Factsheet

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Cover crops and vine nutrition

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Introduction

When it comes to nutrient requirements, grapevines are very economical compared to annual crops. Freeman (1987) studied the level of nitrogen (N) removal and the cycling of N that occurs following pruning and leaf fall. In total, for a 20 tonne/ha crop, between 28 and 34 kg/ha of N is removed, or about 1.5 kg N/tonne. This finding closely matches the figures of Conradie (2005) shown in Table 1, where allocations of nutrients to other vine components are also given. Note that the quantities shown in the Total column of Table 1 will differ from the nett amounts removed from the vineyard. Where leaves fall and stay within the vineyard, and prunings are mulched in-situ, the nett loss will only represent nutrients contained in the berries and stalks, with some N loss from leaves during mineralisation. The trace elements are also of vital importance to vine health, and are removed at levels of grams per tonne of fruit.

What is the relationship between cover crops and vine nutrition?

To answer this question, it is necessary first to consider the rooting patterns of vines in the vineyard setting. The mid-row accounts for some 60% of the vineyard floor area, but nutrient availability from this area will depend on the level of vine root activity extending to the mid-row. While grapevine roots have been found to grow to more than 6 m in ideal soil conditions (Doll 1954), this is unlikely to occur in the soils of Australia. Compaction induced by wheeled traffic can severely restrict root access to the mid-row, so much of the nutritional benefit generated in this region will not be realised by the vine.

However, the size and health of the root system essentially governs the size and performance of the canopy, which will ultimately affect vine balance and berry quality. Optimum berry quality is rarely achieved with a vigorous canopy, but restricted root volumes do not necessarily produce high-quality fruit (Lanyon et al. 2004).

The impact of the cover crop on vine performance is related to the vine root distribution. In vineyards under drip irrigation in warm, dry viticultural regions, vine roots are essentially confined to the vine row, which is the source of water and nutrition (Peacock 2005). Compacted wheel tracks also constrict the vine root to this zone. Soil cover growing between the wheel tracks therefore has little or no impact on vine growth, enabling the growth of summer-active plants in this zone (Penfold 2010). Conversely, with increasing rainfall and improved soil quality, vine roots enter the mid-row. Smart et al. (2005) studied the impact of tillage and permanent cover crop on vine rooting patterns in the mid-row, with vine roots frequently diminished in the top 20–30 cm. Root pruning from tillage and the reductions in available soil moisture through competition with cover crops are

	Contained in clusters		Annual requirement of permanent structure[a]		Leaves (lost at leaf fall)		Shoots (lost at pruning)		Total[b]
	(kg)	(%)	(kg)	(%)	(kg)	(%)	(kg)	(%)	(kg)
N	1.38	35.6	0.91	23.4	1.04	26.8	0.55	14.2	3.89
P	0.25	34.2	0.1	14.4	0.29	39.8	0.08	11.9	0.72
K	1.98	64.8	0.19	6.2	0.47	15.4	0.41	13.6	3.05
Ca	0.17	8.4	0.14	6.9	1.4	69.8	0.3	14.9	2.01
Mg	0.09	14.9	0.08	12.5	0.32	53.9	0.11	18.7	0.6

Table 1: Amount of N, P, K, Ca and Mg in various organs of Chenin Blanc in sand culture, per tonne of fresh grapes (Conradie 2005).

a Amount of nutrients gained by trunk and roots over the course of 1 year, per tonne of fresh grape (start of the second to start of the third season)
b Total annual intake, per tonne of fresh grapes

believed to be the critical factors involved (Smart et al, 2005). Vine nutrition is therefore intimately linked to vine water supply, so the source of the vines' moisture must also be the zone providing adequate nutrition for the growing vine.

Where cover crops can be grown successfully, the mid-row can become a source of nutrition for the vines by transferring the nutrients bound in the cover crop to the vine row by means of a side-throw mower. Doing this at around mid-flowering for legumes, and before seed development in non-legumes, will ensure that the maximum amount of N in the leaf and stem material is maintained (Sarantonio 2003). In many regions of Australia, legume-rich cover crops or volunteer growth will supply the vines with sufficient N (Robinson 1992). This scenario will change, however, in regions of lower rainfall (and therefore less cover crop production) and lighter soils with less organic matter and higher yields being produced. Less organic matter means that less N will be mineralised for uptake by the vines, leading to the need for fertigation (Conradie 2005).

How much nutrient is available from cover crops?

An approximate amount can be determined by cutting the cover crop at mower height from a pre-determined area of, say, a quarter of a square metre at 3 or 4 representative sites in the vineyard. The material is then dried thoroughly and the amount of biomass per hectare (10,000 m^2) calculated as a dry weight. Non-legumes contain about 1.5% N and legumes about 2.5%. If the plant material consisted mostly of non-legumes, multiply the dry weight per hectare by 0.015, and for legumes by 0.025, to provide an amount of plant N per hectare. As an example, a cereal cover crop producing 5 tonne/ha will therefore contain 75 kg/ha of N (5000 × 0.015).

If this material is then transferred from the mid-row to the undervine region, which is approximately half the area of the mid-row, the equivalent of 150 kg/ha will be applied to the undervine area. Not all of this N will be immediately available to the vine. Approximately 20% (or 30 kg/ha in the above example) will be available in the first year, and of the remainder, some will be lost as volatile ammonia, and much of the rest will be tied up in the soil organic matter and available slowly over following years as it is mineralised by the soil microbes.

Using these calculations, it would seem that where good cover crops can be grown using growing-season rainfall, it is possible to readily supply the long-term N needs and potentially most other elements by transferring nutrition from the mid-row to the undervine area. Essentially, this is prescription green manuring, where the mid-row cover crop is selected to provide the requirements of the undervine area. If N is required quickly, then legumes will provide more N and break down faster. A more slowly available N supply, using either soil N or synthetic N as the original N source (rather than biologically fixed N in the case of legumes), will result from cereals. Where nematodes are a concern, then the use of one of the Brassica species as a green manure (McLeod & Da Silva 1994) for transfer undervine is also likely to be beneficial. In the years prior to and following this process, care must be taken that the vines are monitored both visually and with petiole or leaf blade analysis to ensure that desirable vine nutrition is being attained.

Figure 1: In low-rainfall vineyards, the impact of the mid-row on vine performance and nutrient supply is minimal. Nutrients are supplied as fertigation or applied undervine in compost.

Figure 2: Vine roots concentrate under the drip lines as they are the main source of water and nutrients in the warm, dry environments.

Figure 3: A faba bean cover crop will supply a significant amount of nutrient to the vines when mown or rolled in spring.

Conclusion

Where possible, the side-throwing of cover crop to the region of greatest vine root activity is suggested as a means of enhancing the cover crop's value. Using the mid-row as a nutrient source is expected to reduce the real cost of cover crops while simultaneously enhancing vineyard soil and vine health.

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