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"NUTRIENT UPTAKE MECHANISMS IN BLACK SOYBEAN (GLYCINE MAX) : FACTORS FOR AGRICULTURE AND NUTRITION"

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Abstract

Field experiment was laid out at agriculture field of Himalayan university, Jollang during Kharif season 2023-2024 to study the response of black soybean. This study aimed to investigate the impact of long term application of compost and biofertilizer on pattern of nutrient uptake of black soybean in the soil. The field experiments was conducted with eight treatments i.e. T2 =100% NPK + Coir compost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha, T3=100% NPK + Coir compost at 5 kg/ha + Rhizobium at 2.5 kg/ha, T4 = 100% NPK + Vermicompost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha, T5 = 100% NPK + Vermicompost at 5 kg/ha + Rhizobium at 2.5 kg/ha, T6 = 100% NPK + Biochar at 2.5 kg/ha + Vermicompost at 5 kg/ha + Rhizobium at 2.5 kg/ha , T7 = 100% NPK + Biochar at 5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha , T8 = 100% NPK + Coir compost at 2.5 kg/ha + Vermicompost at 2.5 kg/ha + Biochar at 2.5 kg/ha and T1 = control. The highest uptake pattern of nutrient in soybean were associated with integrated application of fertilizer along with (100% NPK + Vermicompost + Phosphate solubilizing bacteria). While, the lowest value was found in control supplementation of fertilizer P with NK (100% NPK) enhanced the content uptake in soybean. However, in general hiigher uptake of nutrients were found in grain as compared to straw. Keywords: Farmyard manure, nutrient content, nutrient uptake, soybean.

Keywords: Nutrient uptake, NPK , Field experiments and Black soybean

Introduction

Soybean (Glycine max (L.) Merrill) is considered to be an important grain legume and oil crop. It is called as vegetarian meat and wonder crop because it is a rich and cheap source of protein 40-42% and oil 18-20% (Ferrier 1975). The studies of Osaki (1991) and Tanaka et al., (1993) investigated nutrient uptake by soybeans in Brazil and were used as references for several fertilization and liming recommendation guidelines in Brazil. However, soybean cultivars have improved since their publications and now soybean cultivars have increased yields, shortened crop cycles and growth habits to allow cropping systems with

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corn as second harvest. These changes have led to changes in nutrient demands. Bender et al. (2015) observed that modern soybean cultivars exhibited doubled daily biomass production and nutrient uptake compared to ultivars planted in the country. The maximum N content in grain and straw was observed with the application of super optimal dose and the lowest content in grain and straw was recorded in control treatment Raghuwanshi et al. (2016) . The balanced fertilization has required for crop production, but combined application of manure may reduce the need for chemical fertilizer. An application of chemical fertilizers in combination with biofertilizers and compost may increase the yield and yield contributing characters such as grain yield, straw yield and biological yield, nutrient content and nutrient uptake, hence ultimately resulting in increased productivity of soybean (Shirpurkar, et al., 2006) . Use of organic manure alone or in combination with organic and inorganic fertilizers will help to improve physicochemical properties of the soils (Maheshbabu et al., 2008). Therefore, adequate and balanced application of organic and inorganic fertilizers is necessary to increase productivity and soil fertility.

Materials and Methods

Present study was conducted during 2023-2024 in Kharif season at experimental site of Himalayan University ,Jollang, Arunachal Pradesh, India (23°10′N, 79°57′E), with soybean (Glycine max (L.) Merrill) as rainy season crop .The region has a semi-arid and sub-tropical climate, with a mean annual temperature of 25.7°C and precipitation of 1350 mm. Soil was medium black soil classified as Vertisol. The experiment consisted of 8 treatments replicated three times in a randomized block design consist of gross plot size 17x10.8 m with 1 m spacing between plots and 2 m spacing between the replications With soybean variety VL Bhat 201; included; T2=100% NPK + Coir compost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha, T3 =100% NPK + Coir compost at 5 kg/ha + Rhizobium at 2.5 kg/ha, T4= 100% NPK + Vermicompost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha, T5= 100% NPK + Vermicompost at 5 kg/ha + Rhizobium at 2.5 kg/ha, T6= 100% NPK + Biochar at 2.5 kg/ha + Vermicompost at 5 kg/ha + Rhizobium at 2.5 kg/ha , T7= 100% NPK + Biochar at 5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha , T8 = 100% NPK + Coir compost at 2.5 kg/ha + Vermicompost at 2.5 kg/ha + Biochar at 2.5 kg/ha and T1 = control . Inorganic fertilizers include urea (0.3036 g/l N kg-1 of Urea), super phosphate (1.28 g/l P kg-1 of Super phosphate), and potassium (2.4 g/l g K kg-1 of MOP) as the sources of N, P, and K respectively. All soybean plants were harvested at crop maturity and grain yield was obtained. Next to this, grain nutrients NPK were analyzed (Bhargava et al., 1984 and Bradstre et al.,

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1965) and the uptake of individual nutrients by the grain and stover was calculated by multiplying the nutrient content of grain and stover by their dry weight and expressed in g NPK uptake = Nutrient content (%) x dry weight of sample (g)/100.

