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RESEARCH ARTICLE :

Effect of organic and inorganic nutrient management on growth and yield of soybean

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SUMMARY : The field experiment was conducted during *Kharif* 2014 at the Agronomy Farm, College of Agriculture, Kolhapur on sandy clay loam soil with the combined application of chemical fertilizers, FYM and biofertilizers in soybean resulted increased growth and yield. Treatment100 per cent GRDF gave significantly higher plant height (30.68, 55.63, 64.98, 73.90 cm), trifoliate leaves (4.06, 13.13, 21.82, 30.10), number of branches (1.13, 3.26, 6.12, 6.89), dry matter production (2.69, 15.60, 23.06, 33.84 g) and leaf area(47.59, 90.53, 110.57, 118.57 dm^2) at 28, 42, 56 DAS and at harvest, respectively and soybean seed yield (29.22 q ha^{-1}) and straw yield (36.01 q ha^{-1})it was followed by treatment 75 per cent RDF+ vermicompost 2.5 t ha^{-1}.

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KEY WORDS :
FYM, Vermicompost, GRDF, Biofertilizers, Growth characters

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BACKGROUND AND OBJECTIVES

Soybean *(Glycine max* L.*)* is known as Chinese pea and Manchurian bean which belongs to the family fabaceae, subfamily fabiodeae. Soybean is the major oil seed crop in the world, accounting for nearly 50 per cent of the total oil seeds acreage as well as production. It ranks third in vegetable oil economy in India, after groundnut and rapeseed.

Soybean has not only gained the vital importance in Indian agriculture, but also plays a decisive role in oil economy of India. Soybean seed contains 20 per cent oil and 40-42 per cent protein. The oil is used for frozen desserts, cookie, confections, ice-cream coating and coffee whiteners. Industrial uses of oil are in soap, paints, resins and drying oil. A number of protein-rich products, soy-milk, soy-paneer, soy-sauce and soy-flour can be produced from seeds. Soybean is preferred especially by vegetarians on account of its richness in protein, fat, carbohydrates, mineral, salts and vitamins (thiamine and riboflavin). Its sprouting grain contains considerable amount of vitamin C. Vitamin A is in the form of precursor of carotene. Soybean being the richest, cheapest and easiest source of best quality protein, fat and having a vast multiplicity of uses as food and industrial products called as a wonder crop (Balasubramaniyan and Palaniappan, 2012).

In India, soybean is grown over an area

of 93.03 lakh ha with a production of 101.28 lakh tonnes and with an average productivity of 1089 kg ha^{-1}. Madhya Pradesh, Utter Pradesh and Maharashtra are the major soybean producing states in India. In Maharashtra, it is grown over an area of 26.03 lakh ha with total production of 27.54 lakh tonnes with average productivity of 1058 kg ha^{-1} (Anonymous, 2011).

The combined application of chemical fertilizers, FYM and biofertilizers in soybean resulted in higher yield and yield contributing characters*viz.*, number of pods plant^{-1}, seeds pod^{-1} and 100 seed weight. The quality of soybean was also improved with integrated nutrient management. (Singh and Rai, 2004).

There is scope for increasing the productivity of soybean by adapting the improved package of practices. Among these management practices, nutritional management is one of the important aspects. By considering this view, the experiment entitled, "Effect of organic and inorganic nutrients on growth and yield of soybean (*Glycine max* L.)" was planned the details regarding the material used and the methods followed during the course of the present investigation at Post Graduate Research Farm, Agronomy section, College of Agriculture, Kolhapur during *Kharif*, 2014.

