WINEGROWING FACT SHEET NO. 1
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Plant & Food RESEARCH
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Why is nitrogen important for wine grape production?

Nitrogen cycling in the vineyard

Nitrogen (N) is a macro nutrient in the vineyard that is important to many aspects of grapevine metabolism. Nitrogen is cycled within the vineyard via a number of processes, so that the exact amount of nitrogen available to the vine is only a portion of the nitrogen that is present in the vineyard (Figure 1).

What are the key times for nitrogen use and uptake?

Once the vine has extracted the nitrogen from the soil, it can store reserves and use them at key growth stages. However, research has shown that nitrogen application at key times can influence vine physiology (Figure 2).

How is nitrogen used in the vine?

Nitrogen in the vine is converted into biologically active amino acids, including arginine. Arginine in turn can then be converted into a range of products (Table 1) within each plant cell.

Table 1: Products into which arginine can be converted in the vine, and their roles in the plant.

Product	Function	Importance
Proline	Produced by the vine in response to stress	Not usable by yeast during fermentation
Polyamide	Produced as a response to stress	Nitrogen not available for fermentation
Structural proteins	Important for cell growth and division	Nitrogen not available for fermentation
Regulator proteins	Enzymes that control cell function	Nitrogen not available for fermentation
Defence proteins	Specialised proteins produced in response to wounding	Nitrogen not available for fermentation
Glutamate	An amino acid which can be further converted	Can be used by yeast
Phenylalanine	Used to make other compounds	Needed to make tannins and anthocyanins
Storage proteins	Provides nitrogen stores in the seed	Nitrogen is present in the berry but not available for fermentation

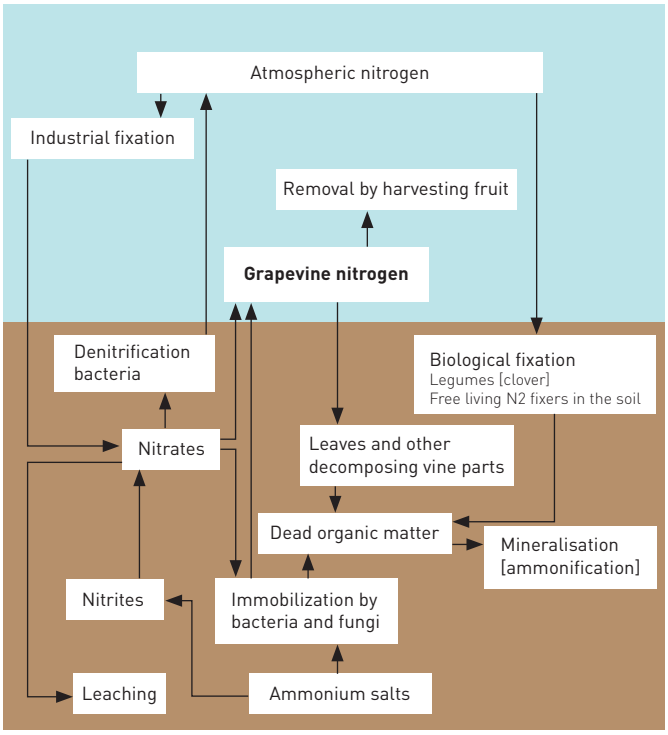


Figure 1: Simple nitrogen cycle in vineyards.

Why do winemakers like phenylalanine?

Arginine that is converted to phenylalanine can then be converted further by enzymes into a number of key products in the vine, including lignins (in the wood), resveratrol (plant defence against infection), flavonols (flavour), tannins (for mouth feel) and anthocyanins (red colour) (Figure 3). If arginine (and hence phenylalanine) concentrations are low, then production of these compounds can be limited, resulting in greater risk of berry infection from disease, poor colour and flavour development of berries, resulting in unfavourable musts and fruit requiring more intervention in the winery to produce high quality wine.

