Trial protocol: Maximising the benefits of different maize establishment methods for soil health, carbon sequestration and yield: a Farm Net Zero trial

Background to the trial:
Maize is commonly grown in the southwest as a fodder crop for the dairy industry. It is traditionally established through heavy cultivation, usually including ploughing and power harrowing, because the seed needs a fine seedbed for maximum soil-seed contact.

Because the crop is very uncompetitive in its early stages of growth, rows are usually wide apart and sprayed with herbicides to limit the growth of competitive ground cover. This means a maize field has a lot of bare soil in the early months of growth, and usually all the way up to and including harvest. It is harvested relatively late in the season, often into October, when the weather is often wetter.

The heavy cultivation used, lack of ground cover, wide rows, shallow roots and late harvest combine to leave the soil in maize fields vulnerable to erosion and runoff throughout the long growing season and especially at harvest.

The objective of the trial:
To investigate the effect of alternative cultivation systems on soil health and yield of maize. Two systems will be investigated:

1- Strip till-cultivating only the drilled strip and leaving the rest unmoved.
2- Disc cultivation instead of plough-based system-considered to be more min-till based, cultivating the whole field to shallower depth without full inversion.

Strip tilling involves cultivating narrow strips of soil where seed is drilled, leaving the ground between the strips undisturbed. The strips are prepared either by a one-pass till-and-drill combination based on a special cultivator plus standard precision drill units, or by a 2-pass system where the ground is strip tilled at the first pass and drilled at the second.

Benefits to farmers:
Opinion is still divided among UK farmers as to the benefits of strip till in maize. There have been relatively few UK trials on the topic, and results are often closed sourced, or more anecdotal rather than rigorous. Further trials should therefore be carried out in the UK to provide open-source data to farmers comparing strip tilling directly to conventional ploughing.

The aim is to make maize less of an environmentally high-risk crop for farmers. If it can be proved that strip tilling maize with an appropriate cover crop has a positive overall impact on crop and soil health (without impacting yield), it is likely that more farmers will adopt it as they will perceive it as less risky practice. This could have huge environmental benefits, particularly on water quality and soil health. It could also potentially reduce fossil fuel use and labour hours from less cultivation, both of which should create financial savings to farmers.

One further consequence of strip till could be in yields of following crops if soil structure has been improved and nutrient leaching reduced, following crops could show increased yield or reduced production costs.

Designing the trial:
The group came together as part of the CAF Lottery Farm Net Zero project. A meeting was held at Stoke Climsland village hall looking at the results of an independent farm trial looking at maize establishment methods. It was decided by the group that this initial, unreplicated trial should be developed into a field lab to produce scientifically rigorous, replicable results.

A second meeting was held in March to work out the trial design with input from Hannah Jones from FCT. The wet spring disrupted drilling and farmer involvement but other farmers came forward wanting to be involved.

The trial design was largely followed with a strip drill cultivator made available by a local machinery company following contact between farmers and equipment company, all led by farmers looking to look at all options.

Trial design
Year 1:
Following the trial operated by a FNZ monitor farmer. Farms will drill trial strips using normal practice, strip till and disc cultivated instead of normal inversion practice. The inversion tillage will be the control. There will be no replication on farms but similar practices including same drill operator will reduce variation. Soil samples will be taken at harvest to assess any differences due to drilling practice.

Farmers who plan to grow maize in the following year will plant green cover crops when appropriate to assess effect of different green covers on yield and soil health metrics.

Year 2:
The same drilling techniques will be repeated either on the same fields to look at long term effects, or following overwinter green manure mixes to compare effects of covercrops and cultivation on yield and quality of maize.

Data Collection
Yield: Yield will provide some of the most important data collected from the trial, because this is what the farmers are most interested in demonstrating, and what is most easily communicated to other farmers. We hope that the yield from the treatments will be at least equal to the control.

Yield will be measured just before harvest by the coordinator. A quadrat will be placed in random locations in each plot, and the maize cut and weighed. When the main crop is harvested a sample will be sent off to be assessed for starch and sugar. (It is possible that some farmers will have access to a harvester which can calculate specific yields from specific plots, but for now we have assumed not).

Other plant data:
Growth rates – farmers to make visual assessments of crop for each plot at different stages of the growing season including noting the time the maize takes to get 50cm / knee high and the time of tasselling. The coordinator and researcher will draw up a simple assessment sheet to help record data. This data will be of interest to the trial as it may show up different growth rates, and crop resilience in response to stresses such as drought. However, it will be optional to farmers, as the yield is the critical measurement of crop success.

Soil Assessments - before beginning the trial soil samples will be taken by the coordinator (or farmer in some cases), from each trial field. These will be sent to NRM for a CarbonCheckPlus test (A422) which includes assessment of Carbon [organic, inorganic and total], Nitrogen [C:N ratio] and density to calculate the Carbon stock and soil organic matter. Plus active carbon to assess the portion of organic matter readily available to soil microbes.

This is a fairly basic soil test, chosen because it can be used by farmers themselves if they wish to run their own trials inspired by this field lab.

The same soil test will be carried out just before harvest to assess what changes have taken place as a result of the different treatments.

Visual Evaluation of Soil Structure VESS:
Just before harvest the coordinator will carry out VESS soil tests on each of the plots. They will visually assess earthworm numbers, soil texture and compaction. Guidance for farmers on how to carry out these soil assessments will be provided so that they and other interested farmers can do it themselves (IF already has this guidance for dissemination).