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Comparison of different drilling techniques for maize

The intensive growing of maize, especially for producing fermentation gas, in consequence causes a needle eye in combination with intercrop harvest and spreading semi liquid manure. Efficient alternatives, like cultivator seeding and row seeding with discs where tested in comparison with precision seeding at the Institute for Agricultural Engineering and Animal Husbandry in Freising–Weihenstephan. Provisional results show lower field emergencies than in precision seeding. But not always the yield of dry mass is significant lower with this alternative seeding systems for maize. Actually the yield, in comparison to precision drill, shows strong fluctuations depending on drill and tillage system, location and repetition.

Keywords
Maize drill, single seed drill, seed drill with discs, cultivator seed drill

Abstract
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The cultivation of silo maize after the harvest of intermediate winter crops is a challenge for many farms. Each additional day leads to higher intermediate crop yields, which has a negative effect on the following silo maize at the latest as of mid-May. Moreover, the available field labour days are scarce in the spring, and the silage harvest as well as slurry spreading and maize cultivation require well-dried soils. Therefore, high area capacities must be striven for and are important in particular in extreme years [1]. For this reason, studies were carried out as part of a project in order to examine whether alternative maize seeding techniques which provide higher capacities and hence, cost and time savings, show comparable results with regard to germination and the harvest yield of precision seeding.

Structure of the trial

Three implements from different manufacturers were chosen which represented precision seeding, row seeding with discs, and cultivator seeding (figure 1). With the aid of these three machines, the same maize variety was cultivated at one location (as of 2008: two locations with differently heavy soils) and under the same conditions. For this purpose, every implement was used with and without prior soil cultivation (cultivator seeding or precision seeding into the stubble of the killed previous crop). This provided six different variants, which were repeated three times. In order to keep the tramline effect from the harvest of the previous crop and the distribution of the fermentation residues constant, the previous crop was not harvested. Instead, this intermediate crop stand with tramlines was killed in the spring, and fermentation residues were spread precisely in these tramlines with exactly identical tank filling or compost distributor weight. Tillage and soil cultivation were carried out at right angles to these tramlines so that every strip had the same number of tramlines. During the evaluation of germination and harvesting, the strips were not registered completely. Instead, they were divided into three parts with a tramline and three parts without a tramline. Thus, comparable lots having a tramline share of 0 and 25% were created. In these lots, germination was determined by counting the plants. The crops were harvested by an experimental forage harvester with a built-in scale. The dry matter was measured by sampling and drying in a drying chamber.

Fig. 1

Tested seeding systems (from left: disc seeder, cultivator seeder, single seed drill)

Results

High, even germination rates are necessary as a basis for an optimal crop stand and, hence, later yield. The determination of the number of plants in the different variants has shown that both the drilling technique and the conditions (soil cultivation, tramlines, weather) have a significant effect on germination and field emergence (figure 2). If precision seeding is applied, more than 50% of the germination rates (years, locations, variants) exceed 90% and reach the desired crop density. However, there are also germination rates below 80% (2007, Gut Rosenau) due to tramline influence and a lack of tillage in combination with the weather (spring drought). With only one exception, all germination values for the two alternative techniques are below 90%. While row seeding with discs leads to a noticeable (negative) influence of the tramlines on the germination rate, cultivator seeding shows uniform, moderate germination rates over all variants. In the extremely dry spring of 2007, coarse-clod seedbed preparation with the seeding cultivator likely caused increased germination losses. The disc drill and the single seed drill also reached the lowest germination rates in 2007.

Despite poor germination or perhaps due in particular to scarce water supply in the thin crop stand, the yields on the cultivator drill lots were identical with those provided by precision seeding in 2007 (figure 3). Even though the difference is not always significant, the highest yields are found on plots with soil cultivation and precision seeding. The values for row seeding with discs are similar, though at a lower level. Soil cultivation and tramline loosening by a cultivator have the same positive effect achieved in combination with precision seeding. With one exception at the location Oberteisbach in the year 2008, the yields provided by cultivator seeding are relatively close together.

