

Abstract

THE TRIPARTITE ASSOCIATION BETWEEN RHIZOBIA, VESICULAR ARBUSCULAR MYCORRHIZAL (VAM) FUNGI AND KIDNEY BEAN (*PHASEOLUS VULGARIS*, L.) : STUDIES ON THE GROWTH RESPONSE

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The effect of dual inoculation on three local red kidney bean (*Phaseolus vulgaris*, L.) cultivars (Miss Kelly, Portland Red, Round Red) with four strains of *Rhizobium phaseoli* (B36, B17, T2 and CIAT652) and three species of vesicular arbuscular mycorrhizal (VAM) fungi (*Glomus pallidum*, *G. aggregatum* and *Sclerocystis microcarpa*) was examined in sterilized and non-sterilized clay loam soil in a greenhouse. Sterilization of soil influenced the selection of effective rhizobia as those selected were not effective in non-sterilized soil. Symbiotic efficiency (promotion of plant growth, N and P nutrition) was found to be dependent on the particular combination of *Rhizobium* strain, VAM fungus and cultivar of kidney bean. While rhizobia strains B36 and B17 when paired with *G. pallidum* or *G. aggregatum* produced maximum

increases in growth response of cv. Miss Kelly and Portland Red, *Rhizobium* strain T2 co-inoculated with any of the three VAM fungi produced the best compatible pairing for the cv. Round Red in non-sterilized soils.

The response of the three cultivars of kidney bean to inoculation with compatible pairings of VAM fungus and *R. phaseoli* selected from greenhouse experiments were field tested. All pairings of VAM fungi and rhizobia inoculated on the three cultivars significantly increased the pod yield, mycorrhizal colonization and nodulation over the uninoculated control in the field.

Dual inoculation of kidney bean cv. Miss Kelly with rhizobia and VAM fungi was done in a bauxitic silt loam. In this soil type no nodulation was observed for all treatments. Mycorrhizal colonization occurred only when VAM fungi was applied and this was minimal. The survival of four *R. phaseoli* strains were compared in both the clay loam soil and bauxitic soil under sterile conditions. Because it is known that cowpea rhizobia nodulate in the bauxitic soil, the survival of four strains of cowpea rhizobia (JRC29, JRC14, JRC19, IRC256) was also examined in both soil types. It was found that while cowpea rhizobia survived well in both

soil types there was a rapid decline in *R. phaseoli* cell numbers within five days in the bauxitic silt loam soil.

The influence of two VAM fungi, *G. pallidum* and *G. aggregatum* on the competitive ability of introduced and indigenous *R. phaseoli* strains for nodulation of kidney bean cv. Miss Kelly, Portland Red and Round Red was examined under non-sterilized soil conditions. The results revealed that *R. phaseoli* strains became more competitive against native rhizobia in the presence of either VAM fungus and that the VAM fungus selectively influenced the nodulation ability of competitive strains.

The effect of five flavonoid compounds (Kaempferol, Quercetin, Myricetin, Hesperetin and Biochanin A) on the germination of *G. aggregatum* spores at varying concentration of flavonoid were examined. The effect of these flavonoid compounds on the growth of kidney bean cv. Round Red inoculated with *G. aggregatum* spores singly or with T2 rhizobia strain were also examined. It was found that flavonoid compounds have a significant effect on the germination of VAM spores and on the growth of kidney bean. Root exudate of kidney bean cv. Round Red inoculated with

VAM fungus and rhizobia singly or dually was examined for the presence of the five flavonoid compounds using HPLC analysis. It was found that four of the flavonoid compounds were present when kidney bean was dually inoculated in comparison to two flavonoid compounds detected when inoculated with rhizobia alone or one flavonoid detected when kidney bean was inoculated with VAM fungus alone indicating that flavonoid compounds are important in the tripartite association.

A preliminary study on the effect of VAM fungi on growth and development of citrus and coffee seedlings demonstrate that VAM fungi are able to increase the vigor of these plants at the nursery stage.