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Research Article

RESPONSE OF DIFFERENT ORGANIC INPUTS ON GROWTH AND YIELD OF SOYBEAN ON INCEPTISOL

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ABSTRACT

A present investigation on "Effect of different organic inputs on soil microbial count, growth and yield of soybean on inceptisol" was conducted during *kharif* 2007-08 at the Cropping Systems Research Project Farm, M.P.K.V., Rahuri to study the response of soybean to various organic inputs under irrigated condition. The experiment was laid out in randomized block design with eight treatments and four replications. Total eight treatments consisting of organic inputs *viz.*, T₁ : Control, T₂ : Farm yard manure (FYM) 5 t ha⁻¹, T₃ :Vermicompost 2 45 DAS), T₆ t ha⁻¹, T₄ : FYM + vermicompost (50+50) , T₅ :FYM + Jeevamrut 2 times (30 and 45 DAS), T₇ : FYM + vermicompost (50+50) + Jeevamrut 2 times (30 and 45 DAS), T₈ : Jeevamrut 2 times (30 and 45 DAS) were tested. The application of FYM + vermicompost (50 % each) + Jeevamrut 2 times (30 and 45 DAS) to soybean recorded significantly higher values for growth, yield attributes and yield of soybean.

The application of FYM + vermicompost (50 % each) + Jeevamrut 2 times (30 and 45 DAS) showed higher protein and oil content in soybean grain than rest of the treatments used. The total uptake of nitrogen, phosphorus and potassium by soybean was significantly higher due to application of FYM + vermicompost (50 % each) + Jeevamrut 2 times (30 and 45 DAS) to soybean. The net monetary return was recorded maximum under FYM + vermicompost (50 % each) + jeevamrut 2 times (30 and 45 DAS) followed by jeevamrut 2 times (30 and 45 DAS) and B:C ratio was higher where jeevamrut applied to soybean 2 times (30 and 45 DAS). Application of FYM + vermicompost (50 % each) + jeevamrut 2 times (30 and 45 DAS) to soybean recorded enhanced microbial count *viz.*, fungi, bacteria and actinomycetes followed by application of FYM + vermicompost (50 % each).

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INTRODUCTION

Soybean (*Glycine max* L. Merrill) is one of the important oilseed pulse of the world. It became miracle crop of 20th century and designated as "Golden Bean". Soybean crop was introduced in sixties as supplementary oilseed crop to overcome the edible oil shortage in the country. Among all oilseeds crops, soybean occupied third position in the edible oil scenario of India. Nutritional point of view, soybean is an excellent source of protein and oil. It contains high amount of protein (43.2 %) and oil (19.5 %). It is also a rich source of vitamin A, B and D. It contains 38-43 per cent minerals and 2 per cent phospholipids. In addition, soybean is legume crop and having considerable potential to fix atmospheric nitrogen. For assessing the reliable estimates of national productivity and production of soybean in India during 2008, SOPA conducted soybean crop survey in major states of the country from September 16 to 24, 2008. Relevant data were generated on various yield attributes to compute realistic productivity of

soybean and production estimates of the crop. As reported by Department of Agriculture of different states of India, during 2008, national acreage under soybean increased to 96.242 lakh ha from 88.496 lakh ha in 2007. In view of timely sowing, better weed management etc. and September rains, national productivity of soybean is estimated to be 1124 kg ha⁻¹ against 1070 kg ha⁻¹, in 2007. Accordingly, the estimated national production of soybean during this year (2008) would be 108.176 MT compared to that of 94.734 MT during last year (2007).

Nowadays, the inorganic fertilizers are producing very hazardous effects on soil properties as well as sometimes enter in food chain and are also injurious to human being. Therefore, it is essential to utilize various sources of nutrients, in order to increase the production of crop by maintaining soil fertility. It may include organic manure vermicompost, farm yard manure, Jeevamrut, green manure and other sources for sustainable agriculture. Organic farming in India is not new; earlier before, manure was used for improving soil fertility and crop

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productivity. However, negligence of organic inputs resulted in deterioration of productive soils, hence for maintaining soil physicochemical and biological properties and increasing the productivity of soil, use of FYM, vermicompost, Jeevamrut alone or in combination may prove to be beneficial. Vermicompost is highly efficient organic manure, which is made from the farm waste and involves the advantage of increase in production and improve the quality of agricultural produce. Vermicompost increases the value of land by increasing the NPK content, water holding capacity and productivity of land. Farm yard manure is another source of nutrients, which also helps in maintaining soil fertility and increasing the water holding capacity of soil. Jeevamrut, a newly introduced liquid prepared from FYM, cow urine, pulses flour, jaggery and soil found below the banyan tree, helps to enhance microbial population, soil fertility and productivity of the soil.

