

Maize and soil health: how it adds up

Overview

Malcolm and Catherine Barrett trialled three maize establishment methods over the Spring and Summer of 2022. The maize was followed by winter barley in 2022-2023.

	Operations	Fuel usage (l/ha)	Fuel cost (£/ha)*
Conventional	Plough, Power harrow, Mzuri drill	9.11	60
Sumo cultivator	Sumo cultivator, Mzuri drill	5.06	33
Direct sown	Mzuri drill	2.02	13

*DERV price of 107.4p/litre

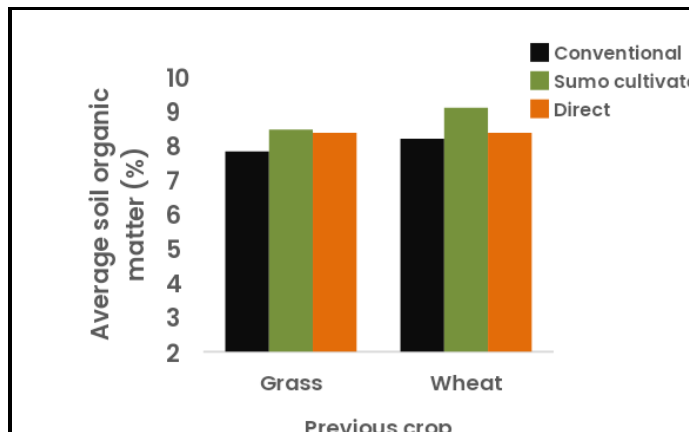
The objective was to determine which establishment method:

- (i) was the most cost-effective considering maize yield, quality and operations;
- (ii) supported improved soil health and reduced emissions; and
- (iii) benefitted the following crop (spring barley).

The three establishment methods were carried out in two fields, one after wheat and the other after a grass ley. The grass was sprayed off prior to the trial.

Soil Carbon

Soil health and carbon were assessed, alongside maize yield and quality. The data to date is provided below.



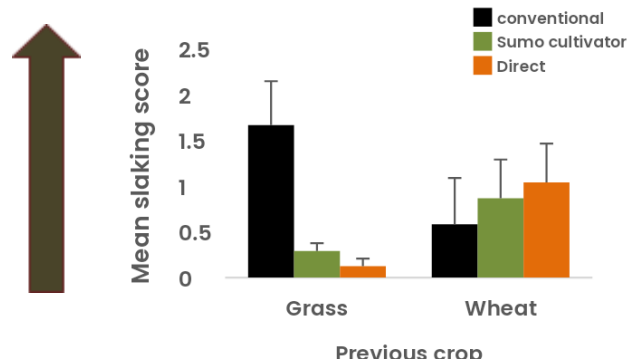
Soil carbon was measured in September 2022. Single measures per treatment indicate that: After grass, 0.5-0.6% less soil organic matter is lost with the direct drill and Sumo cultivator, compared to the ploughed 'conventional' treatment.

After wheat, the picture is more complex. The Sumo cultivator treatment had the highest organic matter which was evident between 10cm and 30cm. A lower proportion of the trash on the surface in the Sumo shallow cultivation compared to a direct treatment may have resulted in more organic material being incorporated into the soil rather than lost as emissions. Deep ploughing, however, leads to the greatest loss of soil organic matter.

Soil health

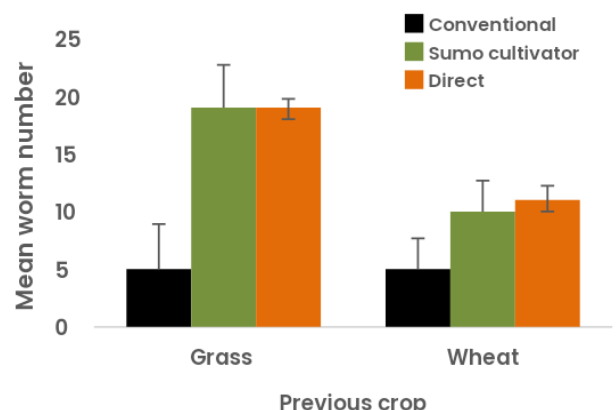
Soil health was measured across treatments in the two fields.

Soil stability (or slaking test) showed that the lower soil stability (and therefore higher slaking score) occurred with the ploughed conventional treatment. This soil is more vulnerable and at risk of being washed away after ploughing.



Error bars indicate standard error.

Worms benefitted from the direct drill and the Sumo cultivator, with numbers more than triple compared to the ploughed treatment after grass. Worm numbers were double when the plough wasn't used after wheat.



Error bars indicate standard error.

Water infiltration was rapid with exception of the direct treatment after grass. This effect may have been due to surface capping, nevertheless the infiltration rate for 100ml was just over one and half minutes in the direct drilled treatment, which was still rapid.



After grass, there was significant white clover soil coverage in the Sumo and direct treatments. The clover re-established

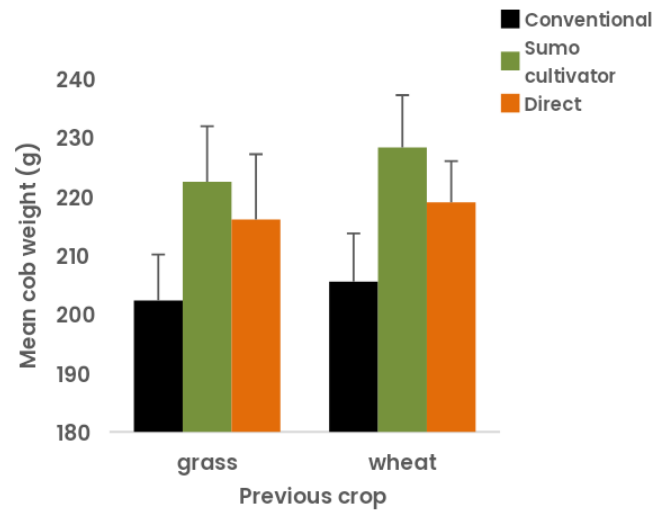
after being sprayed off in the Spring, creating a useful understorey.

