Viticulture Newsletter May 2002
From the Viticulture Staff at Oregon State University
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In This Issue

Introduciton

Welcome to the Oregon State University Viticulture Extension Newsletter. This first edition is dedicated to nutrition. Thanks to the efforts of Jessie Howe and Jessica Cortell, the information provided here is designed to help wine grape growers make decisions regarding nutrition management. We are fortunate to have Jessie Howe on board because she just completed her Masters at OSU. The title of her thesis, *The Effects of Soil Moisture and Nitrogen Application on Leaf Gas Exchange, Fruit Composition, and Carbohydrate Storage of Pinot noir and Chardonnay Grapevines in the Willamette Valley*, was under the supervision of Carmo Vasconcelos. OSU Extension will be providing quarterly newsletters with a designated theme through the Northwest Berry and Grape Information Network. We will make a limited number of hard copies available for individuals who do not have Web access. If you have any suggestions, comments, or questions regarding content please contact us at OSU, Department of Horticulture, 541-737-5453 or e-mail me at connella@bcc.orst.edu. If you have any comments regarding the Web format please contact the Web Master, Ben Exstrom at the North Willamette Research and Extension Center at ben.exstrom@oregonstate.edu. Thank you, Anne Connelly

Upcoming Events:

Mineral nutrients: a summary

Plant growth and development depend on mineral nutrients. Nutrients are divided into two categories: macronutrients and micronutrients. Macronutrients are constituents of organic compounds and are required by plants in substantial amounts. Micronutrients are most commonly constituents of enzyme molecules and are required in small amounts.

Plants obtain mineral nutrients from the soil. The mobility of each individual nutrient varies both in the soil and within the plant. This is important to consider when deciding how to manage nutrients within a given system (i.e. fertilizer application, source, and timing). Each nutrient has functions that it serves in the plant. Table 1 summarizes the different mineral elements, their unique functions, the quantity in which they are present within a plant, and their mobility.

When mineral nutrients become limiting in plants both physiological and biochemical processes are affected and deficiency symptoms can be observed. Table 2 illustrates some of the common deficiency symptoms for each of the mineral nutrients.

Table 1: Nutrient functions, quantity, ionic forms, and mobility

Macronutrient		Function	Quantitiy % dry weight	Ionic forms	Soil mobility	Plant mobility
Carbon	C		45.00%			
Oxygen	O		45.00%			
Hydrogen	H		6.00%			
Nitrogen	N	amino acids, proteins, nucleic acid, nucleotides, chlorophyll, coenzymes, yeast need nitrogen to remain viable during fermentation	2.0-5.0%	NH4+ NO3-	Immobile Mobile	Immobile Mobile
Phosphorus	P	ATP (energy metabolism), nucleic acids, coenzymes, phospholipids, cell multiplication and tissue growth depend on sufficient phosphorus	0.2-0.5%	HPO4-- H2PO4-	Very immobile Very immobile	Mobile Mobile
Potassium	K	Osmosis and ionic balance (reduces transpiration and maintains cell turgescence), stomatal function, enzyme activation, plays a role in the assimilation of carbon by leaves	1.00%	K+	Immobile	Mobile
Sulfur	S	amino acids (cysteine, methionine), proteins, coenzyme A	0.2-0.5%	SO4-	Mobile	Slightly mobile
Calcium	Ca	cell walls, enzyme cofactor, membrane permeability	0.50%	Ca+	Immobile	Very immobile
Magnesium	Mg	chlorophyll, enzyme activation, phytin (a reserve substance rich in P and Ca)	0.20%	Mg++	Immobile	Mobile
Micronutrient			**ppm**			
Boron	B	plays a role in the migration and use of sugars, nucleic acid synthesis, membrane integrity, influences Ca use	20	H3BO3	Mobile	Very immobile
Zinc	Zn	enzyme activation, enzyme component	100	Zn++	Very immobile	Immobile
Iron	Fe	chlorophyll synthesis, cytochrome, nitrogenase	100	Fe++ Fe+++	Very immobile Very immobile	Immobile Immobile
Copper	Cu	enzyme activation, enzyme component, oxidation/reduction	6	Cu++	Very immobile	Immobile
Manganese	Mn	integrity of chloroplast membrane, oxygen release in Photosynthesis, cofactor of enzyme reactions	50	Mn++	Very immobile	Immobile
Molybdemum	Mo	nitrogen fixation, nitrate reduction	0.1	MoO4-	Very immobile	Immobile
Chlorine	Cl	Osmosis and ionic balance	100	Cl-	Mobile	Mobile
Other						
Sodium	Na			Na+	Mobile	Mobile

sources: Righetti, T. Oregon State University. Marschner, H. *Mineral Nutrition of Higher Plants*. 1986. Galet, P. *Grape Diseases*. 1996

