Nutritional Status of Wine Grape Cultivars Grown in Southern Arizona

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Abstract

Ten winegrape vineyards consisting of different cultivars were leaf petiole sampled at bloomtime. Petioles were analyzed and results composited for the survey. There were indications that boron, iron, nitrogen and phosphorus were nutrients where potential problems (deficiencies) were likely to occur. This survey supplied information for the basis of developing a monitoring program on an annual basis.

Introduction

The known nutritional status of grapevines or vineyards is very important in the management of a nutrient program for maximizing vine growth production and fruit quality. The application of needed nutrients, at the right time, in the proper amounts, is essential for good vine health. The application of needed nutrients in the proper form and place (soil vs. foliar) is important. There has been a tremendous amount of research conducted throughout the world on determining the nutritional response of applied nutrients to all the important cultivars of grapevines. It has been established that vines need an annual soil application of nitrogen to obtain optimum growth and production. It has also been established that once nutrients have been applied, they will assume a nutrient content which will result in optimum growth and production. This nutrient content the vine assumes is known as the nutritional status of the vine and can be extended to the vineyard on a block by block basis.

In order to determine the nutritional status of a vineyard leaf petiole samples are collected and chemically analyzed for the essential elements needed for vine growth and preservation. These leaf petiole samples are collected at full bloom from leaves opposite the basal cluster. Previous research has established this technique in vineyards around the world.

The objective of this survey in Arizona was to determine the nutritional status of vineyards in various locales in Santa Cruz and Cochise counties in order to develop nutritional programs for optimization of vine growth and production of excellent quality fruit. It also will be used to identify potential nutrient previously unknown.

Methods

In the spring of 1993, 10 vineyards consisting of 9 different cultivars were leaf petiole sampled at bloom for determination of nutritional status. The cultivars sampled are as follows: Cabernet Franc, Cabernet Sauvignon, Chardonnay, Merlot, Pinot Noir, Petite Sirah, Sauvignon Blanc, White Riesling and Zinfandel. Only one of the nine vineyards sampled was located in Cochise County. The remaining vineyards were located in Santa Cruz county in the Elgin-Sonoita area. The pattern of petiole sampling was a collection of 40 petioles from each cultivar located in each vineyard. This resulted in 31 total samples from the 10 vineyards. Five of the vineyards sampled in 1993 were no

longer in production in 1997. At the time of petiole sampling the vineyards varied in age from 4 to 12 years of age, however, they were all into the production phase of development.

Results

Initial statistical analysis of the results indicate that there was very little difference between cultivars, therefore results will be presented based on a composite of all cultivars. In order to understand the results of the survey, it is important to know and understand what constitutes a critical level or value of a nutrient within the vine. The critical level is where any nutrient value below this level is deemed deficient and will affect plant growth. However, there is also a sufficient level which is required for optimum vine growth. Therefore, a value between the critical and sufficient could affect plant growth in subtle but effective ways. Critical levels or values have been established for most vineyard sites in the world and are amazingly similar, but will vary according to soil type and pH. There critical levels were used in the assessment of nutritional status of vineyards in this survey. The results of this nutritional survey are shown in Table 1. Low and high levels are reported and compared to established critical levels.

In order to fully understand and interpret the results of the survey the amount of variation within each nutrient must be known. This is measured by calculation of the coefficient of variation. A coefficient greater than 20% makes interpretation difficult. In this survey coefficients were established as follows (Table 2).

A C.V. above 20% is considered to be very high and indicates a high level of variation among the vines.

The nutrient that varied the greatest was manganese (Mn). C.V. of 80%. This is exceedingly high, however, manganese uptake is very dependent upon soil pH and considering the variation in soil pH in the Elgin-Sonoita area, this result would be expected. All manganese levels in all vineyards were above the critical level indicating that Mn problems should not occur.

The nutrient that varied the least was Boron (B) C.V. = 13%. Boron is needed in very small amounts but can become deficient if none exists in irrigation water. In this survey the lowest level found in a sample was 27 ppm which was 2 ppm above the critical level.

The only nutrient found to be below the critical level on the average was iron (Fe). The C.V. was 24% which indicates considerable variation. Only one vineyard demonstrated Fe deficiency symptoms indicating that the critical level for iron may be too high. This is a difficult element to discuss due to the uptake mechanism in relation to soil temperature, soil pH and soil calcium content. The other nutrients studied were at or above the critical levels established for wine grapes.

