

Bio-fertilisers in olive production



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Bio-fertilisers are commercial preparations of microbes that, if produced and used properly, can increase productivity and profitability of tree crops. The use of Rhizobium species to boost productivity in legumes is well established but until recently an equivalent technology has not been available for non-legumes. Development of bio-fertilisers for tree crops was boosted by the discovery (by Brazilian scientists in the 1980s) of classes of microbes that lived in various grasses and sugarcanes enabling them to grow well under low nitrogen conditions. Harnessing this exciting discovery to provide practical, effective and reliable products has not been easy. Finally, many years and many failed products later, effective new generation bio-fertilisers are becoming available and entering general use around the world.

How do they work?

An effective biofertiliser acts to increase productivity by a number of mechanisms:

Nitrogen fixation

A bio-fertiliser containing the correct microbial species will fix nitrogen from the atmosphere and supply it to the plant. This has the benefits that it reduces the need (and costs) for nitrogen fertiliser and supplies nitrogen steadily through the season. Additionally, nitrogen is supplied either directly into leaf, shoot and root tissues (for microbial species that live within the plant as endophytes), or into the rhizosphere (the zone immediately next to roots) where uptake is very effective. Different microbial species in different bio-fertilisers will fix different amounts of nitrogen.

Olive producers wanting to use bio-fertilisers to assist in nitrogen nutrition will need to pay attention to which product they purchase, how and when to apply it, and how to integrate it into their current fertiliser program. The following graph shows leaf nitrogen levels from an Australian bio-fertiliser compared to an intensive, open hydroponics citrus system.

Recommendations for this particular bio-fertiliser are to reduce application of synthetic nitrogen by up to 50% initially and to adjust this if necessary in subsequent seasons in response to crop growth and/or leaf tests. For organic olive producers, application

of organic sources of nitrogen should continue in combination with bio-fertiliser applications.

Plant Growth Factors

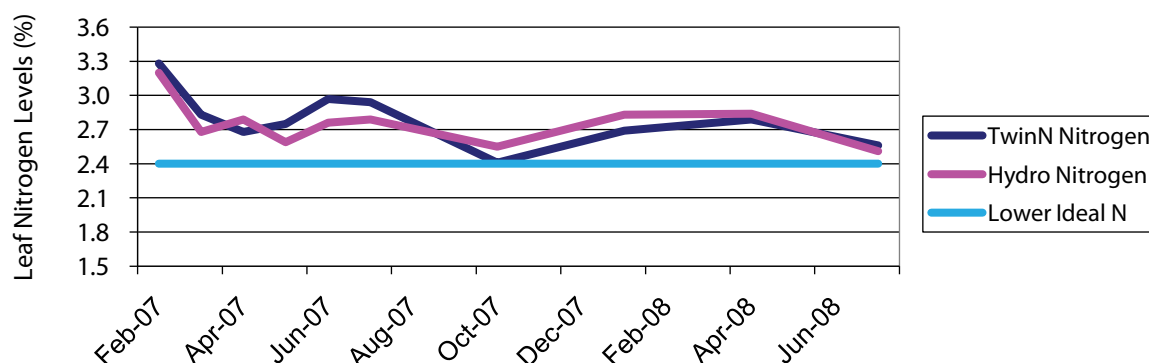
Microbes in bio-fertilisers produce a range of Plant Growth Factors (PGFs) and there is endless debate over whether this is more or less important than nitrogen fixation in enabling good growth with reduced nitrogen fertiliser. One important type of PGF produced by the microbes is auxins which drive the development of more vigorous root systems. This effect can be seen as larger bulk root mass or, perhaps more importantly, as roots with higher density of root hairs which absorb nutrients and water more efficiently. These effects have been reported in the literature many times and the improvement of water and nutrient scavenging is an important mechanism of action of bio-fertilisers.

It is a combination of nitrogen fixation and better capture of applied nitrogen that enables equivalent or higher production levels with reduced applied nitrogen fertiliser.

