Hans-Heinrich Voßhenrich, Volkenrode

Straw distribution and chop quality in the field

The foundations of successful soil cultivation and subsequent sowing is an even distribution of straw and good chop quality. Measurements taken immediately after combining indicate a broad spectrum of different distribution and chop qualities. Based on this, possibilities for optimising distributing equipment are shown and a concept suggested for adjustment of straw distribution.

Fig. 1: Experimental design in the field

PD Dr. habil. Hans-Heinrich Voßhenrich works at the Institut für Betriebstechnik und Bauforschung der FAL, Braunschweig-Völkenrode (Principal: Prof. Dr.-Ing. Sommer) and at the Institut für Landwirtschaftliche Verfahrenstechnik, Kiel University (Principal: Prof. Dr. Isensee); e-mail: vosshenrich@bt.fal.de
Project financing: Stiftung Schleswig-Holsteinische Landschaft

Keywords

Straw distribution, chopping quality

In the study, all contemporary combine harvester systems were investigated. However, no company names have been mentioned in the following report as distribution and chop qualities were shown to be largely independent of the manufacturer-influences.

Methods for recording distribution and chop quality

The straw distribution was recorded at right angles to direction of travel with a method developed by Holz, Traulsen and Keiser [1]. With an industrial vacuum cleaner straw was sucked out of a ring with a defined diameter (60 cm) and filled into plastic sacks (*Fig. 1*). Starting point of every measurement was the sample taken from the centre of each combine pass (sample 0). From there the samples follow to the right (1R, 2R...) and to the left (1L, 2L...). Under laboratory conditions, the samples were dried, cleaned and weighed. A portion of the samples was sieved in order to assess, as well as total straw mass, individual straw particle distribution over the working width.

Because the quality of straw distribution depends on many influences, all the most important influencing factors that occurred were also recorded at the same time. These included wind strength, wind direction relative to working direction of the combine, air moisture content and crop moisture content as well as important data on the combine technology. Represented is a complex system with differing interactions. The different influences were not looked at individually at this point and instead only important correlations noted.

Lateral distribution

An example of a good lateral distribution is shown in *Figure 2*. Total chopped straw is spread almost completely evenly over the working width. Compared with this, *Figure 3* shows an unsatisfactory distribution. Here, no straw is left lying at the outer measuring points to the right (5R) and left (5L). In the case of both measurements, an influence of the wind on the distribution is noticeable.

A compilation of the individual measurements (*Fig. 4*) illustrates the very different

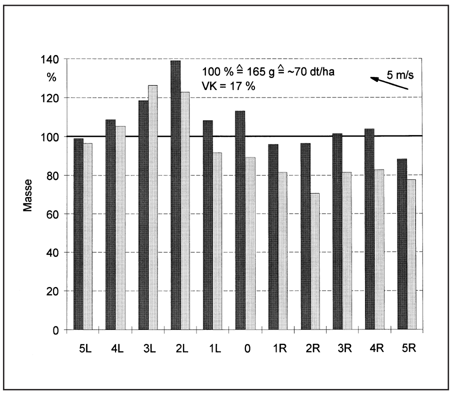

Fig. 2: Good lateral distribution at 6.1 m working width (11 recording points, 0 in the middle of combine, 2 repetitions)

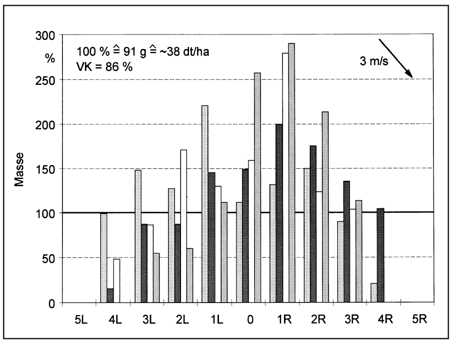

Fig. 3: Insufficient lateral distribution at 6.1 m working width (11 recording points, 0 in the middle of combine, 4 repetitions)

