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Use of Self-propelled and Tractor-mounted High-capacity Mowers

Economic pressure as well as structural change towards larger farms in dairy cattle husbandry requires more effective forage harvesting methods, and this with highest feed quality at lowest costs. Meeting the best cutting time is required and hence the capacity of mowing technology. Therefore cutting grass increasingly is done on a multi-farm basis. Triple combinations mounted to tractors and to carrier vehicles as well as SP-mowing machines attain the highest mowing capacities with working width up to 14 metres.

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Keywords

High-capacity mowers , field capacity, transport

Currently, only a few and incomplete data are available for the evaluation and classification of the technology "grass mowing with high-capacity mowers". The correct classification and better organization of the technology require the greatest possible precision of the process parameters as a function of different field sizes, field distances, and the resulting costs.

Material and method

At the beginning of the study, a survey among Bavarian machinery rings was carried out, which was intended to show the current status in order to determine the main applications of high-capacity mowers. Based on the analysis of the survey results, machinery cooperatives and contractors´ operations, which seemed typical, were selected for more detailed analyses. Two high-capacity mowers working in different regions were accompanied for several days. During this time, all machine times, external conditions, and distances covered were recorded by hand. In addition, a GPS data logger from the company Communication Technology, which was installed on a self-propelled high-capacity mower of the mowing cooperative Berchtesgadener Land / Traunstein BTG GbR, was used as of the mowing season 2004. The data logger (*Fig. 1*) features four analogue and 12 digital entries. In addition to the time, the position, the speed, and the course angle (GPS information), the mower position is recorded, which is determined by means of reed contact. In the mowing season 2005, one tractor with a pushed mower combination (working width 8.5 m) was equipped also with a data logger of this type. The collected data and signals are read in and processed in a SQL database, programmed for the collection and evaluation of process data [1]. The coordinates allow the borders, shapes, and sizes of fields to be determined. In addition, the mower position enables the percentage of work-, transport- and downtimes to be established.

Initial results and discussion

Survey among machinery rings

The survey among machinery rings in the year 2004 showed a remarkably large number of large-capacity mowers in Bavaria (*Table 1*).

According to this survey, 35 self-propelled mowers are used in 20 machinery ring areas. Most of these mowers are found in the foothills of the Alpine region and in the Bavarian Forest.

At the borders of arable farming regions large tractors from arable farming are available from spring until autumn. They are run with triple mower combinations having a mowing width of > 8 m (40 units) either as a "butterfly combination" or with reversing equipment as pushed mowers.

Table 1: Results of the survey about the use of high capacity mowers in Bavaria 2004

Questioned machinery rings in Bavaria	82
Answers / percentage of respondents	40 %
Number of machinery rings with high-capacity mowers (ww > 6 m)	33
Number of high-capacity mowers (ww > 6 m)	140
Number / % of tractor-mounted	105 / 75 %
Number / % of self-propelled	35 / 25 %

Table 2: Utilization parameters for a self propelled high capacity mower in the mowing cooperation BTG in 2004

Parameter	1. cut 2004	Following cut 2004
Total area analyzed [ha]	325	258
Number of fields analyzed	96	91
Ø field size [ha]	3,4	2,8
Minimum field size [ha]	0,14	0,13
Maximum field size [ha]	12	16
Number of mowing days	15	20
Ø fields / mowing day	17	6
Ø field capacity including transport [ha/h]	5,2	5,7
Ø field capacity of mowing, no transport [ha/h]	9,8	10,0
Ø mowing time [%]	53	57
Ø transport time [%]	47	43

Collection of operational data

The results of the analysis of the data recorded on the self-propelled high-capacity mower of the mowing cooperative BTG from the first and the following cuts in 2004 are shown in *Table 2*.

The size of the areas to be mowed varied very significantly from 0.1 ha up to 12 and 16 ha. This is mainly caused by the farm- and field structures. The average number of fields to be mowed per mowing day is considerably larger during the first cut, because a lower number of days is available for the optimal cutting time. In the following cut, the cutting times are farther apart, due to operational processes and the weather. In the first cut, the average field capacity including transport is 0.5 ha smaller. This is a result of the lower average mowing time. Since some ryegrass fields and green rye fields are mowed before the grassland is ready for ensiling, so that silage forage maize can be grown afterwards, more transport time relative to mowing time is required. On average, no difference with regard to mowing capacity can be determined on the field itself [2].

