

# Grid Screen Scanning Method with Straw Index for Assessing Straw Incorporation

*With grid screen scanning the quality of straw incorporation of a cultivator can be rated. However, an exact comparison needs homogeneous initial straw distribution conditions. To compare ratings, which were gathered from different straw masses per unit of area, the straw index was developed and included in the evaluation. In the future it will be possible to assess the straw incorporation quality with a single value, the „implement index“ of a stubble cultivation implement.*

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## Keywords

Amount of straw, incorporation of straw, soil tillage

## Literature

- [1] Voßhenrich, H.H., J. Brunotte und B. Ortmeier: Methoden zur Bewertung der Strohverteilung und Einarbeitung. Landtechnik 58 (2003), H. 2, S. 92-93
- [2] DLG-Focustest 2003: [www.DLG-Test.de/Prüfberichte](http://www.DLG-Test.de/Prüfberichte) 2003, Stroheinarbeitung Grubber

The grid method for evaluating straw tillage was already introduced in the Landtechnik 2/2003 [1]. The method presented here has been expanded with a straw index, among other things. This index allows for comparing ratings, which can be calculated at various sites with different straw yields. Thus the different site input conditions for soil tillage equipment in agricultural practice, caused by different yield levels between and within the sites, are taken into consideration.

## Method

The single steps of the grid method were extensively described in the Landtechnik [1].

Supplementary, in the expanded method presented here, the straw coverage on the soil surface is also evaluated. For this purpose the grid is laid directly along the edge of the profile on the tilled soil. In contrast to the evaluation in the profile wall, the straw coverage level in each individual grid section is not rated, but rather a composite is made of each five sections in the working direction in a rectangular grid of 4.5 cm • 22.5 cm. Thus, for the surface coverage, 40 ratings were established for 180 cm working breadth.

The rating values between 0 and 100 percent were placed into an Excel table and provide an understandable overall picture. The values are additionally coloured, the higher the rating, the more intensive the colour. The more even the adjacent values and colours are, the more evenly the straw was incorporated into the soil. In order to describe zones, where straw was concentrated, the vertical and adjacent ratings were added up.

The sum of all rating values is called the Straw Index. It does not reflect directly the amount of straw lying on the surface of the soil after the harvest, and thus before the tillage, but is closely related to it. As accompanying surveys on the straw deposition on the soil surface show, a straw index of 1500 means about 500 g straw/m<sup>2</sup>, an index of 3000 indicates about 1000 g/m<sup>2</sup> and an index of 4500 means about 1500 g/m<sup>2</sup>. Here 1000 g/m<sup>2</sup> signify 100 dt straw/hectare.

## Results

### *Straw incorporation with a multi-beam and a wing tine cultivator*

The following presentation (Fig. 1) shows the straw incorporation quality of a multi row cultivator, evaluated on the basis of the grid method with Straw Index. The coverage of the soil surface with straw (CSS %) is presented and the coverage of the opened profile wall through incorporate straw (CIS %). The cultivator was used in the first shallow working phase with 10 cm wide shares and in the second deep working phase with 6 cm wide shares. The rating took place during the second deep working phase at a working depth of 15 to 20 cm.

Although we have the same eight-beam cultivator (Fig. 1) at the same location, two single measurements show different results. The high ratings of the straw incorporated into the soil (CIS %) and the accordingly dark coloured sections of measurement 1 make the impression that the straw was more intensively incorporated as in measurement 2. Actually, the decisive difference here is in the different straw masses, which had to be incorporated at the two sites measured. The summed values of the straw covering the surface (sum CSS %) at the location of the first measurement with the index 1450 and straw rated in the profile wall, with the index 1805, show that here significantly more straw lay at the location of the second measurement with the values 450 and 1040. The Straw Index with 3255 in the first measurement and 1490 in the second makes these differing starting points evident in a single figure.

If, as can be seen in the second profile, at some locations little or no straw was incorporated, both the rating value and the colour contrast differ only a little and the Straw Index is low at 1490, nonetheless a good working quality by the equipment can be assumed, in this case due to the low total amount of straw. At the same time, with