RESOURCES AND METHODS

The soil of the experimental field was sandy clay laom in texture, medium in available nitrogen (207.31 kg ha^{-1}), phosphorus (23.55 kg ha^{-1}) and fairly rich in available potassium (287.40 kg ha^{-1}) with pH 7.72. Total seven treatments *viz*, T_1: No fertilizers, T_2: 50%RDF + FYM 5 t ha^{-1}, T_3 : 50% RDF+ vermicompost 2.5 t ha^{-1}, T_4 : 75% RDF + FYM 5 t ha^{-1},T_5: 75% RDF + vermicompost 2.5 t ha^{-1}, T_6: FYM 5 t ha^{-1} + vermicompost 2.5 t ha^{-1}, T_7: 100% GRDF in RBD with three replications.The variety KS 103 (Kolhapur Soybean) was sown30 cm spacing in row proportion as per treatments in second week of June. The seed rate under sole cropping was maintained at 70 kg ha^{-1}. The package of practices recommended for crops were adopted for different organic and inorganic nutrient combination.

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Growth observations :

Data revealed that mean plant height, trifoliate leaves, number of branches, dry matter production and leaf area at 28, 42, 56 DAS and harvest was increased with increasing age of the crop progressively upto 70 DAS. Mean plant height was 65.27 and 65.27 at 28, 42, 56 DAS and at harvest, respectively.

Effect of treatments :

The periodical plant height (30.68, 55.63, 64.98, 73.90 cm), trifoliate leaves (4.06, 13.13, 21.82, 30.10), number of branches (1.13, 3.26, 6.12, 6.89), dry matter production (2.69, 15.60, 23.06, 33.84 g) and leaf area (47.59, 90.53, 110.57, 118.57 dm^2) at 28, 42, 56 DAS and at harvest, respectivelyof soybean was significantly affected due to various treatments under study at all growth stages.

Table 1 : Mean plant height (cm) of soybean as influenced periodically by different treatments

Treatments	Plant height (cm)			
	28 DAS	42 DAS	56 DAS	At harvest
T_1: No fertilizers (Absolute control)	26.00	45.45	59.19	59.55
T_2: 50% RDF + FYM 5 t ha^{-1}	29.00	51.33	62.67	62.73
T_3: 50% RDF + V.C. 2.5 t ha^{-1}	31.80	59.00	64.23	64.35
T_4: 75% RDF + FYM 5 t ha^{-1}	32.00	59.43	65.53	65.60
T_5: 75% RDF + V.C. 2.5 t ha^{-1}	33.00	61.00	68.53	69.02
T_6: FYM 5 t ha^{-1} + V.C. 2.5 t ha^{-1}	28.00	49.10	61.67	61.80
T_7: 100% GRDF	35.00	64.10	73.10	73.90
'F' test	Sig.	Sig.	Sig.	Sig.
S.E. ±	1.84	1.96	2.29	2.18
C.D. (P=0.05)	5.67	6.05	7.06	6.72
General mean	30.68	55.63	64.98	65.27

Among the organic and inorganic treatment combinations, 100 per cent GRDF recorded significantly higher plant height, trifoliate leaves, number of branches, dry matter production and leaf area at 28, 42, 56 DAS and at harvest than rest of treatments and it was on par with 75 per cent RDF+ vermicompost 2.5 t ha^{-1} at each stage of observations and 75 per cent RDF+ FYM 5 t ha^{-1} and50 per cent RDF+ vermicompost 2.5 t ha^{-1} at 28 and 56 DAS of observations as compared with treatment 100 per cent GRDF.However, absolute control, 50 per cent RDF+ FYM 5 t ha^{-1} and FYM 5 t ha^{-1}+ vermicompost 2.5 t ha^{-1} recorded significantly lowest plant height at each stages of observations as compared with treatment 100 per cent GRDF.

All fertilizer management treatments recorded significantly more plant height, trifoliate leaves, number of branches, dry matter production and leaf area at 28, 42, 56 DAS and at harvest as compared to treatment absolute control. The other integrated nutrient management treatments under study indicating need of application of organic and inorganic fertilizers to soybean crops. The increase in plant height, trifoliate leaves, number of branches, dry matter production and leaf area at 28, 42, 56 DAS and at harvest with integrated nutrient management was mainly due to its influence on vegetative crop growth. This may be owing to continuous availability of nutrients to soybean plants because of their slow release of nutrients from FYM during the crop season. Moreover, vermicompost added a good amount of NPK in the soil, besides supplying other essential macro- and micro-nutrients. Similar results were reported by Manral and Saxena (1992); Shinde*et al*. (2009) and Rana and Badiyala (2014).

