Polish study site experiment: EFFECTS OF LIMING, MANURE AND COVER CROPS ON CROP YIELDS

The problem

Soils in Szaniawy, Poland face several challenges. To avoid losing crop productivity, there is a need to increase soil organic matter and water holding capacity, decrease soil acidity, and increase how many legumes are incorporated into cereal rotations to improve soil structure and N fixation.

The proposed solution

The Polish study site for SoilCare explored the effects of soil management practices on crop yields. These practices include liming, manure, and cover crops/intercrops.

The study site was located in Szaniawy, where the main threats to soil include a low water holding capacity, acidity, and low average soil organic matter content.

A randomised field-experiment was conducted for three years to explore the efficacy of the above soil-improving practices.

Experimental design

Treatment no.	Treatment
1	Control
2	Liming ($CaCO_3$, 5-6 t/ha)
3	Cover crops/intercrops
4	Manure (30 t/ha)
5	Liming/cover crops/manure

Map of the treatments within the field.

3	5	1	2	4	3	4	5	2	1	4	2	3	1	5

All 5 treatments were repeated three times. The cover crop mix used was Lupines, Serradella and Phacelia (130, 30, 4 kg/ha respectively). Treatment five included all three measures, with 10 t/ha of manure applied instead of 30 t/ha.

The crop rotation on this field included oat, wheat, and triticale.

The following measurements were taken:

- Visual examination of the soil, including roughness, aggregate stability, soil cover and infiltration
- Precipitation
- Air temperature
- Soil texture
- Bulk density
- Soil water content
- Total porosity
- Thermal properties

