that influence environmental sustainability and profitability.

Photography credit: Bruce Perrygo, MGGA member

PLANT MATERIAL AND PLANTING

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is certified plant material used for vinifera and hybrid selection where possible?	A reputable nursery providing certified plant material (scion + rootstock) is used.	A reputable nursery is used; either the scion or the rootstock is certified.	The nurseryman harvests scion material from a reputable grower whose vines were certified.	Vine scion and rootstock are non-certified material.	

Currently, the primary vine certification program in the U.S. is the Foundation Plant Service (**http://fps.ucdavis.edu/**). They provide budwood and rootstock that is true to type and virus disease-tested. Generally, CA nurserymen buy material from FPS to create certified increase blocks. Budwood from increase blocks is then used for grafting. The use of certified plant material can reduce the incidence of leaf roll virus. However, certification is not a 100% guarantee against viral infection due to many issues including the difficulty in detecting virus in vines, the possibility of transmission by nematodes or mealybugs and transmission from non-certified virus infected material.

Native varieties are included in certification programs. FPS offers Concord, Niagara, Ontario, Catawba, and others in limited quantities, as these varieties are not grown in CA. Several nurseries also offer crown gall-free Niagara vines.

Are the variety and rootstock appropriate for the given site?	Variety and rootstock are appropriate for the given site based on winter hardiness, soil type and site characteristics.	Variety and rootstock are appropriate for the region.		No consideration is given to the appropriateness of variety/rootstock to the specific site or region.	

On replant sites, hybrid varieties susceptible to tomato ringspot virus should be grafted onto resistant rootstock. This includes varieties such as Vidal blanc, Baco noir, and DeChaunac.

Plant Material and Planting

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is fungal resistance considered when selecting varieties for planting?		Fungal resistance is considered and varieties resistant to most fungal diseases are selected.	Fungal resistance is considered and varieties moderately resistant to some fungal diseases are selected.	Vinifera varieties that are highly susceptible to fungal diseases are selected.	
Is the row orientation appropriate for the site?	Rows are oriented N-S to maximize sunlight interception. Where necessary, rows are perpendicular to slopes to minimize erosion.			Row orientation is not appropriate for the site and variety/rootstock.	
Does a map of the vineyard exist?	A detailed map exists of the vineyard, allowing accurate calculation of acreage. The map includes varieties, drainage tiles, irrigation mains/submains, buildings, roads, areas of runoff, water bodies (lakes, ponds, streams) and wells. Map information is tied to production records.		A map exists but is inaccurate or incomplete.	No map exists.	

Matching the variety to the site, is especially important because of the distinct, diverse regions of Maryland. The University of Maryland Extension has researched many variety /location combinations around the state and has very site specific recommendations; contact your local County Extension Educator or State Extension Specialist for details.
It is generally recommended that all hybrids be grafted, especially Chambourcin, Vidal Blanc, Chardonel, Seyval Blanc and Traminette. On replant sites, hybrid varieties susceptible to tomato ringspot virus should be grafted onto resistant rootstock. This includes varieties such as Vidal Blanc, Baco Noir, and DeChaunac.

VINEYARD MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Are there any on-farm experiments evaluating plant material or trellising options?	Experimental varieties, rootstocks, and/or training systems are being evaluated on a small scale. Data is taken to evaluate performance.	Experimental varieties, rootstocks, and/or training systems are being evaluated on a small scale. Evaluation is anecdotal, data is not taken.		No experimentation is being done.	

On-farm experimentation can encompass almost anything from informal evaluations to formal, replicated field trials. Key ingredients that must be used to make field comparisons useful are: **1)** vary only one practice at a time; **2)** leave a portion of the same vineyard block "untreated" or with your standard practice; **3)** measure something objective; and **4)** record your observations. Area extension programs may be useful in helping growers design informal or formal trials. Here are a couple of publications that may be useful for setting up on-farm trials:

How to Conduct Research on your Farm. Northeast Sustainable Agriculture Research and Education Program (SARE)
http://www.sare.org/publications/research/research.pdf

Sundermeyer, Alan. 1997. *Guidelines for On-farm Research* , ANR-007-97, Ohio State University
http://ohioline.osu.edu/anr-fact/0001.html

VINEYARD MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is the training system appropriate for the site and variety/rootstock? *Modified from Ohmart and Matthiasson (2000).*	Training system accommodates vine vigor allowing optimum canopy density and fruit exposure without extensive canopy manipulation.	Training system accommodates vine vigor but remedial steps are necessary to deal with vine vigor.		Training system is not suitable.	

Most vinifera and many hybrid winegrapes are suited to Vertical Shoot Positioned systems. More vigorous winegrapes may be trained using the Scott Henry system. Native and bulk hybrids with procumbent growth habits are suited to top wire systems such as the Hudson River Umbrella or Geneva Double Curtain. The optimum shoot density for single curtain systems is 4-5 shoots/ft of row. Systems with more than one curtain, such as GDC and Scott Henry will have twice the shoot number.
For more detailed information on pruning, including adjusting vine balance, timing, and pre-pruning, go to:
http://go.umd.edu/TVitBalancedPruning1; **http://go.umd.edu/TVitPruningTiming2**; **http://go.umd.edu/TVitPrePruning3**

Is vine size monitored?	Prior to pruning each vineyard block, randomly-selected, permanently-tagged vines are pruned and the brush is weighed.	Prior to pruning each vineyard block, a few representative vines per acre are pruned and the brush is weighed.	Though vine size is monitored, averages exist on a whole farm basis rather than block by block.	No attempt is made to monitor vine size or track pruning weights.	

One of the key measures of vineyard performance is vine size. Vines must be balanced to facilitate light and air penetration. They must also facilitate the production of economical yields of high quality fruit, whether dealing with labrusca, hybrid, or vinifera vines. This topic is addressed in many texts including the classic work, *Sunlight Into Wine* , by Smart and Robinson (1991).

Vine size assessment is done primarily through the weighing of dormant vine prunings. Typically, the weight of canes on a per vine basis ranges from 0.2 – 0.4 lbs pruning weight/ft of row. The ideal weight is related to variety, yield goals, inherent vigor of the scion, etc. For labrusca and hybrid varieties grown on divided canopies, pruning weights would reflect the doubling of linear feet of canopy.

VINEYARD MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
If vines are determined to be unbalanced - too small or too large - are steps taken to increase or decrease vine vigor?	A plan is set forth to increase or decrease vigor of unbalanced vines.	A formal plan does not exist but several steps to modify vigor are being taken.		There are no plans to adjust vine vigor.	
To increase vine size: leave fewer buds at pruning, increase nitrogen fertilization, reduce crop level, till row middle cover in spring, and/or increase irrigation. To decrease vine size: leave more buds at pruning, reduce nitrogen fertilization, delay cluster thinning until veraison, establish permanent cover in row middles, and/or decrease irrigation.					
Is shoot density appropriate? *Note: These 3 guidelines apply primarily to training systems that require shoot positioning.*	A shoot density of 4-5 shoots per linear foot of row is achieved without extensive shoot thinning.	Where necessary, shoots are thinned to 4-5 shoots per foot of row using the following guidelines: • Thinning should be done when shoots are < 6" in length. • Consideration should be given to the maintaining of the training system. • If possible, sterile shoots should be eliminated first.	Shoot thinning is done though guidelines are not followed conscientiously.	Shoot thinning is not done. Shoot density exceeds recommendations, resulting in a dense, shaded canopy.	
A delay in shoot thinning/shoot positioning leads to poor air and light exposure, **important for both pest management and fruit quality.** *For more detailed information on canopy management, including shoot thinning and positioning, go to:* **http://go.umd.edu/TVitCanopyManagement**					

Vineyard Management

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is shoot positioning done in a timely manner?	Catch wires are lifted on a timely basis, shoots are properly tucked and shoot positioning is conscientiously done.	Canopy maintenance is good but improvements could be made in timing and method.	Catch wires are not always adjusted in a timely manner.	Adjusting of catch wires is perennially behind schedule, leading to poor penetration of air, light, and spray.	
Shoot positioning and the straightening of tangled, intertwined shoots, improves air, light, and spray penetration. Along with appropriate adjustments in catch wires, these practices facilitate cluster thinning and leaf removal. **If these practices are delayed, costs increase due to the lignification of shoots and presence of tendrils.** *For more detailed information on canopy management, including shoot thinning and positioning, go to:* **http://go.umd.edu/TVitCanopyManagement**					
Are the canopy management practices of leaf removal and hedging done properly?	Canopy density is such that approximately 50% of fruit is exposed to sunlight. Little or no leaf pulling/hedging is necessary to achieve a canopy of 1.5 leaf layers in thickness.	Leaf removal in the cluster zone is done so that no more than 50% of the fruit is visible. Hedging is done only one time per season. There is no significant growth of lateral shoots.	Leaf removal in the cluster zone is done so that no more than 50% of the fruit is visible. Hedging is done 2-3 times per season with some growth of lateral shoots.	Leaf pulling and hedging are insufficient. The canopy never stops growing, leading to a large canopy with poor air and light penetration.	

