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Research Article

Influence of integrated nutrient management on growth, yield, nutrient uptake and economics of vegetable soybean

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ABSTRACT : A field experiment was conducted at Zonal Agricultural Research Station, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bengaluru, during *Kharif* 2011 to study the influence of integrated nutrient management on growth, yield and nutrient uptake of vegetable soybean. Application of 125 % RDF (75 % N through fertilizer + 25 % through compost) + triple microbial inoculations recorded significantly higher growth parameters *viz*., plant height (40.22 cm), number of trifoliate leaves (20.95), leaf area (1214.83 cm^2 $plant^{-1}$) and total dry matter accumulation (32.33 g $plant^{-1}$), vegetable pod yield (95.30 q ha^{-1}), haulm yield (294.80 q ha^{-1}). The same treatment also recorded higher N, P and K uptake (178.54, 29.84 and 143.75 kg ha^{-1}, respectively) followed by 100 % RDF (75 % N through fertilizer + 25 % through compost) + triple microbial inoculations.

KEY WORDS : Vegetable soybean, Growth, Yield, Nutrient uptake

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INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] is popularly known as miracle crop, introduced in India during mid sixties. In India, the area under soybean cultivation covered to an extent of 96.23 lakh hectares with a production of 108.28 lakh tonnes having a productivity of 1,124 kg ha^{-1} (Anonymous, 2011). It has exceptionally great nutritive value and very rich in protein. It consists of about 43 per cent protein, 18 per cent of edible oil with very important essential fatty acids, lecithin and vitamin A and D. It also contains 30 per cent carbohydrates and 4 per cent fibre. It is considered as 'gold from the soil' and it is also 'treated as man made meat' because of its rich source of protein and fat. Besides, it is also a rich source of amino acids, vitamin C and minerals.

Among the factors responsible for low productivity of soybean in India, inadequate fertilizers use and emergence of multiple nutrient deficiencies due to poor recycling of organic sources and imbalanced use of fertilizers and cultivated mostly in marginal and poor soil fertility conditions.

In view of escalating prices and less availability of chemical fertilizers, there is a strong need to adopt integrated nutrient supply system by judicious combination of chemical fertilizers,

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organics and biofertilizers to improve soil health, crop productivity, save money and environment. Use of biofertilizers with FYM and inorganic fertilizers may prove a viable option for sustaining production of vegetable soybean (Govindan and Thirumurugan, 2005).

The vegetable soybean is newly introduced and it has higher yield potential. At present package for production of grain soybean has been recommended and there were no attempts made to quantify the appropriate nutrient demand for vegetable cultivation. Optimizing nutrient management levels are particular interest in vegetable soybean cultivation. Keeping this in view, present on farm trail was under taken to assess the influence of integrated nutrient management on growth, yield and nutrient uptake of vegetable soybean.

EXPERIMENTAL METHODS

A field experiment carried out at Zonal Agricultural Research Station, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bengaluru during *Kharif* season of 2011 on a red sandy clay loam soil with pH of 5.64, organic carbon 0.45 per cent. The soil was medium in available nitrogen, available P_2O_5 and available K_2O of 278.5, 38.49 and 175.08 kg ha^{-1}, respectively. The experiment was laid out in Randomized Complete Block Design with three replications and 12 treatment combinations (Table 1).

Seeds of vegetable soybean (var. Karune) were sown on 23rd July 2011. The fertilizer was applied in the form of urea, single super phosphate (SSP), muriate of potash (MOP) as per the treatments at the time of sowing. The farm yard manure was applied well before sowing as per treatments. Quantity of FYM to be added to each treatment was calculated on the basis of N content of FYM to substitute 25 and 50 per cent of N through FYM treatment wise. Bioinoculants such as *Rhizobium japonicum*, PSB (*Bacillus megatherium* var. *phoshaticum*) and VAM at 1000 g ha^{-1} seed treated as per the treatment combinations. All other cultivation practices were followed as per the recommended package of practice by the University of Agricultural Sciences, Bengaluru.

EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present study have been discussed in detail under following heads :

Growth attributes:

At harvest, application of 125 % RDF (75 % N through fertilizer + 25 % through compost) + triple microbial inoculations significantly increased plant height (40.22 cm), number of trifoliate leaves (20.95), leaf area (1214.83 cm^2 $plant^{-1}$) and total dry matter accumulation (32.33 g $plant^{-1}$) as compared with other treatments followed by 100 % RDF (75 % N through fertilizer + 25 % through compost) + triple microbial inoculations (Table 1). This may be due to supplementing the inorganic fertilizers with organic sources like FYM and also due to inoculation of biofertilizers. This is ascribed to greater availability of essential nutrients with the application of inorganic fertilizers, FYM and microbial inoculants which promoted various physiological activities in plant which are considered to be indispensable for proper growth and development. The findings are in conformity with Chaturvedi and Chandel (2005) and Deshmukh *et al*. (2005).

Table 1 : Plant height, number of trifoliate leaves, leaf area and total dry matter accumulation (TDM) of vegetable soybean as influenced by integrated nutrient management at harvest

Treatments	Plant height (cm)	Number of trifoliate leaves	Leaf area (cm^2 $plant^{-1}$)	TDM (g $plant^{-1}$)
T_1: RDF	33.73	16.52	1102.21	23.84
T_2:75 % RDF	31.13	15.92	969.13	22.17
T_3:125 % RDF	35.94	17.15	1142.03	27.03
T_4:T_1 + TMI	36.43	17.98	1153.87	27.34
T_5:T_2 + TMI	33.17	16.58	1046.30	22.53
T_6:T_3 + TMI	36.67	18.78	1185.58	28.18
T_7: T_1 (50 % N through fertilizer + 50 % through compost) + TMI	34.07	16.05	1125.13	24.21
T_8: T_2 (50 % N through fertilizer + 50 % through compost) + TMI	32.40	16.22	1010.08	22.33
T_9: T_3 (50 % N through fertilizer + 50 % through compost) + TMI	35.13	16.88	1130.13	25.41
T_{10}: T_1 (75 % N through fertilizer + 25 % through compost) + TMI	40.06	20.42	1199.81	31.20
T_{11}: T_2 (75 % N through fertilizer + 25 % through compost) + TMI	33.20	17.22	1072.13	23.27
T_{12}: T_3 (75 % N through fertilizer + 25 % through compost) + TMI	40.22	20.95	1214.83	32.33
S. E. ±	1.04	0.54	19.24	0.86
C. D. (P=0.05)	3.12	1.59	57.72	2.57

Note: DAS = Days after sowing RDF= Recommended dose of fertilizer (30:80:37.5 kg ha^{-1})
TMI= Triple microbial inoculations (*Rhizobium* + PSB + VAM)

Table 2 : Major nutrient uptake (kg ha^{-1}) of vegetable soybean as influenced by integrated nutrient management

Treatments	Vegetable pod yield (q ha^{-1})	Haulm yield (q ha^{-1})	Nutrient uptake (kg ha^{-1})		
			Nitrogen	Phosphorus	Potassium
T_1: RDF	82.73	254.47	135.33	19.52	95.62
T_2:75 % RDF	73.03	226.87	115.61	16.73	80.13
T_3:125 % RDF	83.67	264.27	143.85	20.79	100.42
T_4:T_1 + TMI	85.10	270.53	147.26	21.81	103.50
T_5:T_2 + TMI	78.68	244.33	132.79	19.35	90.76
T_6:T_3 + TMI	88.63	278.97	158.22	24.69	119.39
T_7: T_1 (50 % N through fertilizer + 50 % through compost) + TMI	80.21	255.77	139.38	20.70	107.46
T_8: T_2 (50 % N through fertilizer + 50 % through compost) + TMI	77.87	229.37	131.43	18.54	99.23
T_9: T_3 (50 % N through fertilizer + 50 % through compost) + TMI	81.83	258.83	147.32	23.00	114.40
T_{10}: T_1 (75 % N through fertilizer + 25 % through compost) + TMI	90.98	281.57	166.63	26.93	131.02
T_{11}: T_2 (75 % N through fertilizer + 25 % through compost) + TMI	79.20	247.80	135.78	20.65	105.15
T_{12}: T_3 (75 % N through fertilizer + 25 % through compost) + TMI	95.30	294.80	178.54	29.84	143.75
S. E. ±	2.77	7.67	4.71	1.02	3.90
C. D. (P=0.05)	8.34	23.08	14.11	3.06	11.73

Note: DAS = Days after sowing RDF= Recommended dose of fertilizer (30:80:37.5 kg ha^{-1})
TMI= Triple microbial inoculations (*Rhizobium* + PSB + VAM)