Table 2: Nutrient deficiency symptoms

Macronutrient		deficiency symptoms
Nitrogen	N	reduced vigor, enchanced senescence of older leaves, yellow leaves, upright leaf petiole angle, uniform chlorosis in mature leaves, reddish petioles, premature shoot lignification
Phosphorus	P	reduced growth with no specific symptoms, some reports indicate reddish petioles and veins, weeping foliage, reduced internode length and fruit set (extreme deficiency)
Potassium	K	reddening of young leaves post flowering (white varieties), reddening spreads towards mature leaves leading to tip and marginal scorch necrosis, leaf rolling, browning (post veraison), leaf drop and halt in berry maturation (extreme deficiency)
Sulfur	S	uniform chlorosis of young leaves and apex or mature leaves
Calcium	Ca	necrosis of young leaves and apex
Magnesium	Mg	interveinal necrosis or chlorosis of mature leaves slowly moving towards youger leaves, leave lesions at flowering (extreme deficiency), premature leaf drop, can result in reduced sugars in berries
Micronutrient		
Boron	B	zig-zag shoot, bleached spots on leaves (yellowish white on white varieties and reddish on red varieties), deformation or necrosis of young leaves and apex, lignified canes, dry inflorescences resulting in flower drop, small soft fruit, mummified fruit
Zinc	Zn	stunted shoot growth, small fan-shaped leaves that roll upwards and thicken, stunted petioles, short and flat internodes, increased lateral shoots,deformation or interveinal/blotched chlorosis of young leaves and apex
Iron	Fe	uniform chlorosis of young leaves and apex,
Copper	Cu	necrosis of young leaves and apex
Manganese	Mn	interveinal/blotched chlorosis of mature leaves moving to young leaves and apex, leaf blade rolls up, small clusters difficult to ripen
Molybdemum	Mo	young leaf and apex deformation

sources: Marschner, H. *Mineral Nutrition of Higher Plants* . 1986. Galet, P. *Grape Diseases* . 1996

Nutrient Management Tools
***Part 1* Soil and Petiole Sampling**

Nutrient management is a critical element of successful crop production. Sufficient nutrients are essential for plant vegetative and reproductive growth as well as post harvest quality. In winegrapes, nutrient management is important for vine establishment and growth (both above ground and below ground), canopy health and light capturing capacity, as well as fruit development and quality.

There are many tools we can use as grape growers to assist our nutrient management strategies and goals. Soil testing is a tool that can be useful in identifying the nutrient status of a pre-existing vineyard or a vineyard you plan on establishing. Soil testing can also help you identify trends in your vineyard system over time. Executing a soil test requires taking soil samples in your vineyard and sending them to a lab to be analyzed.

Taking soil samples is fairly straightforward and easy. To begin, it is important to consider what information you are seeking by taking soil samples. Are you interested in a broad analysis or a more localized site-specific analysis? These considerations can help determine how many samples you should take to make the best decisions for your vineyard. The recommended number of samples to take per vineyard depends on the variability within the vineyard. In general, samples should only be taken from "representative" areas of the vineyard and no less than 1 composite sample per acre. Detailed information on taking soil samples can be found online at the following website:

> *How to take a soil sample…and why*, **EC628**
> J. Hart, Oregon State University Extension Services, 1995
> http://eesc.orst.edu/agcomwebfile/edmat/html/EC/EC628/EC628.html

Tissue analysis is another tool that grape growers can use to determine nutrient status of a vine at a given time during the growing season. Commonly, petiole samples taken at bloom or véraison have been the plant tissue of choice for these analyses. Research trials conducted at OSU have demonstrated that petiole samples collected at véraison may be more indicative of changes in plant nutrients (Howe and Vasconcelos, OWAB Progress reports 2000-2001, and Silva, Sampaio, and Vasconcelos OWAB Progress reports 2001-2002). Moreover, the standards available for petiole analysis at OSU's Central Analytical Laboratory are based on 10-year averages from July 21- August 10 (véraison). Boron may be an exception to véraison sampling (Porter Lombard, personal communication). A recent study conducted by Paul Schreiner (USDA-ARS) and John Baham (Oregon State University) illustrates that there are large differences between leaf and petiole concentrations for 8 out of 10 minerals that were examined. This suggests that accurate nutrient analysis by tissue sampling is dependent on sample time, tissue type, and the individual mineral of interest. Details about the study can be found in the Oregon Wine Advisory Board Progress Reports, 2001-2002. Copies of this publication can be obtained by contacting Deborah Yacas, Department of Food Science and Technology, (541) 737-6483 or email: Deborah.Yacas@orst.edu.

