



Salinity and potato production

Impact of groundwater quality on management of centre pivot grown potato crops

Organic soil amendment, biological and biostimulant products vary greatly in terms of what they actually are and how they function. The applicability of any product to your situation should be based on what your specific barrier or limitation to improved crop health and yield is, how each product functions, and choosing a reputable product that addresses such issues.

This is the final fact sheet in a series of four for potato growers exploring monitoring and management options to overcome many soil and water constraints.

With a growing interest in the area of soil health and the wide range of products available, this fact sheet explores organic soil amendments, biologicals and biostimulants to help growers understand what these products are and how they work.

Soil amendments, biologicals & biostimulants

In recent years soil health has become more of a buzz word, with soil more widely recognised as a living medium, not just the physical and structural resource we manage for food and fibre production. Soil hosts a living zoo, full of bacteria, fungi, protozoa, and larger macroinvertebrates such as beetles and earthworms. The more we explore soil health, the more we realise that diverse soil biology can be very beneficial to crop productivity.

Soil management practices, such as cultivation practices, irrigation, cover crops, chemical inputs combined with climate

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conditions such as heat and rainfall influence the overall health of soils; the chemical, physical and biological components.

Organic soil amendments, biologicals and biostimulants, provide a new suite of natural inputs to assist with feeding and stimulating beneficial soil fauna, improving the condition of their habitat, and ultimately improving the health and function of plants more naturally.



Heavily cropped soil repairing with brassica cover crop.

What are these products & how do they work?

Organic soil amendments

The term organic soil amendment encompasses a broad range of composts, compost teas, manures and biosolids, and other crop wastes such as plant mulches. Soil amendments are generally used to improve overall physical properties such as structure, aeration, drainage and water retention, and must be mixed thoroughly within the root-zone for best results. Organic soil amendments available to growers will be highly dependent on region and proximity to product supplies, so for some this may not be a viable option.

Organic soil amendments can contain decomposing material from plants, animals or both, but always contain carbon along with nitrogen, phosphorous, potassium and sulphur. Trace elements may also be present, along with the potential for beneficial microbes. However, composts do vary greatly in their nutrient status and not all would be suitable for application in saline environments. For example, some composts and biosolids contain heavy metals or pesticide residues, or have elevated levels of harmful salts which should be avoided for potato production. The safest option when purchasing soil amendments is to ask your supplier for a nutrient test before you invest.

Amendments can assist with improving soil health but results vary according to your soil type, rates of product applied, breakdown rates, irrigation and other fertiliser inputs as examples. Know what you are applying and how it may influence your cropping system.

Biologicals

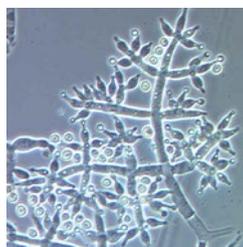
Biological soil improvement products typically contain either beneficial fungi or bacteria. The number and diversity of fungal and bacterial strains within these products varies, as does the inclusion of substances such as humic acids, yeasts, and other microbial exudates that may improve their effectiveness.

Trichoderma

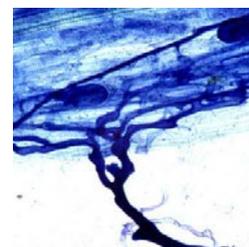
Trichoderma are one type of beneficial fungi which can assist with disease suppression. The fungi are soil dwelling and feed on dead and decaying organic matter. Trichoderma are generally fast growing, and importantly form symbiotic

relationships with plants. For example, *Trichoderma harzianum* is a beneficial fungi that grows within the rhizosphere of plant roots and feed on excess nutrients not used by the plants. The fungal growth in the rhizosphere, the very thin layer surrounding plant roots, can then help provide a physical barrier to fungal pathogens present in the soil. Trichoderma also release enzymes that help to break down the cell walls of fungal pathogens, such as Rhizoctonia, Pythium and Sclerotinia. Some strains of Trichoderma have been found to help solubilise phosphorous bound to soils, a common feature of the alkaline soils in South Australia.

This is where a Trichoderma could assist by naturally accessing nutrients that would otherwise be unavailable to plants.



Trichoderma Harzianum.
Source: Wikipedia.



Mycorrhizae.
Source: Soilhealth.com.

Mycorrhizae

Mycorrhizae fungi are another type of beneficial fungi that colonise the root systems of plants. There are seven major types of mycorrhizae, however just one of these form relationships with 80 per cent of plants including potatoes - arbuscular mycorrhizae.