Summary

Even if the seedbed was not prepared, maize drilling with alternative seeding techniques showed good results. The germination rates are generally considerably lower than after precision seeding. For this reason, the producers recommend a 10% higher seed rate. In most cases, yields are below those provided by single seed drilling, or they are at least subject to heavier fluctuations, which depend on many factors. In principle, precision seeding causes smaller yield fluctuations except for the variant without soil cultivation and under extreme weather conditions. However, the yields indicated here must be compared with the different expenditures even though this comparison is not included in this contribution. Here, row seeding with discs and cultivator seeding as universally applicable techniques have advantages with regard to the range of use, annual capacity exploitation, and worktime requirements. Therefore, farmers who apply "biogas crop sequences" are increasingly using the drill and cultivator seeding technique or are looking for alternatives to precision seeding [2].

Literature

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Table 1

Germination of seeding systems (all years, locations and tillage systems)

Standort bzw. Jahr *location and year* / **Variante** *variant*	**Feldaufgang** *germination*	**Gut Rosenau 2007**	**Gut Rosenau 2008**	**Oberteisbach 2008**
		Feldaufgang [%] der Aussaatstärke *germination*		
ohne Bodenbearbeitung ohne Spur *no till without track*	**Grubbersaat** *cultivator seed drill*	65,2	87,6	78,9
ohne Bodenbearbeitung mit Spur *no till with track*		65,8	86,1	80,2
mit Bodenbearbeitung ohne Spur *with tillage without track*		66,7	84,2	85,3
mit Bodenbearbeitung mit Spur *with tillage with track*		66,5	86,6	83,3
ohne Bodenbearbeitung ohne Spur *no till without track*	**Scheiben-Drillsaat** *seed drill with discs*	75,7	89,1	82,1
ohne Bodenbearbeitung mit Spur *no till with track*		67,6	81,7	74,9
mit Bodenbearbeitung ohne Spur *with tillage without track*		74,1	83,7	90,9
mit Bodenbearbeitung mit Spur *with tillage with track*		72,1	84,4	76,2
ohne Bodenbearbeitung ohne Spur *no till without track*	**Einzelkornsaat** *single seed drill*	76,2	94,4	93,0
ohne Bodenbearbeitung mit Spur *no till with track*		76,7	92,4	73,2
mit Bodenbearbeitung ohne Spur *with tillage without track*		82,2	92,9	95,5
mit Bodenbearbeitung mit Spur *with tillage with track*		82,4	94,4	89,6

Table 2

Dry mass yield of seeding systems (all years, locations and tillage systems)

Standort bzw. Jahr *location and year* / **Ertrag bzw. Feuchte** *yield and moisture* / **Variante** *variant*		**Gut Rosenau 2007**		**Gut Rosenau 2008**		**Oberteisbach 2008**	
		Ertrag *yield* **TM** **[dt/ha]**	**Feuchte** *moisture* **TS** **[%]**	**Ertrag** *yield* **TM** **[dt/ha]**	**Feuchte** *moisture* **TS** **[%]**	**Ertrag** *yield* **TM** **[dt/ha]**	**Feuchte** *moisture* **TS** **[%]**
ohne Bodenbearbeitung ohne Spur *no till without track*	**Grubbersaat** *cultivator seed drill*	208,4	39,3	212,8	28,2	201,6	32,6
ohne Bodenbearbeitung mit Spur *no till with track*		208,4	39,7	214,3	28,5	257,2	33,3
mit Bodenbearbeitung ohne Spur *with tillage without track*		206,2	38,9	211,1	27,4	245,4	33,7
mit Bodenbearbeitung mit Spur *with tillage with track*		194,9	39,1	204,7	27,5	245,3	34,1
ohne Bodenbearbeitung ohne Spur *no till without track*	**Scheiben-Drillsaat** *seed drill with discs*	176,1	39,4	215,1	28,7	235,9	33,3
ohne Bodenbearbeitung mit Spur *no till with track*		177,6	41,7	212,9	29,5	215,7	32,1
mit Bodenbearbeitung ohne Spur *with tillage without track*		204,4	40,4	221,7	28,7	264,2	35,6
mit Bodenbearbeitung mit Spur *with tillage with track*		193,4	39,1	213,2	27,7	243,0	36,2
ohne Bodenbearbeitung ohne Spur *no till without track*	**Einzelkornsaat** *single seed drill*	194,1	39,8	218,6	29,9	243,5	35,0
ohne Bodenbearbeitung mit Spur *no till with track*		195,9	40,3	214,5	28,9	240,9	39,0
mit Bodenbearbeitung ohne Spur *with tillage without track*		203,1	40,7	232,4	30,0	275,3	38,1
mit Bodenbearbeitung mit Spur *with tillage with track*		207,0	41,4	227,0	29,4	258,8	37,3