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VINE NUTRITION: SARE PROJECT RESULTS

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INTRODUCTION

Nitrogen (N) is the most commonly applied nutrient in New York vineyards. Application rates typically vary from 50-100 pounds actual N per acre, depending primarily on the previous season's growth, trellis fill, and expected crop load. Needs for other nutrient elements are determined primarily by petiole analysis, although soil analysis is often used to help determine the rate of application, if an adjustment is determined necessary. Potassium (K) is the most commonly applied nutrient after nitrogen.

The most commonly available sources of N for organic growers are various forms of manure. Composition varies by source, and they also contain varying quantities of other nutrients. Legumes grown as row middle cover crops are another potential means of supplying vines with N. The major concerns with using manure and legume cover crops are control of composition, rate and timing of each of the nutrient elements, particularly N. Mined potassium sulfate is available as an organic source of potash, and is an excellent source for both conventional and organic growers. Some manure sources also contain a significant amount of K.

SARE PROJECT

Ammonium nitrate was used as the primary source of N fertilizer in conventionally managed blocks, although ammonium sulfate was occasionally used on higher pH blocks. A local source of cow manure was used in the organic blocks in 1990, but difficulties in obtaining this manure led to a late application and poor uptake. In 1991, we switched to chicken manure pellets, which allowed for more control of timing and rate. The chicken manure pellets (1994 analysis - 3.62% N, 3.73% P_2O_5, 3.85% K_2O, 2.32% Ca, and 0.62% Mg) were lower in N in 1994 than in the previous years, with the 1991-93 N levels being approximately 5-6%. Other nutrients in the manure varied less than N from year to year. Nitrogen was used as the driving factor in determining rate of chicken manure pellets applied. Regardless of source, both conventionally and organically managed blocks received approximately 100 pounds actual N per acre in most years. White clover as a row middle cover crop was established in subplots within the organically managed blocks.

Table 1. Bloom and Fall (post-veraison) petiole nitrogen levels (%) for conventionally and organically managed blocks, 1990-1992.

		1990		1991		1992	
Cultivar	Method	Bloom	Fall	Bloom	Fall	Bloom	Fall
Concord	Conventional	1.19 a	0.81 a	2.28 a	0.84 a	1.31 a	0.66 b
	Organic	0.92 b	0.77 a	1.88 b	0.80 a	1.30 a	0.74 a
Elvira	Conventional	1.25 a	0.77 a	1.83 a	0.82 a	1.74 a	0.62 a
	Organic	0.86 b	0.75 a	1.33 b	o.68 b	1.22 b	0.62 a
Seyval	Conventional	1.32 a	1.04 a	2.14 a	0.87 a	1.66 a	0.86 a
	Organic	1.03 b	0.87 b	1.76 b	0.80 a	1.62 a	0.91 a

Table 2. Bloom and Fall (post-veraison) petiole nitrogen levels (%) for conventionally and organically managed blocks (including clover sub-plots), 1993 and 1994.

		1993		1994	
Cultivar	Method	Bloom	Fall	Bloom	Fall
Concord	Conventional	1.28 a	0.77 c	1.27 a	0.73 b
	Organic	1.14 b	0.87 b	1.00 b	0.79 a
	Clover	1.32 a	0.95 a	1.20 a	0.81 a
Elvira	Conventional	1.53 a	0.88 a	1.05 b	1.07 a
	Organic	1.17 b	0.73 b	0.90 c	0.82 b
	Clover	1.02 c	0.83 ab	1.19 a	1.03 a
Seyval	Conventional	1.41 a	0.84 a	1.66 a	1.27 a
	Organic	1.06 c	0.84 a	1.26 b	0.94 b
	Clover	1.20 b	0.82 a	1.33 b	0.98 b

Corrective K additions were based primarily on petiole analyses, although crop load and soil levels were also considered. Muriate of potash was used in conventionally managed blocks and sulfate of potash was used in organically managed blocks. The chicken manure used in the organically managed blocks also contributed some K.

