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DLG Evaluation Scheme for the Working Quality of Straw Choppers

In plant cultivation, the trend in seedbed preparation is towards reduced soil tillage (fewer tillage operations), which means considerably higher demands on the working quality of straw management systems in combine harvesters. To assess these systems, DLG-committees (Deutsche Landwirtschafts-Gesellschaft – German Agricultural Society) developed „spreading quality“ and „excess length component“ as examination criteria, which focus on the differing significance of the excess length component for seedbed preparation, on the one hand, and the erosion reduction on the other. The fixed schemes serve as an evaluation basis for future DLG tests, regarding straw spreading with combines.

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Keywords

Chopping quality, straw spreading, evaluation scheme

Literature

Literature can be called up under LT 07120 via the Internet address <http://www.landwirtschaftsverlag.com/landtech/local/literatur.htm>

Chopped straw, which remains on the field after harvesting, serves to fertilise the soil, to reduce erosion and evaporation, and as a nutrient substrate for earthworms. At the same time its degradation leads to nutrient competition for young seeds and its physical condition is a challenge for subsequent stubble and soil tillage. Inadequate size reduction and irregular spreading increase the negative effects and reduce the positive impacts.

Requirements on chopping quality

The chopping quality is therefore an important parameter when assessing the technology used. This quality is essentially evaluated from the plant cultivation standpoint, where the following requirements are made:

- No interference with seedbed preparation (heap formation, clogging)
- No interference with drilling machines caused by straw residues in the seed horizon, as there will otherwise be unequal starting conditions regarding seed depth placement, infection pressure, water and nutrient supply
- Degradation of the straw within one vegetation period
- Erosion-reducing mulch at the soil surface
- No straw mats ploughed in

Widely differing plant population structures



Fig. 1: Inhomogeneous field emergence

can result in the case of insufficient spreading and chopping quality (Fig. 1).

Criteria for assessing the chopping quality

The terms crossways and lengthways spreading as well as chopping length are found in literature to describe the characteristic „chopping quality“. In some cases the splicing of the straw is also named as a criterion.

The crossways distribution is becoming more important as working widths increase, but also technically more demanding. Possible measuring methods for this are the „suction method“ [1] and the „collection method“ [2, 3].

In the suction method an area grid surrounded by a steel frame is placed over the stubble crossways and/or lengthways to the

Table 1: Evaluation scheme „spreading quality“

| Spreading quality CV (%) | Evaluation | Plough drilling | Mulch drilling | Direct drilling |
|--------------------------|------------|-----------------|----------------|-----------------|
| CV < 20 | ++ | x | x | x |
| 20 ≤ CV < 30 | + | x | x | (x) |
| 30 ≤ CV < 40 | o | x | (x) | |
| 40 ≤ CV < 50 | - | (x) | | |
| CV 50 | — | | | |

Evaluation scale: ++ / + / o / - / — (o = standard); (x) conditionally suitable, x suitable

Table 2: Evaluation scheme „excess length component“ - seedbed preparation

| Excess length component, chopped straw fraction > 100 mm (%) | Evaluation | Plough drilling autumn | Suitability for mulch drilling autumn | Direct drilling autumn |
|--|------------|------------------------|---------------------------------------|------------------------|
| Share < 5 | ++ | x | X | x |
| 5 ≤ Share < 10 | + | x | X | (x) |
| 10 ≤ Share < 15 | o | x | (x) | |
| 15 ≤ Share < 20 | - | (x) | | |
| Share ≥ 20 | -- | | | |

Evaluation scale: ++ / + / o / - / -- (o standard); (x) conditionally suitable, x suitable

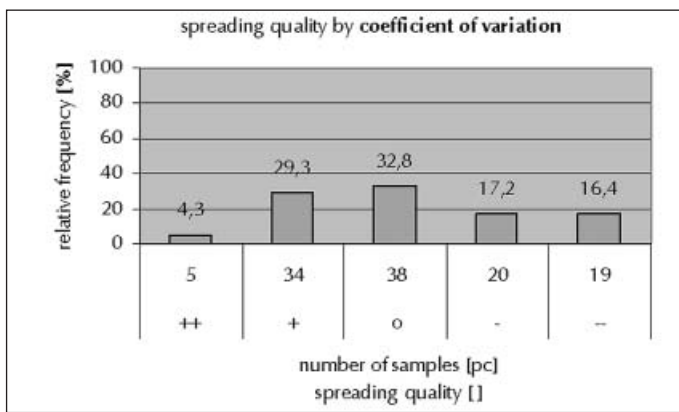


Fig. 2: Evaluation of practical tests „spreading quality“

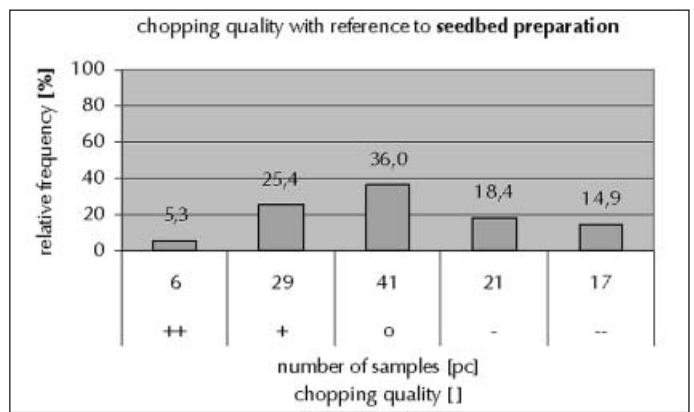


Fig. 3: Evaluation of practical tests „chopping quality“

direction of travel and the chopped material is sucked up from this. The straw/soil mixture sucked up in this way is subsequently dried, cleaned and weighed. The crossways or lengthways spreading is determined from the weights of these chopped matters.