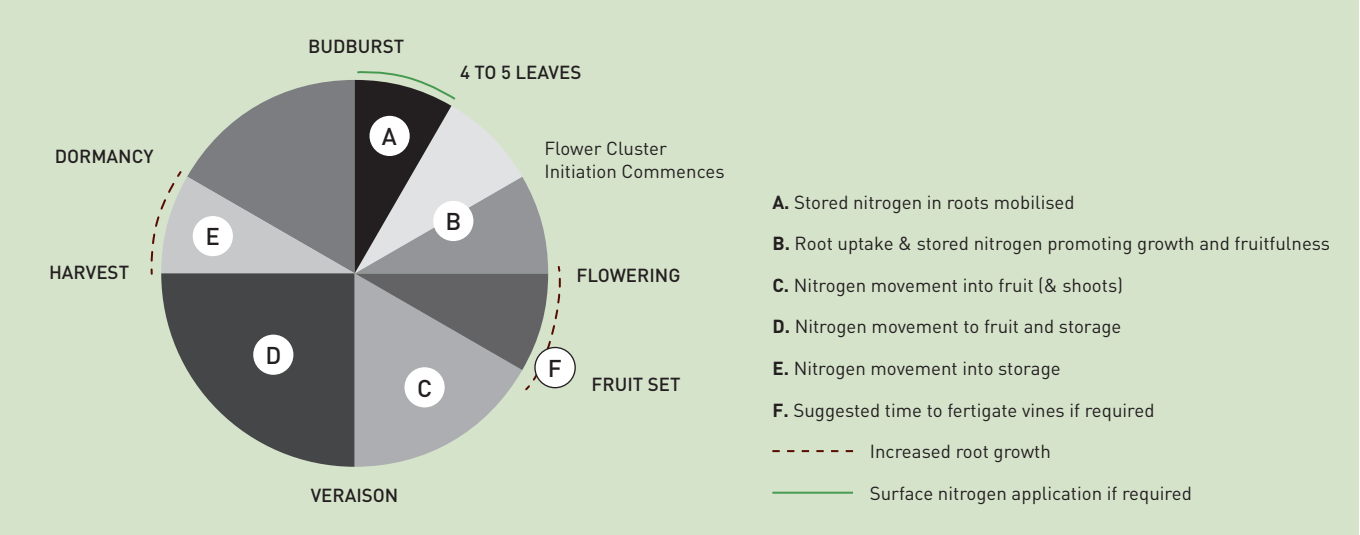


Figure 2: Seasonal timing of nitrogen with relation to vine physiology (adapted from (Goldspink & Howes 2001).

What are some of the effects of nitrogen on grapes?

Differing field manipulations of nitrogen timing, form and rate can change wine quality both directly and indirectly. For example:

1. Applying nitrogen at flowering increases berry set. This can increase yield and result in a delay in fruit reaching a target soluble solids content (sugars, measured as °Brix).
2. Different cultivars have different nitrogen requirements, amino acid compositions and total berry nitrogen contents.
3. Nitrogen can increase disease levels, but it is a complex issue (see nitrogen and botrytis fact sheet Plant & Food Research Winegrowing Fact sheet No. 2).
4. Increases in amino acid concentration in the juice can result in wines with better flavours than those of other wines with the same total juice nitrogen content.
5. Desired levels of amino acids, and methods of achieving them in fruit of cultivars that are important to the New Zealand industry, have yet to be determined.

How can we change the nitrogen content of the fruit?

Total fermentable nitrogen in the must is measured as yeast available nitrogen (YAN), which is determined by adding the ammonium and primary amino acid concentrations of the fruit. A change over time has been reported for some varieties of grapes, with ammonium content starting high and declining to a plateau at harvest. Maximum primary amino acid and minimum ammonium concentrations can be influenced by field applications of nitrogen (Figures 4 & 5). The use of nitrogen additions at key times, as shown in Figure 2, can therefore be used to influence final nitrogen contents of fruit.

