TISSUE ANALYSIS - A GUIDE TO GRAPEVINE FERTILIZATION

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The best method to determine the nutritional status of grapevines is a laboratory analysis of grape leaf tissue. Petioles are most commonly used. However, if no reasonable clue exists as to nutritional deficiency or excess problem, then both the petioles and blades should be taken; but have them analyzed separately.

Time of Sampling

Routine sampling to determine fertilizer needs is done at bloom time. Questionable vineyards should be resampled about one month after bloom. Of course, the more samples taken during the growing season, the better; but economically this is not practical. Trouble-shooting samples to determine the cause of vine disorders should be taken at the time the problem occurs. It's important to keep notes on sampling. Record the date taken, approximate stage of fruit development, location on the vine of the abnormal leaves, and the variety.

Don't sample immediately after an irrigation. Wait a week.

Petiole Sampling Procedure

Routine sampling - Select petioles from the position opposite either of the two basal flower clusters.

Trouble shooting - Select petioles and blades from leaves showing the unusual or abnormal symptoms. Then select petioles and blades from normal appearing vines from the same position on the shoot. The normal sample should be taken from the same vineyard, same variety, and same soil type when possible. The laboratory analyses from these two samples can then be compared to determine the problem.

Size of samples - Take one or two petioles per vine, then skip 3 or 4 vines and repeat. Continue sampling until you have 80 to 100 petioles. Leaf blades require only 40 to 50 for a good sample. A good representative sample is important. Be sure you sample the same variety on the same soil type.

Handling the Collected Sample

Petioles are not washed unless the vineyard is unusually dirty or unless spray residue is present.

Leaf blades, if dirty, should receive a quick rinsing in distilled water containing a very small amount of detergent. Remember that some element such as sodium, potassium, or chloride can be leached easily from necrotic or dead tissue; therefore, make the washing very quick and do a thorough job of shaking and blotting off the excess water. Next, dry the samples. UC uses a forced-air draft oven at approximately 70° C for 48 hours. You can dry samples sufficiently for mailing by using the kitchen oven, set at lowest temperature, door partly open, overnight. Now the samples are ready to be sent to the laboratory for analyses.

Interpretation - Tissue analysis is just another useful tool to aid in determining troubles and needs. The following are approximate deficiency levels based on the research information to date. They are based on data from a few important commercial varieties, notably the Thompson Seedless. However, these are the best guidelines we have to follow. These data are based on petioles taken from opposite the clusters at bloom time, unless otherwise stated. In all cases a (+) or (-) value of about 10 per cent should be included for the "range."

NITROGEN	NITRATE-NITROGEN (NO_3-N) ppm NO_3-N
Deficient	less than 350
Adequate (normal)	600 to 1200
More than necessary*	over 1800
Excess	over 2400

* For Thompson Seedless, values between 1100 and 1700 nitrate-nitrogen may result in some reduction in total crop, but may be justified in areas where extra foliage is desirable to prevent sunburn of fruit. Observational experience indicates that over 2300 nitrate-nitrogen at bloomtime in Thompson Seedless is associated with various detrimental effects--excessive growth, perhaps fewer clusters formed, frequesntly reduced set of fruit, and poorly matured canes for next year's crop.

The table below gives the average nitrate-nitrogen levels for important grape varieties on their own roots. These are four-year averages.

VARIETY	PETIOLE NITRATE-NITROGEN
Grenache	1470
Petite Sirah	1265
Sauvignon blanc	1150
Semillon	900
Mission	800
Alicante Bouschet	790
Carignane	770
Emperor	745
Palomino	725
Cabernet Sauvignon	700
Zinfandel	655
Thompson Seedless	610
Tokay	540
Burger	540
Cardinal	225
Ribier	135

The above table gives relative rankings for nitrate-nitrogen levels of varieties grown in the same soil and in the same location (Davis, Ca.)

Varieties on the rootstock St. George will give you higher nitrate-nitrogen levels than own-rooted varieties.

Nitrate-nitrogen as a diagnostic aid is limited in several ways: varieties differ in "native" level; rootstocks also make a difference; and rainfall or irrigation seems to affect. Trials are under way in cooperation with Dr. Mark Kliewer to see if arginine level in ripe fruit might be a better guide to nitrogen status.

Phosphorus: No deficiency symptoms have been identified in California vineyards, and there have been no measurable responses in yield or fruit quality in University trials. With rare exceptions, bloomtime values lie between 0.3 and 0.6 per cent TOTAL phosphorus. Our negative-response trials have included vineyards with levels of 0.25 per cent; perhaps applications at levels lower than this will bring response --still to be tested. No field trials have been conducted from Davis based on acetate-soluble phosphate, so do not ask your lab to run this analysis.

	Per Cent Total P
Possibly deficient	less than 0.15
Questionable	0.15 to 0.20
Normal	0.30 to 0.60
Toxic	??

Potassium: Some precautions in interpretations: Varietal differences exist for potassium also, although not so great as for nitrate. Potassium level is easily affected by any condition that might reduce the effectiveness of the root system: drought, overcropping, shallow-rooting, nematodes, or phylloxera. Positive response to potash applications in such situations has often been negative. The most striking responses have been in areas with low soil-potassium, usually scraped areas. A big, unanswered question: why does tissue level of K vary so greatly (30-50%) from year to year in the same, untreated vineyards?

	Per cent K
Deficient	less than 1.0
Questionable	1.0 to 1.20
Normal	1.5 to 2.5
Excessive	over 3.0

Magnesium: Most of our California soils have high K/Mg in surface samples, but gradually reversing with depth. Thus, our few instances of Mg deficiency have been with newly-planted (shallow-rooted) vines or instances where there have been deep fills of top soil. In the latter situations, within 3-4 years the vines usually grow through to the Mg-rich lower soil. In short, we have no real problems of magnesium deficiency in California grape vineyards.

The bloomtime values range from 0.3 to 0.8 per cent and in California petiole levels almost always increase, on a dry weight basis, as the season progresses. With the extreme sensitivity of vines to the K/Mg ratio in tissue, our problem is much more one of Mg toxicity rather than of Mg deficiency.

	Per Cent Mg
Likely deficient	Less than 0.3 (very rare in California)
Normal	0.5 to 0.8
Likely toxic	Over 1.0 (might lead to K deficiency)

Zinc: The emphasis, so far, has been on attempts to correct the visual symptoms of deficiency. Until this can be done, easily and practically on cane-pruned varieties, survey analysis and normal levels are of secondary importance.

	ppm Total Zinc
Deficiency symptoms	less than 15
Questionable symptoms	15 to 20
Normal	25 to 50
Toxic	??

Boron: In California we have both deficiency and toxicity With deficiency, petioles and blades show about the same levels; with toxicity, boron accumulates very much more in the blades than in petioles.

	ppm B
Deficiency	less than 25
Questionable	25 to 30
Normal	40 to 60
Toxic	over 300 in blades

Chloride: Of the three elements likely to be toxic under our California conditions (Na, Cl, B), chloride seems to be the most serious in that it reduces total vine growth. Varieties (and rootstocks) differ greatly in tolerance, and we have much yet to learn! Chloride continues to accumulate with the growing season and does so predominately in the petiole even though the symptoms show in the blades.

	Per Cent Cl
Normal	0.05 to 0.15
Excess	0.50 (if continues to rise with season up to over 1.0%)

Sodium: Since chloride is almost always associated with high sodium, we have no real quantitative data as to what is a toxic (if any) level of sodium. At this time, we would say that a bloomtime level of over 0.50 per cent Na might be suggestive of problems, especially if potassium is relatively low.