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Results

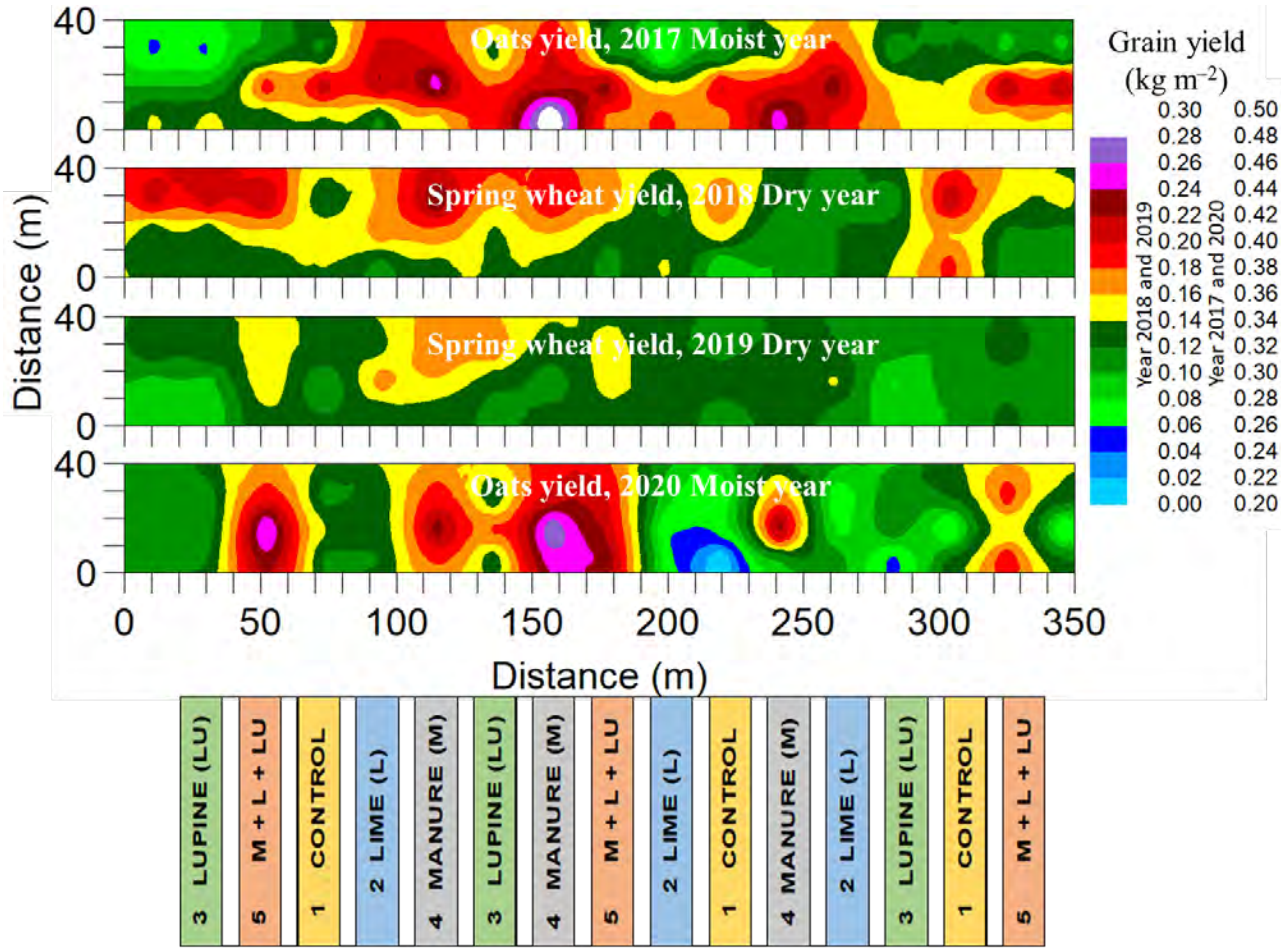

Figure 1. Spatial distribution of the cereal grain yield (2017-2020) and scheme of the experimental field.

- Different soil-improving practices had a significant effect on crop yield in moist in contrast to dry years (Figures 1,2).
- The most positive effect was seen in manure alone and liming/cover crops/manure together on the yield of cereal grain and straw and plant height was observed (Figure 3).
- The crop yield was much lower in dry than moist years, irrespective of soil-improving practice (Figure 3).
- All tested soil-improving practices significantly increased the dry gluten content (DGC) in wheat kernels. The highest DGC was in plots with application of liming/cover crops/manure together (Figure 4).
- Plots with liming/cover crops/manure had the highest top soil mineral nitrogen content (Figure 5).

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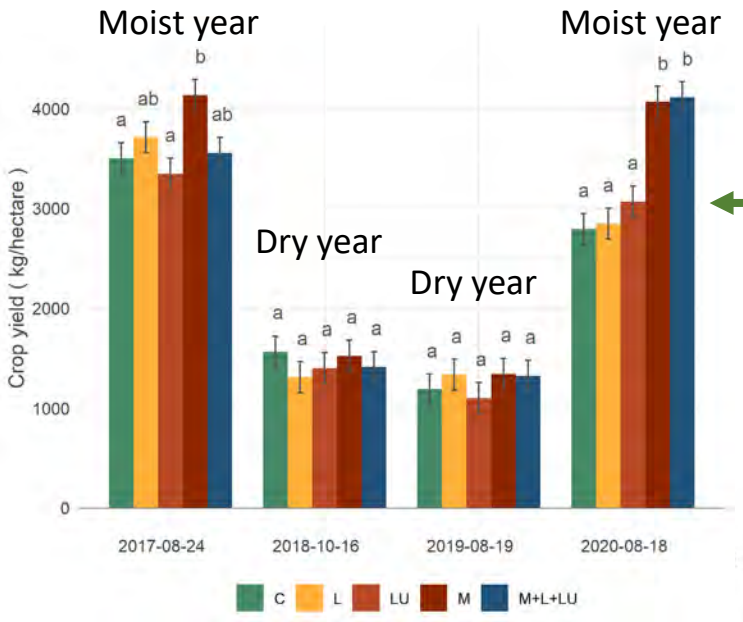
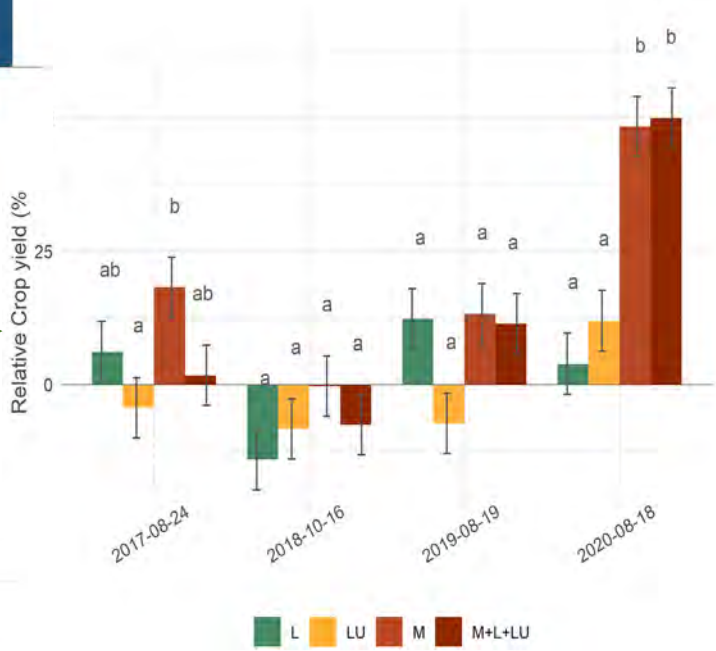