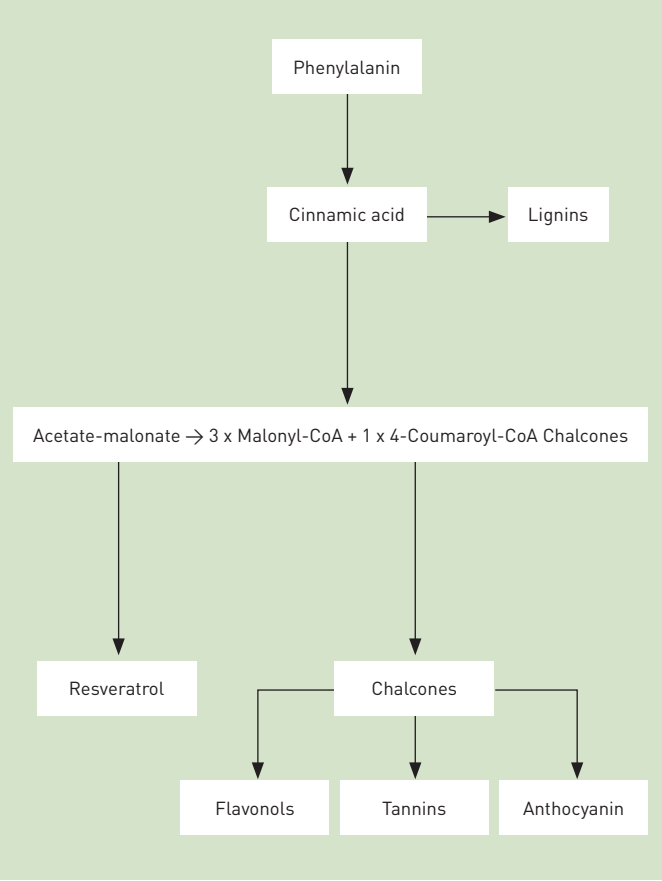


Figure 3: Production of plant defence compounds from phenylalanine (adapted from Bais AJ, Murphy PJ, Dry IB 2000). Enzymes catalyse the reactions shown in the figure.

Why is yeast available nitrogen (YAN) in grape juice important?

The three major berry tissue types are the flesh, skin and seed, with the bulk of wine being derived from the flesh. Total nitrogen and amino acid content of musts vary widely and the amino acid profile of the fruit at harvest has implications for fermentation. Proline, lysine and glycine are not easily assimilated by yeast during fermentation, in contrast to ammonium, arginine, phenylalanine, histidine, valine, and glutamic acid.

Seasonal, cultivar, environmental and maturity differences in the amino acid content of fruit may provide challenges for winemakers wanting to avoid slow or sluggish ferments. While amino acid composition and total juice nitrogen content are not the only possible reasons for problematic ferments in the winery, they do have a part to play. Some remedial action can be taken in the winery to change total juice nitrogen content, but this intervention is most effective if planned before yeast is added to the must.

The most common intervention applied is the addition of di-ammonium phosphate (DAP). In Australia, during a blind tasting of wines made with and without nitrogen fertiliser added in the vineyard, consistently superior flavours and aromas were attributed to the wine from vines with vineyard-applied nitrogen.

Where can I find more information?

Further details on grapevine nitrogen research are available at **http://www.wineresearch.org.nz/projects/Biodigital.htm** **http://www.wineresearch.org.nz/projects/botrytis%20bunch%20rot.htm** or by contacting Dion Mundy at dmundy@hortresearch.co.nz

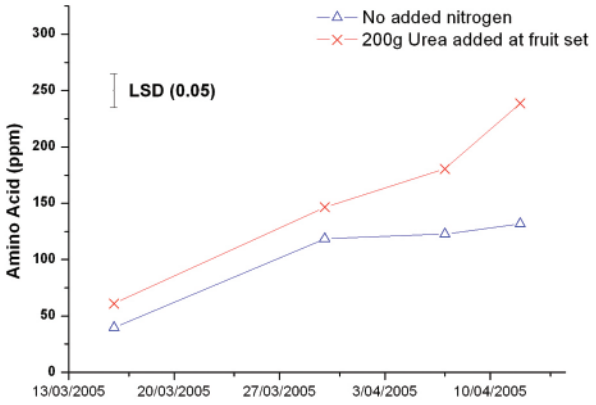


Figure 4: Increase in primary amino acid content over time for Sauvignon blanc vines with no nitrogen added and with 200 g of urea per vine added at fruit set, as measured during maturity in 2005. Means that are different by more than the LSD bar are significantly different at the 5% level.

