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Importance of rhizobia in Agriculture: potential of the commercial inoculants and native strains for improving legume yields in different land-use systems

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Legumes play an important role in the traditional diets of many regions throughout the world because they provide a multitude of benefits to both the soil and other crops grown in combination with them or following them in several cropping systems. The ability of legumes to fix atmospheric nitrogen in association with rhizobia gives them the capacity to grow in very degraded soils. But do we have to systematically inoculate legumes? For example our results suggested that the systematic inoculation of both cowpea and green gram in Kenya with commercial inoculants to improve yields is not really justified, native strains performing better than inoculated strains. But when native rhizobia nodulating legumes are not naturally present, application of rhizobial inoculants is very commonly used. Our results showed that the utilization of effective good-quality rhizobial inoculants by farmers have a real potential to improve legume yields in unfertile soils requesting high applications of mineral fertilizers. For example an effective soybean commercial inoculants was tested in different locations in Kenya (in about 150 farms in 3 mandate areas presenting different soil characteristics and environmental conditions). Application of the rhizobial inoculant significantly increased the soybean yields in all mandate areas (about 75% of the farms). Nodule occupancy analysis showed that a high number of nodules occupied by the inoculated strain did not obviously lead to an increase of soybean production. Soil factors (pH, P, C, N...) seemed to affect the inoculant efficiency whether the strain is occupying the nodules or not. Our statistic analysis showed that soil pH significantly affected nodulation and yield, though the effect was variable depending on the region. We concluded that the competitiveness of rhizobial strains might not be the main factor explaining the effect (or lack of) of legumes inoculation in the field.

Another study was aiming to assess if several factors such as cropping systems, N fertilization and application of crop residues affect the genetic diversity of native strains of rhizobia nodulating soybean in Kenya without any inoculation. Results showed that nodulation was not significantly affected by the different factors except N fertilization, regardless the season. Nodule occupancy revealed only 3 main profiles representing 93.6% and 92.5% of all the RFLP profiles obtained from 2008 and 2009 nodules respectively. This suggested a low diversity of native rhizobial strains capable to nodulate the promiscuous variety. The cropping system, Nitrogen and Residue applications didn't increase the diversity of the rhizobia but results indicated an effect on the distribution of the 3 profiles within the nodules of the plants. Within same treatments, significant differences were found between the two seasons in term of strains occupying the nodules. It could be explained by the shorter rainfall received in 2008 compared to 2009. Results suggest that cropping systems and both N and crop residues applications affect more specifically plant growth and grain yields than the diversity of the native rhizobia nodulating promiscuous soybean variety.
Our work shows how diverse are the factors influencing the success of the field rhizobial inoculation of legumes.