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Intercrops – the first step to conservation tillage

Conservation tillage has several advantages. Considering soil protection the percentage of residue cover is one of the crucial parameters in this matter. Thick straw layers cause problems in the emergence rate of the following crop. In a project of three years with field experiments the relation of emergence rate of the intercrop oil radish from straw quantity and working depth has been investigated. The small differences in the emergence rate and the balanced results between the deep and shallow cultivator treatment shows that the conservation tillage for intercrops is a good starting point and will be successful even with lower working depths.

Keywords

Conservation tillage, straw distribution, soil cover index

Abstract

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■ 21 % of the arable land in Germany is tilled using conservation methods [1]. Conservation tillage is a suitable measurement for soil protection especially for erosion-prone soils and offers lower energy and equipment costs. Therefore, soil cover index is an important factor, a reasonable protection against erosion is reached at 30 % soil cover [2]. In spite of these advantages the majority of farmers in Germany are hesitant to give up approved tillage system with the plough. One of the reasons stated by the farmers is the lower emergence rate due to high straw quantities and high residue cover. This is responsible for the worse development of the following crop. At the same time it is well known that successful conservation tillage demands farmers with high skills and experiences [3]. The application of conservation tillage to intercrops might be a good chance the system with a less risk potential for the farm. In an interdisciplinary project the effect of straw quantity and working depth on the emergence rate and yield of intercropped oil radish was investigated with special focus on soil protection.

Material and method

The field trial was implemented on the area of the Hessische Staatsdomäne Frankenhausen, which is managed according organic agriculture regulation since 1998 (soil: loess derived haplic luvisol, mean annual rainfall: 650 mm). The standard tillage on the farm is done with a mouldboard plough. The field trial was implemented over three years (2007 to 2009) ever after the harvest of the cereal (wheat or triticale). The trial was set up in a randomized split block with four replicates. The size of each

plot was 12 m × 30 m (**figure 1**). Three tillage applications and four straw quantities were investigated:

- Tillage with mouldboard plough (26 cm)
- Tillage (deep) with cultivator „Centaur“ (13 cm)
- Tillage (shallow) with cultivator „Centaur“ (7 cm)

with following straw quantities: 0 t straw/ha (= only the stubble); 4 t straw/ha; 6 t straw/ha; 8 t straw/ha.

Site preparation

In times past distribution of straw quantities in field trials was difficult and mainly done with grassland technology. A new distribution system employing a combine harvester was developed to get a practical-related straw cover and a precise distribution of the four different straw quantities in each field plot: After the harvest the straw got pressed in balls and was taken to the weighing. In accordance to this measured weight the defined straw quantities were re-distributed in the plots. Already during the pressing of the straw balls the ball weight was adapted to the needed straw quantities/plot with variable chamber balers. The straw in each plot is distributed in two strips along the working direction of the combine harvester. It was considered that the straw strips end before the end of the plot, otherwise the harvester would have distributed the straw outside of the field plot. The width of the harvester determines the placement of the strips in the plot to avoid overlapping. The combine chaffed the straw and re-distributed it on the plots. So a practical and regular straw distribution in the plots could be guaranteed.

After the preparation field plots and measuring points were geo-referenced using a GPS unit (Leica GPS system 500) changes in the soil cover index after each tillage application could be seen. Each of the six measuring points per plot could be found with the GPS system with an accuracy of five centimeters. The first shallow tillage (6 cm depth) with the cultivator („Centaur“ from Amazone Co.) was done on the entire field experiment. After eight to ten days the second tillage with different

working depths took place according the field experiment plan (figure 1). The intercrop oil radish (cultivar: Apoll, 20 kg/ha) was sown with a pneumatic seed drill with disc harrows. The residue cover was measured with a new camera sensor, which had been developed within the project [4]. The emergence rate was counted after ten days of sowing in four lines each 0.5 m long. For the yield estimation at each measuring point/plot all oil radish plants of 0.5 m² had been harvested. The plants were dried by 80 °C till constant weight to resume dry matter.