MATERIAL AND METHODS

The experiment was conducted at the Cropping Systems Research Project farm, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra). The experiment was laid out in randomized block design with eight treatments and four replications. Total eight treatments consisting of organic inputs viz. The treatment details are as follows T₁ : Control, T₂ : Farm yard manure (FYM) @ 5 t ha⁻¹ T₃ : Vermicompost (VC) @ 2 t ha⁻¹, T₄ : FYM + VC (50+50) (2.5 t ha⁻¹ + 1 t ha⁻¹), T₅ : FYM + Jeevamrut 2 times (30 and 45 DAS) (FYM 5 t ha⁻¹), T₆ : VC + Jeevamrut 2 times (30 & 45 DAS) (2 t ha⁻¹ + 500 lit ha⁻¹), T₇ : FYM+VC (50+50)+Jeevamrut 2 times (30 & 45 DAS) (2.5 t ha⁻¹+1 t ha⁻¹ +500 lit ha⁻¹) and T₈ : Jeevamrut 2 times (30 and 45 DAS) (500 lit ha⁻¹). *Rhizobium* and PSB biofertilizer is common to all treatments. The soybean seed (cv. JS-335) seed rate @ 75 kg ha⁻¹ was obtained from the Chief Scientist, Breeder Seed Production Unit, MPKV, Rahuri.

The farm yard manure and vermicompost were applied 7 days prior to dibbling of soybean as per the treatment. Jeevamrut was applied to soybean at 30 and 45 days after sowing along with the irrigation. The seeds were inoculated with *Rhizobium* and phosphate solubilizing bacteria (PSB) @ 250 g each for 10 kg of seeds just before dibbling as per treatments. After inoculation seeds were dried in the shade for about one hour and then used for dibbling.

The recommended Jeevamrut 200 lit. per acre was prepared

Material required: 10 kg fresh cow dung, 10 lit. fresh urine of cow, 2 kg jaggery, 2 kg pulses flour. 200 lit. of water and some amount of soil under banyan tree.

Process: Thoroughly mix 10 kg fresh cow dung and 10 kg of cow urine. Mix 2 kg jaggery and 2 kg pulse flour and some amount of soil under banyan tree adds 200 lit. of water stirring all time. The mixture is allowed to ferment for one week before application. This mixture obtained is called Jeevamrut. It is sufficient for application on 1 acre of land.

Application of Jeevamrut: Jeevamrut was prepared as per the methodology, after fermentation it was applied through irrigation water to the crop.

Composition of different organic inputs used.

Sr. No.	Organic input	Nutrient content (%)		
		N	P	K
1	Farm yard manure	0.56	0.35	0.78
2	Vermicompost	1.60	0.70	0.80
3	Jeevamrut	0.01	0.02	0.20

Quantity of Organic inputs used for various treatments

Treatment	Organic inputs		
	FYM (kg plot ⁻¹)	VC (kg plot ⁻¹)	Jeevamrut (l plot ⁻¹)
T ₁ : Control	-	-	-
T ₂ : Farm yard manure (FYM) @ 5 t ha ⁻¹	27	-	-
T ₃ : Vermicompost (VC) @ 2 t ha ⁻¹	-	11	-
T ₄ : FYM + VC (50+50)	13.500	5.500	-
T ₅ : FYM + Jeevamrut 2 times (30 and 45 DAS)	27	-	6
T ₆ : VC + Jeevamrut 2 times (30 and 45 DAS)	-	11	6
T ₇ : FYM + VC (50+50) + Jeevamrut 2 times (30 and 45 DAS)	13.500	5.500	6
T ₈ : Jeevamrut 2 times (30 and 45 DAS)	-	-	6

RESULTS AND DISCUSSION

Growth attributing characters

At 75 DAS and at harvest, application of Farm yard manure (FYM) (50 %) + Vermicompost (VC) (50%) + Jeevamrut 2 times (30 and 45 DAS) was at par with Farm yard manure (FYM) (50 %) + Vermicompost (VC) (50%) and recorded significantly higher values for the plant height of soybean compared to the rest of the treatments of organic input application. The rate of increase in height of soybean was higher in between 30-60 days of crop age. The increase in plant height due to organic inputs might be attributed to increase in the availability of cytokinin to shoot which in turn play a role in cell elongation process either through cell division or cell elongation. Similar results have been reported by Bacchav *et al.* (1996).

