Bernhard Rump and Karlheinz Köller, Hohenheim

Further Development of No-till Coulters

Conservation tillage systems have been increasingly introduced in agriculture in past years. Direct seeding is the least intrusive process, because the seed is placed in the untilled soil after harvest. However, direct seeding is not always unproblematic. Investigations on optimising no-till aggregates have lead to the development of a no-till coulter specifically suited for European conditions.

Farmers focus on no-till systems including direct seeding and conservation tillage in order to save time and costs. Moreover these systems are supported by special government programs. Direct seeding is the most efficient system in regard to cost and time saving. Typically, special seeders with disc or hoe openers are used for direct seeding. European farmers often have to solve problems with the high amount of straw. While hoe openers tend to collect straw, disc openers can push straw into the seed furrow. In this case the seed is placed only with little soil contact, which can result in poor germination. This occurs especially under dry soil conditions.

Currently used direct seeders often are equipped with seeding elements developed for different field conditions than in Europe, where straw layers of 6 tons per hectare and more are typical [1, 2, 3, 4]. So these machines work insufficiently under European conditions, a special coulter for European conditions has to be developed.

Cutting the straw is the main problem

Until now, test of the cutting ability of coulters showed indifferent results. While Kushwaha could cut nearly 100% of the straw layer with a rolling disc in the soil bin, Wendling could not prove that [5, 6]. Therefore a rolling coulter with a diameter of 460 mm was tested in the soil bin of the University of Hohenheim. The soil bin is described in [7]. Tests were conducted to obtain information about the straw cutting ability of a single disc as well as to get information about the disc when meeting the straw. The soil was prepared to obtain a penetration resistance comparable to those found on a long time non-tilled field of the University of Hohenheim. It emerged, that a single disc coulter of a direct seeder could not cut the wheat straw layer of 600 g/m^3. Depending on the speed, the effect shown in *Fig. 1* could be observed.

The tests show that cutting straw with a common disc coulter is nearly impossible. The disc does not cut the straw, but pushes it into the furrow. Sharpening the edge only improves the cutting ability for a short time, because of the missing counteredge.

To overcome the problems, a cutting opener was developed. The first prototype had two cast steel wheels working at an angle toward the driving direction and a single disc in between. When the disc meets the straw, the straw is pressed on the soil surface. This and the angle toward the driving direction provide the straw from being pushed into the furrow. Tests conducted with the new coulter showed a cutting ability of nearly 100%. Tests with chopped straw were less effective. Based on these results, a second coulter was developed.

Close contact of the press wheels is necessary

The coulter II consists of two rubber coated press wheels with a 340 mm diameter. A disc with a 370 mm diameter is between

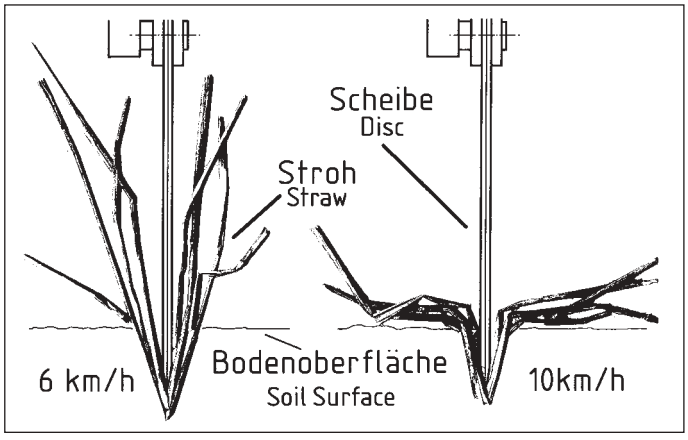

Fig. 1: Reaction of straw beneath the disc at different operating speeds

Prof. Dr. K. Köller is director at the Institute for Agricultural Engineering in the Tropics and Subtropics of Hohenheim University, Department of Mechanization and Irrigation, Garbenstr. 9, D-70599 Stuttgart. Dr. Bernhard Rump was there a scientist; e-mail: *bernhard_r@web.de*
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Keywords

No-till, coulter, straw, soil bin

Literatur

Literaturhinweise sind unter LT 04106 über Internet http://www.landwirtschaftsverlag.com/ landtech/local/fliteratur.htm abrufbar.