Seed yield and straw yield (q ha^{-1}) :

The data on mean seed yield and straw yield of

Table 2 : Mean number of trifoliate functional leaves $plant^{-1}$ of soybean as influenced periodically by different treatments

Treatments	Number of trifoliate functional leaves $plant^{-1}$			
	28 DAS	42DAS	56DAS	At harvest
T_1: No fertilizers (Absolute control)	3.20	9.13	17.30	17.30
T_2:50% RDF + FYM 5 t ha^{-1}	4.00	12.63	20.57	20.57
T_3: 50% RDF + V.C. 2.5 t ha^{-1}	4.03	12.77	21.77	21.77
T_4:75% RDF + FYM 5 t ha^{-1}	4.25	13.43	21.77	21.77
T_5:75% RDF + V.C. 2.5 t ha^{-1}	4.43	16.30	22.57	22.57
T_6: FYM 5 t ha^{-1} + V.C. 2.5 t ha^{-1}	3.80	10.67	18.67	18.67
T_7: 100% GRDF	4.70	17.00	30.10	30.10
'F' test	Sig.	Sig.	Sig.	Sig.
S.E. ±	0.17	0.65	1.30	1.30
C.D. (P=0.05)	0.53	2.01	4.03	4.03
General mean	4.06	13.13	21.82	21.82

Table 3 : Mean number of branches $plant^{-1}$ of soybean as influenced periodically by different treatments

Treatments	Number of branches $plant^{-1}$				
	28DAS	42DAS	56DAS	70DAS	At harvest
T_1: No fertilizers (Absolute control)	1.10	2.47	5.32	5.45	5.45
T_2:50% RDF + FYM 5 t ha^{-1}	1.30	3.32	6.10	6.10	6.10
T_3: 50% RDF + V.C. 2.5 t ha^{-1}	1.40	3.33	6.18	6.18	6.18
T_4:75% RDF + FYM 5 t ha^{-1}	1.50	3.39	6.19	6.20	6.20
T_5:75% RDF + V.C. 2.5 t ha^{-1}	1.75	3.60	6.54	6.73	6.73
T_6: FYM 5 t ha^{-1} + V.C. 2.5 t ha^{-1}	1.20	3.00	5.88	5.90	5.90
T_7: 100% GRDF	1.80	3.75	6.64	6.89	6.89
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.
S.E. ±	0.04	0.08	0.14	0.21	0.21
C.D. (P=0.05)	0.13	0.27	0.43	0.67	0.67
General mean	1.43	3.26	6.12	6.20	6.20

Table 4 : Mean leaf area plant^{-1} (dm^2) of soybean as influenced periodically by different treatments

Treatments	Leaf area plant^{-1} (dm^2)			
	28DAS	42DAS	56DAS	70DAS
T_1: No fertilizers (Absolute control)	43.26	77.20	97.35	97.35
T_2:50% RDF + FYM 5 t ha^{-1}	47.24	90.34	110.57	110.57
T_3: 50% RDF + V.C. 2.5 t ha^{-1}	47.80	92.08	112.29	112.29
T_4:75% RDF + FYM 5 t ha^{-1}	48.75	93.00	112.92	112.92
T_5:75% RDF + V.C. 2.5 t ha^{-1}	49.24	95.52	115.18	115.18
T_6: FYM 5 t ha^{-1} + V.C. 2.5 t ha^{-1}	44.05	87.06	107.08	107.08
T_7: 100% GRDF	52.80	98.54	118.57	118.57
'F' test	Sig.	Sig.	Sig.	Sig.
S.E. ±	1.44	2.83	3.41	3.41
C.D. (P=0.05)	4.46	8.74	10.52	10.52
General mean	47.59	90.53	110.57	110.57

