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's important to adapt vine nutrition practices to site-specific vineyard conditions, rather than applying a 'one-size-fits-all' approach to all vineyard blocks.

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.

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 on all blocks every one to two years. Results are used in planning future fertilization.	Tissue analysis is done on most blocks every one to two years.	Tissue analysis is done only when there is a problem.	Tissue analysis is not done.	
Cornell recommends petiole (leaf stem) analysis 60-70 days after bloom, in the post-veraison period. Bloom tissue analysis might be useful for elements such as nitrogen and boron in part because same-season correction of a significant deficiency might be possible. See www.vinebalance.com for a discussion on petiole and soil testing.					
Is soil analysis done on a regular basis?	Soil analysis is done every other year, 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 three years.	Soil analysis is done less than every three 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 • 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 and NYS) have been found in groundwater in several areas of New York, 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.

Nitrogen (N) Management Practices

	1 - Low Risk	2	3	4 - High Risk	YOUR RANK
What is the total amount of supplemental 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: <50 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: 50-70 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: 70-100 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 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 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 guideleins.	
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 – 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.	
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.					
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 lb urea in 100 gallons (5 lb 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.

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 NY 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. Over a period of time, the benefits may or may not become clear.

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 (as per NRCS Nutrient Management Standard – NY 590) 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.	