Since stored N is the major N source utilized during the first few weeks after bud break, N deficiency that was observed in organic blocks in 1990 and resulted in low early season N in 1991 (Table 1). By veraison in 1991, however, N levels in organically managed blocks were generally comparable to conventionally managed blocks. Although chicken manure pellets were applied in late April-early May in 1991-94, bloom petiole N levels were generally lower in organically managed blocks than in conventionally managed blocks (Tables 1 and 2), indicating that the manure N source was not available as quickly as the synthetic source (ammonium nitrate). The white clover cover crop, once established, resulted in increased petiole N as compared to the rest of the organic blocks in both the Concord and Elvira, but not in the Seyval (Table 2). The lack of response in the Seyval is presumably due to the comparatively poorer stand of clover in the Seyval, as compared to the subplots in the other varieties. Bloom petiole N in the Concord and Elvira clover subplots generally was comparable to the petiole N in the conventionally managed blocks, even though the organically managed blocks had received only half of their N (50 pounds N/acre) prior to bloom (1994 data). Other studies indicate that clover cover crops supply approximately 30-60 pounds of N per acre, which apparently helped elevate petiole N levels in the clover subplots.

Potassium deficiencies occurred in several years in both conventionally and organically managed blocks (Table 3). Deficiencies were generally most severe in the driest years, 1991 and 1993, although deficiencies also occurred in 1990. Large crop loads exacerbated the deficiencies in some cases, and severe water stress due to weed competition (especially in the organic blocks)

Table 3. Fall (post-veraison) petiole K levels for conventionally and organically managed blocks, 1990-1994.

Cultivar	Method	1990	1991	1992	1993	1994
Concord	Conventional	0.57 b	0.53 b	1.28 a	0.32 a	1.21 a
	Organic	0.79 a	0.99 a	1.49 a	0.48 a	1.08 a
Elvira	Conventional	1.25 a	0.70 b	2.02 a	1.31 a	2.87 a
	Organic	0.88 b	1.38 a	2.19 a	1.44 a	1.77 b
Seyval	Conventional	1.01 a	1.38 a	1.85 a	1.66 a	1.99 a
	Organic	0.80 a	1.35 a	1.65 a	1.29 a	1.50 b

Table 4. Fall (post-veraison) petiole levels for conventionally and organically managed blocks, 1994.

		%				ppm		
Cultivar	Method	P	K	Mg	Ca	B	Mn	Cu
Concord	Conventional	.14 b	1.21 a	.38 b	1.16 b	36 a	106 a	7 b
	Organic	.20 a	1.08 a	.61 a	1.45 a	35 a	69 a	53 a
Elvira	Conventional	.22 b	2.87 a	.17 b	1.19 b	27 b	573 a	15 b
	Organic	.38 a	1.77 b	.27 a	1.65 a	32 a	187 b	34 a
Seyval	Conventional	.26 a	1.99 a	.70 a	2.32 a	24 b	153 a	10 b
	Organic	.13 a	1.50 b	.63 a	1.97 a	26 a	169 a	30 a

contributed to the problems. Concord blocks required the heaviest potassium applications, with both conventionally and organically managed blocks receiving over 1700 pounds K_2O over the 5 years. Rates were substantially lower in most other blocks, although the organically managed Seyval required approximately 1500 pounds K_2O over the course of the study. The extreme potassium deficiency that occurred in both the conventionally and organically managed Concord blocks was alleviated by heavy K applications, although the lighter crop loads that generally occurred the following year also created less stress. Organic Concord blocks were still slightly deficient in 1994, however, and this was likely exacerbated by the excessive magnesium (Mg) level (Table 4) as well as the greater apparent moisture stress. It should be noted, however, that the soils in the Concord blocks were initially much higher in pH, Mg and Ca than the other blocks. Conversely, excessive petiole K in the conventionally managed Elvira block contributed to a Mg deficiency in additions of small amounts of Ca and Mg in the chicken manure pellets. There appeared to be no meaningful trends in differences in soil organic matter, and any statistical differences were inconsistent with respect to treatments, and were, therefore, likely due more to sampling variation than any real differences.

Fungicide applications affected petiole copper (Cu) levels in the organic blocks and petiole manganese (Mn) levels in the conventionally managed blocks. Petiole Cu levels were higher in organic blocks of all varieties (Table 4) and there was also a trend toward higher soil Cu levels in organically managed blocks as well. All soil Cu levels were below 0.5 ppm, however, and the levels were so low that statistical differences were unlikely to be meaningful. Elevated soil Cu levels may be a concern where Cu fungicides are used over decades, but over the course of this study, there appeared to be no significant buildup. Copper residues on the fruit were of more immediate concern than soil levels. The use of mancozeb fungicide in the conventionally managed blocks resulted in significantly higher petiole Mn levels (Table 4), although they were still in a desirable range and there was no apparent soil buildup.

