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Beneficial Microorganisms as a Key Factor for Sustainable Common Bean Cropping Systems

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Abstract

Common bean is likely the most important grain legume for the population feeding in developing countries worldwide. Common bean shows a natural ability to obtain nitrogen through biological N_2 fixation, by establishing symbiosis with rhizobia. However, the inoculation technology is poorly exploited in this crop, as well as, the use of other plant growth-promoting rhizobacteria. This work aimed to investigate the effects of *Rhizobium* tropici and Azospirillum brasiliense co-inoculation in common bean cropping systems. Seven field experiments were carried out for three consecutive years under field conditions. Treatments consisted of non-inoculated control (NI), N-fertiliser treatment (NfT), single inoculation of R. tropici (Rt), R. tropici+two doses of A. brasiliense sprayed on plants (Rt+Ab2p) and R. tropici+three doses of A. brasiliense sprayed on plants (Rt+Ab3p). Evaluations were based on the nodule number (NN), nodule dry weight (NDW), root dry weight (RDW), shoot dry weight (MSPA), grain yield (GY), relative grain yield to NfT treatment (RGY:NfT) and relative grain yield to Rt treatment. Also, estimations on economical return and on greenhouse gas emissions were performed. The use of Rt+Ab3p increased NN, NDW, RDW and SDW by 9 %, 25 %, 35 % and 31 %, respectively, as compared to Rt treatment. These increases over nodulation and plant growth resulted in a GY about 3200 kg ha^{-1}, representing an increase in GY of about 5 % and 26 % as compared to NfT and Rt treatments, respectively. The co-inoculation of Rt+Ab3p returned about U$ 1.53 for each U$ 1.00 invested and in a net income of U$ 2171.52 ha^{-1}, resulting in U$ 174.74 ha^{-1} more than the N-fertilised treatment. The substitution of the N-fertiliser by the co-inoculation on the total area cropped with common bean in Brazil can result in the mitigation of about 0.7 Mt CO_2-eq. The results indicate the feasibility of using rhizobia and azospirilla co-inoculation in commercial farms as an efficient technology in replacing N-fertilisers, helping to save expenses and preventing environmental risks. These results also bring an important contribution for common bean crops around the world, especially in the tropical climate, like Myanmar, India and sub-Saharan countries.

Keywords: Plant growth, production cost, soil bacteria, sustainability

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