Arbuscular mycorrhizae fungi form structures within plant roots called vesicles. These vesicles are oval shaped and are believed to assist with storing nutrients and moisture, which may reduce the severity of prolonged periods of heat, and increase drought tolerance of plants. As such, potato cropping in areas that suffer long periods of heat stress during the summer months may find arbuscular mycorrhizae fungi beneficial in a number of ways.

Arbuscular mycorrhizae extend out into the root-zone colonising plant roots with hyphae, well beyond the capabilities of actual plant root hairs. This improves nutrient and moisture uptake from areas otherwise inaccessible by the plant roots themselves. Mycorrhizae fungi also produce enzymes that encourage nutrients to release, which can bind to soil particles.

The effects of a mycorrhizal product were examined in recent fresh market potato trials in the Northern Adelaide Plains of South Australia. It looked at one product that contained four key strains of arbuscular mycorrhizae, plus a humic acid aimed at further enhancing the uptake of nutrients.

Figure 1 shows that an increase in yield of 6.3 T/ha was achievable in fresh market potatoes, providing substantial returns to the grower for their investment. The greatest gain in potato yield from this mycorrhizal product was measured in the size class 75-250g, where the average weight of potatoes was greater than in un-treated areas.

Bacillus subtilis

Bacillus subtilis is a naturally occurring beneficial bacterium commonly found in soils, water and decomposing plant material. Research has shown that certain strains of *Bacillus subtilis* applied to the root-zone of plants colonise the rhizosphere of plant roots, helping to provide a barrier to fungal pathogens and assist with the prevention of resulting diseases. Similar to beneficial fungi, beneficial bacteria also release a complex mix of chemicals that ultimately enhance plant nutrition and can assist with moisture uptake and retention.

Tasmanian processing potato trials using *Bacillus subtilis* applied in furrow, have repeatedly shown improved yields averaging 10T/ha.

Biostimulants

Biostimulants are a relatively new range of agricultural product that are applied to plants or soils to improve crop yields and quality. They consist of a very diverse range of compounds, substances, micro-organisms and formulations.

Biostimulant products are created based on research and development conducted with plants that in nature exhibit significant qualities and coping mechanisms for overcoming natural, and often daily, environmental stresses. The genetic and molecular processes of such plants are studied in great detail, with key performing compounds isolated and refined into specific products to help improve plant performance.

Biostimulants stimulate natural plant growth, helping to improve the overall vigour of plants. Biostimulant products can assist with the production of both fresh and processing potatoes in saline environments as specific products have been developed to target and improve particular areas of plant function. This includes improved absorption of nutrients,

improved root growth, increased photosynthetic activities, improved growth in saline conditions and assisted recovery from stress such as heatwaves or severe frosts.

When incorporating biostimulants into your program, be sure to fully understand what each product is designed to assist with and follow application instructions carefully. It is important to note that biostimulants do not replace fertilisers or crop protection products, but when applied correctly, can greatly improve their performance.

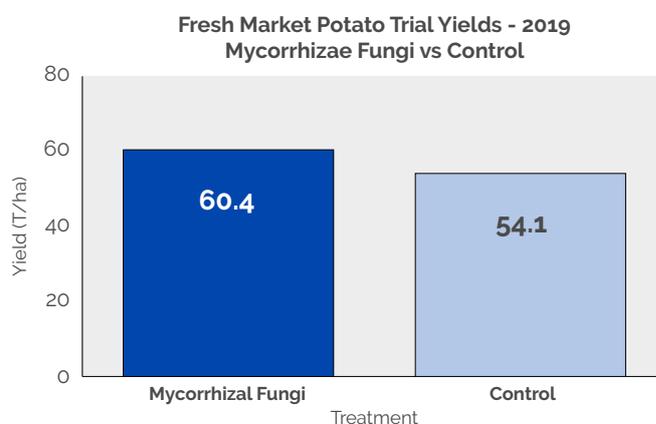


Figure 1: Fresh market potato yield comparing Mycorrhizae fungi treatment to control.

How do I know if a product is right for me?

Trial products for yourself using your own farm as a research tool and against your standard practices so that benefits can be observed and measured over part paddocks or along strips. The results you gain will vary depending on soil types, crop variety and other climatic stresses so try not to make decisions on just one trial.

Measure your crop yields and record visual differences to help you determine the potential benefits to be gained from these products. Soil tests can also be submitted to specific laboratories that undertake testing for microbial populations. This will provide you with a breakdown on diversity and population densities, and what it all means for your soil health. While these tests are relatively new, it will provide baseline information of your soil biology which can be monitored over time. The tests will highlight the potential changes that different crop management practices or seasonal fluctuations may induce.