DISCUSSION

Nutrition of organically managed grapevines need not be a factor that limits production. Although nitrogen deficiency was evident in the

Table 5. Surface soil data for conventionally and organically managed blocks, 1994.

Cultivar	Method	pH	% OM	lb P/A	lb K/A	lb Ca/A	lb Mg/A
Concord	Conventional	6.07 b	5.4 a	6.4 b	190 b	1927 a	189 a
	Organic	6.79 a	5.2 a	21.7 a	247 a	2623 a	225 a
Elvira	Conventional	4.79 b	3.4 a	3.0 b	140 a	642 b	61 b
	Organic	5.63 a	3.7 a	8.8 a	144 a	993 a	104 a
Seyval	Conventional	4.42 b	3.3 b	9.9 b	77 b	410 b	38 b
	Organic	5.08 a	4.4 a	12.7 b	158 a	935 a	89 a

first year of the study due to problems with the initial source, this was largely overcome by the end of the second season by switching to the chicken manure pellets. Supplying adequate N is generally the greatest challenge for all grape growers, both conventional and organic. The major concerns with organic sources are identifying the composition, having N available at times that are efficient for uptake, and avoiding excessive uptake at critical times (i.e. bloom, fall). The lower bloom petiole N levels in organically managed blocks indicates that getting adequate early season N may be more difficult, or at least may require changes in timing or combining of strategies. Getting into the vineyard to make an application earlier in April is often difficult due to field conditions, while applications made in the winter could result in runoff and leaching problems. Due to the slower release nature of most organic materials, excessive uptake at the wrong time should not be a major problem, provided that rates are not excessive and application timing is reasonable. Many conventionally managed vineyards show low N symptoms late in the season, which potentially may be overcome by using organic sources. Splitting applications of the conventional N source into 2 different timings may also be helpful, but summer rainfall is frequently sporadic and may or may not result in good uptake at the targeted times. Legume cover crops appear to offer good potential to enhance nitrogen uptake, and based on our data may be useful in insuring adequate bloom N as well as an adequate late season supply. If N demands are high (>40-50 pounds N/acre), however, white clover would be unlikely to supply the vine's entire needs without some additions of manure or another N source. Other legumes (i.e. hairy vetch) could supply significantly more N than white clover, but these sources may also be more competitive for water than white clover.

Potassium deficiency is potentially problematic for both conventional and organic growers. Mined potassium sulfate (sulfate of potash) is an excellent source of K that is organically acceptable, and has been used by conventional growers as well. Potassium uptake is lower under dry conditions, and may be more problematic in some organically managed vineyards due to increased weed competition. Potassium nutrition should be carefully monitored for this reason, among others. Mechanical cultivation, such as with a grape hoe, can reduce weed competition, but root damage also results. Although this may be preferential to just allowing weeds to grow, cutting roots also limits the vine's ability to obtain water. Amendments, such as hay or straw mulch, are likely to be helpful in reducing moisture stress and, therefore, should result in improved K uptake and likely will provide direct nutrient benefits as well.

The use of copper fungicide over many decades in some European vineyards has resulted in undesirably high soil Cu levels. No significant buildup occurred over the 5 years of our study, however. Copper fungicides are used by both conventional and organic growers in New York, and are likely to be critical to the success of most varieties that are organically grown under our conditions. Where they are used over the course of several decades, soil levels should be monitored for buildup. Copper is tied up with high organic matter and near-neutral soil pH, so plant uptake and leaching should be minimal as long as these conditions are maintained.

All good vine nutrition programs should include routine monitoring by soil and petiole analysis. Balancing K levels with Mg and Ca levels is important for all growers, organic or conventional. In our study, the organic chicken manure source contained Mg and Ca, and Mg became excessively high in the Concord block (which was initially a higher lime soil). While adding Mg and Ca was probably advantageous in the Elvira and Seyval blocks, it exacerbated the potassium deficiency in the Concord. The composition of both synthetic and organic fertilizer sources should be carefully considered. Regardless of whether or not a fertilizer is synthetic or organic, need, rate and timing must all be considered to insure good vine growth and long term productivity.