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Evaluation of Rhizobia for Nodulation, Shoot and Root Biomass from Host Range Studies Using Soybean, Common Bean, Bambara Groundnut and Mung Bean

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Abstract : Rural households in Africa depend largely on legumes as a source of high-protein food due to N_2-fixation by rhizobia when they infect plant roots. However, the legume/rhizobia symbiosis can exhibit some level of specificity such that some legumes may be selectively nodulated by only a particular group of rhizobia. In contrast, some legumes are highly promiscuous and are nodulated by a wide range of rhizobia. Little is known about the nodulation promiscuity of bacterial symbionts from wild legumes such as Aspalathus linearis, especially if they can nodulate cultivated grain legumes such as cowpea and Kersting's groundnut. Determining the host range of the symbionts of wild legumes can potentially reveal novel rhizobial strains that can be used to increase nitrogen fixation in cultivated legumes. In this study, bacteria were isolated and tested for their ability to induce root nodules on their homologous hosts. Seeds were surface-sterilized with alcohol and sodium hypochlorite and planted in sterile sand contained in plastic pots. The pot surface was covered with sterile non-absorbent cotton wool to avoid contamination. The plants were watered with nitrogen-free nutrient solution and sterile water in alternation. Three replicate pots were used per isolate. The plants were grown for 90 days in a naturally-lit glasshouse and assessed for nodulation (nodule number and nodule biomass) and shoot biomass. Seven isolates from each of Kersting's groundnut and cowpea and two from Rooibos tea plants were tested for their ability to nodulate soybean, mung bean, common bean and Bambara groundnut. The results showed that of the isolates from cowpea, where VUSA55 and VUSA42 could nodulate all test host plants, followed by VUSA48 which nodulated cowpea, Bambara groundnut and soybean. The two isolates from Rooibos tea plants nodulated Bambara groundnut, soybean and common bean. However, isolate L1R3.3.1 also nodulated mung bean. There was a greater accumulation of shoot biomass when cowpea isolate VUSA55 nodulated common bean. Isolate VUSA55 produced the highest shoot biomass, followed by VUSA42 and VUSA48. The two Kersting's groundnut isolates, MGSA131 and MGSA110, accumulated average shoot biomass. In contrast, the two Rooibos tea isolates induced a higher accumulation of biomass in Bambara groundnut, followed by common bean. The results suggest that inoculating these agriculturally important grain legumes with cowpea isolates can contribute to improved soil fertility, especially soil nitrogen levels.

Keywords : legumes, nitrogen fixation, nodulation, rhizobia
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