Maize and soil health: how it adds up

Overview

Malcolm and Catherine Barrett have trialled three maize establishment methods over the Spring and Summer of 2022. They have used 3 establishment methods:

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

*DERV price of 107.4p/litre

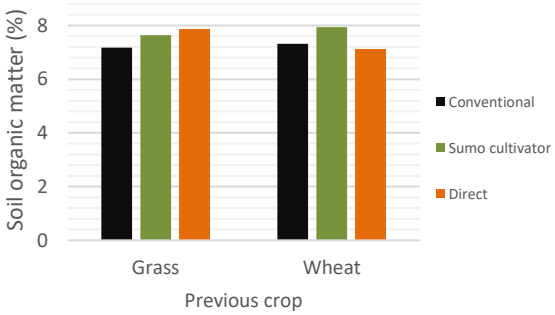
The objective was to determine which establishment method:

(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.

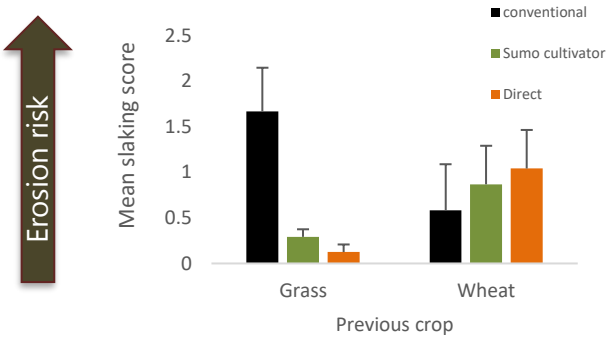


Soil carbon was measured in September 2022. Single measures per treatment indicate that:
After grass, 0.5-0.6% less carbon is lost with the direct drill and Sumo cultivator, compared to the ploughed 'conventional' treatment.

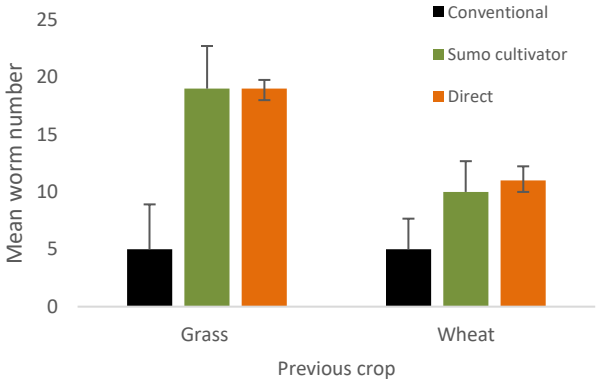
After wheat, the picture is more complex. The Sumo cultivator treatment had the highest organic matter which was evident between 10cm and 30cm. A lower proportion of the trash on the surface in the Sumo shallow cultivation compared to a direct treatment may have resulted in more organic material being 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 poorer soil stability (and therefore higher slaking score) occurred with the ploughed conventional treatment after grass. This soil is more vulnerable and at risk of being washed away after ploughing.



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.



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, 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.

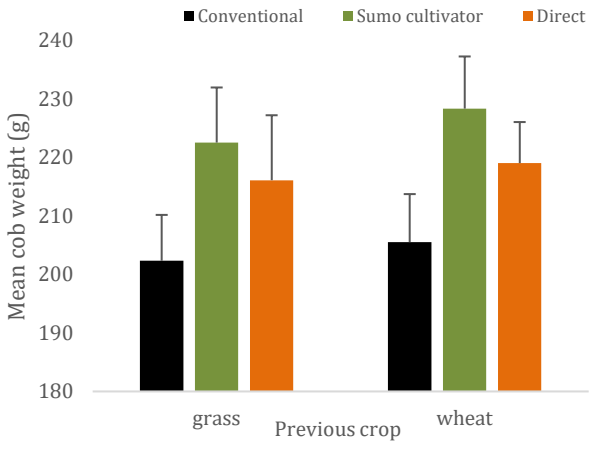
Assessment of available nitrogen is influenced by soil organic matter, biological activity, existing plant cover and soil disturbance.

- The least nitrogen was lost from the direct seeded plots after grass and wheat.
- In the ploughed treatment after wheat, about 60kgN/ha more nitrogen will be lost over the winter compared to the Sumo treatment.
- After grass, the soil was bare in the ploughed treatment but covered with clover in the Sumo and direct treatment. More nitrogen will be lost in the Sumo treatment, circa 80kgN/ha. It is not known if this was due to soil disturbance at harvesting, or enhanced microbial activity from previous cultivations.

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

Crop performance

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 treatment which had a 3 tonne/acre lower yield.



- The conventional ploughed treatment had smaller cobs than the direct and Sumo cultivator treatments for both fields.
- The 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.
- However, there was a 3% drop in dry matter in the conventional and the Sumo treatment compared to the direct seeded maize.

Carbon footprint

For a 1ha field compared with direct drilled treatment:

	Conventional ($kgCO_2e$)	Sumo cultivator ($kgCO_2e$)
Fuel Use	190	100
SOM	After grass = lost 5636 After wheat = lost 2127	After grass= gained 1062 After wheat = gained 7443
Molluscicide application	0	270
50kgN/ha from clover understorey	0	After grass =gained 330
TOTAL	After grass = lost 5826 After wheat = lost 2317	After grass = gained 692 After wheat = gained 7403

Results to date

1. The carbon footprint of the Sumo drilled maize is the best compared to direct drill and the ploughed conventional treatments.
2. Soil health was supported by the direct and the Sumo treatment.
3. Digestibility, crude protein and energy was the highest in the Sumo and direct drilled treatment
4. Dry matter was 3% lower in the Sumo and direct drilled treatment compared to the conventional ploughed maize.
5. Yields were comparable with exception of direct drilled into grass, which was an estimated 3tonnes/acre lower
6. The cost of reduced dry matter in the Sumo treatment balanced by the benefits of this treatment will define the financial viability of the innovation at Tregooden.