



# Sydney Environmental & Soil Laboratory

Specialists in Soil Chemistry, Agronomy  
and Contamination Assessments

## Vineyard Soil Management

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 106 810 708

PO Box 357  
Pennant Hills  
NSW 1715

16 Chilvers Road  
Thornleigh NSW  
2120 Australia

T: 02 9980 6554 E: [info@sesl.com.au](mailto:info@sesl.com.au)  
F: 02 9484 2427 W: [www.sesl.com.au](http://www.sesl.com.au)

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## Vineyard Soil Management

### **A brief introduction to understanding, preparing and maintaining a soil for wine grape production.**

Simon Leake BScAgr(HonsI) ASSSI ASPAC AIAST  
Principal Soil Scientist: Sydney Environmental and Soil Laboratory.

#### **Introduction: Soil properties**

Most soils in the prime NSW Vineyard areas are of the duplex or podsollic soil type. This means they have a sandy to loamy A horizon generally around 150mm deep but sometimes to 600 mm deep, overlying a clayey B horizon layer of a red or yellow colour. Sometimes they have a sandy pale A2 horizon below the darker A1 horizon. This layer is often quite hostile being acidic, low in organic matter, very low in nutrients, and prone to periodic waterlogging. Periodic waterlogging or poor drainage is indicated by the presence of black and tan colored roundish nodules (Fe/Mn nodules).

In their natural state these soils profiles can suffer the following productivity problems:

1. Low organic matter content. Many Australian soils are naturally low in OM but years of sheep grazing, cropping with inadequate rotation, and excessive ploughing will have further degraded them.
2. Low to very low inherent fertility. While they may have supported adequate fine wool pasture and the occasional low wheat yield, their natural fertility is not adequate to support a high yielding intensive horticultural crop like vines.
3. A strong texture contrast from the A to the B horizon. This inhibits downward movement of water, results in a very low oxygen subsoil when wet, and impedes downward extension of root growth.
4. Acidity. The soils of the wine grape growing areas are quite variable, some being highly acidic, others being alkaline (calcic or sodic). Other complications can include the presence of areas of light soil country (sandstone geology) and areas of fluvial and volcanic soils.
5. Sodicity. Usually confined to the subsoil, a high sodium level is common in yellow subsoils and gets worse with depth even in red soil country. High sodium leads to clay dispersion, erosion, poor subsoil structure (and hence root growth), and poor drainage and aeration.

An understanding of the chemistry and physical properties of a proposed vineyard is essential before planting occurs or even before purchase of the property. Money

saved on a cheaper property may well be spent in bringing the soils up to standard. The ideal properties of a soil for vineyard use shown in Table 1.

Table 1. Ideal Vineyard Soil Properties

Soil Property	Ideal Range
pH	6.0-7.0
Exchangeable Na %	< 7.0
Exchangeable Ca %	65-75%
Exchangeable K %	3 - 10%
Bray P mg/kg	>20
Topsoil Organic Matter	3-6%
Total N %	0.1-0.20
Density g/cc	< 1.4 in the surface
Free rooting soil depth	500 mm

Almost no natural soils have these characteristics which means that in nearly all cases soils need to be modified before planting and to be maintained and managed so that these characteristics are enhanced and preserved.

### **Establishment**

The best horticultural soils do not show extreme variation in texture between the A horizon and the B horizon but only a slow increase in texture with depth (ie a gradational profile form). It will thus be necessary to think about destroying any strict A/B boundary by ripping to 500mm.

Before ripping soil tests should be performed in order to gauge the need for basic soil ameliorants like lime and gypsum or combinations of both to bring soil pH and Ca levels to within the desired range for the whole of the surface 500mm. The opportunity can also be taken to add phosphorus before ripping so that it too is mixed thoroughly with the whole surface soil.

Trace element additions are also advisable during this initial soil preparation period as they are very immobile and surface applied trace elements will stay close to the surface for many years.

All nitrogen, potassium, and sulphur nutrients can be watered in or added to subsequent fertiliser programs. Lime, gypsum, and phosphatic fertilisers are not so soluble and should be mixed thoroughly in the topsoil. Superphosphate levels of over 1 tonne per hectare can be needed on soils with high fixation properties.

After ripping it is sometimes necessary to deep plough with discs to invert and destroy the A2 horizon, mix a little subsoil into it, and vice versa, mix some topsoil into the heavy clay B horizon and to lower density for new root extension.

Certainly on row we should aim at a free rooting depth with good chemical properties of at least 500mm. Hilling on row can be helpful in deepening topsoil on shallow, impeded, or rocky sites.

Green manure cropping is often the only cost effective way to increase soil organic matter levels. Ideally at least one green manure crop should be grown on the newly prepared site before planting. The ideal green manure crop in the first instance is a mixed grass/clover sward. If clover is not included then initial nitrogen applications will be need to ensure a good crop of green manure. Green manure should be worked in about 6 weeks before planting so that roots of the new vines have a rich decomposing humus layer to grow into.