CROP MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is the yield appropriate for the vineyard block?	Yield is adjusted according to the following: • Variety • Vine Size • Vine Health • Historical Yield/Quality data Guidelines below are followed for respective varieties.	Yield is adjusted according to the following: • Variety • Vine Size • Vine Health Guidelines below are not necessarily followed.		Crop level is not adjusted according to variety, vine size, or vine health.	

Labrusca and bulk hybrids: Yield is determined by crop estimation at 30 days post-bloom. Crop reduction takes place at that time, if necessary. For every 3 days the bloom date is earlier or later than the long-term average, an additional ton of fruit can be ripened (when it is early) or must be removed (when it is late).

Vinifera and premium hybrids: Yields are adjusted according to the parameters above. In cooler seasons/vintages, some crop reduction may be necessary to ripen late season red varieties such as Cabernet Sauvignon.

CROP MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is crop thinning done in a thorough and conscientious manner?	If necessary, crop is thinned according to the guidelines below.	Crop thinning guidelines are followed though improvements can be made in timing and/or execution.	Crop thinning is done without knowing the potential crop or what percentage is taken off.	Crop thinning is not done even when necessary to maintain fruit quality and vine health.	

Labrusca:

• Thinning is done between 30 days post-bloom and veraison.

• If done mechanically, there is minimal leaf removal and damage to berries and shoots.

• Crop is adjusted to ensure ripening to processor quality standards.

Vinifera:

• Thinning is done soon after fruit set. Pre-bloom cluster thinning is avoided except where improvements in berry set are desired.

• For vigorous varieties, thinning is delayed until veraison.

• When thinning takes place, diseased or damaged clusters are first removed, overlapping clusters are thinned to facilitate airflow and drying, and clusters on short shoots are thinned or removed totally.

• A target number of clusters per vine is determined based on estimated cluster weight. The number is adjusted up or down depending on vine size.

• *For more detailed information on crop management, including targeting and timing of cluster thinning, go to* : **http://go.umd.edu/TVitCropManagement**

CROP MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is yield estimated properly?	Yield estimation is based on historical average cluster weights and mid-season sampling of clusters.	Yield estimation is based on cluster counts and historical average cluster weights.	Yields are estimated by looking at the vines and guessing or counting clusters on a few vines.	Yields are not estimated.	

Labrusca: Yield estimation is based on crop estimation practices done 30 days post-bloom.

Vinifera: The most accurate system for predicting yields is based on cluster weights during "lag phase" which is the period when the growth of berries slows temporarily (typically about 55 days after first bloom). The other traditional method is based on a running historical record of cluster weights for that variety block.

For more detailed information on crop estimation, go to : **http://go.umd.edu/TVitCropEstimation**

MAINTAINING VINEYARD PROFITABILITY

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Are missing vines counted and replaced regularly?	Missing vines are counted and replaced every year. For non-grafted vines, layering is done to replace vines. **AND** Yield records are adjusted to account for missing vines.	Missing vines are replaced every other year; where appropriate, layering is practiced every other year. **AND** Yield records are adjusted to account for missing vines.	Missing vines are replaced every few years; layering is practiced every few years.	Missing vines are replaced sporadically or not at all.	
Missing vines reduce vineyard profitability and lead to inefficiency in use of pesticides and fertilizers. Yield must be estimated with missing vines taken into consideration. If overall yield is 4 tons/acre but 50% of vines are missing, functional crop is therefore 8 tons/acre, a potential overcrop.					
Are adequate production records kept to evaluate vineyard profitability?	Vineyard expenses and income are recorded for each individual block.	Vineyard expenses and income are recorded by variety but not by individual block.	Vineyard expenses and income are not broken out by variety and block but overall farm income and expenses are known.	Overall farm income and expenses are recorded only when tax returns are filled out.	
Many growers in MD have a wide range of varieties with different prices and inputs. Knowing what is spent in each individual block is crucial for making vineyard management decisions and improving profitability. This is particularly true for natives and bulk hybrids. *For more detailed information and tools on keeping records to evaluate vineyard profitability, go to* : **http://go.umd.edu/VineyardEconomics**					

IV. Irrigation Management

Irrigation can be an important management tool for managing vine water relations, particularly in areas with sandy or gravelly soils, young vineyards with limited root systems, and soils with limited water-holding capacity. The availability of water to the vine (both in amount and timing) plays a crucial role in fruit quality. Drought stress limits yield and reduces the vine's ability to fully ripen the fruit, while surplus water can lead to excessive vine growth, loss of fruit quality, and delayed or reduced winter acclimation. Rainfall generally meets or exceeds vine needs in the Mid-Atlantic.

Irrigation also presents the opportunity to deliver fertilizers efficiently to vines through fertigation. The benefits include better timing and placement of fertilizer in the root zone, minimization of losses to volatilization and leaching, and reduced costs associated with field application of fertilizers.

Efficient use of irrigation involves proper maintenance and design of irrigation systems and an understanding of how to apply the right amount of water at the right time to benefit vines. Questions in this section address design, maintenance, and efficient operation of irrigation systems for vineyards.

Photography credit: Bruce Perrygo, MGGA member

This section of the workbook pertains to irrigated vineyards. If your vineyard is not irrigated, you may skip this section

Irrigation Management

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is there off-site water movement?	Irrigation practices result in no runoff. **AND** Conservation practices are in place to minimize runoff (e.g. perennial cover crops, subsoiling, buffer/filter strips, diversions, and grass waterways).	Irrigation practices result in no runoff. **AND** Conservation practices are present but some need improvement.	Irrigation practices result in no runoff but runoff and erosion occurs during high rainfall events. **AND/OR** Conservation practices need major improvement.	Runoff occurs when irrigating and/or during rainfall events.	
See also the guidelines on drainage in the Soil Management section.					
What type of irrigation do you use?	A low volume system such as "drip" is installed. **AND** System has been designed by a technician with experience in irrigation to ensure uniform distribution of water.	A low volume system such as "drip" is installed but no design was used.		A low volume system is not used.	

IRRIGATION SYSTEM MAINTENANCE

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Do you check for distribution uniformity?	System is checked at the beginning of each growing season by measuring emitter outflows and pressure differential in each zone.	Distribution uniformity is tested irregularly by measuring emitter outflows and pressure differential in each zone.		Distribution uniformity is never checked.	

Drip irrigation distribution uniformity should be checked at the beginning of each growing season to ensure that the system is applying water in a uniform manner. This is particularly important for scheduling purposes and if fertigating.

1. Using a graduated cylinder, measure the output of 3 consecutive emitters close to the pump, 3 in the middle of the zone and 3 at the farthest point from the pump.

2. Convert the measured flow to gallons per hour as follows:
__ml/__sec x 1 oz/29.57 ml x 1 gal/128 oz x 60 sec/min x 60 min/hr

3. Average the measurements, making sure the flow range does not exceed ± 15% of the average flow rate. Readings >15% indicate problems with the system, the most obvious being clogged emitters.

IRRIGATION SYSTEM MAINTENANCE

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is routine maintenance performed on the irrigation system?	Water filters are inspected and cleaned whenever pressure differences indicate, and irrigation lines are flushed at the beginning and end of each season. **AND** Chemical treatment of the water is completed if tests show a problem (e.g. to prevent precipitate buildup and kill algae or bacteria present in the system).	Water filters are inspected and cleaned whenever pressure differences indicate, and irrigation lines are flushed at the beginning of the irrigation season each year.		Water filters are not regularly inspected or cleaned, and irrigation lines are not flushed at all.	
OxiDate, a hydrogen peroxide product, is labeled as an irrigation disinfectant. Rutgers Cooperative Extension also has several useful publications on irrigation system maintenance - **http://www.rce.rutgers.edu/**.					
Is a flow meter installed?	Flow meter is installed and used to monitor application rates throughout the season.	Flow meter is installed but not regularly used to monitor the system.	Flow meter is not installed.		

IRRIGATION SCHEDULING

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is the vineyard's soil water holding capacity used in setting irrigation schedules?	The USDA Soil Survey is utilized to determine the average water holding capacity of the most common soils in the vineyard. **AND** The effective rooting depth of your soils has been determined through excavation. **AND** This information is used in irrigation scheduling.	The USDA Soil Survey is utilized to determine the average water holding capacity of the most common soils in the vineyard. **AND** This information is used in irrigation scheduling.		Soil water holding capacity is not known. Vines are irrigated when soil looks dry.	

IRRIGATION SCHEDULING

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Are monitoring devices used to determine the irrigation schedule?	Soil moisture monitoring devices (e.g. neutron gauge, tensiometer, or gypsum blocks) are installed and used to track soil moisture depletion. **AND** Weather data is recorded and seasonal rainfall amounts are considered when deciding when to irrigate and how much water to apply.	Soil moisture monitoring is done by bucket auger (judging by feel). **AND** Weather data is recorded and seasonal rainfall amounts are considered when deciding when to irrigate and how much water to apply.	Soil moisture monitoring devices are not installed. **BUT** Weather data is recorded and seasonal rainfall amounts are considered when deciding when to irrigate and how much water to apply.	An irrigation schedule is maintained regardless of soil moisture or weather conditions.	