The collection method catches the chopped matter before it reaches the ground and thus saves the drying and cleaning operation. Trays are deposited behind the machine being tested and filled with chopped matter as travel continues. In both variants the distribution of the chopped matter lengths results from a screening analysis, in which the percentage weight component of the individual fractions is taken as a basis for the evaluation.

The DLG has been conducting tests with the further developed suction method since 2000. The collection method is being developed further in cooperation with Messrs Claas [3, 4].

The procedures which have been successfully used to assess other spreading devices (fertiliser spreaders, manure spreaders) can be used to evaluate the spreading quality. According to these, the quality of the spreading work can be described accurately with the coefficient of variation CV [%]. The more uniformly the chopped straw is distributed over the area (low CV), the better the spreading quality.

The individual cultivation methods make demands of varying kinds on the quality of spreading. These demands tend to rise in line with the reduction in intensity of soil tillage. That is why the user is given not only an evaluation of a quality stage, but also tips on suitability for the various cultivation methods.

Depending on the design and function of the machine, the chopping length is regular-

ly represented over a large range. In particular the longer pieces of straw can be an impediment in soil tillage, but on the other hand they stabilise the soil surface and prevent erosion. Consequently looking at the mean value of the chopped matter length as a sole characteristic only provides conditional information. It is rather the „excess length“ component in the total chopped straw fraction that is crucial for the further procedural steps. According to [1], this value also correlates closely with the mean length of the chopped material. From the standpoint of direct subsequent seedbed preparation, a lower excess length component is more advantageous. The situation is reversed, however, if attention is focussed on reducing erosion, as here the longer pieces of straw are intended to stabilise the soil surface over a relatively long period.

That is why solely the excess length component is used to assess the chopped matter length. This is done depending on the objective set (direct seedbed preparation afterwards or erosion-reducing mulch), so that two evaluation schemes are specified for this characteristic.

DLG evaluation schemes

The evaluation schemes contain a classification of the parameter to be investigated with an absolute evaluation scale related to this (three stage or five stage), as well as a recommendation on the cultivation method for which the size category is suitable.

The following tables show the evaluation schemes for the criteria „Spreading Quality“ and „Excess Length Component - Seedbed Preparation“ (Table 1, Table 2).

To evaluate the excess lengths from the point of view of reducing erosion in spring

cultivation (Table 3), it is assumed that lengths between 100 and 175 mm are to be assessed favourably as they are not drawn into the soil as quickly by earthworms and contribute to resistant structuring of the soil surface. A share lying between 40 and 60 % is reckoned to be optimal. In the case of even higher share (> 60 %), the figure drops per unit area, and consequently so does the erosion-reducing effect. Pieces of straw longer than 175 mm are an impediment from the point of view of cultivation technology. Their share should always be below 5 %.

Evaluation by practical tests

The field tests introduced since the year 2000 are used to assess the evaluation schemes, which have been specified „in theory“. They comprise several R&D as well as Fokus tests using the suction method, and since 2004 comparative examinations with the collection method.

The following marginal conditions characterise these practical tests:

- more than one crop type and variety
- changing harvesting conditions
- different mounted choppers and straw management systems in conjunction with changing types of combine
- setting of the chopper to the shortest possible chopping length with optimal crossways and lengthways spreading.

As the straw management systems have been optimised exclusively for the requirements of seedbed preparation, it is currently not possible to assess the evaluation scheme for erosion reduction.

The statistical evaluation is based on the Gaussian normal distribution, as this mathematical model is generally used to map distributions of measurements. The test for normal distribution was conducted and documented.

The results of the evaluations (Fig. 2 and Fig. 3) of the practical tests show clearly that the evaluation scheme specified reflects the actual quality of work of the straw management systems examined well, regarding spreading as a prerequisite for seedbed preparation.

| Excess length component > 100 to 175 mm, Share (%) | Excess length > 175 mm, Share (%) | Evaluation (erosion reduction in spring cultivation) |
|--|-----------------------------------|--|
| < 15 | < 5 | -- |
| 15 ≤ Share < 40 | < 5 | o |
| 40 ≤ Share < 60 | < 5 | ++ |
| Share 60 | < 5 | o |
| | ≥ 5 | -- |

Evaluation scale: ++ / o / -- (o = standard)

Table 3: Evaluation scheme „excess length component“ - erosion reduction