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Inoculation of indigenous *Bradyrhizobium* strains increased soybean productivity in varying growing conditions in northeast Germany

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Abstract

Soybean (*Glycine max* (L.) Merr.) is one of the world’s most important oilseed and protein crops. In Europe, commercial inoculants containing exotic *Bradyrhizobium* are often used to inoculate field-grown soybeans. However, the effectiveness of these inoculants has often been low. The use of indigenous *Bradyrhizobium* is among the options to enhance biological nitrogen fixation and increase soybean grain yield. Two field studies were conducted in northern Germany in 2020 and 2021 to evaluate the symbiotic potential of indigenous *Bradyrhizobium* strains as potential inoculum. The objectives were to: 1) assess the ability of locally isolated *Bradyrhizobium* strain(s) to improve soybean productivity under rainfed and irrigated conditions; and 2) assess the effects of irrigation on nodulation, grain, and protein yields in soybean. Three *Bradyrhizobium* isolates (GMF14, GMM36, and GEM96) plus a standard strain (USDA110) and no inoculation control were tested in combination with three soybean cultivars (Siroca, Sultana, and Merlin) of varying maturity groups in a 5 × 3 factorial design.

There were significant strain × irrigation interactions on nodulation, protein, and grain yields. Irrigation resulted in almost twice increase in nodule weight but slightly increased nodule number. However, there were minimal *Bradyrhizobium* effects on nodulation. Inoculation with strain GMF14 significantly increased grain and protein yields, yielding an average grain and protein yield of 2013 kg ha⁻¹ and 765 kg ha⁻¹, respectively, compared to 1814 kg ha⁻¹ and 718 kg ha⁻¹ in the standard USDA110.

While irrigation did not significantly influence crude protein content, it increased grain and protein yields by 25 % on average. Moreover, irrigation had a more pronounced effect on USDA110 than on other strains. Irrigation increased grain yield by 47 % in USDA110-inoculated soybean but only by 11 % in GMF14. Although irrigation increased grain and protein yields in all three cultivars, we saw a more pronounced effect on the cultivar Siroca than on Sultana and Merlin. The study found that supplemental irrigation and using indigenous *Bradyrhizobium* strains as inoculum are viable options for increasing soybean production in Northeast Germany.

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