Similar to collecting soil samples, petiole samples should be taken from vines that are representative of other vines in the vineyard or block. Usually a minimum of 100 petioles need to be submitted for complete nutrient analysis. Although, this may vary between laboratories. Leaf petioles opposite a cluster should be collected for the most accurate analysis. Petioles of immature or senescent leaves should not be sampled. Leaf blades should be removed from the petiole, and the petiole should be placed in a sample bag and kept cool. Petioles should be delivered to the laboratory within 24 hours of collection. More detailed information on collecting tissue samples can be obtained from the specific laboratory conducting the analysis.

It is important to maintain consistency in sampling technique if you plan on comparing soil or tissue analysis between different years. Always take samples during the same time of the season as have been taken previously. Samples should be handled in a way that is recommended by the laboratory that will conduct the analysis. Information on analytical laboratories serving Oregon and the Pacific Northwest can be found online at the following websites:

A List of Analytical Laboratories Serving Oregon **EM 8677**
J. Hart, Oregon State University Extension Services, revised 2002
http://eesc.orst.edu/agcomwebfile/edmat/html/EM/EM8677/EM8677.html

Soil Testing Labs in the PNW
Washington State University
http://css.wsu.edu/Soil_Testing_Labs.htm

Alternative Soil Testing Laboratories
Agronomy Resource List
http://www.attra.org/attra-pub/PDF/soillab.pdf

Part 2 Resources for Interpreting Soil and Tissue Analyses

Interpreting the results of soil and/or tissue analysis can be daunting. Luckily, there is a guide published by Oregon State University Extension Services designed to help interpret soil test results. The guide also provides a unit conversion table which can be helpful. The guide is available online at the following website:

Soil Test Interpretation Guide **EC 1478**
E.S. Marx, J. Hart, and R.G. Stevens, Oregon State University Extension Services, 1998
http://eesc.orst.edu/agcomwebfile/edmat/EC1478.pdf

In addition, Table 3 can be used as a resource when determining what the values of your test results mean. Table 3 illustrates low values for soil nutrients as well as low, average, and high values for petiole nutrients. A low value for a given nutrient would be considered deficient. A high value for a given nutrient would be considered excessive and could potentially lead to toxicity. An average value is representative of a range that would be considered adequate for maintaining vine health.

Table 3: Low mineral nutrient values for soil samples and low, normal, and high values for grapevines petiole samples

Soil[1]			**Petiole**[2]				
Macronutrient		**low**	**Macronutrient**		**low**	**normal**	**high**
Nitrogen	N	10 ppm	Nitrogen	N	<0.50	0.66-1.50	>2.50
Phosphorus	P	20ppm	Phosphorus	P	<0.06	0.11-0.35	>0.80
Potassium	K	150ppm	Potassium	K	<0.60	1.01-3.00	>4.50
Sulfur	S	2ppm	Sulfur	S	<0.08	0.13-0.35	>0.50
Calcium	Ca	3.0-5.0meq	Calcium	Ca	<0.75	1.26-3.00	>3.50
Magnesium	Mg	0.5-1.0meq	Magnesium	Mg	<0.35	0.46-1.25	>1.50
Micronutrient			**Micronutrient**				
Boron	B	0.5ppm	Boron	B	<20	25-50	>70
Zinc	Zn	1ppm	Zinc	Zn	<25	41-100	>150
Iron	Fe	*	Iron	Fe	<15	31-100	>250
Copper	Cu	0.6ppm	Copper	Cu	<3	6.0-20.0	>100
Manganese	Mn	1.5ppm	Mangenese	Mn	<20	61-650	>1200
Other							
Organic Matter		2%					

1 data from Oregon State Extension publication EC 1478 *Soil Test Interpretation* and *Oregon Winegrape Growers Guide*

2 data from Oregon State University Central Analytical Lab

* soil tests for Iron not recommended by Oregon State Univesity

Making Choices on Fertilizer Applications for Oregon Vineyards

Once you have received your soil or tissue test results it is time to make decisions concerning fertilizer application. Considerations should be made about specific products as well as method and timing of application. Decisions should include knowledge about the specific nutrient such as its mobility in the soil and plant (Table 1) and the time the nutrient is most critical for plant growth. Decisions on fertilizer applications should involve yearly assessment and feedback on what has been done in the past, observations in the vineyard, and current test results.

