Penergetic lettuce trial

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Dr Charles N Merfield.

HND Comm. Hort., M.Appl.Sci. Hons, PhD, MRSNZ

The BHU Future Farming Centre

Permanent Agriculture and Horticulture Science and Extension

www.bhu.org.nz/future-farming-centre

Live, like you'll die tomorrow;
Farm, like you'll live for ever.

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1. Introduction

This report presents the results of a field experiment that trialled Penergetic 'p' and 'b' products on lettuces grown under New Zealand conditions. It was undertaken under contract for Penergetic New Zealand Limited (hence forth Penergetic NZ) penergeticnewzealand.co.nz.

Penergetic International AG is a Swiss Company who formulate and manufacture ranges of certified organic agriculture products, which are distributed in over 40 countries worldwide. Penergetic NZ provided the following descriptions of their products.

Penergetic b soil uses biostimulating processes to boost soil activity. The sustainable product promotes humus formation and supports soil life. Activating soil life results in a change in the soil structure and soil compaction is reduced in the long term. Improved root growth helps optimize availability of nutrients in the soil for the plants. Penergetic b benefits include: Stimulates soil activity – Reduces harmful organisms – Helps break down crop residues – Promotes healthy root systems – Propagates mycorrhizal fungi – Lowers fertilizer requirements – Optimizes the soil structure – Makes tillage easier – Reduces the need for machinery – Boosts nutrient uptake of plants – Enriches biological quality – Is environmentally friendly and approved for organic agricultural use – Can indirectly help during drought periods since it leads to an improved soil structure and thus a better capacity for storing water – Product is completely harmless to humans, animals and the environment.

Penergetic-p is used as a plant tonic and as described by Penergetic has a stabilizing effect on plant growth and strengthens the immune system of plants. This reduces susceptibility to diseases and pest infestation. An additional benefit is the stimulation on microbiology in the root area and increase of the plant's natural nutrient uptake. Plants become more resistant and through that a better productivity. Penergetic p benefits: Stimulates root growth – Improved assimilation of nutrients – Stimulates plant growth – Increase mycorrhizal fungi – Strengthens plants and increases resistance – Reduction of fertilizer – Cost savings – Accelerate chlorophyll and photosynthesis activity – Improved yield and enhanced crop quality – Better biological quality – Increase stress resistance – Improves nutrient flow – Environmentally friendly – Improve assimilation of nutrients – Activates the symbiosis of soil-root-plant - Stabilisation of the biological optimum for plants – Works synergistically with other agri-inputs .

Penergetic p and b products are designed to be used together, according to application/dosage instructions. The effect of both Penergetic-b & Penergetic-p is optimised. Crop specific versions of Penergetic-p include a vegetable version used in this trial.

2. Methods and design

The experiment was based at the BHU Organics Trust, Lincoln University, in the 'Maples South' field at 43°39'3.42"S 172°27'13.71"E. The BHU is a certified organic property (by Organic Farm NZ[1]), so the trial was managed according to organic regulations. The trial ran from the 9th November 2021 to 11th February 2022. Lettuces were chosen as the test crop, as they are a widely grown summer vegetable crop in New Zealand.

The lettuces were grown in the same plots as the previous overwinter cabbage trial. This simulates typical New Zealand vegetable growing practices of following a winter crop with a summer crop without a break, e.g., a cover crop or pasture, to maximise land use.

The same randomised complete block (RCB) design was used with six replicates and two treatments, 1) a null control and 2) Penergetic treatment using both p and b products as per the cabbage trial, i.e., the previous plots treatments were maintained, such that the impact of Penergetic treatments

[1] www.organicfarm.org.nz/

on the Penergetic plots for the cabbage trial would be carried over to the lettuce trial, simulating longer term use of Penergetic.

Buffer	**1m**	**Pasture**	**Cabbage**	**Pasture**	**Cabbage**	**Pasture**
Rep 1	**5m**		Penergetic		Control	
Buffer	**1m**					
Rep 2	**5m**		Control		Penergetic	
Buffer	**1m**					
Rep 3	**5m**		Penergetic		Control	
Buffer	**1m**					
Rep 4	**5m**		Control		Penergetic	
Buffer	**1m**					
Rep 5	**5m**		Control		Penergetic	
Buffer	**1m**					
Rep 6	**5m**		Penergetic		Control	
Buffer	**1m**	**1.7m**	**1.7m**	**1.7m**	**1.7m**	**1.7m**

Total length 37 m **Total width 8.5m**

Figure 1. Field trial layout and sizes. Rep = replicate

The trial used the vegetable bed system on 1.70 m wheel centers, giving a bed top of 1.40 m. The plots consisted of two 37 m long beds, with each plot being 5 m long, with a one meter grassed buffer between plots. There was an additional untreated bed between the two 37 m beds that was grassed, to also act as a buffer. There was a requirement for at least 1 m buffer space as Penergetic NZ stated that the effect of the Penergetic products spread through the soil. To ensure treatment plots had the same vegetation on all sides, two more beds were cultivated on the outsides of the trial

beds and also grassed. Each plot therefore had a minimum 1 m grassed and untreated buffer on all four sides (Figures 1 & 2).