Phosphorous solubilisation

In many soil types a large amount of phosphorous (P) is present in the soil but is unavailable as it is chemically bound to soil particles. Microbe species in some bio-

Figure 1 Citrus Nitrogen Farm Trial: TwinN vs Open Hydroponics



fertilisers exude various organic acids that solubilise bound phosphates making them available for uptake by plants. In general it is not recommended that applications of P be reduced if a bio-fertiliser is used since the mechanism by which the microbes act to release it may not be effective in that specific soil type. Rather, it should be considered that P solubilisation is a side-benefit that adds to the general stimulation of crop growth.

Soil health

Soil health is a vague term but, regardless, it is a real factor in tree crop productivity. Use of a good quality bio-fertiliser will improve soil health in several ways:

- Reduced application of synthetic nitrogen fertilisers improves soil structure and avoids issues with decreasing pH in the long term. Reduced nitrogen fertiliser rates will increase soil organic carbon levels over time.
- It has been shown that application of a bio-fertiliser containing appropriate species encourages growth of a healthy population of other beneficial microbes and, in some trials a reduction in soil pathogens has been measured. Strong microbial activity is important to nutrient cycling and assisting growth of healthy effective root systems.

These four mechanisms of action of bio-fertilisers combine to provide short to medium term benefits in yield and profitability, and longer term benefits to yield potential of soils and mature olive crops. They can be used to increase yields, particularly in organic olive crops where nitrogen nutrition is an issue, to maintain yields with reduced input costs, or a combination of the two goals. The choice of increased yields or decreased costs is targeted by how the bio-fertiliser technology is integrated into the existing nutrition management plan, particularly how nitrogen fertiliser application rates are adjusted. This economic decision will be altered as young plantings move into mature fruiting stages.

Carbon footprint and soil carbon

A current hot topic is carbon footprint and carbon credits. The carbon footprint of nitrogen fertiliser is very high and the contribution of nitrogen fertilisers to crop carbon footprints has been extensively measured and modelled, particularly in crops that are used as feedstocks for ethanol and bio fuel production. Labelling of many foods with their carbon footprint is becoming common in Europe, driven by consumer demand and pending legislation. Use of a bio-fertiliser can enable a specific reduction in nitrogen fertiliser and this translates directly into a reduced carbon footprint (CO₂ eq per unit product). Websites are available to help assess the carbon footprint of a crop production system.

Recently announced legislation indicates that payments will be available to producers who adopt practices that reduce greenhouse emissions (such as reducing fertiliser applications) and increase soil carbon sequestration. Bio-fertilisers can assist in both these goals and

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perhaps this is a rare occasion that legislated changes to farm practice correlate directly to benefits to farm profitability and sustainability.

Factors to consider when commencing use of bio-fertilisers

Which bio-fertiliser?

A difficult topic. Qualities vary widely and growers should look at the supporting data from trials and commercial use where it is available. If it isn't available that's probably for a good reason.

How to integrate the bio-fertiliser into your crop system?

Most growers have an effective nutrient management system already and should consult with the bio-

fertiliser company representatives for advice on how to use the technology without perturbing the best aspects of their current system. The main questions are how much and when to reduce their synthetic nitrogen fertiliser inputs and when to apply the bio-fertiliser. A company supplying a quality bio-fertiliser will be able to supply this information easily and most will recommend a conservative approach to reducing nitrogen fertiliser in the first season while growers learn to use the bio-fertiliser on their farm.

How to apply the bio-fertiliser?

This depends on which bio-fertiliser you select, but in general the options are as a foliar, as a soil application, or via fertigation. If the bio-fertiliser can be applied by fertigation, then that will generally

be the most reliable, effective and convenient option to select.

Summary

Olive growers face ongoing challenges to increase yields and lift profitability. Added to these perennial challenges are more recent considerations of long-term soil productivity, soil carbon levels, carbon footprints and improved water use efficiency. Olive growers have a tradition of being innovative and this is reflected in the growing number of producers using bio-fertilisers. Selection of a good quality bio-fertiliser and obtaining good advice on how to deploy the technology will provide Australian olive growers with another significant approach to improving profitability and sustainability. 



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