Result and Discussion

The Nutrient uptake recorded at harvest, is presented in Table no.1. The data shows that there was a significant effect of different treatments on the nutrient uptake and graphically depicted in figure no. 1.

The significant and highest nitrogen uptake was recorded in treatment T4 (Vermicompost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha) i,e., 156.22 kg ha-1 ,T5 (Vermicompost at 5 kg/ha+ Rhizobium at 2.5 kg/ha) i,e., 150.13 kg ha-1 , T6 (Biochar at 2.5 kg/ha+ Vermicompost at 5 kg/ha + Rhizobium at 2.5 kg/ha) i,e., 147.77 kg ha-1 ,T7 (Biochar at 5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha)i.e., 146.01 kg ha-1, T8 (Coir compost at 2.5 kg/ha + Vermicompost at 2.5 kg/ha+ Biochar at 2.5 kg/ha) i,e.,143.98 kg ha-1, T3 (Coir compost at 5 kg/ha + Rhizobium at 2.5 kg/ha)i.e., 141.59 kg ha-1 and T2 (Coir compost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha) i.e., 130.84 kg ha-1. Lowest nitrogen uptake was observed in treatment T1 (control) i,e., 125.14 kg ha-1.

The significant and highest phosphorus uptake was recorded in treatment T4 (Vermicompost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha) i,e., 20.79 kg ha-1 ,T5 (Vermicompost at 5 kg/ha+ Rhizobium at 2.5 kg/ha) i,e., 19.05 kg ha-1 , T6 (Biochar at 2.5 kg/ha + Vermicompost at 5 kg/ha + Rhizobium at 2.5 kg/ha) i,e., 16.70 kg ha-1 ,T7 (Biochar at 5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha)i.e., 15.70 kg ha-1, T8 (Coir compost at 2.5 kg/ha + Vermicompost at 2.5 kg/ha + Biochar at 2.5 kg/ha) i,e., 14.35 kg ha-1 , T3 (Coir compost at 5 kg/ha + Rhizobium at 2.5 kg/ha)i.e., 12.81 kg ha-1 and T2 (Coir compost at 2.5 kg/ha+ Phosphate solubilizing bacteria at 2.5 kg/ha) i.e., 11.96 kg ha-1. Lowest phosphorus uptake was observed in treatment T1 (control) i,e., 10.62 kg ha-1.

The significant and highest potassium uptake was recorded in treatment T4 –(Vermicompost at 2.5kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha) i,e., 71.40 kg ha-1 ,T5 (Vermicompost at 5 kg/ha + Rhizobium 2.5 kg/ha) i,e., 66.36 kg ha-1 , T6 (Biochar at 2.5 kg/ha + Vermicompostat 5 kg/ha + Rhizobium at 2.5 kg/ha) i,e., 64.02 kg ha-1 ,T7 (Biochar at 5kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha)i.e., 62.01 kg ha-1, T8 (Coir compost at 2.5 kg/ha + Vermicompost at 2.5 kg/ha + Biochar at 2.5 kg/ha) i,e., 58.65 kg ha-1 , T3 (Coir compost at 5kg/ha + Rhizobium at 2.5 kg/ha)i.e., 46.63 kg ha-1 and

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T2 (Coir compost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha) i.e., 44.60 kg ha-1. Lowest potassium uptake was observed in treatment T1 (control) i,e., 41.58 kg ha-1.

The probable reason for higher nitrogen, phosphorus, and potassium uptake in the treatment T4– (Vermicompost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha) of black soybean is due to the synergistic effects of vermicompost providing essential nutrients and PSB (Phosphate-Solubilizing Bacteria) enhancing nutrient availability and uptake by plants. Vermicompost enriches the soil with organic matter, making nutrients more accessible to plants, while phosphate solubilizing bacteria solubilizes phosphorus, making it easier for plants to absorb. This combination promotes plant growth and nutrient uptake, leading to higher levels of nitrogen, phosphorus, and potassium in the plants, Yaduwanshi et al. (2018).