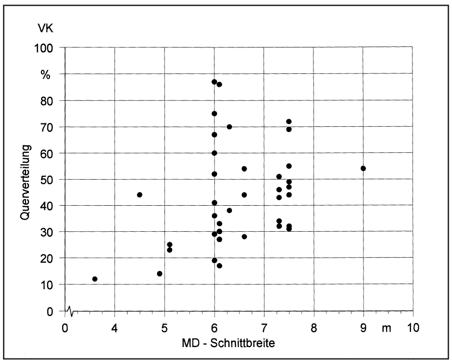

Fig. 4: Lateral distribution and the working width of the combine

Round hole screen; Hole-ø in mm	67	30	16	8	4	2	<2
Average length of the sieved particles in mm	**17,5**	**13,2**	**9,6**	**5,2**	**3,3**	**2,3**	**1,5**
Combine harvester no.	Total share of sieved particles as %						
1	1	9	15	25	31	14	4
2	1	9	22	32	26	7	3
3	1	9	22	32	26	7	3
4	0	2	7	33	43	11	4
5	2	7	16	31	31	9	5
6	0	4	12	33	39	8	4
7	1	7	11	28	33	12	8
8	0	4	11	28	35	13	8
9	0	6	13	28	36	11	5
10	1	7	15	36	31	8	3
11	0	8	14	39	30	6	2
12	0	3	10	27	35	19	6
13	0	3	11	30	36	14	6
14	1	3	10	27	43	10	6
15	0	7	18	33	33	7	3
16	1	4	9	33	39	10	5
17	0	6	14	31	6	3	3
18	0	3	10	38	34	9	5
19	2	7	13	27	35	11	5
20	1	7	12	35	30	10	6
21	1	7	18	32	31	8	4
22	3	13	16	32	24	7	4
23	3	13	16	32	24	7	4
23	2	10	17	31	25	9	5
24	3	12	14	23	34	9	5
25	2	14	25	32	20	3	3
26	0	13	25	32	21	6	3
27	0	0	6	37	38	14	6
28	0	0	7	34	40	13	5
29	1	7	15	34	33	7	3
30	9	5	12	32	35	11	5
31	11	9	14	22	31	9	5
32	0	13	17	26	31	8	4
34	6	6	21	29	26	8	5
35	0	7	19	37	24	6	6
36	0	1	9	27	41	14	8
37	0	2	11	27	35	14	11
38	0	3	7	26	36	19	9
In comparison: silage harvester (Jaguar)	0	2	6	27	46	12	7

Table 1: Quality of chopped straw from 38 experiments

distribution qualities that can be met under practical conditions. Distribution qualities with a variation coefficient (VC) of under 20% were only reached with working widths of up to 6 m. With working widths of over 6 m the best VC values lay in the area of 30%. The reverse conclusion, that working widths of 6 m and under guarantee a good lateral distribution, cannot, however, be drawn.

Basic and fine adjustment

A major cause of uneven lateral distribution is lack of optimisation of the distribution technology. The largest portion of straw lands in the centre of the working width. The portion going towards the sides is notably reduced. Through optimising of the basic adjustments in many cases the requirements for an even lateral distribution can be achieved in that, for example, within guide plate systems the entrance gaps between the guide plates in the middle are made narrower and those at the sides wider (*Fig. 5*). With the optimisation „1“ (middle figure) with 6 m working width a VC value of 30% would be achieved. The amount of total straw going to the sides would be slightly reduced. The distribution quality for the optimisation „2“ (lower figure) was on the whole comparable, although with an already increasing straw proportion to the outer right and left. Fine adjustments then followed hrough alignment of the guiding plates. Correct alignment prevented straw chop landing in the standing crop. Instead, it was thrown as far as possible over the already combined stubble to give an even coverage through overlapping. The aim, therefore, was to achieve an asymmetrical projection by the guiding plates (*Fig. 6*).

In general, it can be said that by taking full advantage of the available technology, the lateral spreading of the straw to a working width of 6 m, even under difficult working conditions, is control-lable. Exceeding this working width means that influences such as side winds, moisture or other influences often represent limiting factors. Additional capacity for better results can be achieved, for instance, through increasing the chop speed or increasing air blast. If spreading quality with a VC of under 20% is to be securely achieved even with a working width of 9 m, power distribution systems should then be reconsidered.

Chop quality

Chop quality influences are just as complex as those for straw distribution. Average chop lengths of from 2 to 3 cm, which are extremely helpful for achieving efficient cultivation and sowing under no-plough regimes, are seldom achieved under practical conditions, although by taking care this difficult target appears to be absolutely possible with different systems from various manufacturers. The silage harvester sets the standards for good chop quality. *Table 1* shows collected examples of silage harvester results.

