viti-notes
[grapevine nutrition]

Research to Practice

Liming

Viti-note Summary:

- Management of soil pH
- Correction of soil pH with lime
- Strategies for pre-planting / young vines
- Strategies for mature vines
- Management of acidification
- Lime Products

Other topics in this Viti-Notes series include:

- Nitrogen fertilisation
- Phosphorus fertilisation
- Potassium fertilisation
- Petiole analysis
- Soil acidification
- *Liming*
- Trace Elements

Management of soil pH

Soil pH can affect the availability of nutrients to vine roots. For more detail on the effects of soil pH on vine nutrition refer to section 3.1.8?.

Correction of soil pH with lime

Lime can be applied to ameliorate acidic soil conditions in many circumstances. The best time to apply lime is prior to vineyard establishment when it can be mixed into the soil by cultivation along the vine row. Lime applied to the soil surface can take a long time for the benefits to take effect.

In established vineyards where surface application is generally the only option, it is best to try and cultivate soil close to the vine root zone or use some other form of incorporation if possible. When applying lime consider the following:

- Investigate all the liming products available. Neutralising value and cartage and spreading costs need to be assessed to select an effective, economic product. Lime particles should be <2mm, the finer the better;
- Do not over-apply lime. It is better to use smaller amounts of lime more often until a target pH is reached;
- Liming an acidic soil may result in a decrease in the availability of manganese and zinc (and possibly copper and iron). It may be necessary to apply foliar sprays of these nutrients if deficiency occurs;
- Clay soils will require more lime than sandy soils to achieve the same correction in pH levels.

Lime is available in various pure forms and mixtures:

- **Calcium carbonate.** This is available as ground limestone, agricultural lime and shell lime. It is the cheapest but least reactive form of lime. The premium grades are more finely ground. If particle size is more than 2 mm it is of little value because of its low rate of dissolution;
- **Calcium hydroxide.** This is available as slaked or hydrated lime. It is more reactive than calcium carbonate, but relatively expensive for agricultural use;
- **Calcium oxide.** This is sold as burnt lime or quicklime, and is the most reactive form of lime. It heats and swells on absorbing moisture so must be stored dry.

All forms of lime will eventually revert to calcium carbonate (agricultural lime) in the soil.

Strategies for pre-planting / young vines

Measuring pH at different depths in the soil and knowing which subsoil materials (such as acidic clays, soft or hard limestone) are present will help to predict the behaviour of the soil and thus the impact on growing vines. Soil pH is best adjusted prior to planting, as this is the only time the soil beneath the vines can be accessed. The application rate will vary according to the soil type and the neutralising value of the lime source. When considering amelioration of acidic soils with lime, some factors to consider include:

- Soils with pH values significantly less than 5 should be treated;
- The amount of lime required will vary from soil to soil;

- More lime is required to raise pH in clays than in sandy soils;
- Depending on soil texture, up to 5 tonnes/ha of lime may be needed to raise the pH of the top 15cm of a soil by one pH unit;
- Subsoil acidity is more expensive and difficult to ameliorate, requiring slotting or deep ripping to place the lime where it is required.

Strategies for mature vines

Careful monitoring of the soil under drippers is recommended. In low-flow irrigation situations, the vine roots are concentrated around irrigation outlets in the vine row. In high rainfall areas, root activity will not be as confined.

Vines affected by soil acidity will grow less vigorously and yield less than unaffected vines. It can be difficult to treat soil acidity in existing vineyards as the soil around established vines is very difficult to mix or cultivate since traditional cultivation of the root area could cause considerable damage or plant death. Trellis structures also make it difficult to use machinery.

Common amelioration practices include the surface application of lime along the vine row, followed by incorporation of lime into the soil of the mid row using different types of tillage implements. It is generally advisable to apply the lime in the autumn to allow winter rainfall to wash it into the profile. Soil sampling should not be carried out until the following autumn when the free lime has had a chance to react.

