Roller, Olaf and Schulze Lammers, Peter

Review on six years of ridge cultivation of sugar beets in Rheinland

In 1999 sugar beets in Northern Germany were reported to be grown in ridges for the first time in order to compensate suboptimal agricultural conditions. While this cultivation was done with technical solutions adapted from carrot-growing (ridge rotary cutter) [1], a special solution for conditions in the Köln/Aachener Bucht (Western Germany) still had to be developed. Therefore a ridge-roll in combination with earth accumulators was used, which was a very compact construction. However the results of six years experience on ridge cultivation of sugar beets will be presented in the following article.

Keywords
Sugar beets, ridge cultivation, precision seeder

Abstract
Landtechnik 64 (2009), no. 5, pp. 357 - 359, 4 figures, 8 references

Fig. 1

Ridge cultivater of the Department for Agriculture Engineering Bonn with Kverneland precision seeder Monopil S. Photo: Roller

There was a report about beginning, essence an purpose of ridge cultivation of sugar beets in the "Landtechnik"-magazine (2005/3) in 2003 and 2004. It was retained that sugar beets cultivated in ridges had longer beet-bodies (which tended to lead to increasing yield) and less soil-adhesion in comparison to commonly cultivated sugar beets. In order to confirm these results additional experiments were conducted during the following years and the ridge-cultivator was simplified due to its costs.

Cultivation technology

The first technology used for ridge cultivation in these experiments consisted of a ridge rotary cutter with a separate ridge former and a monoseeder [1, 2]. The row distance was 50 cm with a ridge height and ridge-crown-width of 15 cm each. This type of cultivator guarantees a fine soil structure with adequate ridge-forming and sufficient soil-compaction. The seeder had to be modified in order to get the transmission wheels to the ground and to discharge the seeders with springs to keep them from pushing apart the ridge. The main disadvantage of this system was power requirement of 120 kW at a velocity of 6 km/h and 6 single seeders.

However, the ILT tried to reduce this power requirement, by ensuring the use of common harvesting technology. By using the same ridge-roll, the geometry of the ridge was kept, even if a different system was used. For this system the ridge rotary cutter was replaced by a modified cultivator, which was equipped with six ridge-tines and the ridge-roll of the former

system. The main disadvantage of this construction was the length of cultivator, which lead to increasing demand of lifting power. Therefore the cultivator-frame was shortened and the ridge tines were modified in order to get them on one single bar of the cultivator (see **figure 1** for details). The ridge-plates were removed and the ridge-roll was spaced directly behind the ridge-tines. This spacing lead to the effect, that the soil was directly linked to the roller, shortly after the tines had loosen it up. In the years 2007 and 2008, the row spacing was reduced from 50 to 45 cm. The working depth of the tines was adjusted by two jackscrews, which were attached to the left- and to the right side of the ridge-roll. By using the jackscrews and modifying the upper-link length and/or position the amount of loose soil could be controlled in order to achieve solid and homogenously formed ridges.

