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Influence of straw residue cover on the sprouting and yield of spring cereals in direct seeding on clay soil in Southern Finland

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1. Introduction

Direct seeding originates from dryer climate area than in Scandinavia. In these arid areas main reasons for conservation agriculture has been save soil moisture and prevent soil erosion. In Scandinavia climate is humid and soil moisture is usually greater disadvantage than dryness, Alakukku et al. 2004, therefore straw residue cover generally don't need to prevent evaporation. Thick straw residue cover causes many difficulties to prepare good seedbed.

2. Material and methods

To examine the influence of straw residue cover on the sprouting and yield of spring cereals in direct seeding on clay soil, an experimental trial was carried out in the South West Finland Research Station Mietoinen in 2003–2005. The trial fields were direct seeded continuously starting from the mid-1990s. Straw residues were spread on the soil in four different quantities. The lowest amount was 2 t/ha, and the amount of residues increased by 2 t increments up to 8 t/ha. The height of stubble was low, because lowest 2 t/ha amount of crop residue includes only stubble. According to Mikkola 2004 long stubble is better than low, because it makes less chaff to soil surface and long stubble don't make difficult to seeding. The cultivated cereals varied from year to year: spring wheat in 2003, winter wheat and oats in 2004, and barley in 2005. In 2005, an experiment took place in the Agricultural Engineering Research unit in Vihti involving the amount of straw residue, weed and disease control and stubble cultivation. The straw residue quantities increased by 2 t steps from 0 t/ha to 8 t/ha. The straw residue management methods were ploughing, stubble tilling and direct seeding.

3. Results

In the experimental year 2003, the yield of spring wheat was highest with the largest amount of straw residue on soil. In this growth season, May was the only rainy month (rainfall 105 mm). Starting from the middle of June, there was a rainless period of seven weeks. In this period, the straw residue sheltered soil from excessive evaporation. In the plot with the lowest (2 t/ha) amount of residue, the yield was 2 660 kg/ha, while in the plot with the highest (8 t/ha) amount, the yield was 50 % higher. Figure 1.

In the year 2004, the rainfall in May was less than usual and evaporation was excessive. Again, the straw residue cover served as a shelter against evaporation. The larger the straw residue mass, the higher the yield of oats. In contrast, however, the yield of winter wheat decreased when the amount of straw residues was 4 t/ha or more. Winter damages were more severe and the plant stand became more open when the amount of straw residues was higher. When straw residues decompose, it produces poisonous organic acids, especially acetic acid, which is dangerous to winter wheat shooting (Mikkola 2004). Sometimes poor growth through surface retained stubble is primarily

related to the physical effects of the stubble rather than biochemical effects related to stubble phytotoxicity or N-immobilisation. Bruce et. al. 2006. When seeding depth is low a part of seeds could stay on thick straw residue, which causes poor sprouting. (Alakukku et al 2005). Open space in winter wheat became colonized by weeds, especially *Matricaria* and *Elymus repens*.

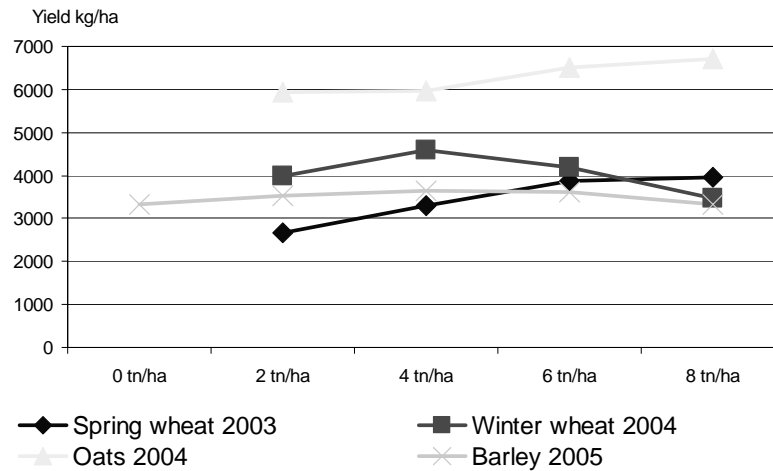


Figure 1. The yield of spring cereals and winter wheat in different levels of straw residue in Mietoinen.

In the year 2005, the highest yield of spring barley was gained when the amount of straw residue was 4 t/ha. The yield was slightly lower with either less or more residues. The number of sprouts decreased by 12%, when the residue cover increased from 0 t/ha to 4 t/ha. By 6 t/ha, the number of sprouts decreased by 44%, and finally, at 8t/ha, the decrease was 56% . Figure 2.

When the straw mass on soil surface exceeded 4 t/ha, it affected like an insulating material. In spring, soil temperature was considerably lower, and melting of frozen soil took a longer time than when the straw mass was 2 t/ha or less. Figure 3. Thick straw residue delay starting of seeding while it shorten growing period.

