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Erosion protection in tractor tracks

Rill erosion in tractor tracks occurs regularly and causes an annual erosion of up to several tonnes of soil per hectare. Intermittent planting allows erosion to be reduced by up to 80%. 142 field trials carried out in the years 2003 to 2005 in Adenstedt (in the south of Lower Saxony) provided recommendations for intermittent planting.

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Keywords

Tractor tracks, rill erosion, soil protection, intermittent planting

In arable farming, tractor tracks are used five to fifteen times per year depending on the intensity of the production technique and the cultivated crop. As compared with the field area which is not used by vehicles, the tracks are compacted and canalize the runoff of surface water [1, 2]. This leads to rill erosion and soil losses, which often reach up to 2 t/ha•a and in some cases even 5 t/ha•a. In Lower Saxony, track erosion affects almost 60% of all fields. If track erosion occurs regularly, erosion protection by means of planting is part of "good practice". Due to the second growth effect, intermittent planting is the only acceptable possibility of erosion protection in grain cultures.

Effects of intermittent planting in winter wheat

Depending on the inclination, the course, and the depth of the tracks as well as the moisture conditions, intermittent planting reduces soil erosion in tractor tracks by 25 to 80% (*Fig. 1*). Under the conditions of conventional tillage, intermittent planting on 25% of the field reduces soil erosion by approximately 40%. The effect of intermittent planting is mainly the result of a larger flow cross section and reduced runoff speed [3]. Due to slower runoff, fine earth deposits in the planted area.

Tillage also influences the extent of soil erosion in the tracks. Under the conditions of conservation tillage, plant residues in the tracks slow down runoff. As a result, fine earth accumulates in front of smaller piles of mulch. If conservation tillage is applied, even unplanted tracks show 80 % less erosion than tracks on conventionally tilled fields (*Fig. 1*). Thus, conservation tillage also reduces erosion in the tracks and makes planting on less steeply inclined slopes unnecessary.

At low track depths and in tracks which do not directly follow the line of slope, water sometimes flows into the neighbouring field. Planted areas increase this effect, which reduces soil erosion. This reduction is not a direct result of intermittent planting. However, it shows that a slightly slanted course of the

tracks on the slope is sufficient to reduce the risk of erosion considerably.

The effect of complete planting in sugar beet

In sugar beet, tracks are generally drawn by shutting off one drill row per wheel track during drilling. In these tracks, complete planting with winter barley for erosion protection suggests itself. If winter barley is drilled at a double seed rate as a short-day plant directly after the beet during the long days, it very quickly produces a dense vegetative mass. Towards the end of June, the barley is killed by spraying. Even then, however, organic residues still provide sufficient surface protection.

In the conventionally tilled variants and under otherwise identical conditions, erosion in the tracks decreased by approximately 73% as compared with unplanted tracks as a result of planting with winter barley (given approximately identical runoff quantities) [4]. In the conservation tillage variant, erosion in the planted track was about 84% lower. In contrast to the conventional variant, this significant reduction not only resulted from planting alone, but also from the larger and more numerous drought cracks.

Recommendations

Intermittent planting in grain

If wide standard tyres (40 to 55 cm) are used in tracks on fields where row crops are grown, the originally narrow grain tracks (25 to 28 cm) must be widened for cultivation tractors to be used in all crops. This requires that four to five grain rows (instead of two like in the past) are shut down. Therefore, the edge rows no longer touch the track surface in grain. Especially after conventional tillage, intermittent track planting is not necessary. Frequency (unplanted, planted) depends on the susceptibility of the location to erosion. The following rules are recommended [5]:

1) Slope inclination < 5%: ratio planted : unplanted 1 : 4 (10 m for 40 m of track)
2) Slope inclination 5 < 10%: ratio planted : unplanted 1 : 3 (10 m for 30 m of track)
3) Slope inclination > 10%: ratio planted : unplanted 1 : 1.5 (10 m for 15 m of track)

The ratio may not be shifted too much in favour of planting because an excessively large percentage of second growth could increase harvesting moisture too much.

