

Maximising Organic Production Systems (MOPS)

OBJECTIVES

Maximizing Organic Production Systems (MOPS) is a European Innovation Partnership (EIP) project that is co-funded by the Department of Agriculture, Food and the Marine and the European Commission. Part of the MOPS project involves a 3-year trial of winter and summer green manure crops under Irish conditions. The same trial will be carried out over three seasons on the same farm in Co. Wexford, to determine the robustness of any effects.

Each of the two green manure trials (summer and winter) consists of three green manure mixes and an unsown control, in which the natural weed population is incorporated. The mixes used in the summer and winter green manures and the experimental design were described in the Winter 2018 issue of "Organic Matters".

SUMMARY (JUNE 2018-MAY 2019)

In the summer green manure:

- Biomass: buckwheat/phacelia>rye/phacelia>clover/ryegrass>control
- Annual weed control: buckwheat/phacelia>rye/phacelia>clover/ryegrass>control
- Perennial weed control: rye/phacelia~buckwheat/phacelia>clover/ryegrass>control
- Beneficial insects: clover/ryegrass>rye/phacelia>control>buckwheat/phacelia
- Soil bacterial diversity: clover/ryegrass>rye/phacelia>control>buckwheat
- Soil nutrient levels: rye/phacelia>buckwheat/phacelia~clover/ryegrass>control
- Cash crop development: buckwheat/phacelia>rye/phacelia~clover/ryegrass>control

In the winter green manure:

- Biomass: Wild Atlantic mix*>rye/vetch>Landsberger**>control
- Perennial weed control: rye/vetch> Wild Atlantic>Landsberger>control
- Beneficial insects: Landsberger>Wild Atlantic~control>rye/vetch.
*Wild Atlantic mix = oats/rye/vetch/clovers
** Landsberger = ryegrass/clovers

RESULTS (MAY 2019-NOVEMBER 2019)

Three studies were carried out on the green manure trial during this period: evaluation of the control of slugs by the increased population of beneficial insects, particularly ground beetles, in the green manure plots; yield analysis of the cash crops following the 2018/19 winter green manure trials; and cost-benefit analysis of the effect of incorporated green manures on the growth of onions, lettuce and broccoli.



An Roinn Talmhaíochta,
Bia agus Mara
Department of Agriculture,
Food and the Marine



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EFFECT OF GREEN MANURES ON FIELD SLUGS

Results from pitfall traps from several of the summer and winter green manures in Year 1, particularly the lower-growing ones, had shown that most of the green manures supported significantly larger populations of ground beetles than the controls. The traps also caught field slugs, but at very low frequencies.

An experiment was set up to test whether the increased ground beetle density caused the decreased population of field slugs, a major pest of vegetable crops. Pitfall traps were set up at a number of sites in the experimental field. The results were that the experimental field supported a very low field slug population, a finding supported from anecdotal evidence from the farmer (Des Thorpe), indicating that the green manures did not cause the low field slug population. Increased populations of ground beetles would be expected to control other pests.



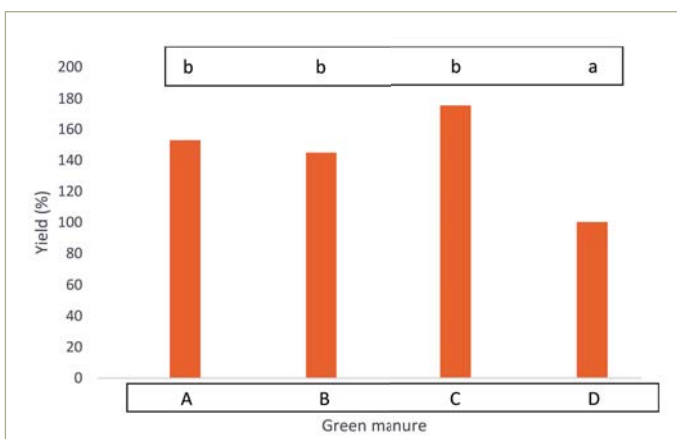


Lettuce crop growing following green manures in 2019

YIELD AND COST-BENEFIT ANALYSIS

Issue 141 of Organic Matters included details on the positive effects of all three summer green manures on the development of the two cash crops, winter cabbage and onions (Fig. 1), with a significant increase in cabbage yield. For the period in question (May to November 2019), the impacts of the green manures were assessed on the yield and cost-benefit of three cash crops, onions (summer green manure), broccoli and red oakleaf lettuce (winter green manure) were assessed.

Fig. 1. Effect of summer green manure incorporation on onion yield, as % of control (D). A: ryephacelia; B: buckwheat/phacelia; C: clover/ryegrass; D: control. Any two bars with a common lowercase letter are not significantly different.