Table 5 : Mean dry matter production plant^{-1} (g) of soybean as influenced periodically by different treatments

Treatments	Dry matter production plant^{-1} (g)			
	28DAS	42DAS	56DAS	At harvest
T_1: No fertilizers (Absolute control)	2.10	10.93	20.23	24.11
T_2:50% RDF + FYM 5 t ha^{-1}	2.45	14.33	21.45	27.35
T_3: 50% RDF + V.C. 2.5 t ha^{-1}	2.59	16.30	21.90	27.97
T_4:75% RDF + FYM 5 t ha^{-1}	2.87	17.40	23.38	28.26
T_5:75% RDF + V.C. 2.5 t ha^{-1}	3.09	18.80	25.50	32.95
T_6: FYM 5 t ha^{-1} + V.C. 2.5 t ha^{-1}	2.37	12.20	21.73	26.37
T_7: 100% GRDF	3.36	19.23	27.23	33.84
'F' test	Sig.	Sig.	Sig.	Sig.
S.E. ±	0.12	0.65	1.09	1.30
C.D. (P=0.05)	0.37	2.01	3.36	4.03
General mean	2.69	15.60	23.06	28.69

soybean as affected by different treatments were recorded at harvest and mean seed yield (24.02 q ha^{-1}) and straw yield (36.01 q ha^{-1}).

Effect of treatments :

The mean seed yield and straw yield of soybean was significantly influenced by different treatments. Application of 100 % GRDF recorded significantly higher seed yield (29.22 q ha^{-1}) and straw yield (36.01 q ha^{-1}) of soybean over rest of treatments and it was on par with 75 % RDF + vermicompost 2.5 t ha^{-1} (28.88 and 35.21 q ha^{-1}), 75 % RDF + FYM 5 t ha^{-1} (26.42 and 33.61 q ha^{-1}) and 50 % RDF + vermicompost 2.5 t ha^{-1} (25.89 and 30.20 q ha^{-1}).

However, treatment Absolute control (8.21and 9.46 q ha^{-1}) recorded significantly lowest mean seed yield of soybean as compared to other treatments under study. 50% RDF + FYM 5 t ha^{-1} (24.74 and 26.31 q ha^{-1}) and FYM 5 t ha^{-1} + vermicompost 2.5 t ha^{-1} (24.52 and 26.73 q ha^{-1}) which indicate role of integrated nutrient management in increasing seed yield of soybean. Higher

Table 6 : Mean seed yield and straw yield of soybean as influenced by different treatments

Treatments	Seed yield (q ha^{-1})	Straw yield (q ha^{-1})
T_1: No fertilizers (Absolute control)	8.21	9.46
T_2:50% RDF + FYM 5 t ha^{-1}	24.74	26.31
T_3: 50% RDF + V.C. 2.5 t ha^{-1}	25.89	30.20
T_4:75% RDF + FYM 5 t ha^{-1}	26.42	33.61
T_5:75% RDF + V.C. 2.5 t ha^{-1}	28.88	35.21
T_6: FYM 5 t ha^{-1} + V.C. 2.5 t ha^{-1}	24.52	26.73
T_7: 100% GRDF	29.22	36.01
'F' test	Sig.	Sig.
S.E. ±	1.08	0.93
C.D. (P=0.05)	3.35	2.88
General mean	24.02	28.21

seed yield was obtained with application of 100 % GRDF which might be due to significantly improvement in growth and yield attributes resulting into higher seed yield of soybean. Similar results were reported by Bandyopadhy *et al*. (2004), Waghmare *et al*. (2012) Singh and Rai (2004), Shinde *et al*. (2009) and Devi *et al*. (2013).

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