Tensiometers reveal soil moisture potential in a specific area. They read changes in soil moisture by measuring the vacuum created by water movement through a ceramic tip. This mimics how soil moisture moves into the root zone of a plant. Tensiometers can help determine when to irrigate but not how much water should be applied. Begin irrigation when the tensiometer reads between 30 and 40 centibars. Observe the response on the tensiometer after irrigating. If it shows that the soil is wet (a gauge reading of 0-10), the system is working well. Operation times can be adjusted based upon the response of the tensiometer.

There are a number of other methods for measuring soil moisture such as neutron probes and gypsum blocks. Alternatively, a more accurate method may be to measure vine water potential using pressure bombs.

IRRIGATION SCHEDULING

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What factors are used to determine length of time for irrigation?	Water is applied according to the water holding capacity of the soil, soil moisture measurement, vine demand, and weather conditions at that time. **AND** Application time is calculated according to the application rate of the system and the measured depletion in the root zone.	Water is applied according to the water holding capacity of the soil, vine demand, and weather conditions at that time. Soil moisture is not measured. **AND** Application time is calculated according to the application rate of the system.	Irrigation water is applied systematically when conditions are dry.	Irrigation water is applied systematically without regard to weather conditions, or water holding capacity of the soil.	

Vine water demand is highest as leaf area increases in spring and summer. Similarly, large canopies such as divided or minimally pruned canopies have higher water requirements than smaller canopies such as those in VSP training. According to Dr. Alan Lakso, a Concord vine with a full canopy needs about 4 – 4.5 gal/day in July and August. It is likely that vinifera vines with smaller canopies require less water.

Once the application rate of the system has been determined, (see previous sidebar) operating time can be determined. This is the length of time necessary to replace the water a single vine uses per day. Assuming a peak consumptive use for vinifera grapes is between 0.2 and 0.25 inches per day, calculation of irrigation time is possible by estimating the rooting area of the vine in square feet. For example: Vines are planted 4' x 8', estimated rooting area is 32 ft^2 and estimated peak consumptive use is 0.23 in/day.

0.23 in/day/12 in/ft x 32 ft^2 x 7.48 gal/ft^3 = 4.59 gal/vine/day

$$\frac{\text{4.59 gal/vine/day}}{\text{\# emitters/vine x gal/hr/emitter}} = \text{\_\_\_\_\_hrs of operation}$$

To minimize leaching, do not exceed calculated operation time for peak consumptive use.

Peak consumptive use (PCU): Weather data was collected from a weather station located on a LI (Long Island) sod farm. The data was entered into an irrigation-scheduling model (Blaney Criddle Method) from Michigan State to calculate consumptive use for specific crops. PCU is the average daily amount of water consumed in evaporation from the soil and transpiration through the leaves in the photosynthetic process by a crop during the 6 – 10 days of the highest water consumption of the season. It generally occurs as the crop is nearing harvest, when vegetation is most abundant and temperatures are high.

V. Weed Management

Weed management is more properly termed "vineyard floor management", as distinct management strategies are implemented for the region under the trellis and the row middles. Vegetation under the trellis must be managed to minimize competition with vines from the key bloom-to-veraison growth stage, after which weed growth has less impact on vine function. Studies have shown that crop losses due to poor weed management are higher than losses due to diseases and insects combined. Row middles can be managed to influence both nitrogen and soil water availability and hence vine vigor. While frequent rainfall often promotes growth of weeds, it also permits establishment of cover crops that can help growers manage water use to limit excess vigor.

This section emphasizes that integration of mechanical and cultural practices with judicious choice and usage of herbicides to achieve a grower's management objectives. Proper choice and timing of pre-emergence and post-emergence herbicides, consideration of tillage, and other non-chemical control methods, proper care and calibration of weed sprayers, and use of cover crops and mulches in row middles where appropriate are covered in this section, along with critical vine development stages (bloom-to-veraison) for reducing weed competition under the trellis.

Photography credits: Bruce Perrygo and Tim Stephens, MGGA members

As part of environmentally responsible vineyard management, it is not necessary to have pristine weed control throughout the season. The most critical time for weed control is budbreak through veraison, after which some additional weed growth is not viticulturally harmful. However, weeds should not interfere with harvest activities, contaminate harvested crop, nor be allowed to proliferate to the point that future weed control is difficult.

Weed Management

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is vineyard monitored and mapped for weeds?	Grower or vineyard manager monitors weeds at least 3 times during the season. **AND** Weed infestations are recorded and mapped.	Grower or vineyard manager monitors weeds periodically. **AND** Weed infestations are recorded and/or mapped.	Weeds are monitored periodically.	Weed composition monitored rarely, if ever.	
The best way to prevent new weed problems is to keep good records. *Weeds fo the Northeast* (Phillips 1956) is an excellent reference book for identifying weed species. *Also, weed photos can easily be found on the internet, try searching:* **http://www.wssa.net/.**					
What percentage of the area between rows contains permanent ground cover? *In vineyards more than one year old.*	>75% of the area between rows contains permanent ground cover.	67-75% of the area between rows is covered.	50-66% of the area between rows is covered.	< 50% of the area between rows is covered. **OR** Row middles are tilled.	
The maximum amount of soil should be covered to prevent erosion and foster non-competitive species diversity.					

WEED MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Are non-chemical weed management techniques being used?	Non-chemical techniques are used exclusively. **AND** Only minimally disruptive cultivation under the trellis is used. Deep cultivation or tillage is avoided. **AND** Erosion is controlled.	Non-chemical techniques are used in combination with post-emergence (foliar-applied) herbicides. **AND** Only minimally disruptive cultivation under the trellis is used. Deep cultivation or tillage is avoided. **AND** Erosion is controlled.	Herbicides are the only form of weed control under the trellis. **AND** Only minimally disruptive cultivation under the trellis is used. Deep cultivation or tillage is avoided. **AND** Erosion is controlled.	Herbicides are the only form of weed control under the trellis. **AND** Frequent, deep cultivation is used. **OR** Erosion is not controlled.	
In planning a weed control program, how are control methods and rates chosen? *From Ohmart and Matthiasson (2000).*	No herbicides are used.	Foliar-applied (post-emergence) herbicides are the only herbicides used. **AND** Herbicides are chosen based on weed species present. **AND** Rates are based on weed species and size.	Soil-applied pre-emergence herbicides are used. **AND** Rates are based on weed species and soil type.	All-purpose tank mixes and standard rates are used for all vineyard blocks.	

WEED MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Are the leaching potential of herbicides and soil characteristics considered in choosing soil-applied herbicides? *From Ohmart and Matthiasson (2000).*	Simazine (Princep), diuron (Karmex), and norflurazon (Solicam) are not used.	Simazine, diuron, and norflurazon are used less than annually but are not used at all in gravelly or sandy soils with high leaching potential or in areas with high water tables.	Simazine, diuron, and norflurazon are used annually but are not used at all in gravelly or sandy soils with high leaching potential or in areas with high water tables.	Simazine, diuron, and norflurazon are used regardless of soil leaching potential.	

Simazine and other herbicides have been found in the waters of the Chesapeake Bay and its tributaries and may affect the growth of important submerged aquatic vegetation (SAV).

WEED MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What type of herbicide sprayer is used?	Application equipment that increases deposition and reduces drift is used (e.g. CDA shielded sprayer).	A standard herbicide sprayer equipped with air induction nozzles and/or a shield in order to increase deposition and reduce drift is used.		Application equipment is not designed to increase deposition or reduce drift.	
Controlled Droplet Applicators (CDAs) use a spinning disc rotary atomizer that creates a mist of similar size droplets under the dome or shield. This technology allows ultra-low volumes to be used, minimizes drift, and places the herbicide efficiently. Efficient and timely placement of post-emergence materials may allow a reduction in rate of material used. Practical experience dictates that these sprayers are less effective with dense stands of weeds. Air induction nozzles (discussed in the *NY and PA Pest Management Guidelines for Grapes*) are well proven with herbicide application and are recommended.					
Is the herbicide sprayer calibrated properly?	Sprayer is serviced and calibrated before the start of each season and prior to each application during the season.	Sprayer is serviced and calibrated before the start of each season.	Sprayer is calibrated infrequently or only after repairs.	Sprayer is not calibrated.	

WEED MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Are residual broadleaf and grass herbicides rotated to reduce the potential for resistant weeds?	Every third year, herbicides are rotated to another chemical family.	Every fourth year, herbicides are rotated to another chemical family.		Herbicides used are always the same.	
This is primarily a weed resistance management strategy. However, weeds can easily develop cross-resistance to substituted ureas (Karmex) and triazines (Princep). Therefore, oxyfluorfen (Goal) or flumioxazin (Chateau) should be a rotational choice. The length of control of grass weeds during the season decreases after several years of reapplication of the same material. Soil microbe populations are thought to build up over time, which consume the herbicide molecules as a food source.					
Is the amount of spring residual (pre-emergence) herbicide adjusted based on soil characteristics?	Based on knowledge of soil types within your vineyard and characteristics of soil-applied herbicides, application rates are adjusted to apply proper amounts in each vineyard block.	Based on knowledge of soil types within your vineyard and characteristics of soil-applied herbicides, application rates are adjusted to apply proper amounts for the entire vineyard.		The historical rate and/or the maximum-labeled rate are applied throughout the vineyard. Soil type and herbicide characteristics are ignored.	