The onion crops after each of the summer green manures were significantly heavier than in the control plots (Fig. 1). For the winter green manures, both cash crops (broccoli and oakleaf lettuce) developed faster in the winter green manure plots than in the control plots. Within the acceptable size and quality range, the mean weight of the lettuce heads over two harvests in each of the three green manure plots was significantly larger than that of the control, with the exception of green manure C (rye/vetch), where the heads were significantly smaller than those of the controls (Fig. 2).

Positive effects were also observed with broccoli, except that all three green manures resulted in significant increases in both numbers of heads of acceptable quality and average broccoli head size (Fig. 3), with average head weights of 392 g (control), 530 g (vetch/clover/ryegrass), 563 g (clover/oats/rye), and 528 g (rye/vetch), with no evidence of an inhibitory effect of the rye/vetch green manure on the broccoli cash crop. Of the nine [green manure × cash crop] combinations, eight resulted in a statistically significant increase in yield compared to the corresponding control, while one (the oakleaf lettuce crop grown after the rye/vetch winter green manure) exhibited a significantly lower yield than the control.

Subsequent pot testing of soil samples from the different plots showed that the soil into which the rye/vetch green manure had been incorporated inhibited lettuce from direct sowing or transplants, with direct sowing being particularly badly affected. Grazing rye is known to have inhibitory ("allelopathic") effects on small-seeded crops, but this is the first report of an inhibitory effect

on transplants, although, of the various crops tested in the pot trial, lettuce was the only sensitive crop. The absence in the field trial of an inhibitory effect on lettuce from the Wild Atlantic mix, which also contained rye, suggested that the lower rate of rye (30% as opposed to 60% in the rye/vetch green manure), or the different rye population (wild rye as opposed to grazing rye in the rye/vetch mix) may have avoided the inhibitory effect.

The cost-benefit analysis of the use of green manures took into account extra costs associated with the use of green manures, namely site preparation (labour; diesel), purchase of green manure seed, sowing green manure seed (labour; diesel), mulching and incorporation of the green manure (labour and diesel). These additional costs were subtracted from any extra income from the cash crop harvest relative to that from the control plots.

Fig. 2. Effect of winter green manure incorporation on red oakleaf lettuce yield, as % of control (D). A: vetch/clover/ryegrass; B: clover/oats/rye; C: rye/vetch; D: control. Any two bars with a common lowercase letter are not significantly different.

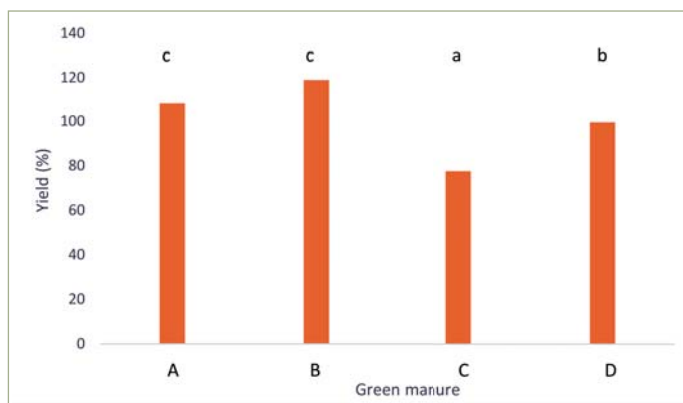


Fig. 3. Effect of winter green manure incorporation on broccoli yield, as % of control (D). A: vetch/clover/ryegrass; B: clover/oats/rye; C: rye/vetch; D: control. Any two bars with a common lowercase letter are not significantly different.

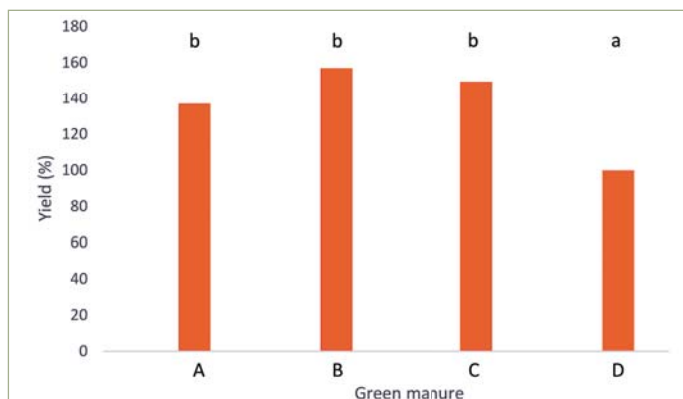


Fig. 4. Net additional income (€150 m²) from onions grown after summer green manure, with control (D) being zero. A: rye/phacelia; B: buckwheat/phacelia; C: clover/ryegrass; D: control. Any two bars with a common lowercase letter are not significantly different.

