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Breeding for improved soybean-*Bradyrhizobia* symbiosis under cool growing conditions in Central Europe

Promoting local soybean production to cover protein demand of Europe in order to improve food sovereignty and avoid deforestation of rain forests

Background

In recent years soybean (*Glycine max* L.) has gained significant attention in Europe due to its ability to produce high quality protein for human and animal consumption. Under the climatic conditions prevalent in Central Europe, low temperature is the major factor limiting soybean growth and symbiotic nitrogen fixation.

Objectives

The aim of the study is to identify (i) *Bradyrhizobia* strains that show improved nodulation under cool growing conditions and (ii) *Bradyrhizobia* x soybean varieties interactions that can be exploited for breeding for improved symbiosis.

Experimental Design

In a pot trial we tested twelve Bradyrhizobia inoculants (plus an inactivated control) on three early soybean varieties at three temperature regimes. The number of nodules, root and shoot biomass as well as chlorophyll content were assessed after six weeks. In parallel commercially available inoculants were tested in the field on the same soybean varieties under organic and conventional farming conditions in Central Germany. The number of nodules was assessed six weeks after sowing and at beginning of flowering. Yield, thousand kernel weight and protein content were assessed at harvest. The most promising *Bradyrhizobia* strains from the pot trial are currently tested on 20 soybean varieties under 16/12°C temperature regime and will be verified in various field trials in 2013 and 2014.

Preliminary Results

In pot trials we found a significant inoculant x temperature interaction for the number of nodules per plant and the chlorophyll content (Fig. 1). In addition significant inoculant x variety interactions were observed at 14/10°C and 16/12°C. At 14/10°C the highest number of nodules was obtained with the strain USDA 30 and the variety Protina, whereas at 16/12°C the commercial product B yielded highest number of nodules with the variety Bohemians (Fig. 2).

The field trials in Frankenhausen and Quedlinburg revealed that product G was inefficient to produce nodules, resulting in a dramatic reduction in soybean yield and protein content (Fig. 3).

Conclusions

The present results show that the careful selection of inoculants adapted to cool growing conditions is as important as the selection of adapted soybean varieties.

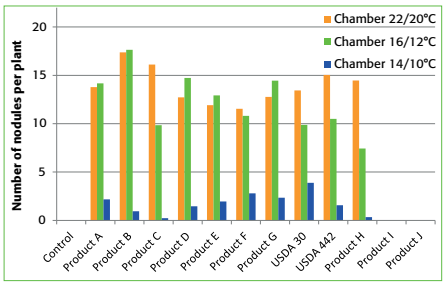

Fig. 1: Number of nodules per plant across three soybean varieties under three temperature regimes (pot trial)

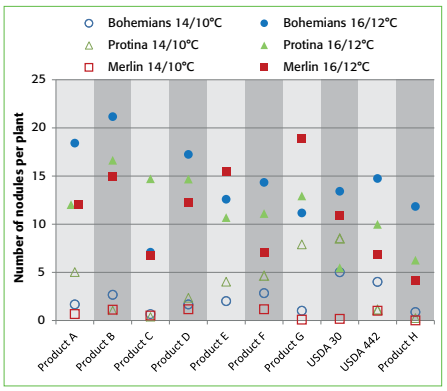

Fig. 2: Number of nodules per plant for three different soybean varieties under two temperature regimes (pot trial)

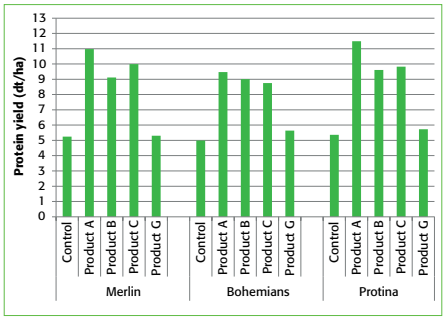

Fig. 3: Protein yield of three soybean varieties tested with four inoculants under organic farming conditions (field trial at Frankenhausen in 2011)

Acknowledgements

This research project was funded by the German Federal Ministry of Food, Agriculture and Consumer Protection under the program for organic and other sustainable agricultural systems (BÖLN) „ Expansion of soybean cultivation in Germany through adaptation by breeding as well as optimization of crop production and processing technology " (www.sojainfo.de), the Mahle Stiftung GmbH in Stuttgart, Germany, and the Swiss Agency for Development and Cooperation, Government of Switzerland under the Indo-Swiss Collaboration in Biotechnology (ISCB). We thank all farmers, advisers, technicians and researchers who contributed to this project.