USING BIOLOGICALS IN A COMMERCIAL FARM SETTING

A demonstration by PotatoLink

A recent demonstration trial at Springbank near Ballarat (Victoria) investigated the impact of farm practices on the effectiveness of biologicals, including the application of fungicides, the influence of soil nutrient availability, and fertiliser applications.

PADDOCK CHARACTERISTICS AND CROP HISTORY

- Clay soil type.
- Olsen P 44ppm and Colwell P 150ppm.
- Paddock history: oat crop (saia oats) grown before planting of the Innovator potato crop in December 2022.
- Innovator crop harvested in mid-late August 2023.
- The crop received a base fertilisation of croplift 800 at 650kg/ac, supplemented with 10kg of humic acid.
- Additionally, in-furrow applications of sulphate of ammonia and fungicide (Metalaxyl and Azoxistrobin) were applied at planting.
- The same seed source was used in the entire paddock.

Amid high input costs, any opportunity to maximise nutrient use by the crop is worthy of further investigation.

A demonstration trial was established with the aim of improving crop health, quality and yield while also reducing inputs. To achieve this, we strived to increase the populations of beneficial microbes – mycorrhizal fungi – in the soil, which can help to improve nutrient availability to plants.

With many new biological products on the market, it can be a challenge for growers to effectively test the products in their farming system. Often, promising results are observed in pot trials, but the real challenge lies in scaling up these results to a commercial farming operation.

The demonstration explored the impact of in-furrow fungicides, and the influence of soil nutrient availability and fertiliser applications on the effectiveness of biologicals.

Given the many products available to growers, navigating and identifying the most suitable and effective options for their specific farming systems can be challenging. Although one demonstration trial is not enough, as we generate more data across seasons and soil types, the resulting database will help farmers make more informed decisions.

REMIND ME AGAIN – WHAT ARE ARBUSCULAR MYCORRHIZAL FUNGI AND WHY ARE THEY WORTH INVESTIGATING?

Arbuscular mycorrhizal fungi (AMF) play a vital role in plant ecosystems, forming mutually beneficial relationships with the majority of plant species. This unique partnership is a give-and-take arrangement, where both the plant and the fungi derive benefits. The plant provides food for the fungi, while simultaneously evaluating what the fungi can offer in return. The plant essentially acts as the gatekeeper of this relationship, deciding whether it's worth investing in.

AMF bring a multitude of benefits to the ecosystems they inhabit including disease suppression by protecting plant roots from various diseases.

Notably, different species of mycorrhizal fungi exist, and native mycorrhizal species may perform differently and be better adapted to specific environmental conditions. One crucial factor influencing AMF performance is the availability of phosphorus.

When phosphorus levels are high, plants may decide not to support AMF, making it more common to observe significant colonisation of the roots by mycorrhizae in soils with high phosphorus-fixing capabilities. Furthermore, AMF are not particularly fond of cultivation and do not like fumigation, although they can bounce back.

Additionally, AMF support a stable soil structure by excreting compounds through their hyphae, effectively helping to bind soil particles together. AMF also play a critical role in nutrient availability, particularly when it comes to phosphorus synchronisation.

THE TREATMENTS

Using the grower's standard practice, EndoPrime was applied and the following treatments were tested (Figure 1):

- EndoPrime (product containing mycorrhizal fungi, applied to whole paddock)
- No Endoprime strip
- No phosphorus strip + EndoPrime
- No base fertiliser strip + EndoPrime (rest of paddock received croplift 800 at 650kg/ac + 10kg humic acid)
- No fungicide strip + EndoPrime (rest of paddock received Metalaxyl and Azoxistrobin) applied in furrow)

ASSESSMENTS

The following were harvested and assessed to determine the effects of a particular treatment:

- Harvested 3 x 3m plots for EndoPrime, no EndoPrime, and no fungicide treatments
- Harvested 2 x 3m plots for no P and no base fertiliser
- Within the plot area, collected:
  - Number of plants
  - Number of stems
  - Number of tubers
  - Weight of tubers
  - Size of tubers in grades below, where <50 is considered out of spec for processing
    - <50mm
    - 50-100mm
    - 100-150mm
    - 150-200mm

RESULTS

In this field trial, the application of EndoPrime exhibited fascinating effects on potato crop characteristics.

The areas where EndoPrime was applied showed a reduction in both the number of stems per plant (Figure 2) and the number of tubers per plant (Figure 3).

Interestingly, despite these differences, the overall yield remained consistent across all treatments summarised as follows and in Figure 4:

- EndoPrime, no fungicide = 59t/ha
- EndoPrime = 55t/ha
- No EndoPrime 51t/ha
- EndoPrime, no P 49t/ha
- EndoPrime, no base fert 37t/ha

Notably, the EndoPrime-treated areas displayed larger-sized tubers, (100-150mm), while the no EndoPrime areas had a lower proportion of larger tubers (Figure 5).

