



Grapevine nutrition 1: Nitrogen fertilisation

Current titles in this Grapevine nutrition VitiNote series include:

1. Nitrogen fertilisation
2. Phosphorus fertilisation
3. Petiole analysis
4. Potassium fertilisation
5. Soil acidification
6. Liming
7. Trace elements

ROLE IN GRAPEVINES

Nitrogen (N) plays a major role in the growth and development of all parts of the grapevine. A significant amount of nitrogen is essential for normal vine growth.

With few exceptions, nitrogen is found in low quantities in Australian grape growing soils. Soil nitrogen reserves depend on the level of organic matter in the soil. With continual harvesting of fruit and removal of prunings, fertilisation with N may become necessary depending on N inputs from cover crops.

The application of nitrogen fertiliser to vines needs to be done carefully as excessive nitrogen increases shoot growth at the cost of fruit set and development. Over supply of nitrogen can also delay fruit maturity and may result in poor fruitfulness of buds in the following season.

NUTRIENT MANAGEMENT WITH NITROGEN FERTILISERS

When applying nitrogen fertilisers, the issues of nitrate contamination of groundwater and acidification of the soil must be considered along with the nutrient requirements of the vines.

The use of best management irrigation practices will enable optimisation of N use efficiency.

Nitrogen inputs from irrigation water, rainfall, crop residues, and the mineralisation of soil organic matter must also be taken into account.

Nitrogen is available in both naturally occurring and commercial fertiliser products in a number of forms. These products have a variety of characteristics and can behave differently in different soil/water conditions (see Table 1).

APPLYING FERTILISERS

Consultation with your winery is always advisable when considering nitrogen applications.

Nitrogen supplements may be necessary to counteract poor vine vigour resulting from pest or disease attack, e.g. nematodes or other debilitating factors. In some vineyards, legumes grown over winter in the inter-row may provide sufficient nitrogen.

On sandy soils or when using drip irrigation, if it is necessary to apply nitrogen, the annual quantity of N should be applied in smaller doses but more often to compensate for potentially higher losses of the nitrogen via leaching. Loam and clay soils have lower leaching rates than do sandy soils. Drip irrigated vines commonly experience leaching problems in the soil under the dripper and thus require nitrogen to be applied.

Maintenance of adequate nitrogen levels in the vineyard may mean at least annual or more frequent fertilising in some situations. There are a number of methods of fertiliser application, each with varied considerations:

- Nitrogen fertiliser applied to the soil surface with broadcast or banding methods of application needs to be incorporated into the soil by rain or tillage, otherwise valuable nitrogen may be lost through conversion to ammonia gas (volatilisation).

- Foliar applications of nitrogen should only be used as a supplement to an appropriate seasonal soil fertiliser program.

NOTE: Only low biuret urea should be applied in foliar sprays to avoid damage to foliage.

- Fertigation offers better control of application, however high rates of urea or ammonium-based fertilisers applied through fertigation can result in ammonium toxicity and soil acidification problems.

Table 1. Characteristics of selected forms of nitrogen-containing fertiliser products

Urea	<ul style="list-style-type: none"> • Very soluble in water. • Easily leached through the soil profile. • Requires microbial activity to transform it to ammonium or nitrate before it is taken up by roots. • Lost as ammonia gas in moist alkaline soils. • Often the cheapest form of nitrogen. • Acidifying effect on soil.
Ammonium compounds	<ul style="list-style-type: none"> • Usually soluble. • Adsorbed onto clay particles in the soil making it less available to vines, but also less likely to be lost via leaching. • Generally transformed to nitrate before it is taken up by the roots, however ammonium can be actively taken up by vines. It is toxic to vines in high concentrations. • Lost as ammonia gas in moist alkaline soils. • Acidifying effect on soil. Sulphate of ammonia is very acidifying.
Nitrate compounds	<ul style="list-style-type: none"> • Soluble. • Moves freely in the soil. • Taken up by plants in the transpiration stream. • Easily leached through the soil profile. • Non-acidifying but more expensive than other fertilisers per unit of N.
Complex organic molecules	<ul style="list-style-type: none"> • Organic materials sourced from vines and weeds, animal and plant 'manures' and organic mulches. • Need to be extensively broken down and converted to ammonium or nitrate by soil organisms. • Also acts to improve soil structure. • Can harbour pathogens.