Table 1. Effect of compost and biofertilizer on nutrient uptake of black soybean

Treatment	Nitrogen (kg ha^{-1})	Phosphorus(kg ha^{-1})	Potassium (kg ha^{-1})
T_1- Control	125.14	10.62	41.58
T_2- Coir compost at 2.5 kg/ha + *Phosphate solubilizing bacteria* at 2.5 kg/ha	130.84	11.96	44.60
T_3 - Coir compost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha	141.59	12.81	46.63
T_4- Vermicompost at 2.5kg/ha + *Phosphate solubilizing bacteria* at 2.5kg/ha	156.22	20.79	71.40
T_5- Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha	150.13	19.05	66.36
T_6- Biochar at 2.5 kg/ha + Vermicompost at 5 kg/ha + *Rhizobium* at 2.5 kg/ha	147.77	16.70	64.02

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T_7- Biochar at 5 kg/ha + *Phosphate* solubilizing bacteria at 2.5 kg/ha	146.01	15.70	62.01
T_8- Coir compost at 2.5 kg/ha +Vermicompost at 2.5 kg/ha + Biochar at 2.5 kg/ha	143.98	14.35	58.65
F Test	S	S	S
SEd (±)	0.48	0.41	0.59
CD (P=0.05)	7.96	2.78	8.73

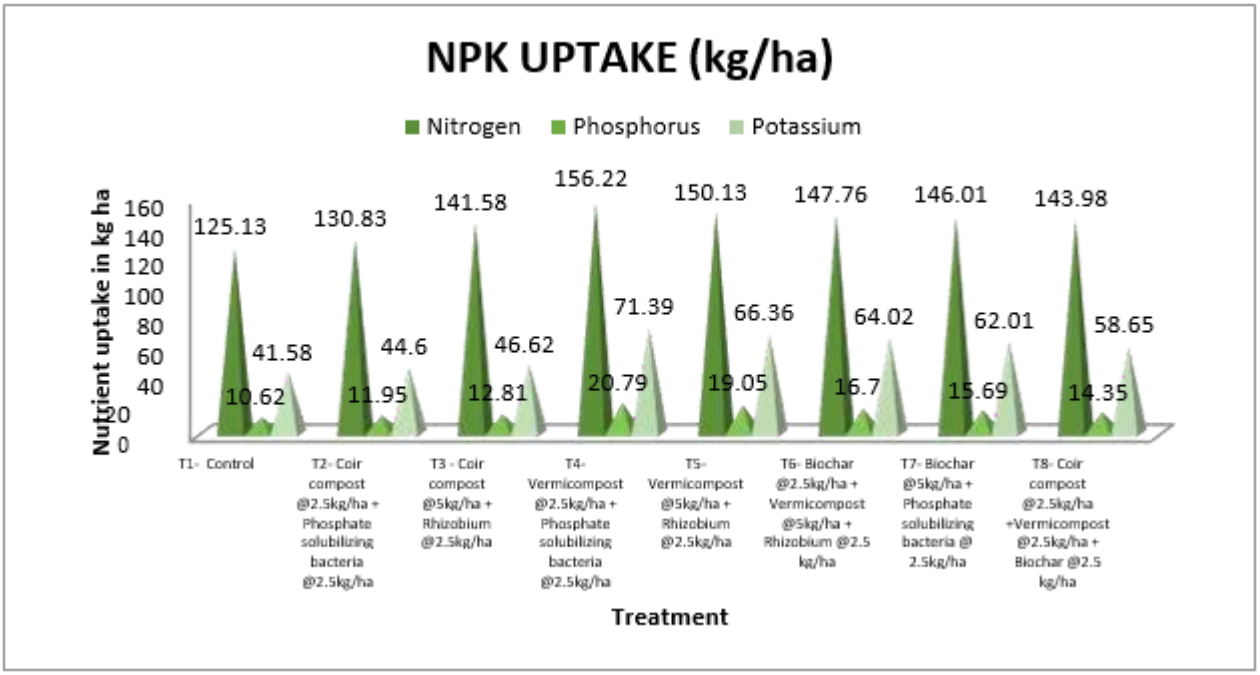

Figure 1: Effect of compost and biofertilizer on nutrient uptake of black soybean

Conclusion

Finally, it could be concluded that the integration of biofertilizers, compost , nitrogen phosphorus and potassium enhanced the yield attributes such as pod length, pod weight, weight of 100 seeds, seed index and seed yield of black soybean . The highest grain yield was recorded in the treatment (T4- Vermicompost

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at 2.5kg/ha + Phosphate solubilizing bacteria at 2.5kg/ha)1.88 t ha -1 through phosphorus , nitrogen and potassium and biofertilizer. Similarly, the highest nutrient content was also obtained from the integration 100% RDF + Vermicompost at 2.5kg/ha + Phosphate solubilizing bacteria at 2.5kg/ha through inorganic fertilzers coupled with organic fertilizers. Thus the objective of maximizing yields as well as maintaining soil health and productivity can be furnished by a balanced use of inorganic fertilizers conjunctively with fertilization and organic biofertilizers.

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