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Application of *Bradyrhizobium japonicum* and Phosphorus Fertilization Improved Growth, Yield and Nodulation of Soybean in the Sub-humid Hilly Region of Azad Jammu and Kashmir, Pakistan

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Abstract: Two separate experiments (pot and field) were conducted to examine the response of soybean to *Bradyrhizobium japonicum* and phosphorus (P) fertilization. Different treatments were i) *Rhizobium* strains (0, S377, S379, and the mixture of S377+S379 i.e. S_0, S_1, S_2, S_3); ii) phosphorus (field only, 0, 50, 100 kg ha^{-1}i.e. T_0, T_1, T_2) and iii) two soils (pot only) i.e. autoclaved (A_1) and non-autoclaved (A_0). A soybean cultivar NARC-1 was tested for estimating growth traits, nodule number and mass, root development and yield traits. In the pot experiment, total number of nodules both in the A_0 and A_1 were negligible but increased significantly following the application of *Bradyrhizobium japonicum*. In the field experiment, number of nodules increased from 6 in the control treatment without strains to a maximum of 86 in S_3T_1. Shoot dry weight increased significantly from 11.8 g $plant^{-1}$ in the control soil to 15.6 g $plant^{-1}$ in S_3T_1. Root length was increased but root mass was unaffected. Soybean seed yields ranged between 615 and 1003 kg ha^{-1} against 543 kg ha^{-1} in the control soil indicating a maximum of 85% increase over control. Shoot dry weight and seed yield had significant correlation with nodulation (R^2=0.91). The results of experiments revealed significant positive effects of rhizobium inoculation and P fertilization on growth, nodulation and yield of soybean and, generally, mixture of strains (S_3) was more effective than the strains S_1 and S_2. Results also indicated that high application of P (100 kg P_2O_5 ha^{-1}) reduced the efficiency of inoculants

for nodule mass and seed yield.

Keywords: *Bradyrhizobium japonicum*, *Glycine max* L., Inoculation, Nodulation, *Rhizobium*, Strains

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