No separation according to particle size

Suspicions that the chopped straw separated out according to particle size on its way to

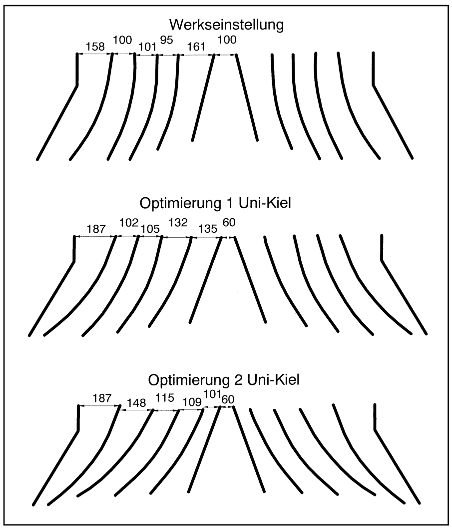

Fig. 5: Entrance slits (mm) between guiding plates of the chopper with 6.3 m working width

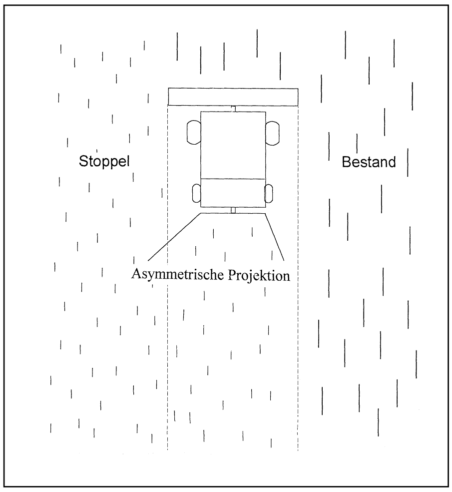

Fig. 6: Unsymmetrical projection by the guiding plates

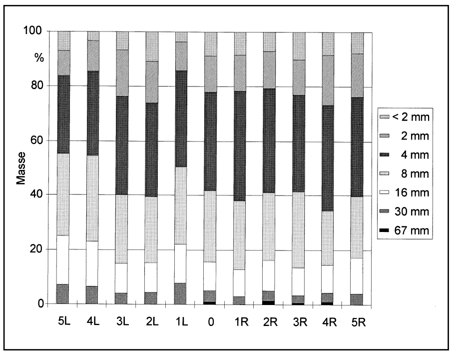

Fig. 7: Sieve fraction of test run (circular openings: 2 - 67 mm)