### **Yearly Management**

Management of soil properties aims at optimising nutrient and water supply within the crop cycle and maintaining or even improving soil properties over time.

#### Soil Nitrogen Supply

Nitrogen is the element most important in managing vines. Excess nitrogen results in excessive vegetative vigour at the expense of flowers and fruits, but nitrogen deficiency has been clearly shown to affect fermentation time and wine quality. Bad experiences with excessive nitrogen or inappropriate timing has sometimes resulted in the belief that there is an inverse relationship between quality and quantity. The conclusion a lot of people make is that the vines must be starved to produce good wine. This is not correct.

All subsequent comments on nitrogen addition should keep the desired wine style in mind. It is now understood that nitrogen application can be manipulated to gain better control over vigour, fruitfulness, juice N content and storage qualities. The propensity of vines to produce a proliferation of vegetative growth or to produce larger fruit with lower quality is controlled by using regulated deficit irrigation (RDI) to concentrate fruit flavours.

The following summary of the calender of events should prove helpful:

**Budburst to Flowering.** Stored N provides only about 20% of the N needed for budburst and extension before flowering. The remaining 80% must be obtained from the soil.

Therefore - work in winter green manure 6 weeks before budburst. In a highly fertile soil with clover in the green manure this may provide enough N from the decomposing green manure otherwise additional surface applications should be

judged subject to previous experience, crop appearance and testing if needed. Remember that time must be allowed for N to be washed down into the soil to where roots can obtain it if the N was not added prior to ploughing in green manure. Do not apply N too close to flowering as bunch shatter can result.

Any other nutrients required, such as phosphorus, potassium, trace elements, etc determined from winter soil analysis should also be added and worked in at around 4-6 weeks prior to budburst.

**Flowering to Verasion.** Nitrogen supply during this period has the greatest effect on final N status of the bunches. Except in the most N fertile soils additional N application during this period will bring the greatest benefits. Up to three soluble N applications as fertigation have been shown to be of benefit. Addition of N should be based strictly on plant petiole testing as it is very difficult to predict the N supplying ability of soil and the plant is the best indicator.

**Verasion to Harvest.** There is usually little advantage in applying N during this stage. The N applied prior to verasion will have had the major effect.

**Harvest to Dormancy.** This is a period of relocation of canopy N into plant stores for the following season. It is widely accepted now that, provided N additions earlier in the season have been adequate, there is no advantage to wine quality from adding N after harvest despite the fact that an additional burst of root growth occurs.

In any event, careful records of N fertiliser additions, juice quality determinants, fermentation characteristics should be kept so that a site specific N management program for that crop variety can be arrived at. With time a tailor made program with your wine style in mind can be developed.

Potassium is rarely needed in the heavier soil types but may need attention in the lighter soil types. Excessive potassium upsets wine acid balance basically through the precipitation of insoluble potassium bitartrate in the must. Keep potassium at the lower end of adequate in Red grape varieties as a general rule.

**Winter.** The dormant period is an important time in the annual cycle. Soil tests should be performed prior to sowing green manures. All vineyards should, in our opinion, utilise green manure crops. They:

1. increase and maintain a high soil organic matter content
2. stimulate a living healthy soil full of organisms
3. improve soil structure
4. maintain a natural temperature balance
5. utilise fertiliser nutrients wasted in the growing season
6. help break weed life cycles.
7. where clovers are used they fix atmospheric nitrogen
8. prevent erosion

Chemical fallow under vines represents an unsustainable practice leading to soil organic matter and structural decline. Use sidecasting mowers to throw mulched

inter-row sod growth onto the on row soil surface. All plants grow much better with mulch.

Green manures can be cereal, legume, or grass crops grown in the inter-row space. Avoid perennial species that are likely to result in weed problems during the growing season. The most suitable green manure for long term maintenance is probably a clover/annual rye or cereal mixture. Bias the green manure program towards legumes if additional soil N is needed, and toward pure grasses if organic matter is needed. It has been shown that dense ryegrass stands lead to the quickest increase in soil organic matter content.

Summary:

- Treat soil physically to destroy texture boundaries and create a gradational soil profile 500mm deep at minimum.
- Correct gross deficiencies before planting using lime, gypsum, phosphate, and trace elements as needed.
- Include green manure in the preplant conditioning program.
- Develop a N fertilising program over time suited to your variety and site by taking careful records. Include N from winter green manure in the program but add N as needed. Apply readily available N only between flowering and veraison.
- Use the winter period for pH and Ca adjustment, phosphorus additions, and green manuring.
- Use inter-row sod grass sward to mulch rows during the growing season, shading and protecting the soil from drying and heating and stimulating soil organisms.
- Wherever possible do not use drip irrigation, use mini sprayers in “pulsed” irrigation methods.

Further reading-

Goldspink B.H. (Ed) 1997. Fertilisers for Wine Grapes. West Australian Dept of Agriculture.