Figure 2. Mean values of crop yield.

Different soil-improving practices had a significant effect on crop yields where there were moist and dry years

Figure 3. Relative crop yields

Crop yields were more than 50% lower in dry than moist years irrespective of soil-improving practice



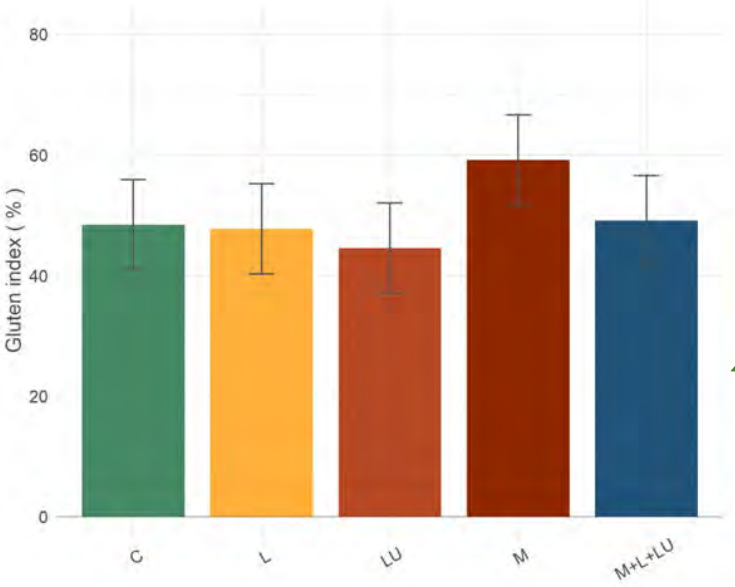


Figure 4. Dry gluten content in wheat kernels

All tested soil-improving practices significantly increased dry gluten content (DGC) in wheat kernels. The highest DGC was in plots with manure applications.

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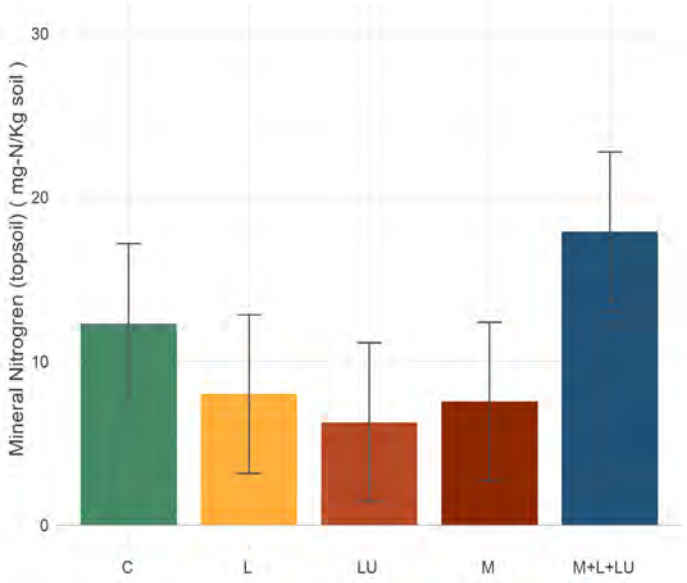

Figure 5. Content of mineral nitrogen in the topsoil at harvesting 2020.