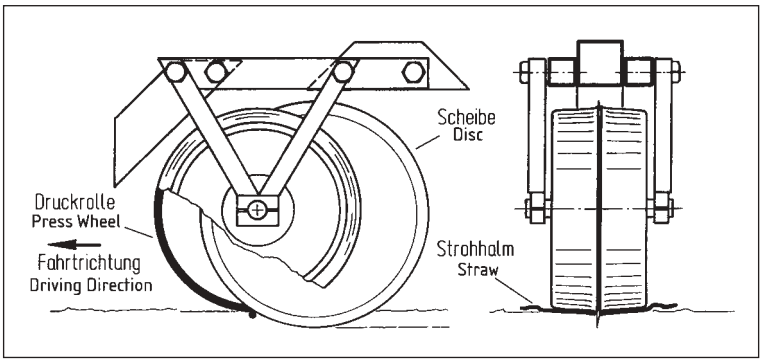

Fig. 2: Side and front view of experimental coulter II

them (*Fig. 2*). Disc and press wheels can be fixed in different positions to realise various working depths. The disc touches the straw as the press wheels clamp the straw between the wheel and the soil. In contrast to the first prototype, the disc of coulter II has close contact to the press wheels. Replacing the cast steels wheels and mounting rubber press wheels resulted in a larger pressed area. Tests were conducted with coulter II in the soil bin to verify the cutting ability. Soil was prepared to obtain a penetration resistance of 0,5 N mm^{-2} and a moisture content of 8,3%. Wheat straw with a moisture content of 13 % was spread perpendicular to the driving direction. In addition, tests with a standard disc coulter, equipped with a lateral depth wheel and an angle of 7° towards driving direction, were conducted. Speeds were 8, 10 and 12 km h^{-1} and working depth was 3 cm. Results are shown in *Figure 3*.

Coulter II could cut between 57 and 81% of the straw, whereas the standard coulter could only cut 45% of the straw. This tests showed that coulter II can cut much more straw than a standard coulter.

Conclusions

Single disc coulters tend to press straw into the seeding furrow. Seeds end up in the straw with little soil contact. To reduce the amount of straw in the seeding furrow two coulters were created. Depending on the working speeds, coulter II fulfilled the requirements, because it reduced the amount of straw up to approx. 50% compared to a standard coulter. Further tests showed, that soil was clamped between press wheels and disc. Open or inclined press wheels could avoid this effect. Moreover a suitable system to place the seeds has to be developed.

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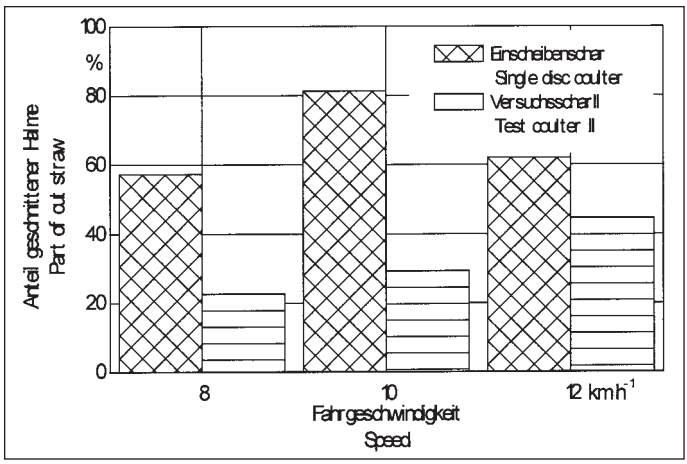

Fig. 3: Percentage of cut straw of experimental coulter II compared to a one-disc coulter of standard no-till seeder