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What Does Seeding Cost?

The Savings Potential of Conservation Tillage

At the Institute of Agricultural Engineering Gießen, studies on conservation tillage in peripheral regions were carried out within the special research area 299 from 2000 until 2003. For this purpose, trial lots for four different tillage techniques with different tillage intensity were set up on three experimental fields. The data of the process-technological measurements, such as performance measurements, were integrated into the economic calculations [1].

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Keywords

Field work, tillage, operation costs, measuring capacities

Tillage is one of the most conspicuous characteristics of agricultural activity. Its classic tasks are soil loosening, the induction of site- and crop-specific improvements in the water-, air-, and temperature household of the soil, and the repair of damage to the soil structure. In addition to improving the soil structure, the homogenizing of the topsoil is of importance. In this process, one must make sure that disruptions in the transition to the subsoil are kept to a minimum. As indicated above, other goal effects of tillage are countermeasures against the development of weeds and weed grass as well as the successful incorporation and decomposition of organic masses [2].

This objective includes the evaluation of different mechanization strategies for peripheral arable farming locations, which is dependent on selected process-technological, economic, ecological, and agronomical parameters. The choice of mechanization is based on the predominant machinery in use and different techniques ranging from conservation tillage to NoTill drill.

Thus, initial evaluations of preferred mechanization variants for the special requirements of peripheral arable farming locations were able to be given after the completion of the trials.

Location	1	2	3
Altitude a. sea level in m	349	300	373
Ø precipitation in mm	720	800	800
Ø temperature in °C	7,6	7,6	7,6
Field size in ha	1,34	1,28	2,78

Table 1: Parameters of the trial locations

Material and Method

Trial Locations

In addition to the long-term trials of the Institute of Agricultural Engineering, which provide a unique possibility worldwide of analyzing different tillage intensities, three additional experimental areas were set up. The trial locations represent areas which are typical of certain regions. Trial locations 1 and 3 feature brown earth soils, while trial field 2 is characterized by impound water soil. At the three locations, soil depth is approximately 40 cm on trial field 1 and 2 and in the hollow of trial field 3. On the stony tops of trial field 3, depth is about 15 cm.

Machines

During the trials, the following process variants were employed for tillage and cultivation:

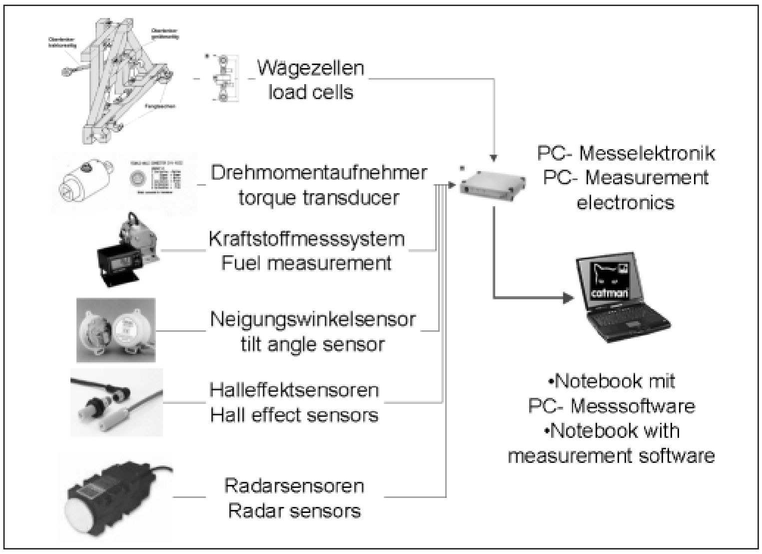

Fig. 1: Measuring technologyused during experiments

Table 2: Power requirements of the different methods

	D00	D01	D02	FS00	FS01	FS02	FR00	FR01	FR02	P00	P01	P02
Turning power P[kW•mAB^{-1}]	1,06	2,10	1,49	14,02	15,59	15,39	14,63	18,89	16,11	15,90	12,29	12,07
Tractive power P[kW•mAB^{-1}]	11,08	10,46	11,41	-2,55	0,74	0,70	18,25	8,61	11,67	36,17	26,79	19,73
Total power P[kW•mAB^{-1}]	12,14	12,56	12,94	13,76	16,33	16,09	32,89	27,49	27,77	52,00	39,08	31,8