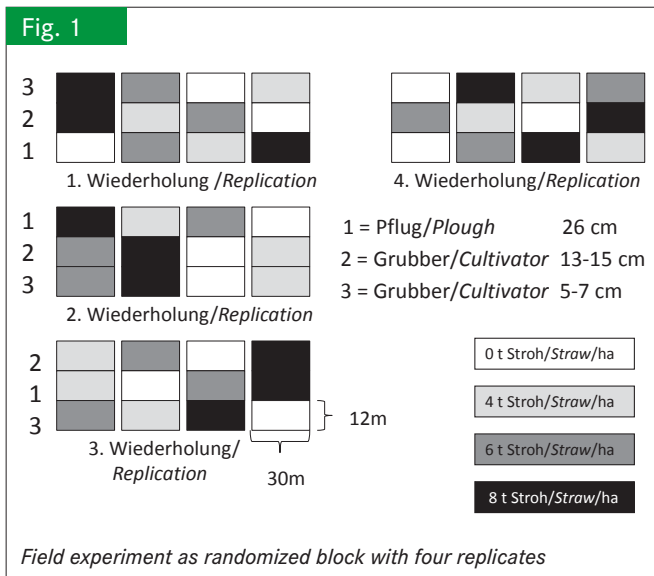
Results

■ Residue cover: As expected the means of the soil cover index after the second tillage show an increase of the soil cover index at higher straw quantities (table 1). This trend was more or less pronounced, depending on the tillage depth. In 2009 the residue cover index of 30%, which is considered as necessary for a reasonable protection against

erosion, was reached in the deep tilled plots with the cultivator (13 cm) only at straw quantities of 8 t/ha. In the plots with the shallow cultivator application (7 cm) the residue cover index of 30% was reached at 4 t straw /ha.

■ Emergence rate: In 2007 and 2009 the highest emergence rate of the oil radish was found in the ploughed plots. In 2008 there were only slight differences in the emergence rate between the different tillage applications (figure 2). In between these two different cultivator applications there was almost no difference in the emergence rate of the oil radish over the three years of the field trial.

■ Dry matter oil radish: In all three years the highest yield was found in the ploughed plots. The differences between the cultivator applications are visible in the graphics below (figure 3). In plots tilled by the cultivator there is in every year a decline in the dry matter yield between the straw quantities 0 t/ha and 4 t/ha.



Conclusions

The new method of straw distribution with the help of a combine harvester has proven to be a practical solution to distribute defined straw quantities in field plots. In combination with the new camera sensor for the measurements of the residue cover index the field trials were efficiently installed and evaluated.

When comparing the use of cultivator vs. plough the emergence rate and the dry matter of oil radish brought better results in the ploughed plots. On the other hand there was almost no difference in the emergence rate and dry matter yield between the two cultivator applications (deep and shallow). Generally, the measured yields in the three year long field trial should be considered low. An explanation for that might be that the field trials were established at the end of the crop rotation and regular manure fertilization was interrupted in an attempt to avoid any influences on the measurements of the residue cover.

Table 1

Mean value of soil cover after second tillage [%]

		0 dt Stroh/ha 0 t straw/ha	40 dt Stroh/ha 4 t straw/ha	60 dt Stroh/ha 6 t straw/ha	80 dt Stroh/ha 8 t straw/ha
2007	Grubber flach/ Cultivator shallow	19 %	29 %	35 %	37 %
	Grubber tief/ Cultivator deep	14 %	19 %	22 %	28 %
2008	Grubber flach/ Cultivator shallow	19 %	27 %	37 %	34 %
	Grubber tief/ Cultivator deep	11 %	19 %	26 %	22 %
2009	Grubber flach/ Cultivator shallow	17 %	32 %	40 %	49 %
	Grubber tief/ Cultivator deep	11 %	19 %	26 %	31 %