Plots with liming/cover crops/manure had the highest topsoil mineral nitrogen content

Stakeholder feedback

- Overall, stakeholders found the results of the study credible and stated that they should be disseminated widely.
- Stakeholders were interested to learn whether drought will affect the applicability of the SICS.
- It was recommended that direct discussions and demonstration days are important for promoting the use of SICS.
- Stakeholders recognised that they have gained new knowledge due to engaging with SoilCare, with some stating that they now realise the importance of soil quality.
- Financial support appears to be the best way to help farmers implement the SICS recommended by the research findings.

Economic findings

Application of manure alone and liming/cover crops/manure together led to significant increases in grain and straw yields of cereals in the last growing season. However, these yield increases did not compensate for additional production costs and consequently, the application of these practices in this short-term experiment was not profitable.

Key findings

A combination of SICS led to increases in crop yields and dry gluten content when compared against a single practice.

The spatial-interpolated maps of crop yield will help the variable-rate application of soil -improving practices for increasing yield and productivity.

The crop yield was lower by over 50% during a dry year, irrespective of soil-improving practice.

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Conclusions

In general, the highest cereal yield and plant height were recorded in plots with application of manure or liming/cover crops/ manure together and the lowest in control plots. Spatial distribution of crop yield was similar to that of soil water content.

Differences in crop yield between the tested soil-improving practices were relatively lower than those between the dry and moist years. The highest and lowest dry gluten content in wheat kernels were respectively in control and plots with liming/cover crops/manure together. The spatial kriging-interpolated maps of crop yield and soil properties will help identifying sub-field areas for applying localized management practices to improve crop productivity.

Practical resources for farmers:
http://microbiome.ipan.lublin.pl/

Fact sheet authors

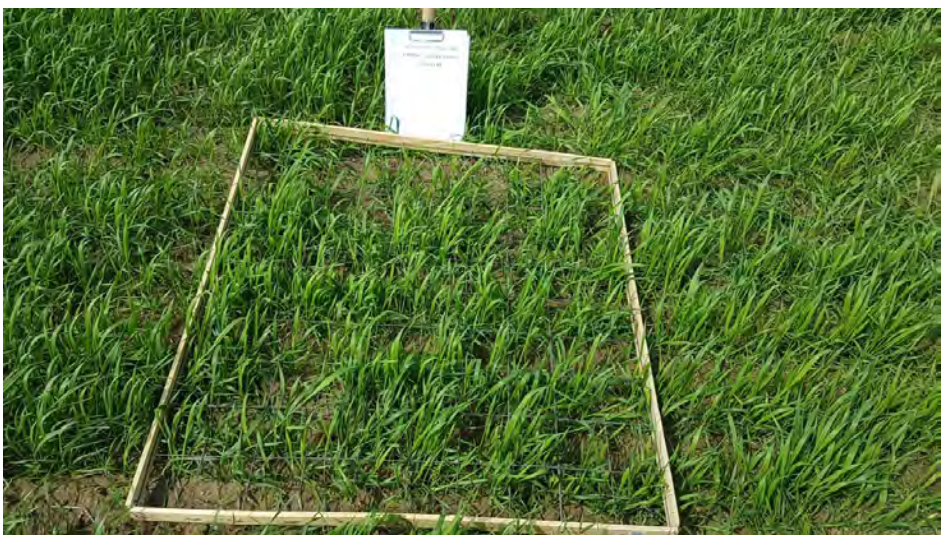
Jerzy Lipiec, Magdalena Frąc, Bogusław Usowicz, Charlotte Chivers

Contact information

Project website: soilcare-project.eu

Study site leader: Jerzy Lipiec, j.lipiec@ipan.lublin.pl

Project coordinator: Dr. Rudi Hessel, rudi.hessel@wur.nl



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