Discussion and Summary

The average level of all nutrients except iron was well above the critical level indicating these vineyards are capable of absorbing most of the nutrients in sufficient quantities to sustain adequate growth. The primary applied nutrient is Nitrogen which had levels indicating judicious fertilization practices by growers.

There would be some concern for the micronutrients Zinc and Boron particularly in high pH soils. However, there seems to be no problem in this survey which would warrant foliar applications. There were no indications by growers that foliar application had been applied previous to sampling. Nevertheless, the fact remains that B levels in some cases were close to the critical level indicating that B deficiency could be a problem under certain conditions (i.e. as in calcareous soils which occur in the Elgin-Sonoita area). Growers in this geographical area should constantly monitor their vineyards for Boron status.

There is less concern for zinc as the lowest level detected by the survey was considerably higher than the critical level. Application of zinc is not warranted but a monitoring program is important.

Survey results indicate that iron is low or perhaps vineyards are deficient in this nutrient. There were some vineyards which showed Fe deficiency symptoms. It could be that these obviously deficient vines could have swayed the data toward that of deficiency. The fact that the C.V. was 24% would further substantiate this concept. Another factor to be considered is that Fe may occur in lower levels in grapevines in Arizona as compared to other growing areas. Regardless of the reason, Fe is easily applied as a chelate through drip irrigation which could correct any Fe deficiency problems. In general, foliar sprays are not very effective unless applied in multiples of four or more.

The two major elements nitrogen (N) and phosphorus (P) are of concern. The lowest level of both of these nutrients was at or very close to the critical level. P deficiency has been documented in the Elgin-Sonoita area and deficiency symptoms have occurred in the Kansas Settlement area of the Sulfur Springs Valley. As P levels approach the critical level, there should be concern that P deficiency is impending. Phosphorus deficiency can be corrected with soil or foliar applications or a combination of the two. Additionally, phosphoric acid can be injected into the drip system as a maintenance program, once sufficient levels have been reached and corrected.

Low levels of nitrogen can be easily corrected by injecting nitrogen into the drip system. The low levels of N detected in this survey came from low vigor vineyards which had not received adequate water or nitrogen. In contrast, the high level of 8230 ppm is approaching the toxicity level. Monitoring N in the vine on an annual basis is important to prevent deficiencies but vigor assessment is also important. Too much vigor should be controlled with judicious pruning but frost or freeze damage can complicate the issue in that loss of crop results in excess vigor. In these cases N application rates should be reduced. The bottom line on N is that it can be manipulated very easily within the vine and should be monitored on a regular basis.

The entire concept of tissue analysis is good in that it is an excellent tool for diagnosing nutrient problems and monitoring the vineyard planning a fertilization program. The results of this survey indicate that growers should be monitoring vineyards for boron, phosphorous, zinc and nitrogen levels on an annual basis. Nitrogen should be monitored to plan rates of application and P, B and Zn for potential deficiencies.

Table 1. Average composite nutrient content of 9 cultivar of winegrapes grown in 10 vineyards in Southern Arizona.

	Nutrient Element					
Level	NO_3 (ppm)	P (%)	K (%)	Ca (%)	Mg (%)	S (%)
Low	355	.10	2.60	1.73	.37	.05
High	8230	.57	5.77	3.57	1.22	.26
Critical	350	.10	1.00	.50	.20	.05
Average	3575	.27	4.04	2.35	.67	.11

	Zn (ppm)	Cu (ppm)	Mn (ppm)	Fe (ppm)	B (ppm)
Low	31	7	52	20	27
High	368	28	352	56	46
Critical	15	5	20	50	25
Average	73	13	107	30	35

Table 2. Coefficients of variation for nutrients measured in the nutritional survey of southern Arizona Winegrape Vineyards.

Nutrient	Coefficient of Variation (C.V.) (%)
NO_3 (nitrate)	41
P (Phosphorus)	50
K (Potassium)	20
Ca (Calcium)	20
Mg (Magnesium)	28
S (Sulfur)	44
Zn (Zinc)	36
Cu (Copper)	29
Mn (Manganese)	80
Fe (Iron)	24