Organic mulching in potato fields to enhance ecosystem regulation services

EcoStack

The overall objective of EcoStack is to develop and support ecologically, economically and socially sustainable crop production via enhancement of ecosystem services provision and protection of functional biodiversity.

Introduction and context

Protecting the soil is an important goal to achieve to better adapt to climate change on farms and have sustainable production of crops. Organic mulching on farms aims to cover the soil with organic material such as straw or plant material. It offers soil protection as it reduces soil erosion, soil evaporation, and encourages soil fauna. It has also the potential to offer agronomic services such as increase yields, suppress weeds and control insect pests.

Field experiments

From 2019 to 2022, experiments were conducted in three countries: Bulgaria by Agricultural University Plovdiv (AUPL), Bosnia & Herzegovina by University of Banja Luka (UBL) and Germany by University of Kassel (UKA) to study the impact of organic mulching in potato fields under diversified pedoclimatic contexts.

In each country different organic mulches were tested on potato fields, and compared to a control treatment with no organic mulch. The mulch material was spread around end of May or beginning of June in each trial. The next table summarize all experimental contexts in EcoStack.

Figure 1: EcoStack countries map and experiment places (EcoStack, 2023).

Figure 2: Spreading of organic mulch on large scale field (EcoStack, 2023).

Country	Germany	Germany	Bulgaria	Bosnia & Herzegovina
Trials type	Small	Large	Small	Small
Mulch material	Triticale/vetch Grass/clover Straw Grass silage	Triticale/vetch Straw	Grass/alfalfa Straw	Grass/alfalfa Straw
Crop	Potato	Potato	Potato	Potato

Table 1: Description of experimental sites on organic mulching in Ecostack (EcoStack, 2023).

The experiments in the three countries focused on the two most important insect pests in potato fields: aphids and Colorado potato beetle. In fact, aphids can be a vector of virus for the potato crop and Colorado potato beetle can eat an important part of leaf surfaces, both leading to decreased potato yield.
Research teams also looked at the abundance of natural enemies with or without mulch and agronomic parameters such as potato yield or weed management.

Key findings

Management of insect pests

1 - Organic mulching was able to reduce the number of winged aphids landing in the field, during high pressure years. During low aphids pressure year, potato crop with or without organic mulching showed comparable numbers of winged aphids landing in the field. Organic mulching has a significant effect on years where it need the most.

2 - In the same way, aphids colonization on potato plants is reduced by applying organic mulching in the field over years with a high aphids pressure.

3 - On experiments in Germany, applying organic mulching also lead to reduce Colorado potato beetles leaves consumption in the field, during high Colorado potato beetle year pressure. Maybe due to a specific pedoclimatic context in Germany, this key findings wasn't confirmed in Bulgaria and Bosnia & Herzegovina where organic mulching lead to reduce daily leaf consumption two years out of four with straw mulching and three years out of four with plants mulching. This insect pests management seems to be more context-dependent.

Figure 3: Colorado potato beetle.

Key findings

Promoting natural enemies

1 - The abundance of natural enemies depend on the preference prey. Natural enemies such as ladybirds are more dependent on prey abundance like aphids. In fact, organic mulching can lead to reduce aphids colonization, thus reducing prey abundance for natural enemies, those with food diet mostly based on aphids were less abundant in organic mulching plots.

2 - By covering the soil, potato fields with organic mulching creates a microclimate on the soil. Ground-dwelling carabids and spiders were recorded in two experiments in Germany and showed higher abundance of these natural enemies in trials with organic mulching.

Agronomic parameters

1 - Over four years of experiments, potato yields were variable depending on the year and the country.
Organic mulching treatment in EcoStack experiment fields had at least the same yield as the control treatment, or better yield in some specific treatment or year. To illustrate, over the three years under Bulgarian climate (Figure 4), potato crop with straw mulching had a significantly higher yield than potato with no mulch. But potato with grass/alfalfa mulching had the same yield as the potato with no mulch, two years out of three.

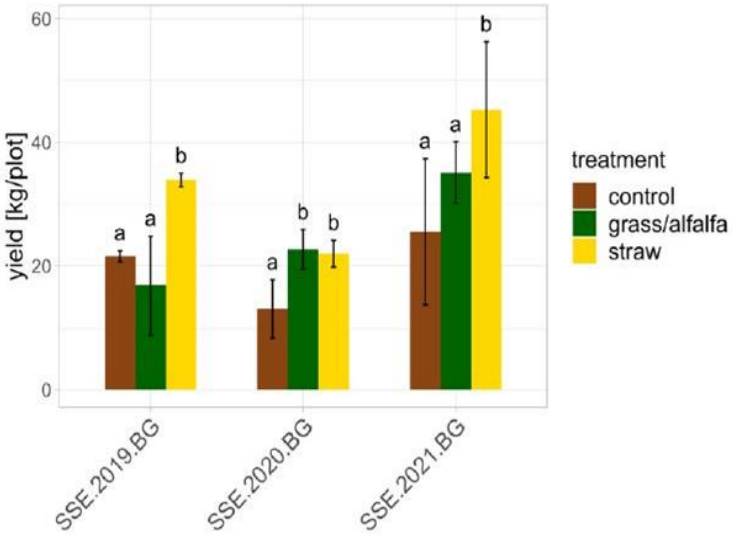

Figure 4: Potato yields in Bulgarian (BG) experiments. Values represent means (±SD). Different letters indicate significant differences between treatments within individual experiments (p <0.05) (EcoStack, 2023).

2 - Weed abundance was recorded in Germany. Weed cover was mostly the same between treatments with or without organic mulching. Nevertheless, applying organic mulching aims to save one weed treatment compared to the control treatment as it cover the soil in the early growing season. Less inputs are needed for farmers to control weeds with organic mulching applied in the field.

Conclusion

Lessons learnt and perspectives

1. Organic mulching in potato fields showed reduction of aphids landing and aphids colonization during high pressure years.

2. The impact of organic mulching on Colorado potato beetle is more variable and more context depend over the three countries.

3. Spreading organic mulch in potato fields decrease the abundance of aphids prey, thus did not promote natural enemies with diet based on aphids. But organic mulching creates micro-climate on the soil, promoting ground-dwelling carabids and spiders.

4. Agronomic parameters, potato yield and weed management, link to this practice on potato crop showed at least the same results or better results in some cases than without organic mulching.

5. These experiments highlight the main points of using organic mulching in an European context. It also provides references on both straw mulching and plants mulching. Many previous studies were looking only straw mulching, theses new references on plants mulching offer more possibilities for farmers to find mulch materials.

6. To be implemented on farms and get all the benefits from this practice in the field, some technical adaptation will be needed, especially at large scale, to find all the plant material needed and organize the spread on the field.

References : EcoStack project's deliverable WP4.2 "Impact of organic mulching on ESP", 2023
Pictures from Sacha Kirchner (Universität Kassel) or Pixabay

Questions? Please contact us at sascha.kirchner@uni-kassel.de , dimitrije.markovic@agro.unibl.org or info@ecostack-h2020.eu

Visit our web site to be informed : www.ecostack-h2020.eu

This project receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773554.
Duration of project: September 2018 - September 2023