Maize: maximising soil health and crop yield

Overview

The wide rows and late harvesting of maize can result in soil damage, soil loss and water pollution. A combination of (1) reduced soil disturbance; (2) under-sowing companion crops into the maize; and (3) following the maize harvest with a cover crop can reduce the environmental impact of this valuable crop.

This FieldLab focuses on measuring the impact of different cultivation methods and companion crops in maize. The results below are from a one-year trial at Duchy College, Stoke Climsland.

Establishment methods

A 6-hectare field (previously a silage ley) was divided in half, one half ploughed and the other Sumo cultivated only. Maize was drilled at 45,000seeds/acre on the 7th May 2024. At 90° to the cultivation method, different under-sow mixes were drilled on the 4th July. These include an area of no under-sow (bare soil), Westerwolds ryegrass only and a diverse mix of Westerwolds, plantain and clovers (white, alsike and crimson).

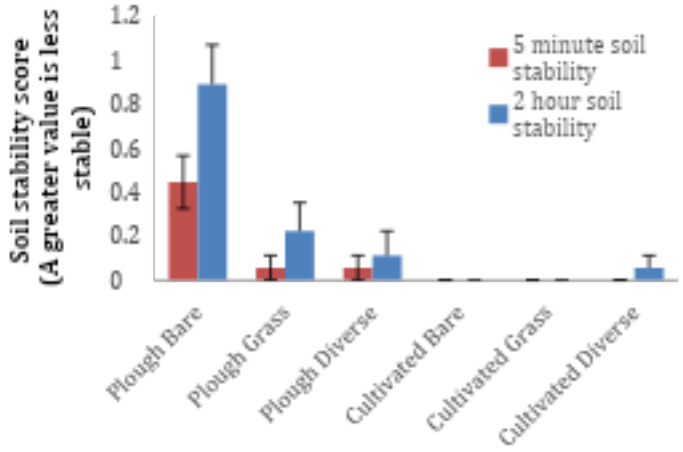
Under-sow mixes being drilled into maize, 4th July 2024. (Photo credit: Anthony Baggaley)

Soil stability – reducing the risk of soil loss

The stability of the soil aggregates is indicative of the potential risk of soil run off. Aggregate stability tests involve measuring the relative disintegration of air-dried soil submerged in water, and provides a measure of the microbial soil community. The breakdown of soil organic matter by larger decomposers such as worms as well as micro-organisms results in the creation of binding agents within the soil. These sticky substances contribute to a soil having a crumbly texture that has air spaces but can maintain integrity during rainfall.

There are indications that minimum tillage had a greater impact on maintaining soil aggregate stability than the type of companion crop.

The companion crop, whether diverse or just grass, significantly increased soil stability. Aggregate stability is assessed from 0 (most intact) to 4 (total disintegration) at 5 minutes and 2 hours of submersion, lower scores are better.



Soil stability scores for maize treatments of ploughed, or sumo cultivated and companion cropped with Westerwolds grass, diverse mix or left bare. Error bars indicate standard error.

Ploughing reduced earthworm numbers compared to the Sumo-tilled plots. The different companion crops did not affect earthworm numbers.

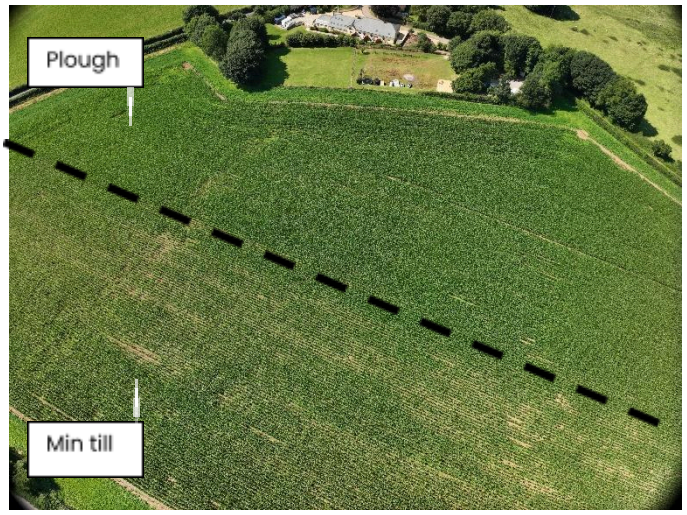
Water percolation through the soil

Good infiltration of water into the soil increases the resilience of the crop to drought and to water logging. **The diverse companion crop had a significantly faster water infiltration than the grass cover or bare ground**. There are early indications that the greatest risk of surface water logging would occur with maize that was established through ploughing and had no understorey.

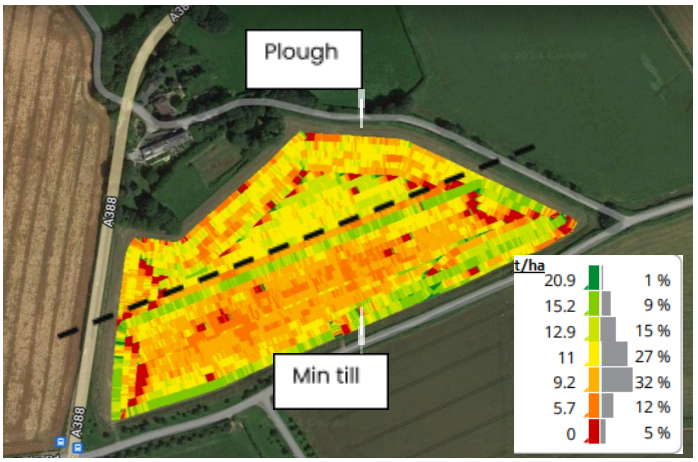
Blockier soils were present in the min-tilled plots both on the surface (~10cm depth) and between 20-30cm depth compared to the ploughed ground.

Maize performance

Visually, the ploughed side of the field appeared to establish better than the min-tilled side. This can be seen in drone imagery of the field (29th July 2024, below [with thanks to Sophie Rapson]).



As harvest approached, forage samples were cut from each of the plots and analysed for maturity using Near-Infrared Spectroscopy (NIRS) with the assistance of Graham Parnell of Limagrain. These results suggested that the ploughed half of the field was marginally more mature than the min-tilled side. There was no significant difference in maize establishment or quality across the under-sow options.



Maize yield at harvest was assessed using John Deere Harvest Lab technology (also NIRS), kindly supplied by Smallridge Bros Ltd. The map above shows the yield results across the field, with more detail shown in the graph below.

John Deere Harvest Lab results	Ploughed	Min tilled
Yield (t/ha)	11.4	12
Moisture (%)	66	64.8
Dry Matter (%)	34	35.2
Wet weight (t/ha)	33.6	34.1
Crude protein (%)	6.9	6.8
Sugar (%)	5.9	5.9
NDF (%)	42.3	42
ADF (%)	26.3	26
Starch (%)	30.2	31.3

Finally...

The establishment of maize by using reduced non-inversion cultivation methods and use of under-sown companion crops will benefit the soil. From the Duchy College results, not ploughing did not affect yield.

The benefits of under-sown companion crops are likely to have a legacy effect on the following crop. These potential benefits need to be measured to fully define cost-benefit of under-sowing.

The impact on the farm's carbon footprint could be measured in protecting soil carbon stocks, as well as the potential for less fuel use when establishing crops into a well-structured soil.