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Investigations on straw distribution through the combine straw chopper

Demands on the quality of chop and lateral spread of straw have risen steeply in recent years. At the same time, however, larger cutterbars have become established which have meant that an even wider distribution of straw is necessary. Starting with an existing serially produced chopper investigations were conducted in field and the laboratory aimed at satisfying the increased requirements on lateral distribution. Based on the collected information a chopper was developed with which an even straw distribution for cutting widths of 7.6 m and more could be achieved.

The quality of chopped straw from the combine and its distribution over the ground has a great influence on post-harvest cultivations and the establishment and emergence of the following crop [1, 2]. The growing trend towards minimum cultivations increases the requirement for good chop quality and even distribution over combine cutting width. At the same time the cutting width of modern combines is expanding making it more difficult to keep up with the demands on lateral distribution.

An investigation at the TU Dresden set out to improve the evenness of lateral distribution by improving an existing chopper. The main points of the investigation lay in:

- the design of the chopper housing,
- the position of the counter shear bar,
- and the design of the straw baffles in the distribution hood.

The chopper rotor and chopper rpm were not altered.

Field and laboratory trials

A combine with straw chopper from the TU Dresden was used in the field trials.

The chopper was prepared so that a rapid readjustment for different trial variants was possible. In that chop quality as well as quality of lateral distribution is influenced very strongly by the straw characteristics and the weather conditions, it was regarded as very productive to fit the test variants for investigation into only one side of the chopper. To facilitate this, a dividing panel was inserted in the middle of the chopper. In this way all modifications could be directly compared with the base version under the same effects from all disturbing influences.

Thus the effects of many modifications were sufficiently well and subjectively evaluated which considerably reduced development input and time.

Figure 1 shows the clearly different ejection characteristics of the divided straw chopper with a one-side fitted test variant.

Video filming of the trials was conducted for documentation and for reproducibility of the subjective evaluation. In that the prepared method for measurement of lateral distribution quality was very time consuming and the strong influence of wind limited the usability of the results, further investigations were transferred to a test bed in the laboratory.

The described trial chopper was also used in the laboratory trials. There, straw was fed into one side over Horden straw walkers. A previously defined straw throughput was realised through suitable loading of the conveyor belt.

Catch boxes were arranged behind the chopper (*figures 2 and 3*). The chopped material trapped by these was weighed and the lateral distribution quantitatively compared. The influence of different test variants on the power requirement could be evaluated through measurement of the drive power.

Fig. 1: Visible differences of straw distribution of test chopper with modification on one side

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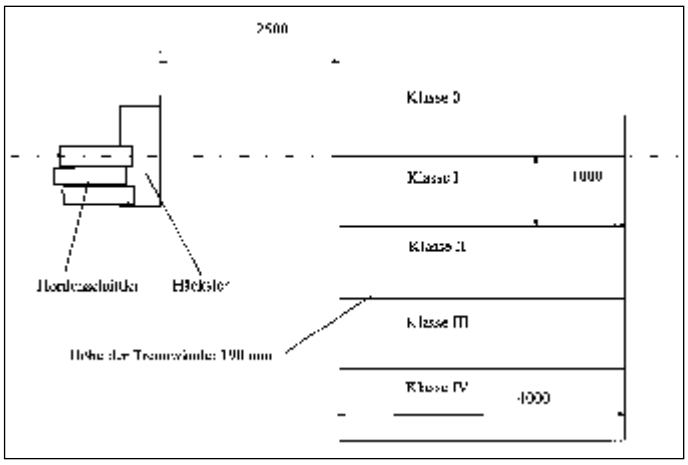

Fig. 2: Testbed in laboratory

Fig. 3: Distributation of straw after test

Summary

The investigations on the combine straw chopper won important knowledge regarding the chopping and distribution process and on the possibilities of influencing the material flow. The important point lay in improving the lateral distribution of the chopped straw in the distribution breadth but also in its consistency.

With the modifications which were carried out and investigated, the overhauled chopper was able to achieve a consistent distribution up to and over 8 m width [3].

Literature

[1] *Voßhenrich, H.-H.*: Strohverteilung und Häckselqualität auf Praxisflächen. Landtechnik 54 (1999), H. 5, S. 306 – 308

[2] *Voßhenrich, H.-H.*: Auf die Verteilung kommt es an. dlz 52 (2001), H.7, S. 69 – 71

[3] *Bischoff, L.*: Verteilvorrichtung einer Zerkleinerungsvorrichtung. Europäische Patentanmeldung EP1031271

Results

The lateral distribution could be greatly improved during the process of the investigations (*fig. 4*).

- Ejection velocity could be increased through a narrower chopper housing with smaller free space for the course of the chopper knives.
- Substantial improvements were achieved in the geometrical coordination of straw discharge from the chopper through positioning of the distributor hood. Only when the chopper floor exit form was adjusted so that it matched the height and the differing angles of the distribution hood did this lead to a continual optimal ejection of the chopped material onto the baffles.
- To achieve a greater spread, a higher ejection velocity and also a stronger lateral directing by the baffles was necessary and this was achieved through lengthening of the baffle angle.
- A steeper intake into the chopper compared with the original version and a deeper location of the counter shear bar led to an improved straw intake and the associated more consistent material flow.

The energy requirement differed only minimally between the investigated variants and was therefore only a minor evaluation criterion compared with that of the achieved improvement in straw distribution.

The information collected from these field and laboratory investigations was the basis for the development of a new chopper. The information could be confirmed by subsequent trials in the field.

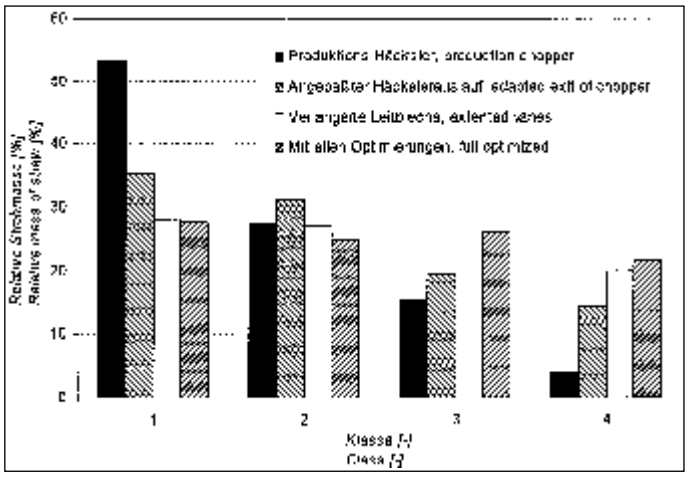

Fig. 4: Chopper distribution at different steps of development