The soil is Wakanui, sib 1a.1, mottled immature pallic, texture is silt with 15 - 35 % topsoil clay, > 1 m diggability depth, stoneless, is imperfectly drained with a moderate over slow permeability profile and with low (23%) topsoil P retention[2]. A full soil test had been done in August 2020 by Hill Laboratories Limited: Soil sample depth 150 mm, pH 6.4, resin P 61 mg/kg, Olsen phosphorus 12 mg/L, anion storage capacity 18%, potassium 0.85 me/100g, calcium 8.4 me/100g, magnesium 1.32 me/100g, sodium 0.16 me/100g, CEC 14 me/100g, total base saturation 75 %, volume weight 0.93 g/mL, sulphate sulphur 5 mg/kg, extractable organic sulphur 6 mg/kg , aluminium ($CaCl_2$ extractable) 0.3 mg/kg, reserve potassium (TBK) 7.2 me/100g, reserve magnesium 23.2 me/100g, potentially available nitrogen 128 kg/ha 15cm depth, anaerobically mineralisable N 92 µg/g, organic matter 4.9%, total carbon 2.8%, total nitrogen 0.26%, C/N ratio 11.1%, anaerobically mineralisable N/total N Ratio 3.6%, phosphorus (Mehlich 3) 97 mg/L, potassium (Mehlich 3) 320 mg/L, calcium (Mehlich 3) 1,641 mg/L, magnesium (Mehlich 3) 157.5 mg/L, sodium (Mehlich 3) 36 mg/L, sulphur (Mehlich 3) 17 mg/L, iron (Mehlich 3) 182 mg/L, manganese (Mehlich 3) 23.7 mg/L, zinc (Mehlich 3) 4.7 mg/L , Copper (Mehlich 3) 0.7 mg/L , boron (Mehlich 3) 1.13 mg/L , cobalt (Mehlich 3) 0.3 mg/L, aluminium (Mehlich 3) 986 mg/L, 'total' phosphorus 596 mg/kg, 'total' sulphur 241 mg/kg, 'total' calcium 3,190 mg/kg, 'total' copper 5 mg/kg, 'total' molybdenum 0.3 mg/kg, 'total' cobalt 7.7 mg/kg, 'total' selenium 0.3 mg/kg, 'total' cadmium 0.12 mg/kg, base saturation K 6.0%, Ca 59%, Mg 9.3 %, Na 1.1%.

In September 2020, 500 $kg \cdot ha^{-1}$ of Balance granulated reactive rock phosphate (RPR) supplying 61 $kg \cdot ha^{-1}$ P and plus 55 $kg \cdot ha^{-1}$ of Sulphurgain Pure supplying 50 $kg \cdot ha^{-1}$ S was applied based on the above soil test. No soil test has been taken post fertiliser application.

On the 9th November 2021 the trial area was prepared, which was 11 days after the cabbages from the previous trail were harvested. The existing beds were manually cleared of the remaining cabbages and other vegetating from the cabbage trial. The beds were then ripped (the soil loosened) to a depth of approximately 30 cm, followed by a rotary hoe cultivation to create a planting tilth. On the 13 December a false seedbed cultivation was undertaken using a 'roller undercutter' (Merfield, 2015) to kill the weed flush. All the control plots were cultivated before the Penergetic plots to ensure that soil from the Penergetic plots was not transferred to the control plots.

On the 10th November, Penergetic-b was applied to the Penergetic plots at the recommended rate of 0.3·g·m^2 / 3 $kg \cdot ha^{-1}$. It was applied using a 40 L sprayer tank with a Shurflo 8000-543-136 12 volt DC pump operating at 4 bar, supplying a hand held spray bar with three DG TeeJet 110 94 VP nozzles, spaced 50 cm apart, with a flow rate of 0.75 L per minute each giving a total flow rate of 2.25 L/m for the three nozzles. The sprayer was filled with 15 L water and 27.9 g of Penergetic-b added to the water, to provide sufficient extra volume of spray liquid for losses in pipes etc. The spay mixture was circulated when transporting to the site and between spray applications. Each plot was then sprayed for 30 seconds with four passes to ensure even coverage, with the spray bar held approximately 30 cm above the soil surface so that there was a small amount of overlap of the spray fans. The spay bar was held diagonally across the bed so to only spray the bed top.