In *Figure 2* is shown the field capacity as a function of field size (2005).

While average field capacity (not including transport) is at a level of > 7 ha/h for all field sizes, in particular minimum field capacity varies between an average of 4 ha/h at a field size of 1 ha and up to 7 ha/h on 10 ha fields. Including transport rides, average field capacity on all fields is 5.4 ha/h. The range varies between 1.9 and 13 ha/h.

Table 3 shows average area mowing capacity on all fields with and without transport. The area-related mowing capacity of the self-propelled mowing system is larger than that of the tractor-mounted system, which is likely caused by slightly larger working width and better manoeuvrability. The area of application of the self-propelled system comprised 800 km^2, whereas the tractor-mounted system was used on 100 km^2. Therefore, the tractor-mounted system had to cover shorter distances and its degree of capacity utilization was 12 % higher.

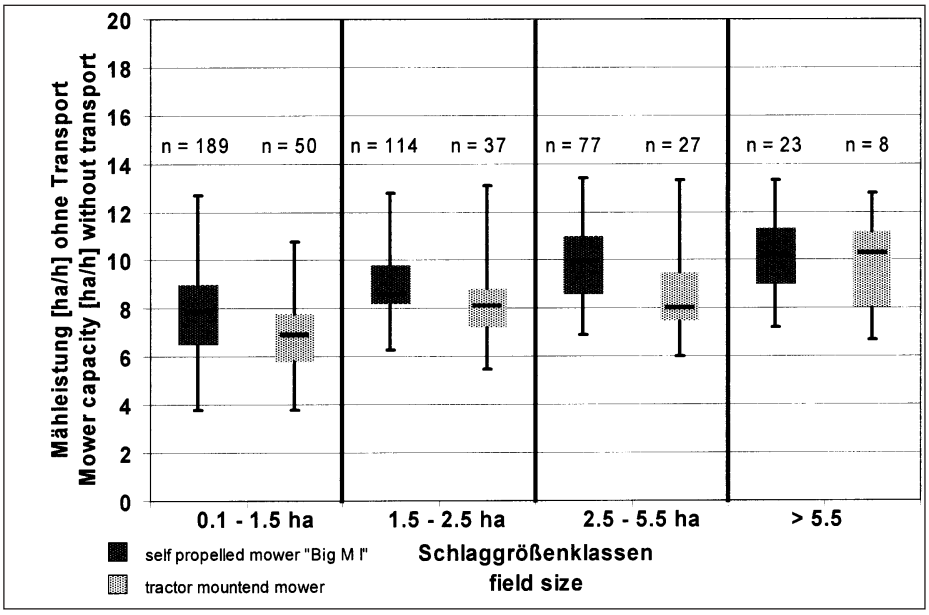

Fig. 2: Field capacity versus field size (2005)

Conclusions

Even on small pieces of grassland, the high-capacity mowers reached average mowing capacities of > 7 ha/h. In practical use, this high capacity is reduced by 30 to 40% to approximately 5 ha/h due to transport- and downtime. A reduction of these unproductive times is absolutely necessary. This can only be achieved by means of optimized application planning in combination with better harmonization of the mowing times of farms, situated closely together. The situation established here evokes associations with cooperative machinery use during the sugar beet harvest. There, unproductive transport time also restricted harvesting capacities for a long time. Only stricter planning of the harvest was able to improve this situation.

Fig. 1: GPS-data acquisition equipment with additional sensors

Examined parameter	Self-propelled mowing system with a conditioner (220 kW, working width 9.10 m) (358 fields)	Tractor-mounted mowing system with a conditioner (210 kW, working width 8.6 m) (292 fields)
Average area-related mowing capacity	8,9 ha/h (s = 1,9 ha/h)	8,1 ha/h (s = 2,1 ha/h)
Average mowing capacity including transport- and downtime	5,2 ha/h (s = 2,5 ha/h)	5,7 ha/h (s = 1,9 ha/h)
Average field efficiency	58 %	70 %

Table 3: Field capacity and efficiency of high-capacity mowers - average of all field sizes

Literature

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