TIMING APPLICATION FOR EFFICIENT UPTAKE

Application of a mobile nutrient like nitrogen should follow periods of active root growth when vine uptake of the nitrogen is rapid. These occur at two main times in the season:

- Around 4–6 weeks after budburst (dependent on soil temperature and moisture levels)
- Post harvest, i.e. in the second flush of root growth if there are no limiting factors (e.g. drought, cold soil)

Timing of nitrogen application is much more efficient if fertigation is employed as it is better to apply smaller amounts at regular intervals (bearing in mind the peak uptake periods), rather than applying a large rate of nitrogen fertiliser all at once. The amount applied can then be adjusted according to vine vigour and leaf colour.

If fertigation is not an option, then split applications of nitrogen fertiliser are more effective than single applications:

- At least 4–6 weeks after budburst
- Approximately two weeks after flowering

Prior to budburst

Application of synthetic nitrogen fertilisers before this time is wasted as there is little or no root growth. Rates of uptake are generally low and, this early in the season, the vine is still using nitrogen stored from the previous season to support its growth. The probability of leaching is also high in many areas due to rainfall.

Between fruit set and veraison

Applications of nitrogen between fruit set and veraison can enhance amino acid concentration in berries. However, applications around veraison and during ripening require care as it is necessary to avoid prolonging or promoting excess growth in most circumstances.

Post harvest

When the supply of available nitrogen is sufficient between harvest and leaf fall, grapevines store nitrogen over winter in the woody tissues for use

the following spring. Generally, post harvest applications are only beneficial as a supplement to nitrogen applications made earlier in the season (especially if vine nitrogen status is low). Also, the viability of leaves should be considered at this time, as this will impact on the vine's ability to uptake and store nitrogen for the following season. If close to leaf fall, the uptake of nitrogen will be low and most will be lost to leaching through the soil profile.

MODEL NITROGEN FERTILISER REQUIREMENTS

During establishment

- Young vines usually require about 2–5g of actual N per vine per week (observe vine vigour and leaf colour to determine if this rate needs to be altered).
- Use calcium nitrate on acidic soils to avoid acidification.
- Urea and ammonium nitrate can be used on neutral to alkaline soils.

In mature vineyards

- In warm regions, plan to apply 50–60kg of actual N per hectare of vineyard across the season. Assess vine vigour to determine if this rate needs to be adjusted.
- In the cooler regions, the rate required is more likely to be approximately 20kg of actual N per hectare of vineyard applied across the season. In some cooler areas inputs from rainfall, cover crop turnover, contaminated bore water, etc are sufficient to supply the needs of the vines without additional fertiliser.

ENVIRONMENTAL AND SUSTAINABILITY ISSUES

There are various issues relating to both the sustainability of the nitrogen resource in a given vineyard and the use of nitrogenous fertilisers in the greater environment. These include minimising the impact of N on:

- leaching losses from the vineyard, and
- soil acidification.

FURTHER INFORMATION

Product or service information is provided to inform the viticulture industry about available resources, and should not be interpreted as an endorsement.

This VitiNote has been prepared for growers who wish to apply nitrogen fertiliser. The decision to apply nitrogen may have been arrived at through visual observations of deficiency symptoms or decreased vigour, or from petiole analyses. For petiole analyses see VitiNote *Petiole analysis*.

Further detail on nitrogen sources, nutrition, deficiency symptoms and management can be found in the *Grapevine Nutrition: Research to Practice*[™] training manual, Cooperative Research Centre for Viticulture, Adelaide 2005.

Useful references on these topics are:

- Robinson JB, (1997) Grapevine Nutrition, in Viticulture Vol 2 Practices, Eds Coombe BG & Dry PR, reprinted 2001, Winetitles, Adelaide, pp178-208.
- Nicholas P, (Ed.) (2004) Soil, irrigation and nutrition, Grape Production Series 2, SARDI, Adelaide.

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