WEED MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What types of post-emergence herbicide are used?		Low toxicity and/or rapid breakdown in environment (e.g. Roundup Ultra, Touchdown, Poast, Rely, Aim or Scythe).		High applicator toxicity or long soil half-life. e.g. Gramoxone (paraquat)	
Paraquat is persistent in the soil for more than one year after application. Although generally unavailable to soil microbes, some studies have found that initial application is harmful to beneficial microbes.					
How often are post-emergence herbicides applied?	Applied once at appropriate time or not at all.	Applied twice at appropriate times.	Applied 3 times.	Applied more than 3 times.	
It is important to properly time post-emergence herbicide applications. An internet search will provide a variety of guides.					

WEED MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is spot treatment of visible weeds employed to reduce the total amount of post-emergence herbicide used?	No post-emergence herbicide is needed or applied.	Vineyard weed scouting is used to identify weed patches. **AND** Visible weeds are treated with a manual hand gun sprayer. **OR** Machine sprayer is manually turned off when no weeds are present.		Spray is applied to the entire vineyard without regard to the presence of visible weeds.	

New technology allows infrared sensors to detect the difference between weeds and bare ground. Sensors tell the sprayer to apply only to the weeds and not to the bare ground. This technology is not yet sufficiently tested in vineyards.

VI. Pest Management

Managing insect and disease pests is one of the key tasks of any vineyard manager and involves numerous decisions throughout the growing season. Effective management involves monitoring weather conditions, correctly identifying insects and disease pathogens present in a vineyard, taking account of differences in varietal susceptibility to diseases, and choosing appropriate control methods, including pesticides. Collective use of these multiple tactics for making informed decisions forms the basis for Integrated Pest Management (IPM) programs that effectively and economically control pests while minimizing environmental risk.

This section emphasizes correct pest identification, use of scouting and treatment thresholds for insect pests, phenology (vine development)-based disease management, integration of canopy management into disease management, resistance management and improved sprayer technology to protect vines from pests.

Photography credits: Bruce Perrygo and Tim Stephens, MGGA members

PESTICIDE APPLICATION EQUIPMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What type of canopy sprayer is used?	Application equipment is used that increases target deposition (i.e. reduces drift) and allows for a reduction in the amount and/or rate of pesticides used [e.g. a) recycling sprayer, b) tower sprayer, c) directed deposition sprayer].	Application equipment is used that improves deposition and reduces drift [e.g. a) airblast sprayer with low drift nozzles such as air induction nozzles, b) modified airblast sprayer with deflectors, c) nozzle orientation adjusted to improve deposition].		The application equipment does not address drift (e.g. an unmodified airblast sprayer).	

The *NY and PA Pest Management Guidelines for Grapes* (**http://ipmguidelines.org/grapes**) provides an overview of spray drift management and nozzle types, including air induction nozzles. Air induction nozzles are well proven with herbicide applications and are recommended. Canopy application trials have been successful but further season-long trials are still needed.

Top and bottom deflectors should be fitted to airblast sprayers to funnel the pesticide-laden air into the canopy. Correct nozzle orientation (to overcome the effects of the uneven airblast resulting from fan rotation) allows the spray plume to target the canopy.

PESTICIDE APPLICATION EQUIPMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Are the selected nozzles appropriate for use? Are they replaced when worn?	Appropriate size nozzles are chosen. For canopy sprays, 150-200 micron nozzles are recommended. This is known as a "fine" spray classification. **AND** Nozzles are replaced when worn or damaged.	Appropriate size nozzles are chosen. For canopy sprays, 150-200 micron nozzles are recommended. This is known as a "fine" spray classification. **BUT** Nozzles are not replaced when worn or damaged.		Nozzle size is not appropriate for canopy sprays. **AND** Nozzles are not replaced when worn or damaged.	

Dr. Andrew Landers notes that for nozzles < 150 microns in size, droplets are likely to drift, and if temperature is high and humidity low, droplets will evaporate. All nozzles can be purchased with different spray classification characteristics from "fine" to "coarse". These classifications appear in nozzle catalogs and will soon appear on pesticide labels. If nozzle output exceeds manufacturer recommendations by >10%, the nozzles need replacing.

PESTICIDE APPLICATION EQUIPMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is the canopy sprayer calibrated properly?	Sprayer is serviced and calibrated before the start of each season. **AND** Sprayer is recalibrated for major growth stages and/or different types of applications when amounts of air or liquid are changed and/or nozzle orientation is adjusted (e.g. spray directed at canopy vs. clusters). **AND** Calibration is repeated at least once during the growing season.	Sprayer is serviced and calibrated before the start of each season. **AND** Sprayer is recalibrated for different types of applications when amounts of air or liquid are changed or nozzle orientation is adjusted (e.g. spray directed at canopy vs. clusters).	Sprayer is serviced and calibrated before the start of each season.	Calibration is done infrequently or not at all.	
The annual *NY and PA Pest Management Guidelines for Grapes* (**http://ipmguidelines.org/grapes**) provides an overview of sprayer calibration. This should be used in concert with recommendations from the manufacturer of your sprayer.					
Are environmental conditions considered before deciding to spray?	No spraying is done if winds are >10 mph unless using a sprayer that is designed/modified to improve deposition and reduce drift.	Most of the time spraying is not done if the winds are >10 mph unless using a sprayer that is designed/modified to improve deposition and reduce drift.		Spraying is done in conditions where significant drift will occur.	

PESTICIDE APPLICATION EQUIPMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is the canopy sprayer maintained properly?	Sprayer is serviced annually in addition to necessary repair work. Routine maintenance is conducted after the conclusion of each application.	Sprayer is serviced annually in addition to necessary repair work.		Sprayer is not serviced annually. Service occurs only when equipment breaks.	

The annual *New York and Pennsylvania Pest Management Guidelines for Grapes* (**http://ipmguidelines.org/grapes**) provides a pre-season checklist for sprayers, as well as a routine maintenance checklist.

Additional comments from Dr. Andrew Landers: Tractor speed should be fast enough to provide a good output per hour while ensuring canopy penetration; speeds too fast result in poor penetration in a full canopy, and moving too slowly results in poor output per day. Growers should also minimize the volume of air displaced by their sprayer, if possible. The airflow should be adequate to displace the air in the canopy with pesticide-laden air from the sprayer. The volume of spray should provide acceptable coverage, though the grower should not spray to the point where the leaves are dripping. Grower should apply sufficient spray for the developing canopy as the season progresses. Alternative row spraying (a common early season practice with airblast sprayers) provides inadequate coverage in many instances, and where disease pressure is highest, research has shown that spraying every row is preferable.

PRUNING AND DORMANT VINEYARD PRACTICES

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is pruning done in a way to minimize overwintering pathogens and insects?	Wood infected by significant amounts of overwintering fungi is pruned off to minimize sources of inoculum. Old cluster stems may harbor overwintering Botrytis; mummified fruit – black rot and/or Phomopsis; scabby spurs and canes (particularly the basal 2-3 nodes) – Phomopsis. **AND** Spray program is adjusted to reflect the level of overwintering inoculum.	Wood infected by significant amounts of overwintering Phomopsis cane and leaf spot, black rot, and/or powdery mildew is sometimes pruned off. **AND** Spray program is adjusted to reflect the level of overwintering inoculum.	Wood infected by significant amounts of overwintering Phomopsis cane and leaf spot, black rot, and/or powdery mildew is sometimes pruned off. **BUT** Spray program is not adjusted to reflect the level of overwintering inoculum.	Pruning is done without regard to the presence of overwintering inoculum, and spray program is not adjusted.	

PRUNING AND DORMANT VINEYARD PRACTICES

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Can the Vineyard Manager identify Eutypa dieback and other trunk canker symptoms?	The Vineyard Manager can identify Eutypa dieback and other trunk cankers. Where Eutypa and other trunk cankers are suspected, vines are double pruned and/or cut well below the canker. Vines are flagged during the growing season for future observation. Dead wood and prunings are removed each year and disposed of by burying or burning.	The Vineyard Manager can identify Eutypa dieback and other trunk cankers. Action against Eutypa and/or other suspicious trunk symptoms has been done but not in a thorough manner. Dead wood and prunings are sometimes removed from the vineyard and disposed of by burying or burning but not on a yearly basis.		The Vineyard Manager cannot identify Eutypa dieback and/or suspicious trunk cankers, and other suspicious symptoms are ignored. Dead wood and prunings are not removed from the vineyard.	

According to Dr. Wayne Wilcox (Dept. of Plant Pathology, NYSAES, Geneva), Eutypa canker has long been known as a cause of declining grapevines. More recently, vine decline has been recognized as a disease complex associated with a number of potential trunk-infecting fungi. Eutypa and some other fungi typically infect through pruning wounds, and then cause cankers that slowly expand down and around the infected arm, cordon, or trunk. A cross section through such cankers typically reveals a distinctive wedge-shaped zone of dead wood radiating from the center of the cylinder. Another group of vine-decline fungi do not cause such cankers. Rather, cross sections through trunks of symptomatic vines often display black spotting or gumming whereas longitudinal sections reveal black streaks through the water-conducting vessels of the wood. Current research suggests that decline symptoms from these infections are unlikely to occur unless the vines are subjected to stress. Therefore, viticultural practices designed to minimize vine stress should help to prevent/minimize the occurrence of such forms of vine decline. These practices would include timely irrigation, balanced nutrition, minimized trunk injury from machine implements and so forth.

