Picture 1: Rolled first crops before maize sowing

# REDUCED TILLAGE TO SILAGE MAIZE

By 2021, organic maize production in Germany will amount to 38,000 ha and will continue to grow in importance. In this context, there is growing interest in reduced tillage and direct seeding methods. The University of Kassel-Witzenhausen has coordinated a joint project to test different methods.

Using ploughing to grow maize causes difficulties and negative effects on the environment:

- Soil erosion
- Nutrient leaching
- Complex weed control

Climate change and the resulting increase in weather extremes (e. g. heavy rainfall) are exacerbating the problems. For this reason, adaptation measures are needed to make the farming system more robust (= resilient) to the effects, so that yields can be stabilised. Reduced tillage to direct seeding improves soil conservation, but at the same time often increases weed infestation and leads to yield losses. This is where innovative cropping systems are needed to address the problems in their entirety.

## Aims and structure of the project

In a joint project between the University of Kassel, the Bavarian State Research Centre for Agriculture and the Thünen Institute, different maize cultivation systems were tested at three locations in Germany: In the north of Germany, the site was located in Trenthorst/Lübeck. A more central location was in Neu-Eichenberg/Witzenhausen and in the south in Puch/ Munich.

The cultivation of a winter hardy cover crop/first crop (CC/FC) before maize was basic and consistent. The following varieties were tested.

Variants:

1. Control without FC and with ploughing in autumn and intensive tillage for sowing
2. Harvest FC winter pea/rye-mixture (wp/rm), reduced tillage to maize
3. Rolling the FC winter pea (wp) – direct sowing maize
4. Rolling of the FC wp/rm – direct sowing
5. Rolling of FC winter vetch (Wi) – direct sowing
6. Rolling the FC Wi/rye-mixture – direct sowing

CC were sown in early October and harvested at flowering in late May/early June (Var. 2) or rolled (Var. 3–6). The control maize in Var. 1 was sown in early May after seedbed preparation.

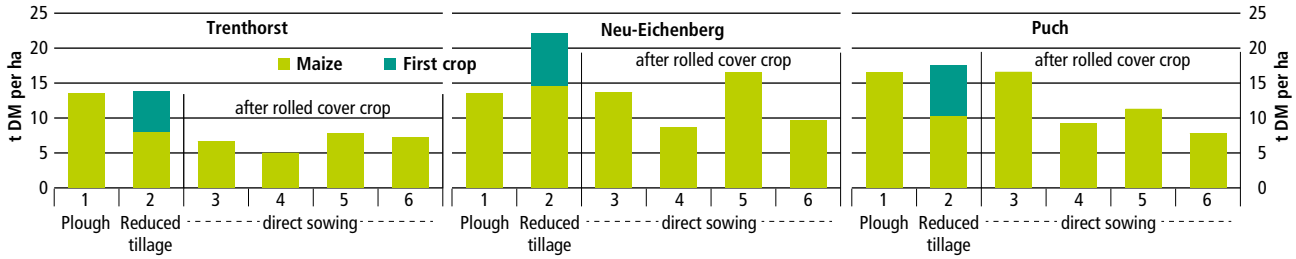
## Results

At Trenthorst, yields were highest in the ploughed control (Fig. 1). The slower development of CC due to the site resulted in even later sowing after flowering and lower maize yields than at the other sites. At Eichenberg, maize yields were comparable to the control despite late drilling after harvesting FC winter pea/rye-mixture and after pure rolled legumes. Harvesting the first crop resulted in a significantly higher total yield per year. At Puch, maize yields after pure vining pea were as high as the ploughed control. At all sites, maize yields were higher after rolled sole-cropped legumes alone than after rolled mixtures due to higher nitrogen (N) fixation. The rolled legumes formed a thick biomass layer (Fig. 1) into which the maize was sown using a special direct seeder. This cleared the biomass from the seed row with a clod clearer for precise seed placement. To achieve sufficient dry matter content with late sowing, maize varieties with a lower silage maturity number should be used.

## Synergy effects and ecosystem services

Harvesting two crops results in high annual yields and distributed risks, for example

## FIG. 1: SILAGE MAIZE AND TOTAL ANNUAL YIELD OF THE TRIAL CROP OPTIONS AT THREE LOCATIONS




1. Control without FC and with ploughing in autumn and intensive tillage for sowing, 2. Harvest FC winter pea/rye-mixture (wp/rm), reduced tillage to maize, 3. Rolling the FC winter pea (wp) – direct sowing maize, 4. Rolling of the FC wp/rm – direct sowing, 5. Rolling of FC winter vetch (Wi) – direct sowing, 6. Rolling the FC Wi/rye-mixture – direct sowing (Mean values for the years 2020/2021)

yield losses due to extreme weather events. Reduced tillage with the residual crop and root residues provides good soil protection (Fig. 2), which is further enhanced by rolling the CC.

CC can suppress weeds preemptively and lead to lower weed pressure in maize. Control was hoed/weeded up to five times, while the control was hoed/weeded the maize was hoed a maximum of twice after harvesting and not regulated at all after rolling. With insufficient rolling and insufficient tillage, the resprouting of the CC resulted in weed infestation (Var. 4+5 in Puch, Fig. 2), otherwise the cover rates were the level of the control variety, with the control variant in Eichenberg had very high values. This indicates the importance of rolling the CC at the right time (during flowering). It provides a competitive advantage for the maize.

The rolled varieties were not fertilised and were still able to achieve yields similar to those of the varieties 1 and 2 fertilised with up to 80 kg N/ha. The maize benefited from the N fixation of the pure CC legumes.

**Picture 2: Maize after winter peas/rye-mixture and reduced tillage for sowing, 1 week after sowing.**

**Picture 3: Maize after rolled winter peas, 7 weeks after sowing.**

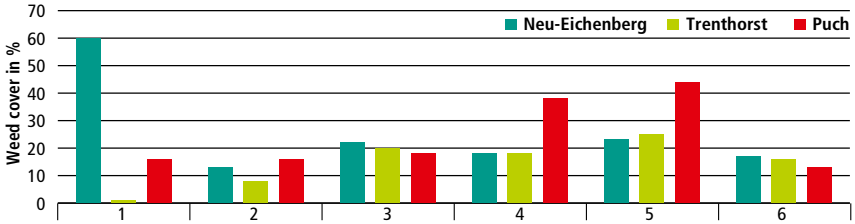
### Rolling requirements

The systems presented place increased demands on management. The biomass rolling systems are also more expensive than reduced tillage because of the need for specialised machinery. In addition, depending on the location, sufficient water must be available for two crops; for example, maize yields were sometimes very low in the drought year of 2022, according to CC.

### Concluison

Intensive intercropping of legumes (or in mixtures with cereals) has great potential to reduce tillage to maize with improved soil conservation and possibly reduced weed pressure. Which system is used needs to be considered and adapted.

## FIG. 2: COMPARISON OF WEED COVERAGE IN PERCENT BETWEEN VARIANTS 1–6 IN 2021




Variants 1–6 see Fig. 1

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