

Effect of Different Sources of Nutrient on Nodulation, Nutrient Uptake and Yield of Soybean (*Glycine max* (L.) Merrill) in Black Soil

R.C. Jain¹, Anita Shukla^{2*}, Nimisha Tiwari³, M.K. Tarwariya⁴, V.K. Jain⁵ and B.K. Sharma⁴

¹Principal Scientist, Soil Science, R.A.K. College of Agriculture, Sehore (Madhya Pradesh), India.

²Scientist (H and Food Scientist), KVK Khargone (Madhya Pradesh), India.

³Ph.D. Scholar, RVSKVV, Gwalior (Madhya Pradesh), India.

⁴Assistant Professor, Agronomy, R.A.K. College of Agriculture, Sehore (Madhya Pradesh), India.

⁵Scientist, Agricultural Engineer, K.V.K. Ashok Nagar (Madhya Pradesh), India.

(Corresponding author: Anita Shukla*)

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ABSTRACT: Soybean (*Glycine max* (L.) Merrill) crop belong to leguminaceae family and is basically native to East Asia. In the last century, chemical fertilizers were introduced and this made farmers to be happy of getting increased yield in agriculture in the beginning. But slowly chemical fertilizer started displaying their ill-effect such as leaching, polluting water basins, destroying microorganism and friendly insect, making the crop more susceptible to the attack of diseases, reducing the soil fertility and thus causing irreparable damage to soil health. The prices of fertilizer are increasing day by day and therefore it is necessary to reduce the cost of fertilizer by using *bradyrhizobium* and PSB inoculation to increase yield of legume crops. Nowadays, the inorganic fertilizers are producing very hazardous effect on soil properties as well as sometimes enter in food chain and are also injurious to human being. The appropriate combination of mineral fertilizers with organic inputs can be feasible and visible to sustain high yield of crop without deterioration in quantity and quality of the produce and soil health. FYM (Farm Yard Manure) and Vermicompost are the most popular and readily available for use as an organic sources of plant nutrients. Therefore, the present experiment was laid out in a randomized block design consisted of 7 treatments variety JS 95-60 was used under experimentation consecutively for three years since *Kharif* 2016-17, 2017-18 & 2018-19 which was conducted in black soil. Analysis of soil and plant samples was done as per standard methods. The study revealed that the application of 75% RDF + Vermicompost 1.5t/ha + BF (T₇) followed by T₆ and T₃ treatments recorded the significantly highest nodules number, its dry weight, uptake of nutrients (NPK) and seed yield. The enhancement in these parameters could be ascribed due to fair availability of nutrients in the soil with the application of organic and inorganic sources. The increment in supply of essential elements through organic and inorganic sources, their mobilization and influx into the plant tissues increased and hence such results.

Keywords: Soybean, nodulation, vertisol, organic and *bradyrhizobium*.

INTRODUCTION

Integrated plant nutrient management system (IPNMS) is basically an open system with soil, plant, animal and the immediate environment as components of the system and nutrients from various sources of supply as low to the system (both inflow and outflow). The nutrient flow in the soil is determined by soil parameters, plant requirements, the crop residues, roots and stubbles remaining in the soil the animal dung/excreta put back to soil and therefore the rate and volume of the flow in various systems would vary. IPMNS takes into account a quality aspect as intensity parameter and a supply power parameter properly put to use the system should Jain *et al.*,

be able to supply and regulate the flows and volume of nutrients in the system. Integrated use is not the same thing as complementary use. It has linked IPNMS to concept of capital-working capital and annual investment for plant nutrients (Ange, 1997; Jain *et al.*, 2018; Jain *et al.*, 2021).

India has the third largest vegetable oil economy in the world after USA and China and oilseed form the second largest agricultural commodity after cereals in India, sharing 14% of the gross cropped area and accounting for nearly 5% of the gross national product and 10% of the value of all agricultural products. About 14 million

people are involved in the production of oilseeds and another one million in their processing.

Soybean (*Glycine max* (L.) Merr.) a species of strange combination of oilseed and pulse, widely grown in North and North-Central India, covering an area well over 4.25 m ha (Tripathi, 1985; Jain *et al.*, 2018; Jain *et al.*, 2021). Soybean offers good potential to be introduced into cropping sequences or intercropping systems. It is a short duration leguminous energy rich crop. It is relatively tolerant to drought (Lawn, 1982) and excessive moisture (Wright *et al.*, 1988) it is remunerative cash crop too. The other desirable features are that its cultivation does not cause any all allelopathic effect on companion/succeeding crops, leaves 45-60 kg residual nitrogen per hectare to the succeeding crop and creates a salutary physicochemical environment in the soil for crop growth. It is also instrumental in sustaining soil organic matter status through substantial recycling of foliage/rhizosphere root mass. Experimental evidences have established that soybean could fit aptly in any traditional cropping systems in all the five-agroclimatic zones of India specified for soybean (Bhatnagar *et al.*, 1996; Jain *et al.* 2018).

The gaseous composition of the atmosphere, radioactively active or green house gases in the atmosphere trap out going solar radiation, which warms the earth, control the average temperature of the earth surface. Major natural sources of these gases are terrestrial ecosystems, including world soils, biota, wetland and volcanic eruption. Emission and absorption of these gases have been in equilibrium from millions of

years. However this balance has recently been disturbed by human activities like agricultural, industrial, urban activities, burning fossil fuel, deforestation and land use. Soybean (*Glycine max* (L) Merrill) is one of the important oil seed and legume crops of India which not only helps in maintaining soil fertility but also a rich source of protein and fats. It is a triple beneficiary crop, which contains about 20 percent oil and 38 to 42 percent protein, possessing high level of essential amino acids. It is known as the "GOLDEN BEAN" of the 20th Century and also used as food beverage (Jain *et al.*, 2018).