PRUNING AND DORMANT VINEYARD PRACTICES

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Can the Vineyard Manager identify symptoms of crown gall infection?	The Vineyard Manager can identify crown gall. Vines, or portions of vines, rendered unproductive by crown gall are either removed or a new trunk is trained up. **AND** Preparations designed to rid the vine of crown gall are NOT used as efficacy has been poor in both research and grower trials.	The Vineyard Manager can identify crown gall using fact sheets. Vines rendered unproductive by crown gall are either removed or a new trunk is trained up. **AND** Preparations designed to rid the vine of crown gall are NOT used as efficacy has been poor in both research and grower trials.		The Vineyard Manager either cannot identify the presence of crown gall, has not addressed crown gall problems in the vineyard, or has addressed the problems with topical preparations that have been proven to have poor efficacy in both research and grower trials.	

Crown Gall is a bacterial disease of grapevines that results in tumorigenic growth on trunks. According to Dr. Tom Burr (Dept. of Plant Pathology, NYSAES, Geneva) scion and rootstocks differ in their susceptibility to crown gall. In addition, the younger the vine is at infection, the greater the impact on the vine. Crown gall compromises the wound healing process by preventing normal differentiation of cells that are generated in the cambial zone following wounding.

PRUNING AND DORMANT VINEYARD PRACTICES

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Are dormant fungicide sprays applied? *[Note – dormant and post-harvest are two distinct time periods. Dormant refers to the absence of green tissue and leaves.]*	Due to data indicating marginal benefits and high costs, dormant sprays are NOT routinely applied to the vineyard.		A single dormant spray is applied.	Two or more dormant sprays are applied to vines with the general goal of reducing overwintering inoculum of powdery mildew or Phomopsis.	

According to Dr. Wayne Wilcox, a single dormant spray MAY be appropriate if extreme levels of powdery mildew or Phomopsis are present on canes, but only if spray coverage is maximized with an efficient sprayer. Any benefits derived from such a spray are highly unlikely if a low efficiency sprayer, such as an unmodified airblast sprayer, is used.

Experiments conducted in upstate NY in the 1980s showed that dormant application of lime sulfur reduced the viability of overwintering inoculum of the powdery mildew and Phomopsis fungi, and sometimes improved the efficacy of the standard spray program that followed. However, these trials were conducted using a rate of over 30 gal/acre of lime sulfur in 300 gal/acre of water. (Note that lime sulfur is not a mix of lime + sulfur but rather calcium polysulfide, a completely different material.) This rate is extremely expensive and impractical. Lower rates (e.g. 10-12 gal lime sulfur in 100 gal water per acre) have been advocated in California, but data on their efficacy is very limited. In a recent NY trial, they provided only modest benefits at a relatively high cost. Most conventional fungicides should have little or no activity if applied during the dormant season, nor are they labeled for use at that time of year.

DISEASE MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Are proper canopy management practices followed to minimize fungal disease pressure?	The canopy is managed following recommendations in this guide to facilitate light, air, and spray penetration. See the Vineyard Management section.	The canopy management recommendations in this guide are sometimes followed.		Canopy management recommendations in this guide are mostly ignored. The canopy is dense with poor light penetration and poor drying.	
When planning a fungal disease management program, is block history taken into account?	Historical susceptibility to disease is taken into account when planning a fungal disease management program.			Historical susceptibility to disease is not taken into account when planning a fungal disease management program.	

DISEASE MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What actions are taken to minimize disease pressure in all variety types?	Disease management consists of 2 sprays, 1 at the immediate pre-bloom period and another post-bloom with spray intervals not exceeding 10 to 14 days. **AND** Spraying focused on periods of peak cluster susceptibility. **AND** Disease management concentrates on limiting infection by primary inoculums of black rot, powdery mildew, downy mildew, and Phomopsis cane and leaf spot.	Disease management consists of 2 sprays, 1 at the immediate pre-bloom period and another post-bloom with spray intervals not exceeding 10 to 14 days. **AND** Spraying focused on periods of peak cluster susceptibility.	Disease management consists of 2 sprays around the bloom period but the interval between sprays exceeds 14 days.	Disease management does not begin until after bloom, requiring use of an eradicant material in an attempt to manage established infections.	

Overwintering inoculum of black rot and Phomopsis should be minimized by pruning and disposing of infected canes and bunches during the dormant season. Fungicide sprays should include a minimum of an immediate pre-bloom application and a post-bloom application 10-14 days later with materials providing protection against all four diseases. For varieties (e.g. Niagara) and locations subject to severe Phomopsis infections, an effective material is often required soon after cluster emergence as well. The need for additional applications (either pre- or post-bloom) are determined each year depending on weather conditions, over-wintered inoculum potential, and the presence of current-season infections as determined by scouting.

DISEASE MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Can the Vineyard Manager identify fungal and viral disease symptoms on shoots, leaves and fruit?	The Vineyard Manager can identify on leaves, shoots, and fruit- all of the following diseases: • Fungal – black rot, Phomopsis, powdery and downy mildews and Botrytis • Viral – leaf roll, fanleaf • Any unknown disease is ID'd with outside input. **AND** Vineyard Manager has knowledge of life cycles and crop susceptibility at different times in the growing season.	The Vineyard Manager can identify most of the aforementioned fungal and viral disease symptoms and life cycles with the aid of publications and fact sheets.	The Vineyard Manager cannot identify more than half of the fungal and viral disease symptoms and does not use publications or fact sheets to ensure proper identification.	The Vineyard Manager cannot identify ANY symptoms of fungal and viral diseases.	

Photos can be found at **http://www.nysipm.cornell.edu/factsheets.** These publications also have good photos: *Grape Pest Management, Compendium of Grape Diseases,* and *Grape IPM in the Northeast.* See the references at the end of the workbook for details.

DISEASE MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
How are virus-infected vines dealt with?	Vines diagnosed with viral infection are immediately removed if the vines are not producing sufficient quality or quantity of fruit. If vineyard removal is necessary, the site is replanted with a resistant rootstock or left fallow for a minimum of 3 years. When vines are removed, as much of the root system as possible is removed.	Vines diagnosed with viral infection are immediately removed if the vines are not producing sufficient quality or quantity of fruit. If vineyard removal is necessary, the site is left fallow for less than 3 years.	Even if the vines are not producing sufficient quality or quantity of fruit, there is no systematic removal of virus-infected material and/or there is no attempt to renovate sites where virus-infected vines grow.	Nothing is known of viruses and therefore no action plans are in place.	

DISEASE MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is scouting done for fungal and viral diseases?	Scouting is done every other week or at key phenological times preferably by the same person. Scouting results are recorded and entered into a historical database. Vines are scouted May through September.	Scouting is done occasionally, often targeting hot spots. Records of scouting results are kept and entered into a historical database.	Scouting is done informally (e.g. tractor scouting) or on an irregular basis. No records are kept.	Scouting is not done.	

Monitoring of fungal and viral diseases requires vigilance. Particularly with fungal diseases, it is important to address any problems as soon as possible. Remedial steps tend to be much more effective in the early stages of infection vs. during a raging epidemic. Ideally, in a given vineyard block, 5% of the vines or a minimum of 10 vines are examined weekly for signs of disease. These vines can be chosen using historical records to ensure that hotspots are the first to be scouted. Other options are randomly chosen vines or vines that are permanently tagged. Permanent tags offer the additional advantage of charting a range of measurements (e.g. vine pruning weight, disease status, etc.) from year to year. Both foliage and fruit should be examined for signs of disease.

DISEASE MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Does the Vineyard Manager provide or arrange training of field staff in disease and insect identification?	The Vineyard Manager annually provides training to field staff on identification of grape diseases and insects.	Training has been provided once or twice but not on a regular basis.		Training is not done.	
Are fungicides with low leaching potential selected for use?	Materials with high leaching potential are avoided.	Materials with high leaching potential are avoided except where no alternatives exist.		Leaching potential is not taken into account when selecting fungicides.	

DISEASE MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Where possible, are reduced risk fungicides, biopesticides, minimum risk fungicides and/or organic fungicides used?	Where practical, these materials are used for control of fungal diseases and total >50% of the spray materials used.	These materials are used for control of fungal diseases and total at least 20% of the spray materials used.	These materials are used once or twice.	These materials are never used.	

See **www.vinebalance.com** for a description of reduced risk, minimum risk, organic and bio-pesticides.

- For a complete list of minimum risk materials, go to: **http://www.epa.gov/oppbppd1/biopesticides/regtools/25b_list.htm**
- For a complete list of bio-pesticide materials, go to: **http://www.epa.gov/oppbppd1/biopesticides/index.htm**

The OMRI list of certified organic materials can be accessed via the web at **www.omri.org**.

