CONSERVATION TILLAGE – A NEW STRATEGY IN FLOOD CONTROL

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1. Introduction

It may seem at first that there is no connection between tillage methods on arable land and flood disasters in a watershed. But flood disasters are frequently the consequence of extensive amounts of water originating from surface runoff from soils due to a lack of infiltration caused by soil sealing or crusting. The last has to be seen in context with soil erosion on arable land, which results from inhibited water infiltration through soil siltation. Soil sealing is caused by raindrops hitting the soil surface with a force great enough to destroy soil aggregates. Dispersed surface clods and aggregates form a thin sealing soil layer, which inhibits water infiltration in a very efficient way [1]. On sloped arable land, inhibited infiltration by soil sealing causes surface water runoff, which causes on- and off-site damages through soil erosion.

The best way to decrease or to prevent surface runoff on arable land is to prevent soil sealing and crusting. In the following we want to show that conservation tillage combined with mulch seeding is one of the most efficient strategies against siltation on arable land. Conservation tillage has an influence on a number of physical and hydrological soil parameters. In most cases, this contributes to a drastic reduction of surface runoff on arable land.

In Saxony more than 60 % of arable land (450,000 ha) is endangered and regularly afflicted by water erosion. To reduce or prevent on- and off-site damages caused by water erosion, extensive soil protection measures are needed in entire regions or watersheds. Conservation tillage and mulch seeding are recommended as effective methods against water erosion by the agricultural extension service and will be more and more practised on arable land in the future.

Since reduced water erosion is closely connected with reduced water runoff, conservation tillage on arable land in the whole catchment may be both an effective strategy against water erosion and an efficient element of flood control. In the following this possible relationship will be demonstrated by field experiment results. These results were obtained at various sites in Saxony in different tillage systems with simulated rainfall experiments (Fig. 1).
### Rainfall simulation setup

<table>
<thead>
<tr>
<th></th>
<th>1 m²</th>
<th>1 m²</th>
<th>44 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plot size</strong></td>
<td>1 m²</td>
<td>1 m²</td>
<td>44 m²</td>
</tr>
<tr>
<td><strong>Rainfall intensity</strong></td>
<td>0.7 mm*min⁻¹</td>
<td>1.9 mm*min⁻¹</td>
<td>0.7 mm*min⁻¹</td>
</tr>
<tr>
<td><strong>Duration</strong></td>
<td>60 min</td>
<td>20 min</td>
<td>60 min</td>
</tr>
<tr>
<td><strong>Nozzle type</strong></td>
<td>VeeJet 80/100 (1 unit)</td>
<td>VeeJet 80/100 (1 unit)</td>
<td>VeeJet 80/100 (15 units)</td>
</tr>
</tbody>
</table>

### Examined parameters

- Surface water runoff, infiltration
- Soil loss
- Soil aggregate stability [2]
- Soil organic matter content
- Soil coverage with mulch

Figure 1. Experimental methods applied in experiments assessing the effect of heavy rainfall events on physical and hydrological soil parameters

## 2. Soil Tillage Systems in Germany

Cultivation of annual crops (e.g., wheat, barley, oil-seed rape, sugar beet, corn) in Germany is presently achieved with three different tillage systems:

1. **Soil tillage with the mouldboard plough**, defined as *conventional tillage*. It is characterised by a soil-turning action to a depth of up to 30 cm. This is highly effective in burying and thereby killing annual and perennial weeds and volunteer crops. Ploughing produces a clean surface, which facilitates precision seeding with common seeding machines.

2. **Soil tillage without mouldboard plough**, defined as *conservation tillage*. This includes shallow tillage methods without the soil turning action of the plough. Different tillage implements are used, like cultivators, (rotary) harrows, disks, normally in conjunction with mulch seeding of different crops (for example, corn, sugar beet, oil-seed rape, wheat, barley).

3. **No-tillage systems or direct seeding**. Except for nutrient injection and seeding, soil is usually not disturbed between harvesting and planting under no-till systems.

The main tillage method currently practised in Germany is ploughing. This is done to kill annual and perennial weeds as well as volunteer crops and/or to