Table 3: Diesel fuel requirements of the different methods

	D00	D01	D02	FS00	FS01	FS02	FR00	FR01	FR02	P00	P01	P02
B [l•ha^{-1}]	5,79	6,99	5,84	14,81	8,47	8,64	15,26	22,78	25,08	38,91	33,67	29,33
B [g•kWh^{-1}]	530,15	442,19	421,76	797,25	357,07	355,32	248,64	321,60	318,89	779,93	767,39	935,7

Table 4: Possiblediesel fuel savings when selecting appropriate methods

[€•ha^{-1}]	P opt.	P real	FR opt.	FR real	FS opt.	FS real	D opt.	D real	Fruchtart
VF1 2002	144,67	219,20	-45,24	-81,79	-65,84	-110,98	-107,76	-146,23	TR
VF2 2002	115,98	224,32	-16,09	-83,96	-36,89	-115,29	-78,82	-150,18	WG
VF3 2002	115,98	224,32	-16,09	-83,96	-36,89	-115,29	-50,91	-122,33	WG

- A plough with a rotary harrow and a semi-mounted box seeding machine (P = PP + KE)
- A wing share cultivator with a tine rotor and a semi-mounted pneumatic seeding machine (FR)
- Rotary seeding (FS)
- NoTill drill (D)

For these techniques, which are sorted according to diminishing tillage intensity, process-technological, soil-physical, agronomical, and ecological parameters were measured. These form the basis of the economic calculations.

Measuring Technology

A Fendt Xylon 524, which provides sufficient space for the installation of the measuring equipment due to its double cab, served as trial carrier. The instruments shown in *figure 1* are combined with the carrier vehicle into a measuring system. Thus, the measurements were able to be taken on-line during tillage and seeding.

Results

In *tables 2 to 4*, selected process-technological results are listed. They were used for the economic calculation of the techniques, which is described in a shortened form here, in addition to the data provided by the manufacturers and the KTBL. The normal cost was calculated based on a portion of the overall expenses. Identical work steps in the techniques, such as fertilizing, were not considered in the cost calculation. Over the trial years (D00-02), the D techniques provided the lowest total power requirements per metre of working width (table 2) and the lowest fuel consumption per ha. The lower power requirements, which resulted in the capacity of the carrier vehicle not being fully utilized, explain the higher specific fuel consumption per kilowatt hour in technique D. Among the other techniques, the FS technique ranks before the FR technique followed by the P technique, which performs more poorly in particular due to its two work steps.

The ranking for fuel consumption per hectare is similar (*table 3*). With regard to fuel consumption per kilowatt hour, the FR technique ranks before the FS technique due to better engine capacity utilization.

Over the course of the trial years, average driving speeds ranged between 5.08 km•h^{-1} in the FR technique and 11.33 km•h^{-1} in the D technique. Depending on the area configuration, i.e. depending upon the possible annual work rate, the techniques allow potential savings of more than € 150 per ha to be achieved as compared with the P technique. In the latter technique, improved area configuration provides savings of up to € 108 per ha.

In order to achieve higher work rates in the future and thus to exploit this savings potential, the cultivation of these areas ultimately requires cooperative machinery use. The substantial capital tie-up needed for individual mechanization would only pay off if the farm entrepreneur put the free machinery capacities at other farmers' disposal for a fee. Since, however, legal conditions in particular exert a considerable influence on the process-technological possibilities of tillage, these conditions will be a significant determining factor for tillage not only in peripheral regions, but also in all of Germany or even Europe-wide. If the conditions persist, farm entrepreneurs can significantly reduce the expenses for work in arable farming using the aid of conservation tillage systems or NoTill drill techniques.

Literature

Books are identified by •

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