Norway study site experiment 2: COVER CROPS FOR IMPROVING SOIL HEALTH

The problem

Soil erosion, nitrogen losses, and runoff of nutrients are common soil threats in Øsaker, Norway, largely due to the continued existence of bare soils. This study aimed to explore ways of reducing the prevalence of bare soils.

The proposed solution

Cover crops are often grown to prevent losses of nitrogen and protect the soil from erosion during autumn and winter. Certain cover crops can also be beneficial to soil carbon stocks, crop yields, physical properties and hydraulic properties.

Spring sown CC Mix 1	Spring sown CC Mix 2	Autumn sown CC mix 1	Autumn sown CC Mix 2
Chicory (*Cichorium intybus)*	White clover (*Trifolium repens)*	Daikon (*Raphnus sativus)*	Vetch (*Vicia sativa)*
Perennial ryegrass *Lolium perenne)*	"Birdsfoot trefoil" (*Lotus corniculatus)*	Ww. Ryegrass (*Lolium multiflorum Lam. Var. Westerwoldicum)*	Hairy vetch (*Vicia villosa)*
Alfalfa (*Medicago sativa)*	Crimson clover (*Trifolium incarntum)*		Pea (*Pisum sativum)* in 2018 Crimson clover (*Trifolium incarnatum)* in 2019

Experimental design

The study site in Øsaker (Østfold county) is located in southeast Norway. In collaboration with the Norwegian Agricultural Extension Service, a field (24 x 15m) with 5 plots (each 6 x 1,5 m) and 3 replicates was established in spring 2018 to investigate cover crop mixtures sown in spring cereal at two different timings (spring and autumn).

Sampling

The following measurements were taken in each plot:

- Crop yield and quality
- Organic carbon
- N-min
- Phosphate levels
- Cation levels
- Bulk density
- Aggregate stability
- Earthworm count

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Results

Control - No cover crop, SN - Spring sown nitrogen fixating cover crop, AN - Autumn sown nitrogen fixating cover crop, SR - Spring sown cover crops root mix, AR - Autumn sown cover crops root mix

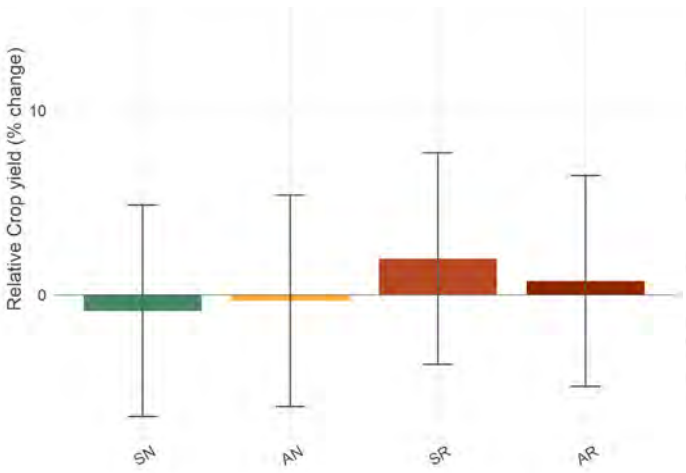

Figure 1. Relative crop yield versus treatment. No significant differences were found but the Spring sown cover crop root mix led to the highest change in relative yield.