Fig. 8: Sensor for recording wind direction and wind speed

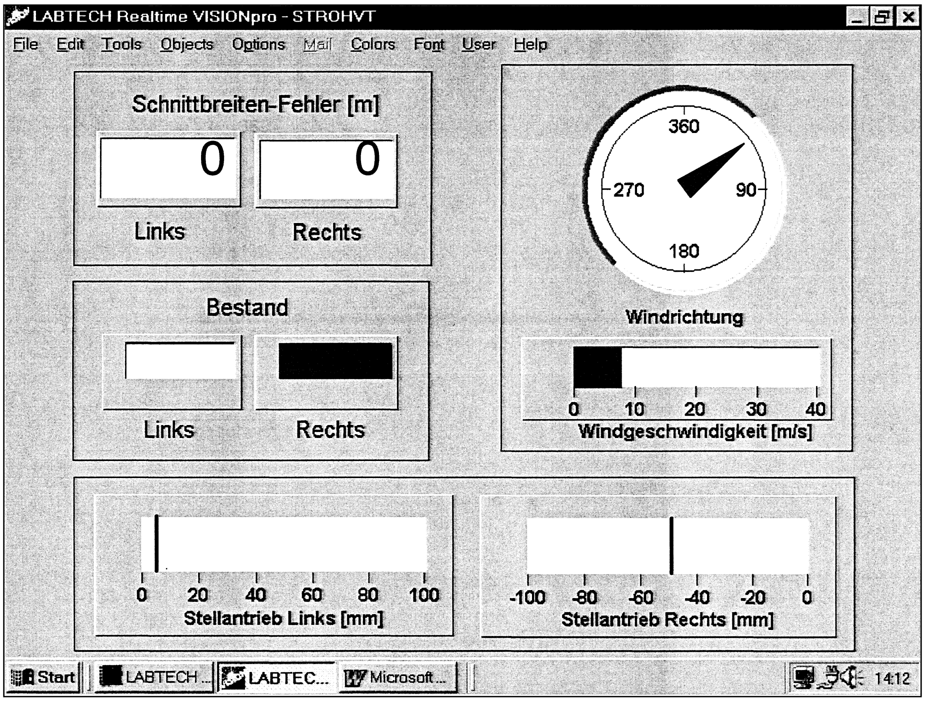

Fig. 9: Combine monitor for data recording

the ground from the chopper were not proved. Sieve analyses of the straw particles sampled across the spreading width indicated that the size dispersal remained unchanged (*Fig. 7*). A possible explanation here is that the air blast carried the particles in their original position right to the ground. Only isolated particles escaped the mainstream of straw, eddied, and fell to ground in a haphazard way.

Current developments

Good distribution technology doesn't help much when it is not fully used by the combine operator. In that the operator is fully employed by steering work, especially in critical situations, it appears that what is needed is support through chopper/distributor control and steering systems. An example here is the development of a sensor that steers the guide plates according to wind direction and strength (*Fig. 8*). Decisive in this case is not the absolute wind direction but its direction in relation to combine travel. On a monitor (*Fig. 9*) the working direction is defined on a 360° basis. The wind arrow indicates the direction from which the wind blows. 360° means a head wind, 90° wind from the right, 180° a following wind and 270° from the left. For control, the position of the steering drive for fine adjustment of the guide plates left and right is indicated. The technology is being developed and tested at the moment.

NEW BOOKS

Dioxin- und PAK-Konzentrationen in Abgas und Aschen von Stückholzfeuerungen
By Thomas Launhardt, Reinhold Hurm, Volker Schmid and Heiner Link. Publication series „BayStMLU-Materialien“, vol. 142.
Marketing: Bayerisches Staatsministerium für Landesentwicklung und Umweltfragen – Publication Post Office – Rosenkavalierplatz 2, D-81925 München, Tel: 089/92143166, Fax: 089/92142266; e-mail: poststelle@stmlu.bayern.de 1999, 149 p., 30 tab., 50 ill., (text volume), additionally 515 p. data collection
The text volume is free to all interested parties. The data collection can be loaned as copy presentation on request. The presented text collates the results of an extensive research project which was financially supported by the Bayerischen Staatsministerium für Landesentwicklung und Umweltfragen. The target of the project is to create a dependable data base to serve as a technical basis and decision aid for the assessment of pollutant emissions and the quality of ashes from domestic wood-fired heating. Subjects especially in the centre of attention here are highly toxic compounds like polychlorinated dibenzo-p-dioxine (PCDD) and dibenzofurane (PCDF) as well as polycyclic aromatic carbohydrate (PAC). The data, based on trials in four conventio nal ovens (7 to 30 kW_{th}), was utilised for the following observations:

- Basic evaluation of the organic pollutant load (PCDD/F and PAC) following the burning of untreated firewood and the illegal burning at the same time of domestic garbage substances and treated wood
- Identification influence factors connected with fuel and burning
- Balancing of the PCDD/F and PAC material flows
- Assessment of annual PCDD/F total emissions from domestic wood burning

Technik der Ernte und Trocknung von Krambe
By Gerd J. Sauter. VDI-MEG Paper 341.
Marketing: Institut für Landwirtschaftliche Verfahrenstechnik, Kiel, 1999, 142 p., 57 ill., 22 ill., 25 DM
Crambe oil is valued by the chemical industry. Within the framework of a project supported by the Fachagentur Nachwachsende Rohstoffe harvesting, drying and preparation of the seed were, among other aspects, investigated in Kiel. For harvesting, a combine harvester fitted with rape cutting head is basically suitable. However, with the adjustment of the machinery certain special points have to be observed. High threshing drum rpm lead to more short-straw which hampers cleaning. The light seed allows only a low cleaning fan rpm. With higher throughflows of material matting of the sieves can occur. The reaction to this – more wind – leads to cleaning losses.

Preview

Features in the next issue of your LANDTECHNIK:

- Previews of Agritechnica '99
- Mobile hydraulics in agricultural engineering – further information
- VDI-MEG meeting agricultural engineering 1999
- Efficiency of spatially-based herbicide application
- Material-expediting technique with combine harvester straw choppers
- Building of slurry and FYM stores: what are the costs?