Strohindex: Summe (BdE + BdO) = 3255		Messung 1		Mittel	Summe
BdO %	75 75 50 75 75 25 25 10 10 10 10 10 10 50 50 25 10 10 10 25 75 75 75 25 25 50 50 75 25 25 25 50 50 25 10 25 25 25			36	1450
BdE %	25 25 10 25 25 25 25 10 10 10 25 10 10 10 10 25 25 10 25 25 25 25 10 10 10 10 10 0 10 10 25 25 25 25 10 10 10			19	740
	10 10 25 25 10 25 10 10 10 10 10 10 0 10 25 25 10 10 10 10 25 25 0 0 10 0 25 0 25 10 25 10 0 10			23	930
	0 0 25 10 0 10 10 10 10 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 10 10 0 0 0 0 0 0 0 0 0 0			3	135
	0 0			0	0
	35 35 60 60 35 60 110 85 70 30 60 75 100 35 30 20 60 35 50 35 100 50 35 35 35 45 35 10 10 20 10 45 10 75 75 35 50 20 10 20			45	1805
Strohindex: Summe (BdE + BdO) = 1490		Messung 2		Mittel	Summe
BdO %	10 25 10 10 25 10 10 10 25 25 50 25 10 0 10 10 10 10 0 0 0 0 0 10 0 0 10 10 10 0 25 25 0 0 10 25 10 10			11	450
BdE %	25 25 25 25 10 10 25 25 10 10 10 0 10 25 25 25 10 0 0 0 0 10 10 0 0 10 25 25 10 10 10 0 0 10 10 25 10			17	660
	10 10 25 25 10 10 10 10 10 0 0 10 10 0 25 25 10 0 0 0 0 10 0 0 10 25 10 0 10 0 0 0 0 10 0 0 10			8	335
	0 0 0 0 0 10 25 10 0			1	45
	0 0			0	0
	0 0			0	0
	35 35 75 100 100 45 35 30 35 60 35 10 10 20 10 10 50 50 35 10 0 0 0 0 10 20 0 0 20 50 35 10 20 10 0 0 20 10 25 20			26	1040

Fig. 1: Soil profile with a good incorporation of straw (eight row cultivator)

higher Index values, the darker colours can be seen in the top profile.

Figure 2, in contrast, shows uneven straw incorporation. Here a two beam wing tine cultivator was used successively in the first working process shallow, and in the second working process at a depth between 15 and 20 cm. The zones of different straw concentrations can be clearly seen in both measurements. Low rating values from 0 and 10 percent are again next to high values of 75 and 100 percent. These sudden changes are not only rated direct on the soil surface in the first grid, but also beneath in the second and third grids.

### Evaluation of the Method

With the grid method, the quality of straw incorporation by cultivators can be assessed.

An exact comparison of implements needs homogeneous conditions concerning the straw distribution. To be able to compare ratings, which are calculated on the basis of different straw masses per area unit, the Straw Index has been developed and included into the evaluation. With this, the reality of agricultural practice has been taken into consideration, to compare cultivators with each other, which have been tested under different working conditions. The examples of the re-

sults show clearly, that the same cultivator achieves under different working conditions a similar rating, while two different cultivators with different working qualities are differently assessed. Presently the grid method with a Straw Index is being further developed. It will be possible to describe with one value, the „index of implement“, which is a measure of deviation, the quality of straw incorporation by a stubble tillage implement.

Fig. 2: Soil profile with a poor incorporation of straw (wing sweep cultivator)

Strohindex: Summe (BdE + BdO) = 2330		Messung 1		Mittel	Summe
BdO %	10 0 0 10 10 10 10 10 25 10 10 10 0 10 10 10 10 0 10 25 50 25 10 10 25 50 50 75 10 10 0 0 10 10 10 10 25 10			15	600
BdE %	10 0 10 0 10 10 25 25 10 10 10 10 25 10 0 0 0 10 10 10 0 0 25 25 25 0 10 25 10 60 25 30 25 25 0 0			21	725
	10 0 10 0 10 10 25 25 0 0 0 0 0 25 25 25 25 0 0 10 0 0 25 25 25 10 0 10 0 25 25 30 25 25 10 0 0			18	855
	0 0 0 0 0 10 0 25 10 0 0 0 0 10 25 10 0			4	150
	0 0			0	0
	20 0 20 0 20 30 75 150 110 10 10 10 10 50 85 ## 60 60 25 25 10 10 20 10 0 25 50 75 35 0 10 35 10 100 100 135 125 35 0 0			43	1730
Strohindex: Summe (BdE + BdO) = 3200		Messung 2		Mittel	Summe
BdO %	10 25 50 75 25 10 10 10 10 0 0 10 10 10 10 25 25 25 10 10 10 25 10 10 25 50 25 10 25 10 25 25 10 10 0 0 10 0			17	660
BdE %	10 25 25 25 10 25 25 10 10 10 0 0 25 25 10 25 10 10 10 10 25 10 10 0 0 0 10 10 10 25 10 0 0 0 0 10 10			16	630
	0 0 25 25 25 25 0 0 0 0 10 25 25 10 10 10 10 10 10 10 0 0 0 0 0 10 25 25 10 0 0 0 0 0 0 0			19	765
	0 0 25 25 25 25 0 0 0 0 25 25 0 0 0 0 10 25 25 0 0 0 0 0 0 0 0 0 0 10 0 0 0 0 0 0 0 0			29	1145
	0 0			0	0
	0 0			0	0
	10 25 150 100 60 125 125 35 10 10 0 10 200 150 85 100 85 60 20 20 30 45 150 200 135 35 0 0 0 10 120 110 150 135 20 0 0 0 10 10			64	2540