Under the conditions of conservation tillage, intermittent track planting is generally unnecessary (exception: very steep slopes). However, even incorporation (1st pass: short-disc harrow, 2nd pass: cultivator) is required in order to accelerate straw rotting. Despite intensive cultivation, the degree of surface coverage after the field emergence of grain still ranges between 25 and 40 %, which provides a sufficient reduction of soil erosion even after one-time autumn application and at slope inclinations of more than 10%.

Complete planting in row crops

The track technique known from grain cultivation has been extended to comprise row crops. In sugar beet, for example, efficient, soil-protecting cultivation between the rows is no longer possible with 9.5 inch tyres. The establishment of tracks, however, provides space for wide tyres (16.9 R 34, for example), which can transmit the loads of large container volumes to the soil at a reduced tyre inflation pressure.

The reasons for track erosion in row crops are the late coverage of the row by the leaf canopy and the impairment of soil structure due to high rolling-over frequency. If larger quantities of precipitation fall, the tyre tread is not sufficient to reduce runoff even if it is directed downhill (which is only the case in every second track). As shown above, however, this reduction can easily be achieved with the aid of track planting with winter barley. Due to spring drilling and continuous vehicle passes, the five grain rows stock very well. Track planting can be recommended under the following conditions:

1. After a plough furrow on fields with an inclination of more than 5%
2. Under the conditions of conservation tillage, planting on sloped fields with an inclination of more than 5 % is only necessary in the case of mulch drilling after straw if the degree of straw coverage falls below 15% as a result of excessively frequent cultivation.

These recommendations for soil cultivation and planting exclusively apply to tracks used by vehicles with wide standard tyres and an attached plant protection sprayer at tyre inflation pressures of approximately 1 bar.

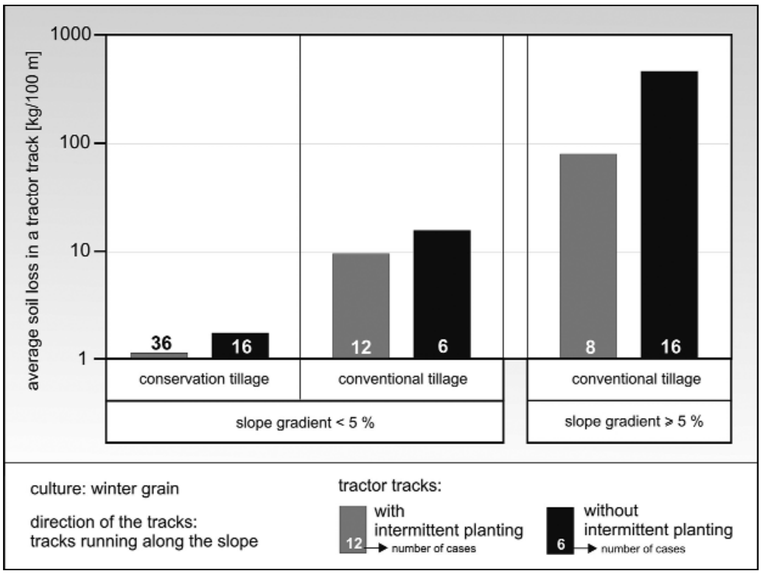

Fig. 1: Effect of intermittent planting on rill erosion in tramlines of winter grain at different slopes and with different tillage methods

Conclusions

Track planting is very efficient and can make an important contribution towards erosion protection. A combination of measures from several areas best prevents runoff and erosion along lines. In principle, wide tracks should be established which provide space for wide standard tyres. In combination with attached implements, this allows the wheel load to be reduced even if large-volume containers are used and thus enables the field to be driven over at a low tyre inflation pressure of 1 bar. Intermittent or complete track planting is mainly required after soil cultivation with the plough. For reasons of good practice, only conservation tillage should be applied on slopes with an inclination of more than 5%. If inclination is extreme and the degree of coverage is low, tracks should additionally be planted.

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