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Effects of mechanical weed control in organic soybean cultivation on weed biomass and diversity in Luxembourg

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With a high protein content ($\pm 40\%$) and an optimal amino acid composition, soybean (*Glycine max* (L.) Merr.), a member of the family *Leguminosae*, is one of the most important feed protein sources in animal nutrition. By signing the European Soy Declaration in 2017, Luxembourg aims to promote the regional cultivation of protein crops, e.g. soybean. Organic soybean cultivation in Luxembourg is still in its initial stage, with knowledge gaps mainly in mechanical weed control. The aim of the project “Sustainable and resource-efficient protein production using various mechanical weed control methods in grain legume cultivation, using soybean as an example” (LeguTec) is to investigate the efficiency of the selected mechanical systems under consideration of, inter alia, weed biomass.

In 2018 and 2019, field trials took place on two organic farms in Luxembourg (in Manternach and Hostert). Five mechanical methods were tested in soybean cultivation (variety Merlin), including A) harrow, B) interrow cultivator with duck-foot shares, C) interrow cultivator with duck-foot shares and finger-weeder, D) a combination of treatments A and C, and E) mixed cropping of soybean and camelina in combination with harrow. A positive control F) weeded by hand and a negative control G) not weeded are also implemented. Field trials were set as one-factorial-exact-trial with four replicates. Weeds were counted and identified and biomass cut before and after each weed control run as well as at flowering. Weed diversity was estimated by means of the Shannon index. Data were analysed using ANOVA ($p < 0.05$) and appropriated pairwise comparison Tuckey tests.

In 2018, significant less weed biomass is observed in Hostert for D in comparison to A and E, and for B, C and D in comparison to A and E, in 2019. Biomass in Manternach in 2019 is significantly lower in treatment D. Globally, weed biomass at flowering tends to be lower in the hoeing treatments (B, C and D) than in the harrowing treatments. High weed pressure from the beginning on in all treatments in Hostert has limited the efficiency of weeding but with a tendency in favour of the interrow cultivator. At the Manternach site, weed pressure was low in 2018, allowing good regulation resulting in low diversity in all treatments. Values of the Shannon index tend to be negatively affected by mechanical weeding across all field trials. In 2019, significant lower Shannon

index is observed in Hostert for treatments C and D, as well as for treatment C in Manternach. Hoeing generally tends to lower the most weed diversity in addition to weed biomass. Low abundant species were more likely to disappear, while 1 to 4 species became over-dominant in each treatment.

The increased interest in regional soybean cultivation in Luxembourg due to the LeguTec project shows the need of further research on soybean cultivation to reach the long-term goal of overcoming cultivation barriers and promoting a sustainable, resource-efficient protein production in Luxembourg.