

Effect of bio-fertilizers on nodulation, uptake of nutrients, yield and economics of soybean [*Glycine max* (L) Merrill] production in vertisol

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ABSTRACT

A field experiment was conducted to study the effect of bio-fertilizers on nodulation, yield, nutrient uptake and biological properties of soil by soybean. The study revealed that 100% RDF with dual inoculation (*Rhizobium* + PSB) resulted in the highest grain (1363 kg ha⁻¹) and straw yields (1798 kg ha⁻¹). Bio-fertilizers increased nodule number, fresh as well as dry weight of nodule plant⁻¹ and also improved the soil fertility by increasing organic carbon content and effective bacterial population in soil. The yield and nutrient (N, P and K) uptake also increased due to dual inoculation in presence as well as absence of chemical fertilizers.

Key words : : Soybean, *Rhizobium*, PSB inoculation, Bio-fertilizers, Nodulation.

There is need for integrated application of alternate source of nutrient for sustaining the desired crop productivity (Tiwari, 2002). Bio-fertilizers are low-cost and Eco-friendly input have tremendous potential for supplying nutrients which can reduce the chemical fertilizer dose by 25-50 % (Vance, 1997). For increased 'N' supplies through bio-fertilizers, there is a need to inoculate the crops with effective environment of the soil by applying the deficient nutrients needed for biological N₂ fixation. Nutrient management is very much essential for maintaining higher crop productivity and soil fertility. Attempts have been made through the present investigation to study the effect of bio-fertilizers (*Rhizobium* and PSB inoculation of seed) on nodulation, yield, nutrient uptake and biological properties of soil by soybean.

MATERIALS AND METHODS

The field experiment was conducted during *kharif* season 2004-05 with soybean cultivar JS-335 (Jawahar) on clay soil at Cotton Research Station, Marathwada Agricultural University, Parbhani. The experimental soil was clayey in texture with coarse sand 8.60%, fine sand 8.92%, silt 26.85%, clay 54.05%, pH 8.30, EC 0.27 dSm⁻¹, organic carbon 4.69 gm kg⁻¹ and ammonical and nitrate nitrogen (Devarda's alloy method) 106 kg ha⁻¹ and 31 kg ha⁻¹, respectively. Olsen's 'P' 15.9 kg ha⁻¹ and available 'K' 588 kg ha⁻¹.

The experiment was laid out in a factorial randomized block design with four replications and 12 treatment combinations (Table 1). Nitrogen, phosphorous and potassium were applied in the form of Urea, Single Super Phosphate and Muriate of Potash, respectively. The basal

dose of fertilizer was applied as per treatment at the time of sowing. Seed inoculation was done with *Rhizobium japonicum* and PSB inoculants @ 250 g /10 kg seed as seed treatment before sowing. The mixture of 250 g of *Rhizobium japonicum* and PSB culture plus 150 ml starch was added to 10 kg seed and mixed thoroughly. After mixing, the uniformly coated seed were dried under shade. For recording biometrics observations, three plants were randomly selected from the net plot and were marked by fixing the peg near each plant. The grain and straw sampled were analyzed for 'N' content by Kjeldhal's method and for 'P' content by Vanadomolybdo yellow colour method.

RESULTS AND DISCUSSION

Nodulation and grain yield:

The data on nodule number, fresh and dry weight of nodules (Table 1) reveal that the seed inoculation with *Rhizobium* and PSB alone significantly increased the nodule number plant⁻¹ (1058 and 1.49 folds), the fresh weight plant⁻¹ (1.61 and 1.49 folds) as well as dry weight plant⁻¹ (1.94 and 1.63 folds) over the control (20.60 nodules plant⁻¹, 0.41 mg fresh and 0.19 mg dry weight plant⁻¹), respectively. However, the dual inoculation of *Rhizobium* and PSB produced maximum nodulation (1.85 folds), fresh weight of nodule (1.78 folds) and dry weight of nodules plant⁻¹ (2.05 folds) over the control. Lanje *et al* (2005) reported that highest nodule plant⁻¹ was recorded in *Rhizobium* + PSB treatment. Singh and Pareek (2003) reported highest dry weight of nodules plant⁻¹ in *Rhizobium* + PSB treatment.

Grain yield of soybean due to different treatments varied between 7.52 and 15.46 q ha⁻¹ (Table 1). The