Seeding-experiments and results

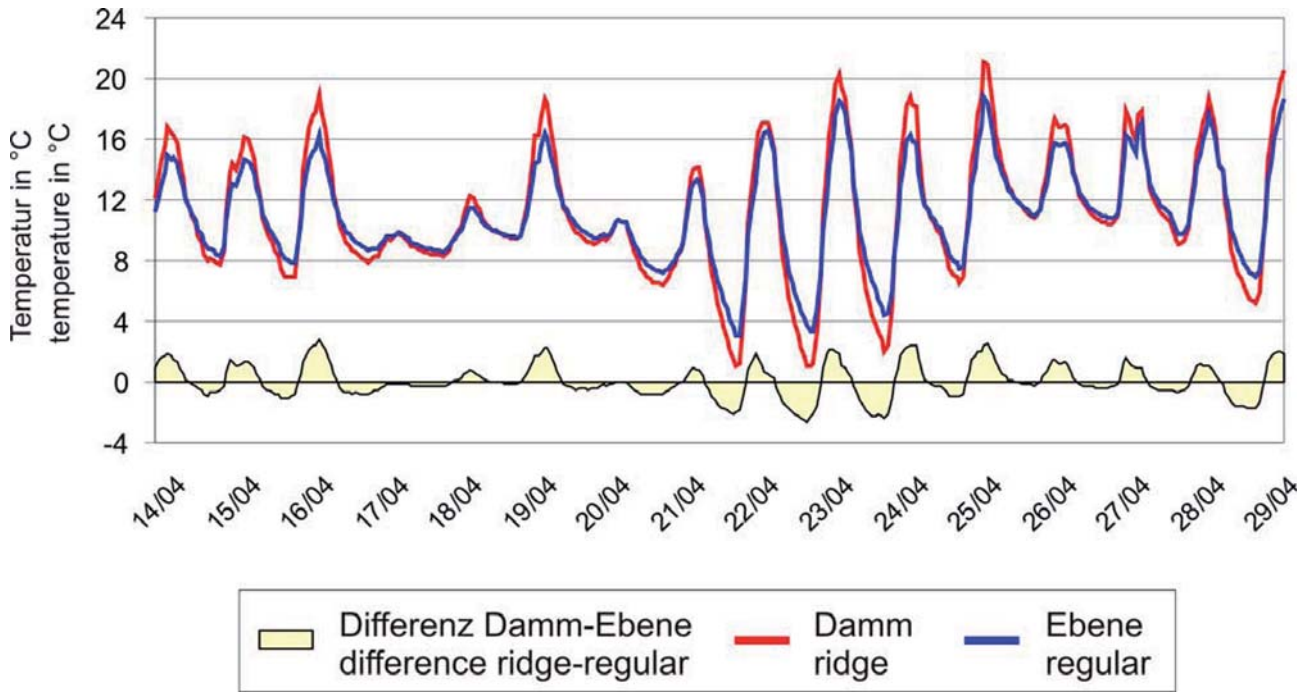
At the beginning of our experiments different ridge-forms and row-spacings were tested. However, harvesting technology in Western-Germany limits row spacing to 45 or 50 cm. The first experiments on ridge cultivation were conducted on a research farm in Wesseling (Western-Germany, close to Cologne). 11 different places in the Rheinland in 2004 were chosen for ridge cultivation in order to get accurate results due to different soil conditions. However, in 2007 and 2008 our experiments were limited to the research farm „Campus Klein-Altendorf“ in Meckenheim (south of Cologne).

For the experiments field-emergence of the sugar-beets was the main criterion in spring. In autumn plant density, length of the beet-body, maximum beet-diameter, and single-beet-mass were recorded shortly before or during harvest respectively. Yield of the sugar-beets was calculated using single-beet mass and plant-density.

For ridge-cultivation, it is reported that soil warming is much faster due to the significantly larger soil-surface [3-6, 7]. However at the beginning of our research soil temperature in 3 cm and 10 cm soil-depth was recorded every 30 minutes during the growing-season. As shown in **figure 2** for a soil depth of 3 cm the soil in the ridges was heated up faster during the day, but was also cooled down much faster during the night compared to regular soil conditions. However, with 4.075 °C heat sum was slightly higher for the ridges then in regular soil (4.054 °C) during the recorded period of time. Therefore no difference in yield was expected especially because there was no difference in the heat-sums of the following year.

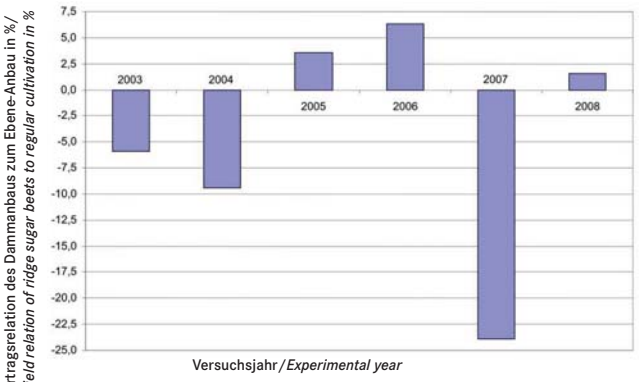
In 2007 ridge cultivation of the sugar-beets in Meckenheim didn't lead to higher yield, because advantages in soil warming were compensated by missing soil water. Due to the very dry conditions in spring 2007 the water saturated soil was transported to the top of the ridge by the ridge-cultivator and dried-up. Therefore field emergence of the „ridge sugar beets“ was observed to be three weeks later than field emergence of the conventional ones. However, when first rain appeared field emergence of the ridge sugar beets was better and lead to higher plant-density in comparison to the conventional sugar beets. During the harvest the beet bodies in the ridges were observed to be 1 cm longer in mean. However there was no significant difference in yield, because beet-diameter was significantly smaller. In 2006 ridge cultivated sugar beets were seeded 15 days earlier