The nitrogen story is complex. In the Sumo cultivator and direct treatment after grass, the amount of white clover understorey could be estimated to supply in the range of 150kgN/ha per year, which will be released when the subsequent crop of barley is sown.

The only effective way to determine the benefits of clover presence will be to assess the effect on the following crop.

Maize performance 2022

Crop performance was assessed by weighing cobs, and forage analysis. Yield data was limited due to the logistics of weighing trailers. However, the average yield was 16 tonnes per acre, with exception of the direct drill after grass yielded 3 tonne/acre.



- The conventional ploughed treatment had smaller cobs than the direct and Sumo cultivator treatments for both fields.
- There was no significant difference in cob weights between the after grass and after wheat fields.

The maize quality data is available just for the after-grass treatments:

	Conventional	Sumo cultivator	Direct
D Value (%)	63	70	69
ME (MJ/kg)	10.3	11.5	11.2
NDF (g/kg)	423	397	380
Starch (g/kg)	353	351	330
Bypass Starch (g/kg)	125	124	109
Dry Matter (%)	27.1	27.2	30.7
pH	3.9	3.8	3.8
Crude protein (g/kg)	64	76	78

- The Sumo cultivated and direct drilled maize was the best for digestibility, energy, and protein.
- There was a 3% drop in dry matter in the conventional and the Sumo treatment compared to the direct seeded maize.

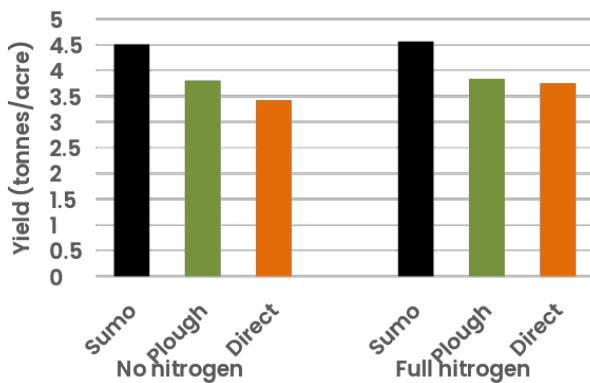
Barley yield 2023

Winter barley was sown using the Mzuri drill into the previous maize ground. Seed rates and reduced depth cultivation were the same across all the previous maize plots.

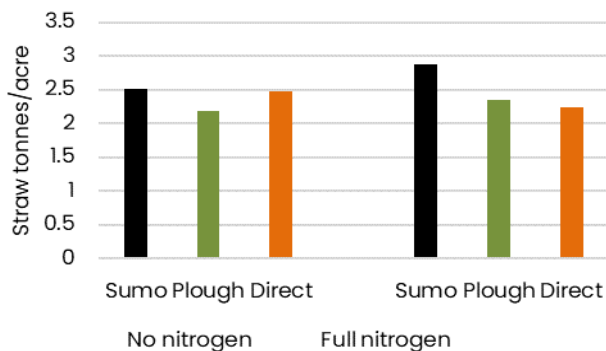


One pass perpendicular to the original maize plots had no nitrogen applied throughout the season.

Single quadrat areas of barley were cut and threshed, and an estimate of barley yield was made.



Single plot grain yield estimates for winter barley after maize with and without the standard rate of nitrogen.



Single plot straw yield estimates for winter barley after maize with and without the standard rate of nitrogen.

Carbon footprint

- The benefits of not ploughing were dominated by the higher soil organic matter when the plough was not used. For a single assessment, the change was an estimated loss of 0.6% soil organic matter (69 tCO₂e per ha)
- Additional savings were made by using less fuel when not ploughing (0.09 tCO₂e per ha).
- The clover understorey from the Sumo cultivator treatment potentially saved 100 units nitrogen/acre (0.82 tCO₂e per ha).
- Additional costs are associated with the slug treatment required in the Sumo-cultivated maize at 0.27 tCO₂e per ha.
- Additional yield data from multiple years are needed to confirm yield and quality are equal or better than at plough-based system when considering overall productivity.

Trial findings:

1. Improved soil health was supported by the direct and the Sumo-established maize treatment.
2. Maize digestibility, crude protein and energy was the highest in the Sumo and direct drilled treatment for single plot comparisons.
3. Dry matter was 3% lower in the Sumo established and direct drilled maize compared to the conventional ploughed maize for single plots.
4. Yields were similar between ploughed, and sumo established maize, but an estimated 3 tonnes/acre less in the direct drilled maize.
5. Winter barley after maize yielded higher in the sumo-established maize. The effect is likely to be due to a combination of improved soil health through shallow cultivation and the clover understorey.
6. The potential benefits of reducing nitrogen fertiliser inputs of clover under the maize can only be realised if applications are reduced.
7. Grass weeds were a challenge in the direct – sown barley after harvest.
8. The benefits of improved soil health are particularly pertinent under conditions of drought. The maize experienced an early summer drought, and the barley a late spring drought.

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