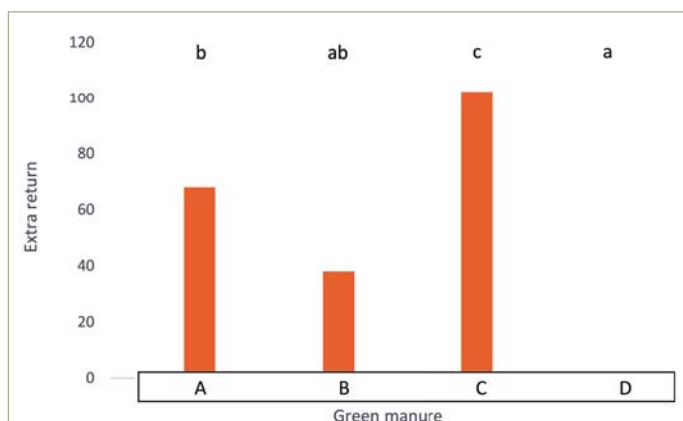


Fig. 5. Net additional income (€150 m²) from red oakleaf lettuce grown after winter green manure, with control (D) being zero. A: rye/phacelia; B: buckwheat/phacelia; C: clover/ryegrass; D: control. Any two bars with a common lowercase letter are not significantly different.

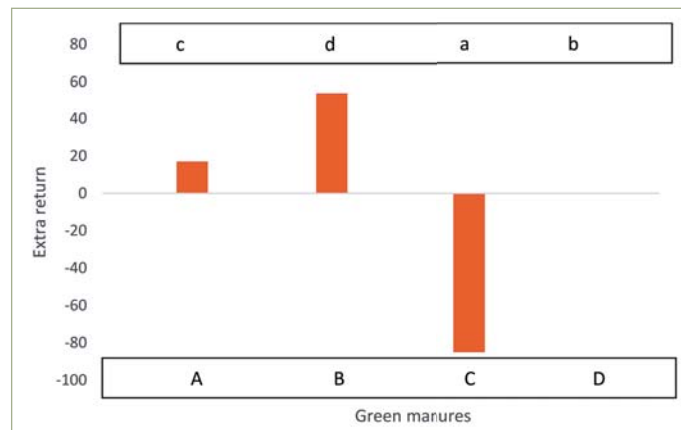
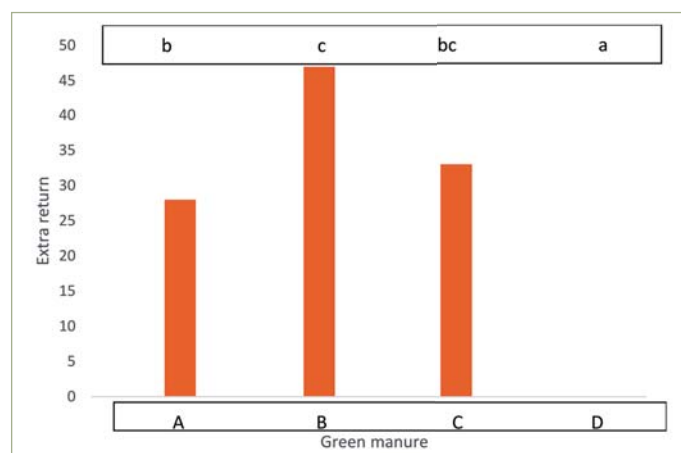


Fig. 6. Net additional income (€150 m²) from broccoli grown after winter green manure, with control (D) being zero. A: rye/phacelia; B: buckwheat/phacelia; C: clover/ryegrass; D: control. Any two bars with a common lowercase letter are not significantly different.



The cost-benefit analyses showed that all but the lettuce crop after the rye/vetch winter green manure resulted in a significant increase in returns over and above the costs associated with setting up the green manures. To our knowledge, this is the first report of a cost-benefit analysis, demonstrating increased net returns from green manures under Irish conditions.

No single effect was associated with the increased yield or net return, rather a number of effects such as improved nutrient availability, weed control, pest control, altered soil bacterial population, accelerated crop development and improved soil structure. Des Thorpe reported that, following green manure incorporation into the plots, the soil texture was markedly improved, with the soil in the green manure plots being more friable and easier to work than that in the control plots.

MAIN FINDINGS (MAY 2018-NOVEMBER 2019)

- Eight out of nine winter and summer green manure combinations with cash crops resulted in significant increases in cash crop yields, the only exception being lettuce after the rye/phacelia winter green manure.
- The inhibitory effect on lettuce of the rye/vetch residues were seen after 60% rye but not after 30% rye in the green manure.
- The positive green manure effects resulted in significantly higher net returns after the costs of the green manures were taken into account.