Cooperative Research Centre for Viticulture

Grapevine nutrition 6: Liming

Current titles in this Grapevine nutrition VitiNote series include:

Soil pH is a measure of the acidity or alkalinity of a soil. Each mineral nutrient responds differently to changes in soil pH, and this will influence the availability of the nutrient to vines.

Low pH (acidity) can cause nutrient deficiencies and toxicities in aluminium and manganese. The soil pH (1:5 soil:water) most suitable for grapevines is between 5.5 and 8.5. In this range they can acquire nutrients from the soil and grow to their full potential.

Some soils are naturally acidic (i.e. pH less than 7), particularly in high rainfall areas. Use of herbicides to keep the soil bare or the use of ammonium-based nitrogen fertilisers may also cause acidification of vineyard soils (see VitiNote *Acidification*).

Important effects of soil pH on nutrient availability

Highly acid soils (below about pH 5.5*) may exhibit:

- Low molybdenum availability
- High aluminium and manganese availability
- Low phosphorus availability.

Highly alkaline soils (above about pH 8.0*) may exhibit:

- Reduced iron availability, made worse if the soil is cold, poorly aerated and/or waterlogged
- Low zinc, manganese and copper availability
- Ammonium nitrogen can volatilise and may be lost as ammonia gas
- Soil application of micronutrients is usually ineffective on alkaline soils.

* Measured in dilute calcium chloride

> Liming is recommended if the vineyard soil has a pH less than 5.5.

CORRECTING 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. It can take a long time for the benefits of lime to take effect if it is only applied to the soil surface.

In established vineyards where surface application is generally the only option, it is best to try and cultivate the soil in autumn, close to the vine root zone or use some form of incorporation.

Remember that lime is sparingly soluble — earthworms and other soil organisms are necessary to slowly incorporate the lime into the soil.

The requirement for lime can vary with soil texture and the buffering capacity of the soil. Soil tests should be used to determine an appropriate rate of lime. As a guide, Table 1 shows the approximate amount of lime required to raise the pH of the soil by one pH unit. Higher rates are required if treating deeper soil. Consult a qualified consultant for further advice on neutralising value and lime requirement for local soils and conditions.

Table 1. 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

When applying lime consider the following:

- 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 is likely.
- Clay soils will require more lime than sandy soils to achieve the same correction in pH levels.
- 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.

Table 2. Chemical analyses of pure and commercial grades of the major lime products

Lime product	Neutralising value (NV)			Calcium (% Ca)			Magnesium (% Mg)		
	Pure form	Commercial grades		Pure form	Commercial grades		Pure form	Commercial grades	
		Good	Fair - poor		Good	Fair - poor		Good	Fair - poor
Agricultural lime (Calcium carbonate)	100	95–98	60–75	40	36–39	28–32	0	Trace usual <1%	–
Hydrated (slaked) lime (Calcium hydroxide)	135	110–120	<105	54	44–49	<40	0	Trace usual <1%	–
Burnt lime (Calcium oxide)	179	128–150+	<120	71	49–58	<45	0	Trace usual <1%	–
Dolomite (Calcium/ magnesium carbonate)	109	92–102	60–75	22	21	10–15	13	12	4–7
Burnt dolomite (Calcium/ magnesium oxide)	214	110–160	80–100	42	25–32	–	25	12–18	–
Magnesite (Magnesium carbonate)	119	95–105	–	0	0.5–1.0	–	28.6	20–28	–
Burnt magnesite (Magnesium oxide)	250	180–220	–	0	1–2	–	60	43–55	–

LIME PRODUCTS

Lime is available in various pure forms and mixtures (see Table 2 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 2mm 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 2) 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.

The amount of lime required to neutralise the acidifying effect of some commonly used fertilisers are shown in Table 3.

Soil sampling should not be carried out until the following autumn when the free lime has had a chance to react.

Table 3. Some nitrogen sources, their N content and the amount of lime required to neutralise their acidifying effect on soils

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 ($CaCO_3$) required to either neutralise the acid-forming reactions[a] of 1 kg N or the amount of $CaCO_3$ required to equal the acid-reducing effects of 1 kg N.

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

Source: Glendinning JS, (2000) Australian Soil Fertility Manual, CSIRO Publishing, Collingwood, Victoria.

FURTHER INFORMATION

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

Further detail on liming 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, Winetitiles, Adelaide, pp178-208.
- Nicholas P, (Ed.) (2004) Soil, irrigation and nutrition, Grape Production Series 2, SARDI, Adelaide.
- Goldspink B, (1997) Liming of vineyard soils, in Fertilisers for winegrapes, Eds BH Goldspink et al, Agriculture Western Australia.

ACKNOWLEDGEMENTS

This VitiNote has been prepared by L Chvyl and C Williams of SARDI based on information in the *Grapevine nutrition: Research to Practice®* training manual (CRCV, 2005).

The authors thank Ben Thomas of Scholefield Robinson Horticultural Services for comments made on the draft.

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