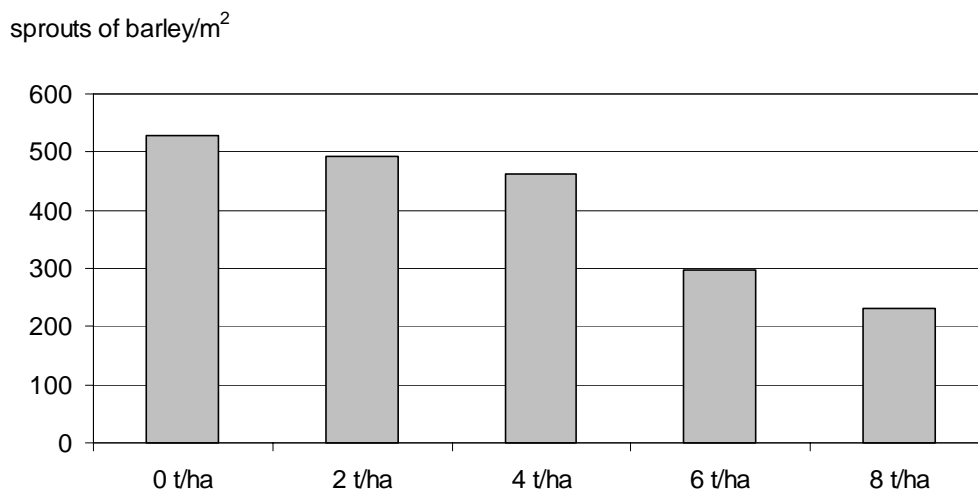


Figure 2. Number of barley sprouts under straw bed in Mietoinen 2005.

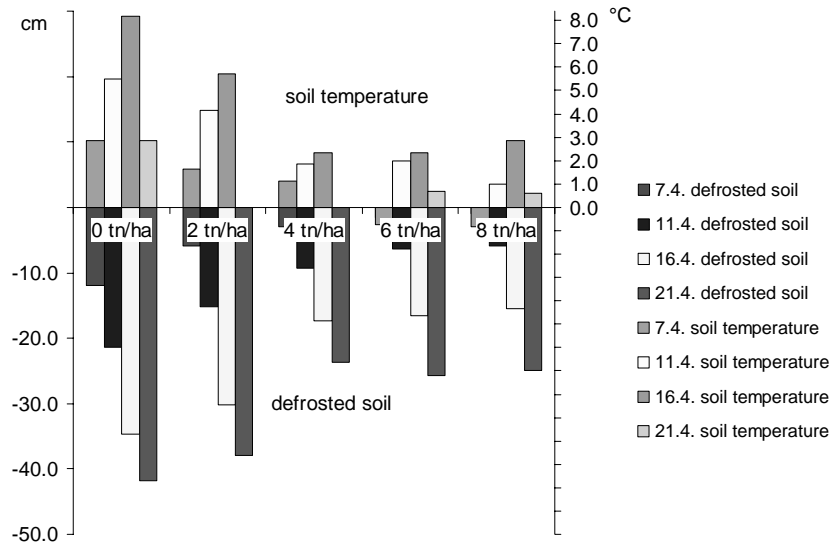


Figure 3. Melted frost and soil temperature in spring under 0-8 t/ha straw bed in the year 2005. South West Research Station in Finland.

When no weed or disease control was performed, the highest yields were gained with the lowest straw residue mass on soil surface. Ploughing moulds the residues from surface into the soil, and so does stubble tilling with a low amount of straw. The yield of direct seeding was at the same level as in ploughing with 2 t/ha of straw residue. Yield decreased when the straw residue cover became thicker both in stubble tilling and in direct seeding. When weed and disease control were performed, the yields increased in every experimental setting. The increases were significant, from 1120 kg to 1660 kg/ha Figure 4.

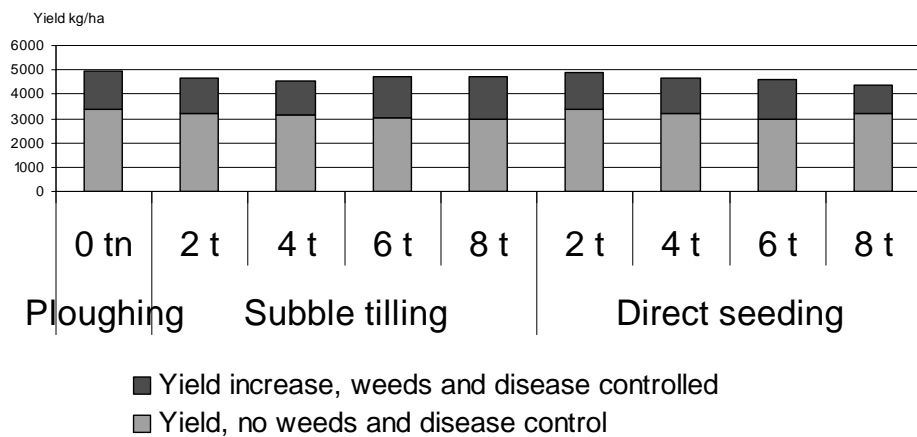


Figure 4. Influence of straw residue and residue management to yield in Agricultural Engineering Research unit in the year 2005.

4. Conclusion

In normal years when there is no insufficiency of water, 2–4 t/ha is an adequate amount of straw residue to cereals on soil surface in direct seeding, but if the beginning of growth season is very dry, a thicker straw residue cover is better. The obverse is that sprouting became/becomes lower with thicker straw residue covers. The need of weed

and disease control is obvious, irrespective of the cultivation system, especially if the weather and environmental conditions promote spreading of diseases.

5. References

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