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FARMLINK RESEARCH REPORT 2021

## INCREASING NUTRIENT EFFICIENCY WITH NEW ORGANIC AMENDMENTS

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**TRIAL SITE LOCATION** Temora Agricultural Innovation Centre, NSW & Tallimba, NSW

### INTRODUCTION

Many farmers have access to manures or other organic amendments, but transport and spreading costs along with uncertainty over crop responses and longer-term impacts on soils have limited their use. Crop responses can be inconsistent because organic amendments can have variable effects on soil nutrient cycling and longer-term soil carbon stores. This is due to the complex interactions between soil microbes and soil carbon, and the additional nitrogen, phosphorus, sulphur and carbon inputs from organic amendments.

When carbon, nitrogen, phosphorus or sulphur are added to soils, and one element is in short supply, soil microbes typically obtain the missing nutrient to sustain their growth by degrading existing soil organic matter to release the needed element. As a result of these processes, and following the death of soil microbes, crop plants may accumulate more of a given nutrient than was applied in the fertiliser or amendment.

This is often simplistically seen as 'enhanced nutrient use efficiency (NUE)'. However, while there may be some short-term nutrient gain, it comes at the expense of native soil organic matter degradation and this will have longer term consequences for both soil processes and crop nutrition.

The project will examine the impact organic amendments, mainly manures, on soil carbon levels and nutrient availability in the field, and will determine the effectiveness of manures as phosphorus fertilisers compared to synthetic fertilisers. A range of soil health parameters will also be assessed to investigate whether manures have any effects on soil health compared to synthetic fertilisers. Ultimately the project will develop recommendations for the use of new organic amendment products to give growers confidence to replace or partially replace mineral fertiliser inputs with organic amendment products.

### PROJECT PARTNERS



### FUNDING PARTNERS



PROJECT CODE - ION20

### Methodology

As part of the Soil CRC funded project, FarmLink have established two field trial sites in 2021. One site was located at TAIC and the second was at Tallimba, NSW. These two sites will evaluate soil health and nutrient use efficiency of organic amendments over a 3-year period.

### Tallimba Trial Site

This trial was focused on measuring Phosphorus (P) uptake in plants as a result of applying organic amendments. Chicken manure from a local poultry farm was the chosen amendment and analysis was performed to determine the available nutrient content of the manure. Once the P concentration was known, different amounts of manure were applied to treatments to meet target concentration of P applied in kg/ha. Separate treatments also had the same P concentrations applied in the form of single super phosphate (SSP) fertiliser. These treatments are outlined in Table 1.

The treatments were applied in a randomised small plot trial design. Once the manure was applied, half of each plot was incorporated using an offset disc so that incorporation verse nil incorporation (incorporated by sowing) could also be compared. The SSP was applied using a small plot seeder. A combination of urea and slow-release urea was applied as well as micronutrients copper and zinc. This was to make sure any confounding effects of nutrients contained in the manure would be balanced out across all treatments. Once all treatment were applied the trial was sown with a commercial crop of field peas so that it matched the crop rotation of the paddock the trial was located in. No additional fertiliser was applied throughout the year.

During the season, root and shoot samples were taken from each treatment just prior to anthesis so that P concentration in the plant and roots could be measured. Grain yield was also measured by harvesting with a small plot header.

The site is resown in 2022 with canola and no additional P fertiliser as been applied. However, high rates of N will be applied to balance out the N concentration of the manure so that only P concentration is variable between treatments.

Table 1 - Treatment list of the Tallimba trial site

No.	Treatment	P Rate (kg/ha)
1	Manure	0
2	Manure	5
3	Manure	10
4	Manure	20
5	Manure	30
6	Manure	45
7	Manure	60
8	SSP	0
9	SSP	5
10	SSP	10
11	SSP	20
12	SSP	30
13	SSP	45
14	SSP	60

### TAIC Trial Site

This site is focused on measuring soil health and nutrient use efficiency once organic amendments have been applied. Different amendments and rates of application were used. Phosphorus was used as the key factor to determine application rates. In the ‘annual manure’ treatment, 15kg P/ha is applied each year in the form of animal manure as this amount is roughly what would be removed in grain harvested from a 5t/ha cereal crop. The ‘annual manure’ treatment mimics a scenario where a grain grower may have a contract with a feedlot or poultry shed and spreads manure each season. A second scenario was also examined, where a grower may apply manure in a large dose periodically. A once in 3-year application was also included where 45kg P/ha was applied in year 1, with no further P additions in years 2 and 3. Synthetic fertiliser control treatments were also included to match the nutrition applied in the manures using SSP, urea and slow-release urea to allow for the slow release of nitrogen through the season which would occur with the manure products once they breakdown. All treatments are listed in Table 2 below.