On the 24th November, twelve 105 cell seedling trays (23 x 57 cm) were sown with 'McGregor's buttercrunch lettuce (*Lactuca sativa*) batch UFD18 with a 2023 expiry date. The standard Lincoln University Nursery 3-4 month plant raising mix, made of 400 L composted bark, 100 L pumice, Osmocote exact 3-4 month 1.5 kg, horticultural lime 500g, hydraflo 500g, per 500 L finished mix. All trays were filled, and then half the trays were then emptied of the plant raising mix, which was then mixed with Penergetic-b at the rate of 0.3 g/m^2 of tray surface. With a surface area of the six trays

[2] smap.landcareresearch.co.nz/

being 1.57 m^2 0.47 g Pb was mixed into the plant raising mix. This was done by spreading the plant raising mix out on a clean flat surface, then sprinkling the Penergetic-b over the mix, then the pile was turned four times to thoroughly mix the Penergetic-b into the mix. The five empty trays were then refilled with the Penergetic-b treated plant raising mix. The lettuce seeds were then individually sown into each cell and covered with a thin layer of sieved plant raising mix, and placed in a propagation glass house, and kept watered. Any double seedlings in cells were thinned to one plant.

On the 14th December the Penergetic lettuce seedlings were watered with 5 g P-p vegetables in 1 L water, while the control trays were given 1 L untreated water. Sixty lettuces per plot were then planted out in four rows, spaced 30 cm apart with lettuces spaced 25 cm apart down the row. This gives 26 lettuces from the center of the plots to be harvested for measurements with the outside rows and rows ends treated as guard rows.

Plots were then and covered with mesh crop cover to protect them from mostly vertebrate pests, principally rabbits and pukekos (Figure 2, Merfield, 2017).

Figure 2. Mesh crop cover.

Due to whitefly (*Trialeurodes vaporariorum*) being seen on the lettuce transplants at planting time the whitefly parasitoid *Encarsia formosa*, purchased from Bioforce Ltd. www.bioforce.co.nz, were put under the mesh on 16th December at 100 parasitoids per plot. These successfully controlled the whitefly.

On the 2nd January 2022 the plots were weeded with a 4 Wheel Hoe and a hand hoe, and the Penergetic plots were sprayed with 0.2 $g \cdot m^2$ / 2 $kg \cdot ha^{-1}$ Penergetic-p vegetables using the same method for applying Penergetic-b to the soil (see above)and (Figure 3). The sprayer was filled with 20 L water and 16.8 g P-p vegetables to allow for losses in pipe work etc.

The second application of Penergetic P vegetables was applied on the 14th January.

The trial was irrigated with 20 mm of water on the 16th January as soil moisture levels were getting low. The weather subsequently turned wet, see appendix.

Figure 3. Control plot (left) Penergetic plot (right) on 2nd January post weeding and prior to being sprayed.

The lettuces were harvested on the 11th February Figure 4. Due to the exceptionally wet weather in the week leading up to harvest, a total of 51 mm of rain over four days, some of the lettuces rotted off, so that the aim of harvesting 26 lettuces per plot could not be achieved, instead, the plot with the lowest number of harvestable lettuces was identified, which was 17, and then 17 lettuces were randomly harvested from the centre of every plot, and then the lettuces from each plot were weighed together. Results were analysed by general ANOVA using Fisher's unprotected LSD.

Figure 4. Lettuces on 4th February one week before harvest.

3. Results

The average weight of the control lettuces was 4.31 kg and the Penergetic treated lettuces was 4.89 kg, a 13% increase, at a p value of 0.082 and $LSD^{5\%}$ of 0.669 which is significant at the 10% threshold.

The 'p' value is a measure of probability in statistical tests such as ANOVA, and is a way of determining that the results did not occur by chance. The smaller the number the more robust the result is. The standard p value used to decide if a result is a real effect is 5% (p=0.05) but, a 10% (p=0.1) threshold is also used to indicated that the result is still significant but at a lower level of statistical robustness.

$LSD^{5\%}$ stands for the **L**east **S**ignificant **D**ifference at a 5% p value. If the difference between measurements is larger than the LSD then the difference between them is statistically significant at the 5% p level. It is presented to allow readers to compare the actual difference among the measurements with the LSD.

4. Discussion

A 13% weight increase is a biological and economically significant increase in weight due to Penergetic treatment, although at a lower statistical threshold. It was disappointing that the large amount of rain in the week leading up to harvest caused some lettuces to rot off, reducing the number that could be used for analysis. However, 17 lettuces per plot is still more than sufficient to ensure reliable comparisons. The experiment shows that Penergetic treatment increases crop performance.