When choosing a spray material, consider both the potential efficacy against the target pest, as well as, other aspects of the compound. Copper compounds, for example, are effective downy mildew (and to a lesser extent, Phomopsis and black rot) materials that are allowed in organic programs. Unfortunately, in other grape growing regions worldwide, copper use has been banned (outright bans as well as bans in organic production exist) due to concerns about the accumulation of this heavy metal in soils. Thus in this particular circumstance, copper would be considered an organic option (the OMRI approved labels) but should be used sparingly and only when necessary.

DISEASE MANAGEMENT

Additional comments from Dr. Wayne Wilcox: Reducing the application rates of fungicides can save money and reduce the potential for short-term environmental pollution. However, this is not a long-term sustainable practice for certain fungicides. Specifically, reducing rates of the DMI fungicides (also called SIs or sterol inhibitors - Elite, Nova, Procure, and Rubigan) and the strobilurins (Abound, Flint, Sovran) is known to promote the development of resistance to these materials. In contrast, reducing the rates of traditional protectant materials (Dithane, Manex, Penncozeb, coppers, sulfurs, etc.) has no impact on resistance development but can shorten the duration of their active period. Also, note that pesticide rates are typically expressed on a per-acre basis for both legal purposes and convenience, although target organisms actually respond to a rate per unit area of canopy volume. Thus, a rate of 3 oz/acre applied to a thin canopy early in the season, may provide the same level of activity as 6 oz/acre applied to a thick canopy in mid-summer. In short, efforts to reduce pesticide rates should be governed not only by the particular materials in use but also by the canopy volume.

DISEASE MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is a Botrytis control program in place for susceptible varieties?	A Botrytis management plan follows these points: • Conscientious canopy management is done; esp. leaf pull to improve light, air, and spray penetration into the cluster zone. • Cluster thinning is done in such a way that clumps of overlapping clusters are loosened/thinned. • Only susceptible varieties are treated, unless extreme weather conditions warrant otherwise. • Particularly during bloom, a treatment is applied only if weather conditions warrant. • Sprays are directed at the cluster zone; GPA of water and the need for a surfactant follow pesticide label recommendations. • N fertilizers applied so that vine growth is balanced.	4-5 of the 6 considerations are followed for Botrytis control.	3 or fewer of the 6 considerations are followed for Botrytis control.	Botrytis Management relies on fungicides alone.	

INSECT AND MITE MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Can the Vineyard Manager identify insect and mite pests and the damage they cause?	The Vineyard Manager can identify all of the following insect/mite pests and the damage they cause: • Major Insects • Minor Insects • Mites • Any unknown pest is ID'd with outside help • VM has knowledge of crop susceptibility and insect life cycles.	Using fact sheets and websites, the Vineyard Manager can identify a majority of the insect and mite pests, and the damage they cause, and has knowledge of crop susceptibility and insect life cycles.	The Vineyard Manager has difficulty identifying more than 3 insect and mite pests and the damage they cause.	The Vineyard Manager cannot identify ANY insect pests or the damage they cause.	

Insects are found in regions noted – if no region is cited, insects are found in all regions:

Major Insects: Grape Leafhopper (FL), Potato Leafhopper (LI), Japanese Beetles, Grape Berry Moth, and Rose Chafer.
Minor Insects: Cutworms, Flea Beetles, Thrips, Aphids, Girdlers, Gallmakers, Scale Insects, Grape Plume Moth, Grape Cane Borer, Banded Grape Bug (FL & LE), Grape Rootworm (FL).
Mites: European Red Mite, Two Spotted Spider Mites.

Photos can be found at the following web address: **http://www.nysipm.cornell.edu/factsheets**. The following publications (see the reference section for details) also have good photos: *Grape Pest Management, Compendium of Grape Diseases, and Grape IPM in the Northeast.*

INSECT AND MITE MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Are dormant miticide sprays applied?	Due to the data indicating marginal benefits, dormant sprays are NOT applied to the vineyard for mite control.		A single dormant spray of a labeled horticultural oil is applied with the goal of reducing the viability of European Red Mite eggs. A minimum of 100 GPA water is used or amount of water as per label directions.	More than one dormant oil or other insecticide spray is applied to vines, all in accordance with pesticide labels.	

Dormant oils, when applied properly, can provide some control of overwintering European Red Mites (ERM) in tree fruit, particularly apples. High water gallonage (200-300 gal/acre) and rates based on time of year/stage of growth are used. In apples, mites become progressively more susceptible to control with dormant oil as spring arrives.

Horticultural oil research has been conducted statewide. Sprays were applied at multiple timings with a backpack sprayer. Treatments were unsuccessful in controlling subsequent mite populations. Grower experience with airblast sprayers has been similarly disappointing. The location of mites in cracks and crevices and under bark makes control much more difficult than tree fruit. For areas with potentially high overwintering ERM populations, an efficient sprayer that achieves excellent coverage would be the best choice for dormant oil application. Coverage must be sufficient to penetrate areas where overwintering mites reside. Be sure to use an oil product labeled for dormant use in vineyards.

INSECT AND MITE MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Does scouting for insect and mite pests take palce?	Scouting takes place on a regular basis (every other week and/or at the first signs of the pest) for major insect pests such as European Red Mite, Potato Leafhopper, Japanese Beetles, Grape Berry Moth, Grape Leafhopper, and Rose Chafer.	Informal scouting or scouting less frequent than every other week takes place.		Scouting is not done for insect and mite pests.	
See **www.vinebalance.com** for a general description of scouting goals and techniques.					
Are insect/mite thresholds considered when making a treatment decision?	Where thresholds exist, scouting results are used to help determine the need for a treatment. Currently, informal thresholds exist for Grape Berry Moth, European Red Mite, Potato Leafhopper, Grape Leafhopper, Climbing Cutworm, and Flea Beetles.	Thresholds are sometimes used to help determine the need for a treatment.	Thresholds are disregarded when deciding the need for a treatment.	An insecticide is applied routinely with most spray applications.	
Suggestions for thresholds can be found in the article describing scouting techniques. One additional threshold - 2% infested buds for Grape Flea Beetle.					

INSECT AND MITE MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is spot treatment used for insect/mite infestations?	If infestations are localized, only the vineyard areas with economically damaging levels of a pest are treated. For example, only the block by the wooded edge is treated for berry moth; blocks A & B but not C are treated for ERM.	Spot treatment is sometimes done.		Spot treatment is never done. If an insect or mite outbreak occurs, the entire vineyard is treated.	
Where practical, are reduced risk, minimum risk and/or organic insecticides and miticides or biopesticides used?	These materials are always used for insect/mite control.	Where effective and economically feasible, these materials are used for insect and mite control.		These materials have not been used during the growing season for insect/mite control.	

See **www.vinebalance.com** for more information on reduced risk, minimum risk, organic and biopesticides. For a complete list of minimum risk materials, go to **http://www.epa.gov/PR_Notices/pr2000-6.pdf**. For a complete list of biopesticide materials, go to **http://www.epa.gov/pesticides/biopesticides/ingredients/index.htm**.

The OMRI list of certified organic materials can be accessed via the web at **www.omri.org**.

When choosing a spray material, consider both the potential efficacy against the target pest as well as other aspects of the compound. Rotenone, for example, is an organically approved insecticide. It is also moderately toxic to ERM predators and highly toxic to fish, and in fact, it is used to remove unwanted fish populations. The economic sustainability of a low risk material must also be considered. It is not sustainable if it is a prohibitively expensive treatment, particularly one with marginal benefits in terms of pest control.

INSECT AND MITE MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is the impact of a material on European Red Mite (ERM) predators considered when making a treatment decision?	The spray materials are adjusted so that only pesticides (fungicides, insecticides, and miticides) with a low to moderate negative impact on ERM predators are used.	Only a few pesticides in the spray schedule are known to be detrimental to mite predators.		More than half of the spray materials used is rated as harmful to mite predators.	

The selection of spray materials that are less harmful to *Typhlofromus pyri,* a main predator of European Red Mites (ERM), may help to maintain their populations and provide biological control of ERM populations. The impact of various pesticides on the survival of *T. pyri* is seen in the following chart.

Toxicity of Vineyard Pesticides to *Typhlodromus pyri*, Predator of European Red Mite *Panonychus ulmi*

Fungicides

Material	Active Ingredient	Class of Material	Effect on T. pyri
Abound	azoxystrobin	strobilurin	L?
Captan 50 WP, 80 WP, Captec 4L	captan	carboximide	L
Carbamate WDG	ferbam	DMDC - Dimethyldithiocarbamate	M-H?
Champ, Kocide	copper hydroxide	fixed copper	L?
Dithane, Manex, Penncozeb (many labels)	mancozeb, maneb	EBDC - ethylenebisdithiocarbamate	M-H
Elevate 50 WDG	fenhexamid	hydroxyanilide	L?
Elite 45 DF	tebuconazole	sterol inhibitor	L?
Flint 50 WG	trifloxystrobin	strobilurin	L

Fungicides (continued)

Material	Active Ingredient	Class of Material	Effect on T. pyri
JMS Stylet Oil	paraffinic oil	horticultural oil	L
Kaligreen	potassium bicarbonate	potassium salt	L?
Nova 40W	myclobutanil	sterol inhibitor	L
Nutrol	monopotassium phosphate	potassium salt	L?
Procure	triflumizole	sterol inhibitor	L?
Ridomil Gold MZ Ridomil Gold/Copper	mefanoxam + mancozeb or copper	phenylamide + EBDC or fixed copper	M-H – MZ L-M – Gold
Rubigan	fenarimol	sterol inhibitor	L
Rovral 50 WP	iprodione	dicarboximide	L
Serenade	Bacillus subtilis	biological	L?
Sovran	kresoxim-methyl	strobilurin	L
Sulfur - WP, DF, F formulations	sulfur	elemental	L-M?