Fig. 2

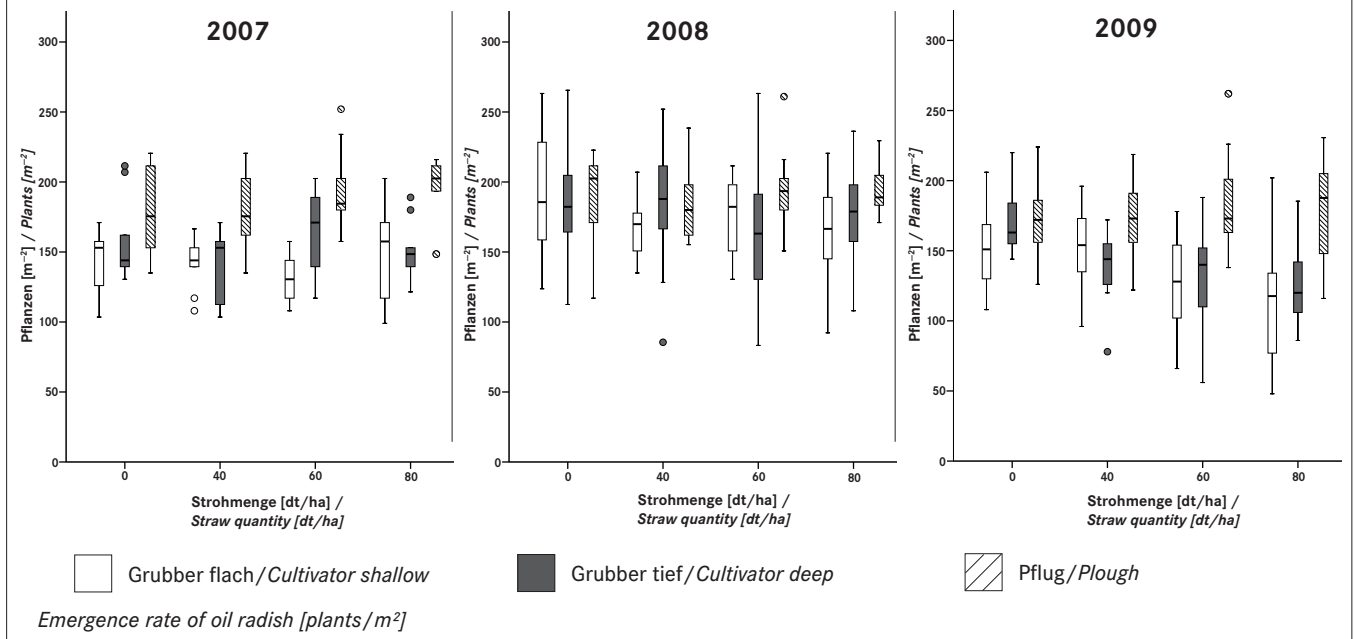
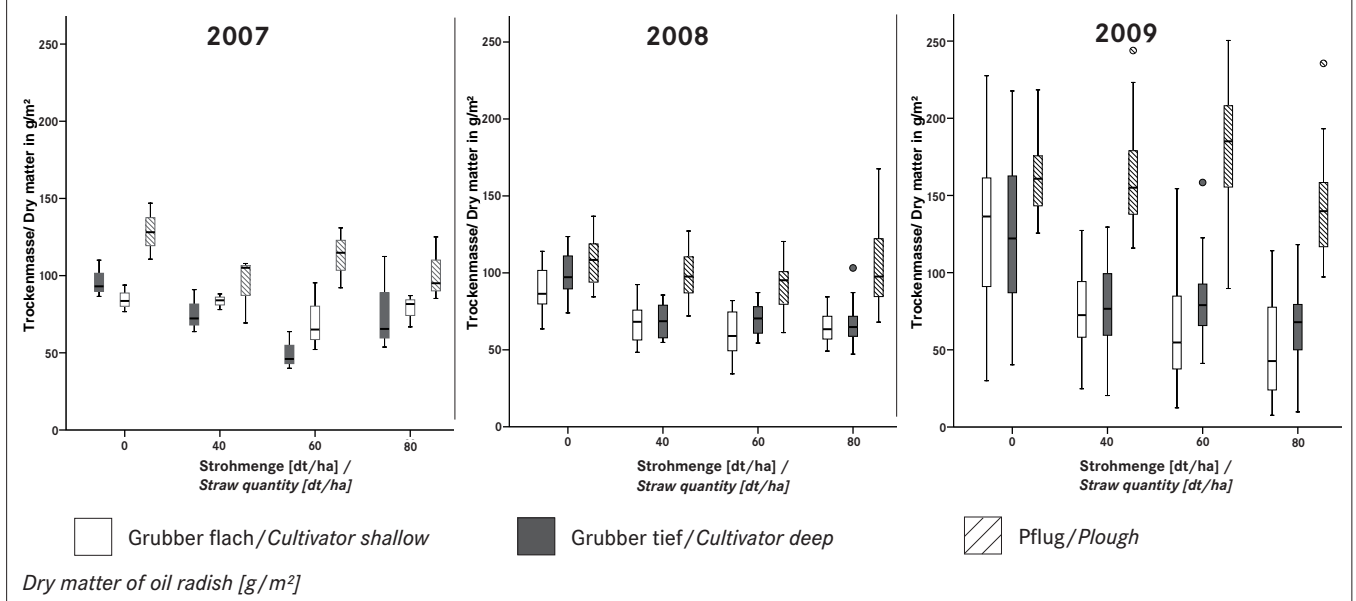


Fig. 3



The different straw quantities in the plots with cultivator application show only small effect on the emergence rate and yield of the intercrop. These results demonstrate the development of modern tillage technology with strong improvements in the incorporation of straw residues even with shallow tillage. Under these conditions an introduction of conservation tillage at intercrops is reasonable without any further problems and doesn't require deep tillage.

Literature

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