Unsurprisingly, mycorrhizal root colonisation levels were notably higher in the treatments with no fungicide, no base fertiliser, and no phosphorus, compared to no EndoPrime and EndoPrime areas that both had the other inputs applied (Figure 6).

Additionally, treatments involving EndoPrime exhibited higher specific gravity, ranging from 1.079 to 1.088, in contrast to the no EndoPrime treatment, which had a specific gravity of 1.073 (Figure 7).

These results give some insights into the dynamics of plant-fungi symbiotic relationships. Root colonisation appears to be a reliable indicator of whether this partnership is genuinely established and how it impacts the plant's functionality.

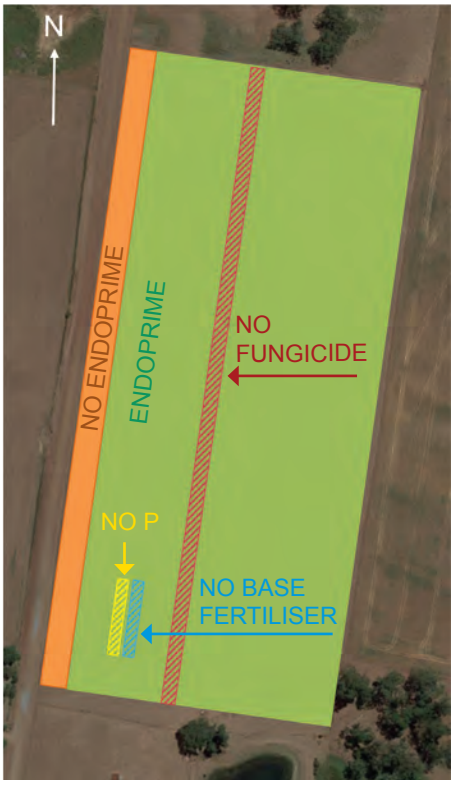

Figure 1. Demonstration treatment layout

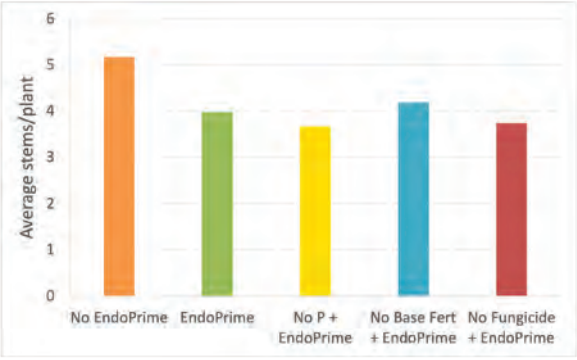

Figure 2. Stems per plant across different treatments - treated areas had 4 stems/plant compared to 5 stems/plant in the no EndoPrime areas.

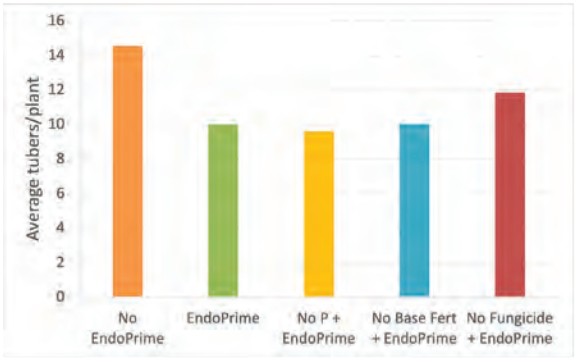

Figure 3. Tubers per plant – EndoPrime treated areas had less tubers with 10 tubers/plant compared to 14 tubers/plant in the no EndoPrime area.

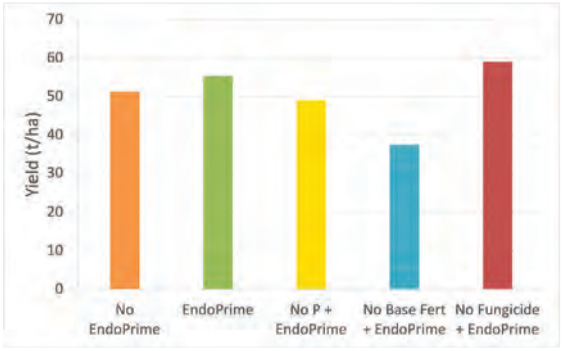

Figure 4. Average yield (t/ha) across different treatments.