Fig. 2



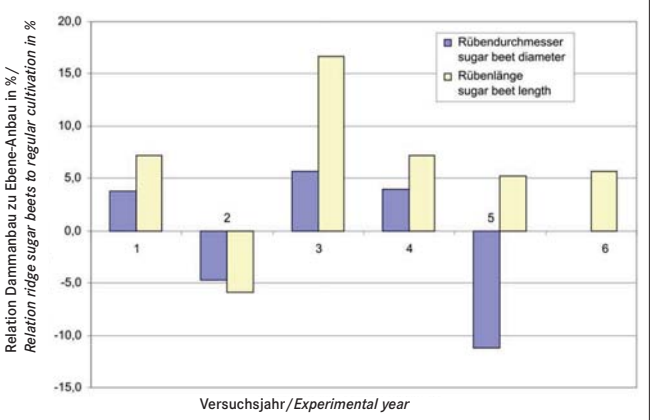
Ground temperature in a depth of 3 cm at the experimental field Klein-Altendorf in 2004

Fig. 3



Yield difference of sugar beets in ridge cultivation in relation to the regular cultivation, Campus Klein-Altendorf

Fig. 4



Length and diameter relation of the ridge cultivated sugar beets to the regular cultivated beets

than usual. With an average of 90 % field emergence of earlier seeded and ridge cultivated sugar beets was lower than of later seeded and commonly cultivated sugar beets, which showed field emergence of 95 %. In contrast to this earlier seeded sugar beets had a clearly distinguishable advantage in leave-development during early plant development, which was compensated in adult stages of plant growth.

Figure 3 shows relative yield difference of ridge cultivated sugar beets in comparison to conventionally cultivated sugar beets at the research farm „Campus Klein-Altendorf“ over the years. It is clearly distinguishable that there is a strong influence of a year's individual conditions. In 2007 there was a long phase of drought in spring, and therefore yield decreased very strong due to the conditions mentioned before. However, other experimental sites in 2004 showed increase of yield, which couldn't be confirmed by the results on „Campus Klein-Altendorf“.

As shown in **figure 4** ridge cultivated sugar beets were longer (except 2004) and mostly had a greater diameter. However these factors didn't lead to yield increase. Plant-density and form of the beet-body may have had an influence on yield too.

Conclusions

The development of ridge-forming for sugar beets in Western-Germany from a ridge rotary cutter to a ridge cultivator was presented in this article. The last stage of this system, developed by ILT Bonn, was a 6-row ridge cultivator with low requirements on engine-power and lift-power while seeding can be done very precisely.

The experiments over a period of six years showed that beet-bodies were longer and soil adhesion was lower when sugar beets were cultivated in ridges. However the yield calculated by plant density and single-beet-mass was not increased significantly. However, we conclude, that yield-level in the Rheinland (Western-Germany) is high enough to limit yield increase due to ridge cultivation.

Literature

[1] Grape, K., G. Sander und G. Schlinker: Ist der Dammanbau eine Alternative? Zuckerrübe 53 (2004), H. 1, S. 31-33

[2] Grape, K.: Dammanbau – Erfahrungen aus Norddeutschland. Landwirtschaftliches Wochenblatt Westfalen-Lippe 162 (2005), H. 11, S. 27-28

[3] Große Enking, J.: Mehrertrag im Dammanbau. Landwirtschaftliches Wochenblatt Westfalen-Lippe 161 (2004), H. 29, S. 25-26

[4] Große Enking, J.: Mehrerträge bestätigt. Landwirtschaftliches Wochenblatt Westfalen-Lippe 161 (2004), H. 47, S. 24-25

[5] Kremer-Schillings, W.: Experiment Dammanbau. Zuckerrübenjournal-LZ Rheinland 33 (2005), H. 8, S. 16-17

[6] Moritz, H.: Rüben auf Dämmen bringen höhere Erträge. top agrar 32 (2003), H. 11, S. 50-53

[7] Schulze Lammers, P. und M. Rose: Dammanbau von Zuckerrüben. Landtechnik 60 (2005), H. 3, S. 136-137

[8] Schmitz, S.: Rheinische Rüben im Dammanbau? LZ Rheinland 171 (2004), H. 10, S. 24-25

Authors

Dr. agr. Olaf Roller is supervisor of experimental field research at the Institute of Agricultural Engineering, Institut für Landtechnik, University of Bonn, Germany, Nussallee 5, 53115 Bonn, E-Mail: roller@uni-bonn.de

Prof. Dr. Peter Schulze Lammers is supervisor of the department of Technology of Crop Farming at the Institute of Agricultural Engineering, University of Bonn, E-Mail: lammers@uni-bonn.de