Table 3 : Economics of vegetable soybean production as influenced by integrated nutrient management

Treatments	Cost of cultivation (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	B:C ratio
T_1: RDF	23,121	1,24,100	1,00,978	4.37
T_2:75 % RDF	22,377	1,09,550	87,172	3.67
T_3:125 % RDF	23,708	1,25,500	1,01,791	4.29
T_4:T_1 + TMI	23,296	1,27,650	1,04,353	4.48
T_5:T_2 + TMI	22,552	1,18,025	95,472	4.23
T_6:T_3 + TMI	23,883	1,32,950	1,09,066	4.57
T_7: T_1 (50 % N through fertilizer + 50 % through compost) + TMI	25,382	1,20,320	94,937	3.74
T_8: T_2 (50 % N through fertilizer + 50 % through compost) + TMI	24,306	1,16,800	92,493	3.81
T_9: T_3 (50 % N through fertilizer + 50 % through compost) + TMI	26,301	1,22,750	96,448	3.90
T_{10}: T_1 (75 % N through fertilizer + 25 % through compost) + TMI	24,062	1,36,475	1,12,412	4.67
T_{11}: T_2 (75 % N through fertilizer + 25 % through compost) + TMI	23,809	1,18,800	94,991	3.99
T_{12}: T_3 (75 % N through fertilizer + 25 % through compost) + TMI	25,472	1,42,945	1,17,473	4.61

Note: DAS = Days after sowing RDF= Recommended dose of fertilizer (30:80:37.5 kg ha^{-1})
TMI= Triple microbial inoculations (*Rhizobium* + PSB + VAM

Yield:

Significantly higher vegetable pod yield (95.30 q ha^{-1}) and haulm yield (294.80 q ha^{-1}) was recorded with application of 125 % RDF (75 % N through fertilizer + 25 % through compost) + triple microbial inoculations (Table 2). The better yield was due to better supply of readily available nutrients which might have improved supply of metabolites and photosynthates. In addition to this, triple inoculation of *Rhizobium*, PSB and VAM results in cumulative effects such as supply of N and P to the crop along with production of growth promoting substances like auxin, gibberlins and cytokinins. The results are in conformity with the findings of Ramesh *et al*. (2008) and Thenua *et al*. (2010).

Nutrient uptake:

Significantly higher uptake of N, P and K (178.54, 29.84 and 143.75 kg ha^{-1}, respectively) were registered with application of 125 % RDF (75 % N through fertilizer + 25 % through compost) + TMI and followed by application of 100 % RDF (75 % N through fertilizer + 25 % through compost) + TMI (Table 2). The higher uptake of NPK is attributed to continuous and steady supply of available nutrients through out crop growth period because of application of both organic and inorganic forms. Similar results were reported earlier by

Babalad (2000) and Tiwari *et al*. (2007). Higher uptake was due to higher mineralization of nutrients from applied organic and inorganic source. FYM application reduced the loss of nutrients through leaching and made available significant amount of plant nutrients, which created a balancing effect on supply of nitrogen, phosphorus and potassium (Singh *et al*., 1979).

The results revealed that the integrated nutrient use of 125 % RDF (75 % N through fertilizer + 25 % through compost) + Triple microbial inoculations is required for increasing the growth, vegetable pod yield and nutrient uptake of vegetable soybean in red sandy clay loam soil of agroclimatic zone-5 of Karnataka.

Economics:

Net returns (Rs.1,17,473.0 ha^{-1}) and B:C (4.6) ratio increased with supplementation of recommended dose of fertilizer with FYM (Table 3). Higher net returns and B:C ratio was obtained with application of 125 % RDF (75 % N through fertilizer + 25 % through compost) + triple microbial inoculations. It was due to additional cost of organic manures was compensated by the additional pod yield of vegetable soybean. FYM integrated with 100 % RDF and triple microbial inoculations also resulted in higher net returns and B:C ratio than RDF alone. This was due to higher net returns obtained and relatively low cost of FYM and microbial inoculations.

From the results of the study it could be concluded that integrated use of 125 % RDF (75 % N through fertilizer + 25 % through compost) + triple microbial inoculations is beneficial in achieving higher production potential and protein yield of vegetable soybean as well as obtaining higher net returns.

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