Fungicides (continued)

Material	Active Ingredient	Class of Material	Effect on T. pyri
Vangard 75WG	cyprodinil	anilinopyrimidine	L?
Ziram 76DF	ziram	DMDC	M-H?

Insecticides and Miticides

Material	Active Ingredient	Class of Material	Effect on T. pyri	Comments
Acramite	bifenazate	carbazate	L-M	miticide
Agri-Mek	abamectin	macrocyclic lactone	M	miticide
Biobit, DiPel	Bacillus thuringiensis	biological	L	GBM specific
Danitol	fenpropathrin	pyrethroid	H	broad spectrum
Imidan	phosmet	carbamate	L-M	broad spectrum
Kelthane	dicofol	chlorinated hydrocarbon	M	miticide
Lannate	methomyl	carbamate	H	broad spectrum

Insecticides and Miticides (continued)

Material	Active Ingredient	Class of Material	Effect on T. pyri	Comments
Nextar	pyridaben	pyridazinone	M	miticide
Provado	imidacloprid	chloronicotinyl	L	Potato Leafhopper or Mealybug
M-Pede	potassium salts of fatty acids	insecticidal soaps	L	Leafhopper, Beetles, Mites
Various products.5	rotenone	plant derived	M	broad spectrum
Sevin	carbaryl	carbamate	L-M?	broad spectrum
Thiodan/Thionex	endosulfan	chlorinated hydrocarbon	L	broad spectrum
Vendex	fenbutatin-oxide	organotin	L	miticide

? – Indicates the rating is a best guess based on field observations and knowledge of the product.

Toxicity ratings: Low (< 30% mortality after 48 hrs)
Medium (30-70% mortality after 48 hrs)
High (>70% mortality after 48 hrs)

References:

Apple IPM, A Guide for Sampling and Managing Major Apple Pests in New York State. NYSIPM Publ. No 207, 1993.
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Produits de traitement, Les effets secondaires, La Vigne, Jan. – Fev. 1994, pp. 37-38.
1988 Cornell Chemical Recommendations for Commercial Tree Fruit Production.
2001 Cornell Pest Management Recommendations for Commercial Tree Fruit Production.
Revue Suisse Vit. Arb. Hort. 1990: vol. 22 (1), p. 75.

INSECT AND MITE MANAGEMENT

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Are mancozeb products used in a way that minimizes their impact on ERM predators?	Products with the active ingredient mancozeb are known to be particularly harmful to predators of ERM. These are only used in sprays applied prior to bloom.	Regardless of the application of mancozeb in the pre-bloom period, only 1 mancozeb spray is applied in the period during or after bloom.		2 or more mancozeb sprays are applied in the period during or after bloom.	

See **www.vinebalance.com** for a discussion of the biological control of European Red Mites.

VII. Pesticide Management

This section covers procedures for safe storage, mixing and loading, and handling of pesticides to protect worker health, and avoid the potential for contamination of wells, groundwater, and ponds.

Managing mixing and loading processes to protect health and contain or avoid spills is particularly important, since pesticides are most concentrated before they are mixed in the spray tank. Simple precautions described in this section can greatly reduce the risks to worker safety and reduce the potential for spills and groundwater contamination. Use of worker protection standards (WPS) to provide worker protective equipment, signage, and decontamination sites is mandated by the Environmental Protection Agency (EPA) and the Maryland Department of Agriculture. A synopsis of Maryland pesticide applicators laws and regulations can be obtained through the University of Maryland Extension Service.

Cost-sharing through local Soil and Water Conservation Districts for improving mixing, loading, and storage facilities has assisted growers in financing improvements in the past and may be available in the future.

Photography credits: Susan Watson, Robin Hill Vineyards & Tim Stephens, MGGA member

PESTICIDE STORAGE

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What type of storage shelving is in place?	Metal or plastic, with lips to prevent tumbles, heavy containers on lowest shelves. **AND** Powders are stored on upper shelves, liquids on lowest shelves.		Wood covered with epoxy paint or plastic sheet, heavy containers are on high and low shelves.	Bare wood with no lip, heavy containers are on the highest shelves. **OR** No shelves, pesticide containers are on the floor.	
What is the condition of the floor in the pesticide storage area?	Impermeable floor (e.g. sealed concrete) with curbs or dikes to contain leaks/spills.	Impermeable floor without curbs or dikes, but containment pallets or spill-proof trays with lips are used.	Impermeable floor without curbs or dikes to contain leaks.	Permeable floor (e.g. gravel, dirt, or wood).	

PESTICIDE STORAGE

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What security measures are taken at the storage area?	Area is locked or fenced. **AND** Separate from all other activities. **AND** Used only for pesticides. **AND** Posted with appropriate signage.	Area is separate from other activities. **AND** Used only for pesticides. **AND** Posted with appropriate signage.	Area is separate from other activities. **AND** Used only for pesticides.	Area is open to other activities that could damage containers or spill chemicals or allow entry of unwanted persons.	
What is the storage duration of pesticides?	Pesticides are purchased and used in full as needed.	Pesticides are stored during the growing season.	Pesticides are stored for two seasons.	Pesticides are stored for more than two seasons.	
What is the condition of the containers?	Original containers are clearly labeled - no holes, tears, weak seams, or missing lids/caps.		Pesticides are in their original containers but have unreadable or missing labels.	Pesticides are not in their original containers. **OR** Containers have rust, holes, or tears that allow chemicals to leak.	

LOADING AND MIXING PRACTICES

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What is the proximity of the mixing/loading area to wells, surface water, and watercourses?	Mixing and loading is done down slope and at least 200 ft from any well, surface water, or watercourse on an approved agrochemical mixing facility.	Mixing/loading area is done down slope and at least 100 ft from any well, surface water, or watercourse on an approved agrochemical mixing facility.	Mixing/loading area is done down slope and at least 100 ft from any well, surface water, or watercourse.	Mixing/loading is within 100 ft of a well, surface water, or watercourse.	
The NRCS AMF standard NY-702 requires a minimum of 100 feet from private wells or surface water-bodies to the mixing pad. At least 200 feet will lower the risk and is suggested whenever feasible.					
Is a spill kit available?	A spill kit is readily available and fully stocked.	A spill kit is readily available but used - remaining contents depleted/unknown.	Operator has a spill kit, but it is not readily accessible.	No spill kit is available.	
How are spills handled?	Spills are cleaned up immediately.			Spills are not dealt with until major time has elapsed or not at all.	
A spill kit should contain personal protection equipment (PPE), shovel, broom, dustpan, absorbent material, heavy-duty detergent, a sturdy plastic container, and emergency telephone numbers. Source: AEM Tier II Worksheets for the Long Island Agricultural Stewardship Program.					

LOADING AND MIXING PRACTICES

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What type of mixing and loading area is used?	All mixing and loading is done on an impermeable pad with a curb that keeps spills contained and holds 125% of maximum chemical volume. Sumps allow collection and transfer to storage or back into sprayer for field application. The facility meets or exceeds the standards for an approved agrochemical mixing facility.	All mixing and loading is done on an impermeable pad without curb or sump. **OR** In-field mixing is done in a different location every time.	Most mixing and loading is done in the field at a different location most of the time or switched frequently.	There is no mixing/loading pad. **AND** Mixing and loading done in the same location every time.	

LOADING AND MIXING PRACTICES

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What is the water source for pesticide applications? Is a proper anti-backflow device in place?	Water is obtained from a well dedicated to farm use and water used to fill the spray tank is from a nurse tank. **OR** Water from farm pond fills nurse tank at least 100 ft from open water (pond or stream). **AND** A RPZ device is in place or an air gap equal to twice the diameter of the filler source pipe above the sprayer tank is installed to prevent backflow.	Water is obtained from a well dedicated to farm use and spray tanks are filled directly from the well. **OR** Water is brought directly from a pond but the filling area is at least 100 ft from open water. **AND** A RPZ device or air gap equal to twice the diameter of the filler source pipe above the sprayer tank is in place to prevent backflow.	Water is obtained from a well used for drinking water. **OR** Pond water filling area is < 100 ft from open water. **AND** A RPZ device or an air gap equal to twice the diameter of the filler source pipe above the sprayer tank is in place to prevent backflow. **BUT** Spray tanks are filled directly from the well or pond.	Water is obtained from a well used for drinking water. **OR** Pond water filling area is adjacent to the pond. **AND** A RPZ device or suitable air gap is not in place. **AND** Spray tanks are filled directly from the well or pond.	

