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Influence of INM on nutrition, quality and microbial population in soybean

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Abstract
A Field experiment was conducted during 2017-18 at experimental farm of College of Agriculture, Badnapur to study Soybean nutrition through INM. The results emerged out clearly indicated that various growth parameters like plant height, number of nodules, dry matter, seed yield, protein content, uptake of nutrients and microbial population after harvest were increased due to application of INM. 100% NPKS +Biofertilizes+FYM application showed synergistic effects on nutrients (N, P, K and S) uptake.

Keywords: INM**,** Biofertilizers, Rhizobium, PSB, microbial population

Introduction
Currently, decreasing soil fertility has raised concerns about the sustainability of agricultural production. Future strategies for increasing agricultural productivity will have to focus on using available nutrient resources more efficiently, effectively than in the past. Hence Integrated management of the nutrients is needed for proper plant growth, together with effective crop, water, soil and land management. It helps to restore and sustain soil fertility and crop productivity n, checks the emerging deficiency of nutrients other than NPK. INM brings economy and efficiency in fertilizer use and favourably affects the physical, chemical and biological environment of soil. Therefore INM has been considered as an integral part of sustainable part of agricultural system.

Material and Methods
The experiment was conducted during 2017-18 at College of Agriculture, Badnapur in randomized block design with five treatments and four replications Viz.T1: Control, T2: 100% NPKS, T3: 100% NPKS + Biofertilizer (Rhizobium +PSB), T4: 100% NPKS + Biofertilizer + Grade I Fertilizer, T5: 100% NPKS + Biofertilizer + FYM, each treatment consisted of 10 rows with row to row spacing of 45 cm. The soil was clayey in texture. NPK fertilizer application (30:60:30) and other agronomic practices were carried out uniformly according to the recommendations in all the treatments. The physico – chemical properties of experimental site were as, 7.85 pH, 0.28 dSm^{-1} EC, 5.4 g kg^{-1} Organic carbon, 5.4 g kg^{-1}, 220.4 Kg ha^{-1} Available Nitrogen, 12.60 Kg ha $^{-1}$ Available Phosphorus, 480.60 Kg haA^{-1} vailable Potassium, 16.45 Kg ha^{-1} Available Sulphur. Random 5 Plants were taken from each treatment For counting of number of nodules and number of pods per plant, for noting plant height, dry matter Plant $^{-1}$ and economic yield. Protein content was estimated by multiplying N content with 6.25. Plant and soil samples were analysed for nutrient content by following standard methods described by Jackson (1967) [3] and Piper (1966) [7].

Uptake of nutrients: Nutrient uptake i.e. uptake of N,P,K was calculated by considering grain and dry matter yield at harvest in particular treatment plot in relation to concentration of particular nutrient in respective treatment plot using the formula. Uptake ($Kgha^{-1}$) = Nutrient concentration % x (dry matter yield Kg ha^{-1})/100.

Microbial Properties: For isolation of actinomycetes, bacteria and fungi from soil Ken knight medium, Nutrient Agar medium and Potato Dextrose Agar Media respectively has utilised by following serial dilution plate technique.

Result and Discussion

Plant height: Significantly highest height was noted with application of 100% NPKS + Biofertilizer + FYM (T5) (51.70 cm) followed by T4 and T3. However, minimum height was observed in control (T1) treatment. It may be due to the positive effect of application of 5 tons FYM ha^{-1}, which had accelerated various metabolic processes and resulted in increasing vegetative growth. Similar result were recorded by Mohod *et al.* (1910) [5].

Number of nodules per plant: The data presented in Table 1 indicatesd significant impact of INM on number of nodules per plant. Maximum number of nodules per plant (30.40) over observed in the plot which was application by 100% NPKS + Biofertilizer + FYM (T5) followed by T4 i.e. 100% NPKS + Biofertilizer + Grade I Fertilizer (26.53) and 100% NPKS + Biofertilizer (T3) (26.00). While, minimum number of nodules per plant (23.25) was observed in the control plot. The maximum number of nodules per plant may be due to favourable effects of FYM in improving the soil fertility through positive effects on physical, chemical and biological soil properties. Tomar *et al.* (1910) [9] also noted similar observations.