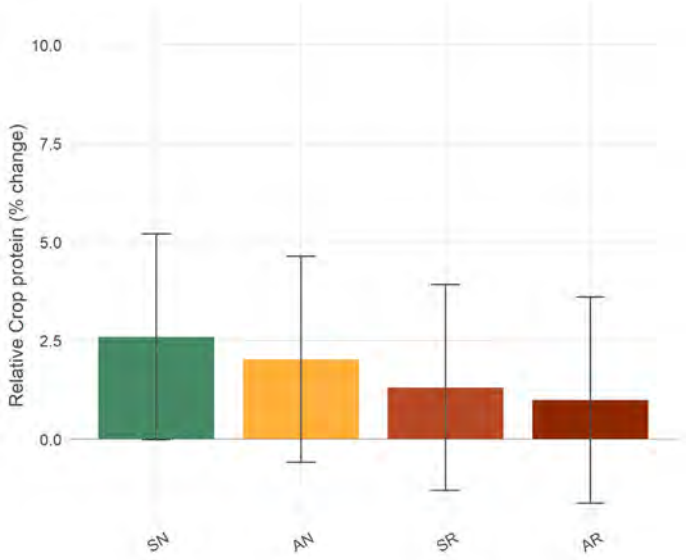

Figure 2. Relative crop protein versus treatment. No significant differences were found but the Spring sown cover crop nitrogen mix led to the highest change in relative yield.

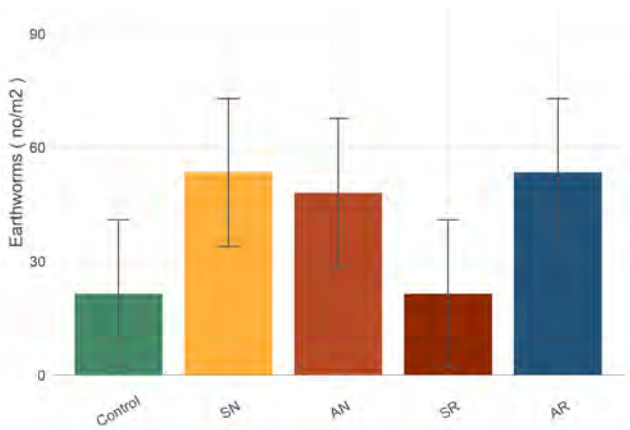

Figure 3. Treatment versus earthworm count. The differences were not significant. However, Spring sown N fixing cover crops and Autumn sown cover crops (root mix) resulted in the highest counts.

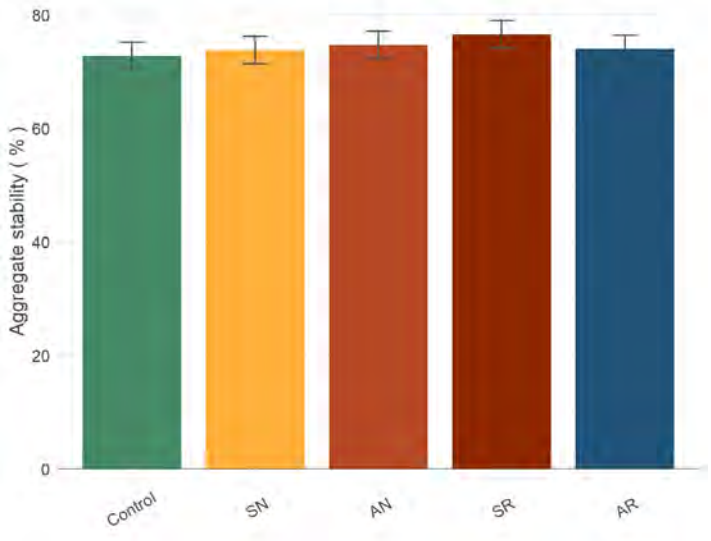

Figure 4. Aggregate stability versus treatments. No significant differences were found.

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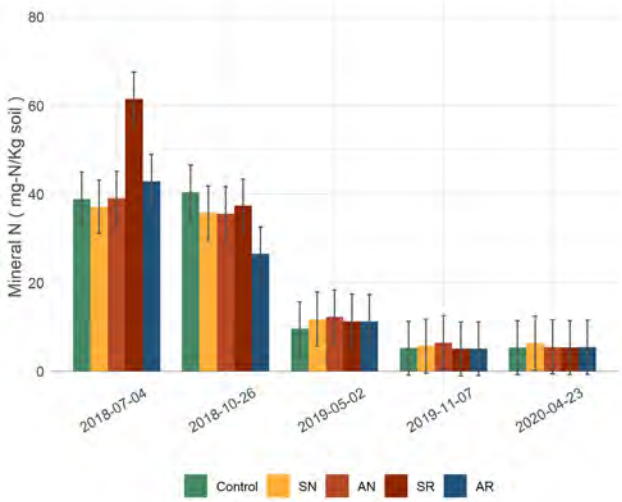