Regulations concerning use of surface water (ponds) for filling sprayers vary. Long Island vineyards exclusively use wells or municipal water supplies. In other areas, growers commonly use water pumped from ponds, particularly where wells or municipal water supply are not available. When ponds are used as a source, the filling area should be below the grade of the pond, and at least 100 feet away from surface water. Nurse tanks are recommended, because they reduce the amount of time it takes to fill spray tanks.

An acceptable Reduced Pressure Zone (RPZ) device contains a minimum of two independently acting check valves with an automatically operated pressure differential relief valve between the two check valves.

LOADING AND MIXING PRACTICES

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Is filling supervised by a certified applicator?	A certified applicator does the mixing and loading. **OR** A certified applicator provides constant supervision.	A certified applicator has provided appropriate training for mixers and loaders and is available for consultation as needed.	Supervision is provided most of the time.	Supervision is provided seldom or never.	
How is the sprayer cleaned and how is rinsate disposal handled?	An in-field cleaning system is used. Rinsate is applied to labeled crops.	Sprayer is washed on a pad at the farmstead. Rinsate is applied to labeled crops.	Sprayer is washed at the farmstead (not on a pad), and rinsate is sprayed back onto the vineyard following label recommendations.	Sprayer is washed at the farmstead. Rinsate is dumped at farmstead or in field sump or adjacent to streams or waterways or is sprayed along a fence line or hedgerow.	
Is an inspection and emergency plan in place? ***Emergency phone numbers are required to be posted in a central location – WPS regulation.***	Plumbing and well connections are inspected before each day of use for breaks and leaks. Emergency plan is centrally posted with telephone numbers. Equipment for fire or spills is reviewed and checked annually.		Plumbing and well connections are inspected only when there are breaks and leaks. Emergency plan and telephone numbers known but not posted. Equipment for fire or spills is in place but not reviewed or checked.	Plumbing and well connections are never inspected. **AND/OR** No emergency plan or phone numbers are in place.	

PESTICIDE CONTAINERS

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
How is the disposal of pesticide containers handled?	Triple-rinsed or power-rinsed containers are returned to a supplier for recycling. Bags are returned to a supplier, or an appropriate waste collection service is used.	Triple-rinsed containers are disposed of through an appropriate waste collection service as per label instructions.	Triple-rinsed containers are stored or disposed of on the farm.	Unrinsed containers or empty bags are stored or disposed of on the farm. **OR** Pesticide containers are burned on the farm.	
What type of pesticide containers is purchased?	Where available, all pesticide products are purchased in recyclable or returnable containers to reduce the number of empty containers that require disposal.	Some pesticide products are purchased in recyclable or returnable containers.	Most pesticides are purchased in containers that require special handling or treatment before disposal.		

PESTICIDE USE

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What is done with unwanted or banned pesticides?	Participate in an EPA/DEC "return" program, and unused pesticides are returned to a dealer or disposed of through a hazardous waste collection service.			Unused pesticides are disposed of on your property or at a local garbage dump. **OR** Unused pesticides are stored indefinitely on the farm.	

PESTICIDE USE

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What is the distance of spray application from water bodies?	Label restrictions are followed, or if not stated on label, spray is applied at least 35 ft from open water source.		Spray is applied less than 35 ft from an open water source.	Spray is applied adjacent to or over top of open water.	
How well are pesticide records kept?	Pesticide use records include: • Pesticides used • EPA registration # • Where applied • Date applied • Quantity applied • Rates applied • Method of application • Applicator's name • Target pest **AND** • Weather conditions • Stage of crop development • Stage of pest development • Apparent effectiveness	Pesticide use records include only records necessary for DEC reporting: • Pesticides used • EPA registration # • Where applied • Date applied • Quantity applied • Rates applied • Method of application • Applicator's name • Target pest		No records are kept. Chemicals used are known by memory or through invoices only.	

VIII. Continuing Education

Vineyard management practices are constantly changing. New techniques, crop protection materials, and research results can and should influence your practices. Continuing education is important, because it facilitates the flow of research-based information, allows for exchange of ideas among growers, and helps growers understand how agricultural practices influence the environment and their community.

This section addresses what information sources, references, and educational venues growers can use to keep up to date with new ideas and practices.

Photography credit: Tim Stephens, MGGA member

CONTINUING EDUCATION

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Does the Vineyard Manager have these essential publications?	Grower has at least 4 of these suggested or similar publications: • Wine Grape Production Guide for Eastern North America • *NY/PA Pest Management Guidelines for Grapes* – latest ed. • *Compendium of Grape Diseases* • *Cornell University Disease and Insect fact sheets* • *2015 New York and Pennsylvania Pest Management Guidelines for Grapes (Web)* • *Pest Management Strategic Plan for Wine Grapes in Virginia and North Carolina*	Grower has 3 of the suggested publications.	Grower has 2 of the suggested publications.	Grower has 1 or none of the suggested publications.	

CONTINUING EDUCATION

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Does the Vineyard Manager have these useful publications?	Grower has all 4 or more significant viticultural publications, including but not limited to: • *Grape Pest Management* – 2nd ed. • *Wine Grape Production Guide for Eastern North America* • *A Pocket Guide for Grape IPM Scouting in the North Central and Eastern United States* • *Grape IPM in the Northeast*	Grower has 3 significant viticultural publications.	Grower has 2 significant viticultural publications.	Grower has 1 or none of the additional viticultural publications.	

CONTINUING EDUCATION

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Does the Vineyard Manager subscribe to industry newsletters?	Vineyard Manager subscribes to 2 or more Grape Industry newsletters.	Vineyard Manager subscribes to 1 newsletter, preferably the regional newsletter.		Vineyard Manager subscribes to no newsletters.	
Does the Vineyard Manager subscribe to trade magazines?	Vineyard Manager subscribes to 3 or more grape industry magazines, either print or online, including but not limited to: • *Practical Winery and Vineyard* • *Vineyard and Winery Management* • *Wine Business Monthly* • *Wines and Vines*	Vineyard Manager subscribes to 1-2 grape industry magazines.		Vineyard Manager subscribes to no industry magazines.	

CONTINUING EDUCATION

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
Does the Vineyard Manager attend grower meetings?	Vineyard Manager attends all regional grower meetings every season as well as at least 1 outside the region.	Vineyard Manager attends at least 2 regional grower meetings per season.	Vineyard Manager attends at least 1 regional grower meeting per season.	Vineyard Manager does not attend any grower meetings.	
Does the Vineyard Manager attend other meetings specifically pest or pesticide management?	Vineyard Manager attends all WPS/pesticide compliance meetings or other pest management meetings every year. **AND** Vineyard Manager is enrolled in the local extension program.	Vineyard Manager attends at least 2 WPS/pesticide compliance meetings or other pest management meeting per year.	Vineyard Manager occasionally attends pest and pesticide management meetings, but not every year.	Vineyard Manager has not attended any additional pest management, WPS, or pesticide regulation meetings.	

Action Plans

Upon completion of the workbook, the next step is to develop an action plan based on the results of your self-assessment that will address the practices that you believe you can effectively modify within the financial and management capacity of your farm. Concentrate on the issues that you assessed as a "3" or "4", with the goal of reaching the more sustainable "1" or "2" rating for that practice. If there are practices that you assessed a "2" that you feel you can easily climb to a "1", include those as well. The action plan is yours, and only you will know what is practical and possible on your farm.

Below you will find an Action Plan Template that includes an example of a practice to be modified. All of the practices that you assessed a "3" or "4" should be listed on the template. For each potential action in your action plan, you must (1) decide if you want to take action on that specific practice (Action Y/N), (2) determine what you want to do in regard to that action (Goals), (3) organize your steps along the road to adoption of the modified practice (Action Steps), and (4) provide a timeline for completion (Timetable). The template also contains space for the completion dates of your action steps as well as space for any pertinent notes regarding your proposed action. It is important that your action plan details all of this information in order to fulfill the requirements for potential cost-sharing opportunities with your Soil and Water Conservation District (SWCD) and Natural Resources Conservation Service (NRCS) offices. The second page of the action plan template is left blank and can be photocopied as necessary to include all of the practices that you assessed a "3" or "4".

Extension personnel from your regional grape program will provide as much assistance as you desire. In addition, your local Soil and Water Conservation District office is equipped to aid action plan development and educate you on possible cost-sharing opportunities for actions in your plan. After you have completed the workbook and are prepared to construct an action plan, contact your grape and Soil and Water Conservation District programs to take advantage of the guidance available to you.

Example Action Plan

Section (Page)	Topic	Score	Action (Y/N)	Goals	Action Steps	Timetable	Date Complete	Notes
EXAMPLE								
Nutrition Manag. (Page 38)	Consideration of Nitrogen (N) contribution from organic sources	4	Y	4 → 1: Experiment with cover crops to reduce N inputs, increase soil health & take up water in the spring	1. Establish cover crop research plots 2. Calculate cover crop N contribution 3. Develop & implement vineyard-wide plan	1. Fall 2016 2. Spring 2017 3. 2017-2018	1. _____ 2. _____ 3. _____	Will experiment with legumes, cereal rye, and other cover crops

Action Plan Template

Section (Page)	Topic	Score	Action (Y/N)	Goals	Action Steps	Timetable	Date Complete	Notes

References

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