Table 1: Growth, yield, nutrient uptake and microbial population of soybean as influenced by INM

Treatment	Plant height (cm)	No. of nodules plant $^{-1}$	Dry matter (kg ha^{-1})	Yield (kg ha^{-1})	Protein (%)	N Concentration Seed (%)	P Concentration Seed (%)	K Concentration Seed (%)	S Concentration Seed (%)	Bacteria (CFU X^{10-7})	Actinomycetes (CFU X^{10-5})	Fungi (CFU X^{10-4})
T1	41.43	23.25	1150.00	871.25	27.10	4.13	0.37	4.35	0.30	16.97	8.30	2.63
T2	44.78	25.10	1190.00	1000.00	28.09	4.53	0.55	4.40	0.31	17.89	9.11	2.80
T3	46.33	26.00	1412.50	1282.50	28.81	5.10	0.60	4.45	0.32	20.27	9.53	3.01
T4	47.68	26.53	1772.50	1693.75	29.39	5.28	0.61	4.82	0.34	22.16	10.53	3.25
T5	51.70	30.40	1970.00	1815.00	31.34	6.00	0.66	5.42	0.37	23.84	11.11	4.18
S.Em.±	1.20	0.88	59.13	33.74	0.17	0.14	0.01	0.18	0.009	0.58	0.35	0.13
C.D.@5%	3.70	2.73	182.22	103.98	0.52	0.43	0.04	0.56	0.03	1.81	1.10	0.40

Dry matter production

Application of 100% NPKS + Biofertilizer + FYM (T5) recorded highest dry matter (1970 kg ha^{-1}) followed by T4i.e. 100% NPKS + Biofertilizer + Grade I Fertilizer (1772.50 kg ha^{-1}). Where as, minimum dry weight was found in absolute control treatment (T1). Significantly higher dry matter yield of soybean was recorded by Nimje and Jagdish Seth (1988) [6] with application of F.Y.M. @ 10 tha^{-1}.

Economic yield of Soybean: Highest seed yield was recorded with treatment T5i.e. 100% NPKS + Biofertilizer + FYM (1815 kg ha^{-1}) which was significantly higher over control (T1). The lowest grain yield (871.25 kg ha^{-1}) was noted in absolute control (T1). FYM application showed significantly increase in grain yield of soybean in all the treatments over control (T1) and NPKS (T2). Integrated application of fertilizer with FYM was found to be beneficial for maintaining the fertility in improving the productivity potential of soybean. Chaturvedi and Chande (2005) [2] found combined application of 100% recommended dose of NPK + FYM @ 10 tonnes improved seed yield.

Protein content: The highest protein content (31.34 %) was recorded by 100% NPKS + Biofertilizer + FYM (T5) followed by 100% NPKS + Biofertilizer + Grade I Fertilizer (T4) (29.39 %) and 100% NPKS + Biofertilizer (Rhizobium +PSB) (T3) (28.81 %). While, lowest protein content (27.10 %) was observed in the control plot. Increased protein content with FYM could be due to supplementation of soil reservoir on mineralization of organic N and P of FYM and enhanced microbial activity of ammonifiers, nitrifiers and phosphate solublizing bacteria in particular, due to available organic carbon which might have increased root growth and nodulation resulting in increased nitrogen and protein content. Singh and Rai (2004) [8] also recorded similar results.

N, P, K Concentration: The significantly maximum concentration of N, P, K and S in soybean was recorded by application of 100% NPKS + Biofertilizer + FYM (T5) which was followed by 100% NPKS + Biofertilizer + Grade I Fertilizer (T4) and 100% NPKS + Biofertilizer (Rhizobium +PSB) (T3). T4 treatment was at par with T3. In presence of F.Y.M. the increase in nutrient concentration could be attributed to enhancement in vigour of crop growth with increase in utilization and translocation of nutrients in to plant and synergy between nutrients in soil system resulting in the enhancement of yield. Similar, results were observed by Arbad and Ismail (2011) [1] in soybean.

Microbial population after harvest of Soybean

The significant increase in microbial population in soil after harvest of Soybean crop was also noted with application of FYM along with recommended dose of fertilizers over control. Significantly highest value of bacteria population (23.84) were noted in (T_5) 100% NPKS + Biofertilizer + FYM This treatment provided sufficient organic matter which act as a substrate and sources of food for bacteria, significantly highest value of fungi population (4.18) were noted in (T_5) 100% NPKS + Biofertilizer + FYM, Significantly highest values of actinomycetes population (11.11 CFU × 10^{-5}) were noted in (T_5) RDF + T5: 100% NPKS + Biofertilizer + FYM. Mairan and Dhawan (2016) [4] reported that the population of bacteria, fungi and actinomycetes decreased in higher proportion in control followed by farmer's practice, however, highest population of microbes was observed in the treatment receiving FYM.

Conclusion

It can be concluded that significantly highest yield, uptake of N,P,K,S and microbial population was recorded with treatment of 100% NPKS + Biofertilizer + FYM (T5).

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