Choices on what products to use can be based on product information and management strategy. This may include cost analysis, availability, ease of application, effectiveness, natural versus synthetic products, and many other factors. Important criteria to consider are whether you are participating in an organic certification or the LIVE program (http://liveinc.org). In this case, you need to ensure that the products and amounts you plan to use are allowed in the program. Product types include granules, powders, pellets, solutions, suspensions, and organic materials such as mulches. It is important to look at the guaranteed analysis on the bag to get the actual percent of the nutrients as well as amounts of trace nutrients or contaminants. The formula below can be used to make per acre calculations:

$$\frac{\text{Pounds of nutrient recommended}}{\text{\% of nutrient in fertilizer material}} \times 100$$

This calculation will give the amount of product needed to achieve the recommended rate. It is wise to consider trace elements (such as zinc, iron, or boron) that may be in the product so that you can adjust your micronutrient additions as needed and to avoid toxicities. This is also critical when using organic products because most will contain a range of trace elements. If you are relying on the incorporation of cover crops for your nutrient additions, the cover crop residue can be tested or approximate nutrient amounts can be estimated (i.e. mineralizable N). Careful consideration should be made regarding incorporation of cover crops. This practice has been shown to enhance nutrient availability in the vineyard. However, some growers are reporting that after multiple seasons of seeded cover crop incorporation, cover crop growth is reduced. This may be due to depleted nitrogen in the top fraction of soil.

Timing of fertilizer applications is based on vine physiology, type of nutrient and product being applied, and the purpose of the application. Below are some general guidelines for the most commonly applied nutrients.

Nitrogen – N can be applied by banding, broadcast, or through fertigation. Ammonium forms (such as Urea) can volatize if applied to the soil surface and are not incorporated. For vineyards, additions are often made to replace the amount of N removed by the crop. The greatest demand for soil N is from around the time of mid-shoot leaf expansion through véraison. Vigor problems and poor fruit quality can result if too much N is applied. It is important to note that nitrogen-containing fertilizers can be acidifying to the soil. Table 4 illustrates the amount (%) and form of nitrogen in specific fertilizers. It also illustrates the approximate lime requirement required to neutralize the acidity of 100kg of each fertilizer.

Phosphorus – Is immobile in the soil so it should be “banded” or “placed” in the rooting zone or incorporated with tillage. Raising the pH in vineyards can also increase the availability of phosphorus.

Potassium – Is immobile in the soil so it should be “banded” or “placed” in the rooting zone or incorporated with tillage. In vineyards, potassium doesn’t need to be applied unless tissue tests continue to show deficiencies. Potassium additions (such as potassium sulfate or potassium chloride) should be banded near the vines, applied through the irrigation, or applied as a véraison spray.

Calcium / magnesium – Deficiency symptoms of these nutrients are rare in vineyards but applications can be made to raise the pH. Adjusting the soil pH is easiest to do before the vineyard is planted. If it is applied in planted vineyards, it should be done on a yearly basis of 1-2 tons/ac and incorporated into the soil as much as possible.

Boron – Boron should be applied as a broadcast application or foliar as banding can sometimes result in toxicities. Boron is relatively immobile in the grapevine so it is most effective when applied directly to the buds. This is the most frequently applied nutrient in Oregon vineyards. Boron is commonly applied as a dilute solution of 20.5% boron as borate. A pre-bloom spray of .4 lbs actual B / 100 gallons and a post-harvest spray of up to .8 lbs actual B / 100 gallons is a common maintenance program.

Zinc - Is immobile in the soil and relatively immobile in the plant so it should be "banded" or "placed" in the rooting zone or incorporated with tillage or applied as a foliar**.** A dormant spray of 5 – 15 lbs Zn / 100 gal. can be applied just prior to budbreak. An additional spray 2 weeks before flowering of 1 lb. Zn in chelate form can be applied if deficiency symptoms are severe. This spray can be split into two applications and mixed with fungicide (check with your fertilizer representative regarding tank mixing with other chemicals).

Additional information regarding fertilization practices in Oregon can be found online at the following website:

Winegrape Fertilization Practice for Oregon
E. Hellman, Oregon State University Extension Services, 1997
http://berrygrape.orst.edu/fruitgrowing/grapes/grapfert.htm,

Table 4: Fertilizers that contain nitrogen and their acidifying properties

Fertilizer	**Form and % nitrogen**				**Other nutrients contained (%)**			**Lime Requirement (kg)***
	Ammonium	Nitrate-N	Urea-N	Total N	P	K	S	
Sulfate of ammonia	21			21			24	110
Ammonium nitrate	17	17		34				60
Mono-ammonium phosphate	10-11.2			10-11.2	22-23			43
Di-ammonium phosphate	18			18	20			55
Calcium nitrate		15		15				20
Potassium nitrate		13		13		38		26
Urea			46	46				84

source: adapted from Coombe and Dry, *Viticulture volume 2 Practices* . 1992

* approximate quantity of lime (kg) required to neutralize the acidity of 100 kg of each fertilizer

Additonal references and websites used in this issue:

OWA Oregon Winegrape Growers Guide

Hart, J. Fertilizer and Lime Materials FG 52. 1998.
http://eesc.orst.edu/agcomwebfile/edmat/html/fg/fg52/fg52.html

Soils and Fertilizers, LIVE
http://liveinc.org/soil-fertilizer.htm