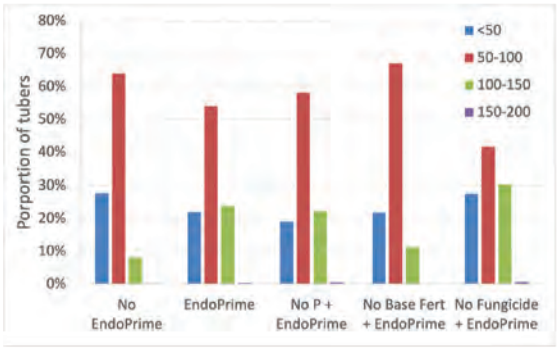

Figure 5. Proportion of average tuber size (mm) across treatments.

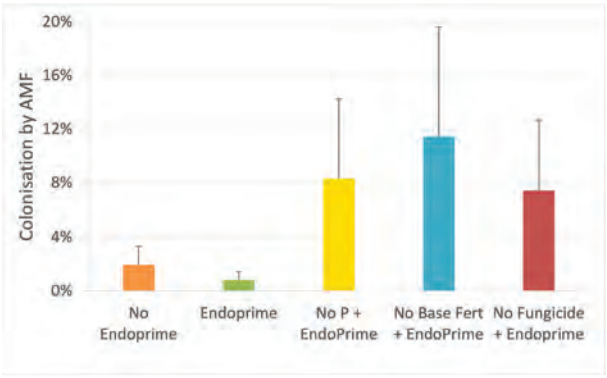

Figure 6. Average root colonisation by AMF across treatments – bottom to middle paddock. Bars indicate the standard error of each mean value.

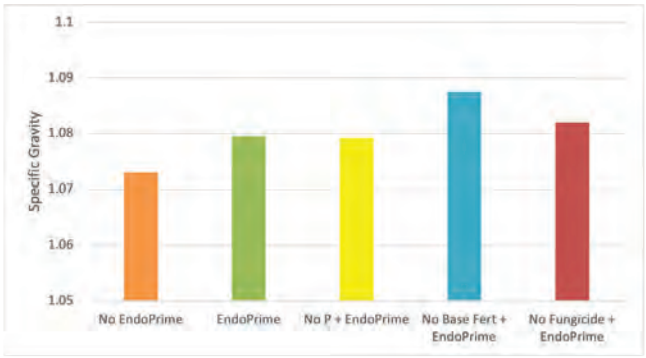

Figure 7. Specific gravity across different treatments.

THOUGHTS FROM THE GROWER

Demonstration site host and grower Neville Quinlan has observed similar trends across his whole farm in terms of tuber numbers and size. He notes that EndoPrime's inclusion of humic acid may have contributed to the promising results, particularly in terms of improved specific gravity, however this requires further investigation. The notable improvements in tuber size observed has led to Neville's strong inclination towards continued use of EndoPrime.

For growers, it is important to consider the following:

- It can be challenging to discern small, incremental improvements in the field, necessitating precise measurements.
- Understanding whether a product contains live organisms the appropriate storage and handling through the supply chain and before application is crucial.
- The quality of seed potatoes can significantly influence trial outcomes.

And a word of caution: changes observed in one strip may not solely be due to the treatment but could also be attributed to other factors including seed source and handling.

It's important to note that not all conditions may lead to observable changes, as outcomes are contingent on the specific environmental conditions. For a more complete and comprehensive understating of the impact of AMF on potato yield and quality, it is best to accumulate data from different farms and across different seasons.

Building a broader picture over time can provide valuable insights into the effectiveness of various agricultural practices and products.

KEY POINTS

- Where EndoPrime was applied showed a reduction in both the number of stems per plant and the number of tubers per plant.
- Overall yield remained consistent across all treatments.
- EndoPrime-treated areas displayed larger-sized tubers.
- The no EndoPrime area had a lower proportion of larger tubers and a higher proportion of smaller tubes.
- Treatments involving EndoPrime exhibited higher specific gravity.
- In this trial, the application of EndoPrime resulted in a decrease in stem and tuber numbers per plant, and an increase in tuber size. Similar patterns have been observed at other sites.

The PotatoLink team would like to thank grower Neville Quinlan for access to his farm and assistance in the trial, and PotatoLink regional representative Stuart Grigg who has worked with us to carry out the trial and interpret the results.

Hort Innovation POTATO – PROCESSING FUND
This project has been funded by Hort Innovation using the potato – processing research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au

Hort Innovation POTATO – FRESH FUND
This project has been funded by Hort Innovation using the potato – fresh research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au

PotatoLink team member Steph Tabone evaluating the trial results.

Trial paddock - left two rows between the bucket lids are no P + Endoprime, and the right two rows are no base fert + EndoPrime. Image date: 03 Feb 2023. Photo by Ryan Hall

Trial paddock when data was collected. Image date: 25 Apr 2023. Photo by Steph Tabone

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