Management of acidification

There are a number of viticultural practices that can be used to prevent the development or exacerbation of soil acidification in the upper portions of the soil profile. If deeper layers are acidified, the problem may be expensive to rectify or in some cases irreversible. Management practices to avoid acidification include:

- Avoid over application of fertiliser. Apply the correct amount of fertiliser for the vine size and crop load. Correct amounts can be determined using petiole analysis and can be modified with ongoing monitoring and analysis;
- Reduce the amount of fertiliser applied in a single dose. This involves spreading applications over a number of irrigations if fertigation is used, or a number of weeks/months if a solid granular form is used;
- Apply nitrogen to correspond with periods of vine demand so that maximum uptake will occur and maximum benefit will be obtained;
- Apply nitrogen late in an irrigation cycle so that it is retained in the soil near the roots, thus optimising uptake by the vine;
- Using less acidifying nitrogen sources, e.g. calcium nitrate;
- Maximise irrigation efficiency to avoid leaching and increasing nutrient retention near the vine roots.

The use of some forms of fertiliser (particular nitrogen fertilisers) may lead to acidification of the soil. The acidifying effect of some commonly used fertilisers and the amount of lime required to neutralise the acidifying effect are shown in Table 1.

Table 1 Some nitrogen sources, their N content and the amount of lime required to neutralise their acidifying effect on soils.

Source: Glendinning (2000)

Nitrogen source	N content (%)	Lime requirement*
Ammonium sulphate	21	5.2
Anhydrous ammonia	82	1.8
Ammonium nitrate	34	1.8
Urea	46	1.8
UAN solution	28-32	1.8
MAP	10-11	5.0
DAP	18	3.1
CAN	26	0.3-0.7

* Amount of pure calcium carbonate (CaCO3) required to either neutralise the acid-forming reactions of 1kg N or the amount of CaCO3 required to equal the acid-reducing effects of 1kg N

- Most of the acid-forming effects are due to the activities of soil bacteria during nitrification.

The requirement for lime can vary with soil texture. Soil tests should be used to determine an appropriate rate of lime. As a rough guide, the following table shows the approximate amount of lime required to raise siol pH by 1 pH unit.

Table 2 Lime requirements for soils of different textures^

Soil texture	Lime requirement (t/ha)
Sands and loamy sands	1.0 – 2.0
Sandy loams	2.5 – 3.5
Loams and sandy clay loams	3.5 – 4.0

^ Approximations for a soil layer about 15-20 cm deep

Lime Products

Lime is available in various pure forms and mixtures (see table below for chemical analyses of major lime products):

- **Calcium carbonate.** This is available as ground limestone, agricultural lime and shell lime. It is the cheapest but least reactive form of lime. The premium grades are more finely ground. If particle size is more than 2 mm it is of little value because of its low rate of dissolution.
- **Calcium hydroxide.** This is available as slaked or hydrated lime. It is more reactive than calcium carbonate, but rather expensive for agricultural use.
- **Calcium oxide.** This is sold as burnt lime or quicklime, and is the most reactive form of lime. It heats and swells on absorbing moisture so must be stored dry.

To determine the most suitable lime product consider:

- The economic value of the neutralising power of the lime. This can be determined by dividing the neutralising value (see table below) by the cost per tonne.
- Cartage costs - burnt agricultural lime is more expensive than ordinary lime, but if it has to be carted some distance, it may be cheaper to buy less of the more strongly neutralising burnt lime.

All forms of lime will eventually revert to calcium carbonate (agricultural lime) in the soil.

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Further information

Training

For regional specific training in grapevine nutrition management, the AWRI is running *Research to Practice: Managing grapevine nutrition in a changing environment.*

Contact

Marcel Essling: rtp@awri.com.au for more information.

Useful references

Nicholas, P. 2004. *Soil, irrigation and nutrition.* Adelaide: Winetitles.

Articles about grapevine nutrition and viticulture in general are available to the Australian wine industry through the Australian Wine Research Institute library. Visit http://www.awri.com.au/information_services/jfml/ for details.

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

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