The treatments were applied as a randomised small plot trial and included half incorporated and half unincorporated (incorporated by sowing) plots, which effectively means there are 20 treatments in the trial. After the amendments and urea were applied, the half plots were cultivated and then the SSP was applied using the small plot seeder. Canola was sown in 2021 across the plots and no additional fertiliser was applied throughout the season. Establishment counts, NDVI, harvest index, grain yield and grain quality were measured through the season.

Baseline soil testing to 1 m depth was conducted in each plot before the amendments were applied and further soil testing will take place to measure the physical and chemical properties of the soil and the effect the amendments have over the course of the trial. The soil testing will include measuring soil carbon, microbiology, hydraulic conductivity and nutrition.

Table 2 - Treatment list of the TAIC trial site

No.	Treatment
1	Nil Control
2	Nil N, + P
3	Nil P, + N
4	Annual Pig Manure
5	Annual Synthetic
6	Annual Poultry Manure
7	Annual Match Stubble Synthetic
8	3 Year Poultry Manure
9	Extreme Treatment – 10T/ha Poultry Manure
10	3 Year Synthetic

### Results

As the trial has only just begun, there are only preliminary yield data from the first year of the trial to analyse with further results to follow as the project progresses. The Tallimba P uptake trial did not show any significant differences in yield between treatments in the field peas. This is due to the field peas’ P requirement being low, however with canola sown in 2022 on the same area, it is expected that there will be significant differences in the second season where no additional P fertiliser has been applied.

The TAIC trial yield results have been summarised in Figure 1.

Across all treatments, ploughed treatments yielded significantly higher than unploughed treatments ( $P < 0.05$ ). This was because ploughing increased establishment and early vigour of the canola as there was a high stubble load in the areas left unploughed. There may also be less nitrogen loss from the manures with incorporation from loss pathways such as volatilisation. Significant differences in yield between amendments and rates ( $P < 0.001$ ) show there was a very strong response to the higher rates of manure, however from observing the results of the synthetic fertiliser treatments, this only seems to be a response to additional N and not a P response. This has been determined from the nil P, + N and Nil N, + P treatment results. This is likely due to a high starting Colwell P, and a stronger response may be seen in following years when no additional P fertiliser will be applied.

Further soil analysis results will follow once more data has been collected and the analysis has been completed.

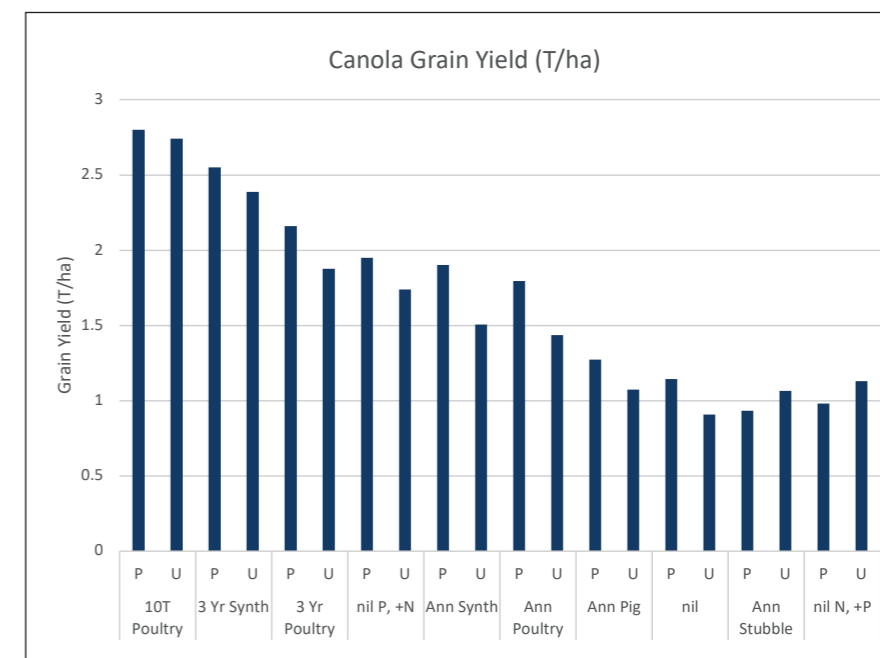


Figure 1 - Canola grain yield (T/ha) from the TAIC trial in 2021. P represents ploughed treatments (amendment incorporated) and U represents unploughed (incorporated by sowing only).



Figure 2 - A 3-year manure treatment at TAIC where the effect of unploughed (left) and ploughed (right) is noticeable.