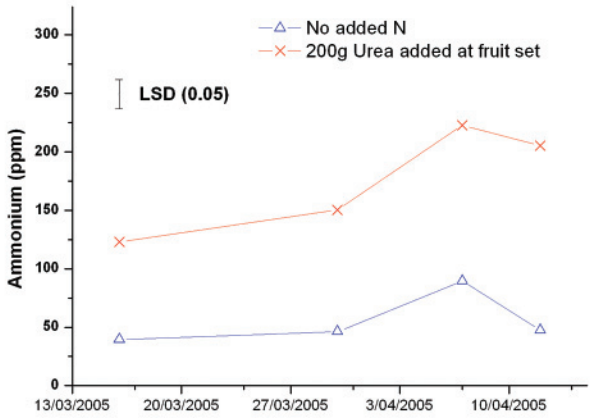
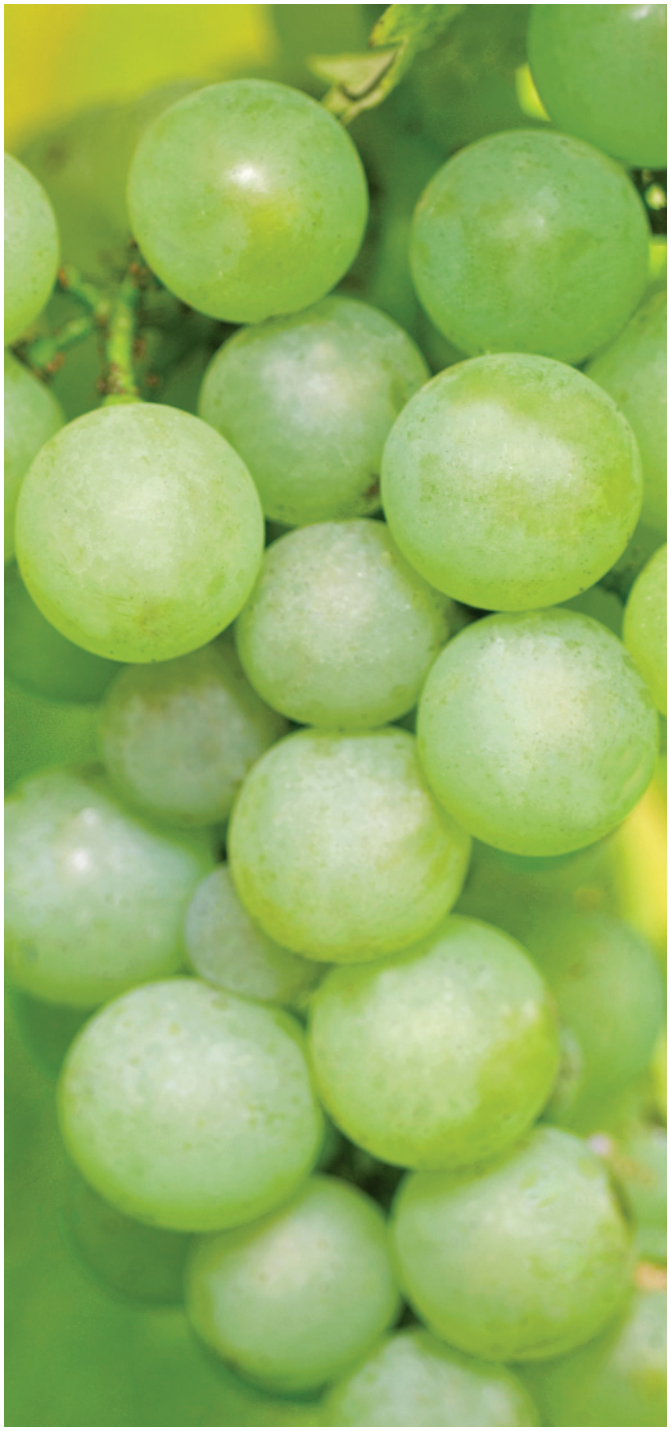


Figure 5: Increase in ammonium content over time for Sauvignon blanc vines with no nitrogen added and with 200 g of urea per vine added at fruit set, as measured during maturity in 2005. Means that are different by more than the LSD bar are significantly different at the 5% level.



Suggested reading

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FURTHER INFORMATION //

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