MATERIALS AND METHODS

The present experiment was laid out in a randomized block design consisted of 7 treatments variety JS 95-60 was used under experimentation consecutively for three years since *Kharif* 2016-17, 2017-18 & 2018-19 which was conducted in black soil (Table 1). Analysis of soil and plant samples was done as per standard methods. The study revealed that the application of 75% RDF+ Vermicompost 1.5t/ha + BF (T₇) followed by T₆ and T₃ treatments (Table 2) recorded the significantly highest nodules number, its dry weight, uptake of nutrients (NPK) and seed yield. The enhancement in these parameters could be ascribed due to better availability of nutrients in the soil with the application of organic and inorganic sources. The increment in supply of essential elements through organic and inorganic sources, their mobilization and influx into the plant tissues increased and hence such results.

Table 1: Chemical composition of the soil (Mean of three years) of the harvest of the crop.

| Sr. No. | Particular | Initial soil status | Soil status after harvest | Level | Method adopted |
|---------|---|---------------------|---------------------------|--------|---|
| 1. | Soil Organic carbon (%) | 0.41 | 0.46 | Low | Walkley and Black Method (1934) |
| 2. | Available Nitrogen (N kg ha ⁻¹) | 189.25 | 204.18 | Low | Modified alkaline permanganate method (Subbiah and Asija 1956) |
| 3. | Available Phosphorus (P ₂ O ₅ kg ha ⁻¹) | 9.25 | 11.36 | Medium | Olsen's extractant colorimetric method (Olsen's <i>et al.</i> , 1954) |
| 4. | Available Potassium (K ₂ O kg ha ⁻¹) | 380.18 | 424.25 | High | Neutral normal Ammonium acetate (Hanway and Heiel 1952) |
| 5. | Available Sulphur (mg kg ⁻¹) | 7.25 | 9.80 | Normal | Turbidimetric Methods (Chesnin and Yien 1951) |
| 6. | Soil pH | 7.12 | 7.65 | Normal | By pH meter using 1:2.5 soil: water extract as described by (Jackson, 1973) |
| 7. | Electrical conductivity (dSm ⁻¹) | 0.38 | 0.36 | Normal | By conductivity meter as described by (Jackson, 1973) |

RESULTS AND DISCUSSION

The study revealed that the application of 75% RDF+ Vermicompost 1.5t/ha + BF (T₇) followed by T₆ and T₃ treatments (Table 2) recorded the significantly highest nodules number, its dry weight, uptake of nutrients (NPK) and seed yield. The enhancement in these parameters could be ascribed due to better availability of nutrients in the soil with the application of organic and inorganic sources.

The increment in supply of essential elements through organic and inorganic sources, their mobilization and influx into the plant tissues increased and hence such results (Jain *et al.*, 2018). These results however are also well corroborated with the findings of Shinde *et al.* (2009); Ramesh *et al.* (2009); Jain and Chandravanshi (2014); Jain *et al.* (2018); Jain *et al.* (2021).

Table 2.

| Sr. No. | Treatments | Nodulation, nutrient uptake and yield of soybean (Mean of three years 2016-17 & 2017-18-and 2018-19) | | | | | |
|----------------|--------------------------------------|---|---|-----------------------------------|-----------------------------------|-----------------------------------|--------------------|
| | | No of nodules/plant at 45 DAS | Dry weight of root nodules per plant (mg) | Total N-uptake by soybean (kg/ha) | Total P-uptake by soybean (kg/ha) | Total K-uptake by soybean (kg/ha) | Seed yield (kg/ha) |
| T ₁ | Absolute control | 42.35 | 102.08 | 71.84 | 8.47 | 36.54 | 982.34 |
| T ₂ | 100% RDF | 48.35 | 120.51 | 96.07 | 13.18 | 53.25 | 1327.01 |
| T ₃ | RDF + Bio fertilizer | 53.95 | 135.99 | 113.29 | 14.91 | 58.29 | 1472.01 |
| T ₄ | 50% RDF + Farm Yard Manure 5t/ha | 46.44 | 126.78 | 106.39 | 13.66 | 56.42 | 1369.01 |
| T ₅ | 50% RDF + Vermi-compost 3 t/ha | 49.87 | 134.18 | 109.82 | 13.23 | 58.99 | 1415.01 |
| T ₆ | 75%RDF + FYM2.5t/ha + Bio fertilizer | 54.15 | 140.22 | 120.36 | 15.33 | 65.11 | 1504.68 |
| T ₇ | 75% RDF + Vermi-compost 1.5t/ha + BF | 58.96 | 146.04 | 132.09 | 17.37 | 68.29 | 1591.34 |
| | SEm± | 2.18 | 3.02 | 4.299 | 0.521 | 2.362 | 61.35 |
| | CD at 5% | 6.70 | 9.27 | 13.244 | 1.604 | 7.276 | 189.02 |

CONCLUSIONS

The studies concluded that the application of 75% RDF+ Vermicompost 1.5t/ha + BF (T₇) followed by T₆ and T₃ treatments (Table2) recorded the significantly highest nodules number, its dry weight, uptake of nutrients (NPK) and seed yield in black soil of central India for fetching optimum production of soybean and improving soil physical and chemical health.

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Conflict of Interest. None.

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