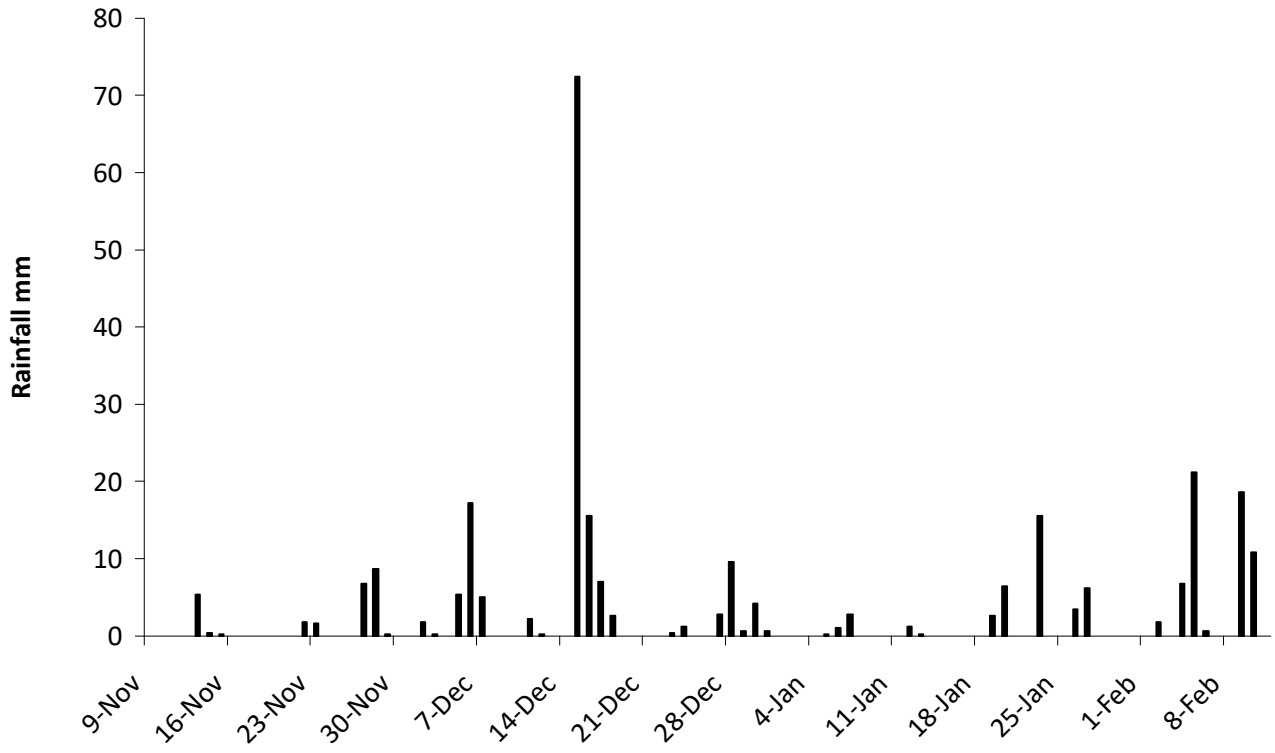
5. References

Merfield, C. N. (2015). False and Stale Seedbeds: The most effective non-chemical weed management tools for cropping and pasture establishment. The FFC Bulletin, 2015(V4), 25. http://www.bhu.org.nz/future-farming-centre/information/bulletin/2015-v4/false-and-stale-seedbeds-the-most-effective-non-chemical-weed-management-tools-for-cropping-and-pasture-establishment

Merfield, C. N. (2017). Mesh crop covers for pest control in commercial crop production. Lincoln, New Zealand: The BHU Future Farming Centre http://www.bhu.org.nz/future-farming-centre/ffc/information/crop-management/production/mesh-potatoes/mesh-crop-covers-for-pest-control-in-commercial-crop-production-2017-ffc-merfield.pdf

6. Appendix

6.1. Rainfall data



A total of 273 mm of rain fell during the trial, which with the 20 mm of irrigation applied on the 20th January gives a total of 275 mm of rain during the trials 95 day duration.

6.2. Raw data

Rep	Treatment	Weight kg
1	Penergetic	5.17
1	Control	5.05
2	Penergetic	5.30
2	Control	3.38
3	Penergetic	4.62
3	Control	4.88
4	Penergetic	4.74
4	Control	3.70
5	Penergetic	5.05
5	Control	4.36
6	Penergetic	4.44
6	Control	4.47