Soils are Alive Newsletter

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Welcome.....

This is the second issue of our *Soils are Alive* Newsletters for 2001. In this issue we address the roles of soil organisms in viticulture.

Sustainable production depends on establishing soil conditions that maximise nutrient cycling and take advantage of biological processes that reduce the need for some chemical inputs and enhance soil biological fertility. Arbuscular mycorrhizal fungi are present in all soils and contribute to making more efficient use of phosphate fertilizer. In addition, recent advances in the assessment of microbial communities in soil and their functional diversity can be used to interpret soil management in a sustainable context. Biological processes in soil are an integral component of soil fertility and much is still to be understood about how vineyard management practices influence the contribution that soil organisms make to the sustainability of viticultural production systems and to grape quality.

Acknowledgements

The Ian Potter Foundation supported the establishment of the *Soils are Alive Newsletter* and the *soilhealth.com* website.

The Land Management Society (LMS) initiated the *Know Your Soil Biology:Soils are Alive* workshops that we present throughout Western Australia.

LMS Website: http://www.lmsinfo.com

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Viticulture

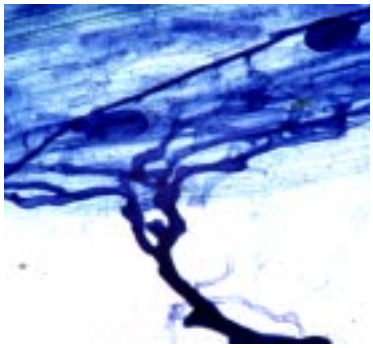
by Ben McMillen

Arbuscular Mycorrhizas

Most agricultural and horticultural plants form arbuscular mycorrhizas, and this includes grapevines. However lupins and canola, which can be used as cover crops, do not form mycorrhizas. Non-mycorrhizal cover crops could reduce beneficial mycorrhiza development in vines.

Arbuscular mycorrhizal (AM) fungi need to form an association with a plant so that they continue to grow. This is because the root supplies the fungus with its carbon. In return, the plant receives phosphorus that is transported to the roots from pockets of soil that the roots cannot reach.

Hyphae binding soil particles



Mycorrhizal hyphae entering root

Ben McMillen is studying the way that vineyard management practices influence mycorrhizal fungi in soils of south-Western Australia. His PhD Scholarship is provided by the Grape and Wine Research and Development Corporation.

AM fungi absorb nutrients and water from the soil through threadlike structures called hyphae. In a mycorrhizal association some of these nutrients, particularly phosphorus, and water, are transferred to the host plant.

The hyphae of the AM fungus may extend into the soil as far as 12cm away from a root. This increases the amount of soil from which the plant is able to obtain its phosphorus. The increased phosphorus absorption resulting from the mycorrhizas can ensure that phosphate fertilizer is used effectively.

It may be useful to inoculate grapevines at the rootling stage with species of AM fungi that can provide a benefit to the plant under vineyard conditions. However, more information about the survival of inoculated fungi is required to determine whether this is necessary.

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Vineyard Management Practises

Vineyard management practises could significantly affect the benefit gained by grapevines from mycorrhizas. However, the benefit is difficult to measure.

If too much phosphorus is applied to soil, the abundance of AM fungi is greatly reduced. Therefore, it is important to get the right balance between added phosphorus and potential mycorrhiza function.

AM fungi provide most benefit to their host plants when soil P is applied at levels that are not too excessive. Applying high levels of P fertiliser to soil decreases the beneficial effect of AM fungi. This occurs because there is a decrease in the amount of mycorrhizas formed.

Localised placement of P fertiliser or use of slow-release P might help the plant to get maximum benefits from mycorrhizas.

Although grapevines are known to be colonised by AM fungi, little is known about whether the fungi present on the roots are the most effective for the plant in a particular location. This requires further study.

The Use of Grape Marc in Sustainable Vineyard Management

Viticulture practices such as use cover crops and straw mulching alters soil biological activity compared with bare soil. These practices influence the environment of soil organisms that participate in the breakdown of organic matter and release nutrients that can be used by the grapevine.

Briony Lalor is a 4th year Agriculture student at The University of Western Australia. Throughout 2001, Briony conducted a research project investigating the use of organic wastes as soil amendments in a vineyard. Such practices are becoming increasing popular with many producers as a way to improve soil physical, chemical and biological properties. The extent to which this leads to increased soil fertility and more sustainable soil management is not known. In viticultural regions, the harvest waste (or grape marc) poses a significant management problem for growers. It is because of this that many growers have been informally composting grape marc and applying it under-vine as an organic mulch.

A field trial near Busselton in Western Australia was set up this year to investigate the rate of soil organic matter formation and to measure changes in soil biological fertility following the application of grape marc on the ground under vines. The grape marc was applied at 60 tonnes/ha and at 120 tonnes/ha. The quantity of microorganisms in the soil (microbial biomass) and the state of nitrogen were assessed at a later time.

The study found that 8 weeks after application of grape marc, the quantity of soil organisms (microbial biomass) had almost doubled and at 16 weeks it was three times greater (Figure 1). Both quantities of grape marc had the same effect. The soil microbial biomass plays a significant role in organic matter turnover and nutrient cycling. Therefore, increases in microbial biomass may lead to improved nutrient cycling and increased soil biological fertility.

In addition to the field study, a laboratory study was conducted to determine the amount of nitrogen released from grape marc at a particular time.

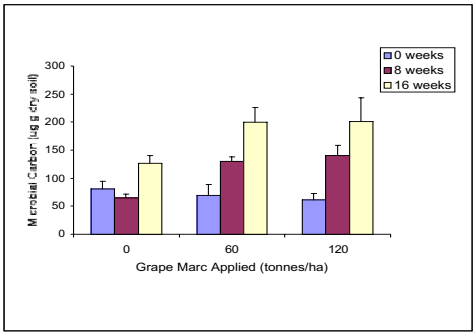

Figure 1. Soil microbial biomass 8 and 16 weeks after application of grape marc.

Investigations of the cycling of nutrients from organic waste material can be linked to studies of other nutrients. This will help determine the effect of nutrient availability on the quality of the harvested grape. This type of research involves understanding microbial processes that are carried out by many different species of bacteria and fungi. The organisms work together to recycle nutrients in soil and deliver them to grapevine roots.

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