Figure 5. Mineral N versus treatment. No significant differences were found, however, the drought in 2018 led to high levels of soil mineral N in autumn 2018 compared to 2019 and 2020

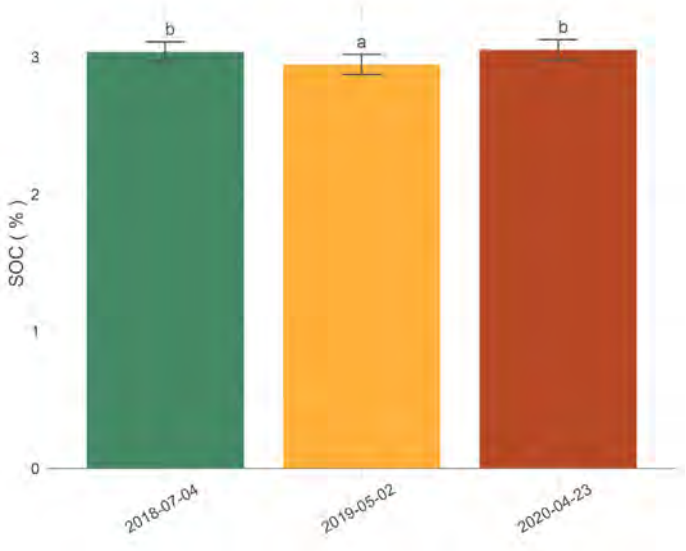

Figure 6. Soil organic carbon (SOC, %). There was a significant effect on SOC between years, but not an effect of cover crops. The lack of plant material introduced to the soil in 2018 (due to the drought) may, in part, explain these results.

Economic impacts

- Using cover crops had a strong positive economic impact in this experiment
- This positive economic result is, in part, due to the subsidisation of cover crops through a regional environmental programme
- The calculation of cover crop costs was based on ryegrass and clover; the seed costs may increase if other species were used
- The table below presents the economic data from this experiment, with costs shown in Euros/ha.

Agricultural management technique	No cover crop (control)	Cover crop (SICS)
Investments costs	0	7.6
Maintenance costs	0	68.3
Production costs	0	0
Benefits	208	338
Summary=benefits-costs	208	262.2
Percentage change	26	

Table 1: Summary of the benefits of SICS (SICS vs. control), this case shows a positive impact of SICS in comparison to the control, the numbers are in euro/ha.

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Stakeholder feedback

- Stakeholders were pleased with the focus on cover crops, which they found interesting and useful. Some did, however, expect the results to be more significant, with larger effects.
- Some acknowledged that SoilCare has been important for raising awareness and changing perceptions surrounding cover crops
- It was posed that planting cover crops in larger blocks may have reduced slug burdens
- Further research is needed according to stakeholders, with long-term experiments appearing keen to maximise credibility
- Overall, SoilCare appears to have been successful for building stakeholder networks both nationally and internationally, and for providing stakeholders with information and knowledge surrounding cover cropping.

Roots of alfalfa in the soil during growing season 2020. Picture: T. Seehusen

Conclusions

- It was difficult to establish and achieve sufficient density of cover crop plants in the small plot scale experiment in Øsaker, especially in years that are dry (2018) and in years with high precipitation (2019).
- occasionally high amounts of weeds (chickweed), as well as practical challenges, might have affected the growth of the cover crop species and the main crop in later years.
- High temperatures in 2018 resulted in poor plant growth and consequently an excess in mineral nitrogen in the soil, as illustrated by the high levels of mineral N in 2018 compared to 2019 and 2020
- Differences in soil organic carbon between years could be an effect of the summer drought.
- The plant species most often observed through field observations was vetch in the SN mixture and ryegrass in the SR and AR treatments. Crimson clover in the SN treatment and radish in AR treatment was observed occasionally.
- The results show a decrease in mean relative crop yield for treatments where legume cover crop species were included (Treatment SN and AN).

Contact information

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