Application of Farm yard manure (FYM) (50 %) + Vermicompost (VC) (50%) + Jeevamrut 2 times (30 and 45 DAS) was at par with Farm yard manure (FYM) (50 %) + Vermicompost (VC) (50%) and recorded significantly higher mean number of branches per plant of soybean compared to the rest of the treatments of organic input application. The rate of increase in number of branches per plant was higher in between 30-60 days of crop age. This might be due to an early stage crop accumulates more amount of constituents and nutrients which results to stimulate the cell division in the meristematic tissue and increase in vegetative growth of plant. Muthuvel *et al.* (1985) reported that number of branches per plant was significantly influenced due to FYM application (10 t ha⁻¹) to redgram crop.

At 30, 60, 75 DAS and at harvest, application of Farm yard manure (FYM) (50 %) + Vermicompost (VC) (50%) + Jeevamrut 2 times (30 and 45 DAS) was at par with Farm yard manure (FYM) (50 %) + Vermicompost (VC) (50%) and vermicompost + Jeevamrut 2 times (30 and 45 DAS) and recorded significantly higher mean number of compound leaves per plant of soybean compared to the rest of the treatments.

Table 1 Effect of different organic input treatments on growth attributing characters of Soybean at harvest

Treatment	Plant height (cm)	Number of branches per Plant	Mean number of compound leaves per plant	Mean leaf area (dm ²)	Mean plant spread (cm)
T ₁ : Control	45.80	3.04	3.21	1.43	21.92
T ₂ : Farm yard manure (FYM) 5 t ha ⁻¹	51.31	3.21	3.31	1.52	23.13
T ₃ : Vermicompost (VC) 2 t ha ⁻¹	52.91	6.61	4.80	1.80	26.91
T ₄ : FYM + VC (50+50)	57.72	7.61	5.90	2.83	22.01
T ₅ : FYM + Jeevamrut 2 times (30 and 45 DAS)	51.33	5.64	4.72	2.42	24.71
T ₆ : VC + Jeevamrut 2 times (30 and 45 DAS)	56.23	6.94	5.31	3.07	25.31
T ₇ : FYM + VC (50+50) + Jeevamrut 2 times (30 and 45 DAS)	63.21	8.70	6.00	5.01	27.60
T ₈ : Jeevamrut 2 times (30 and 45 DAS)	49.40	3.42	3.84	1.80	25.13
S.E. _±	2.15	0.64	0.30	0.19	0.66
CD at 5%	6.43	1.91	0.89	0.57	1.97
General Mean	53.49	5.65	4.64	2.87	24.59

Table 2 Effect of different organic input treatments on growth attributing characters of Soybean at harvest

Treatment	Mean dry matter accumulation (g)	Mean number of root nodules per plant at fifty per cent flowering		Days required to 50 % flowering and maturity	
		At flowering stage	At harvest	50 % flowering	Maturity
T ₁ : Control	17.31	26.02	24.41	37.20	84.60
T ₂ : Farm yard manure (FYM) 5 t ha ⁻¹	23.23	29.81	29.30	38.11	85.74
T ₃ : Vermicompost (VC) 2 t ha ⁻¹	27.51	34.46	28.43	39.01	86.70
T ₄ : FYM + VC (50+50)	35.91	45.20	32.52	38.90	86.33
T ₅ : FYM + Jeevamrut 2 times (30 and 45 DAS)	24.34	32.60	30.34	38.33	85.32
T ₆ : VC + Jeevamrut 2 times (30 and 45 DAS)	29.20	36.25	35.13	39.10	86.65
T ₇ : FYM + VC (50+50) + Jeevamrut 2 times (30 and 45 DAS)	36.71	48.43	44.80	38.82	86.74
T ₈ : Jeevamrut 2 times (30 and 45 DAS)	19.72	30.85	42.21	37.02	84.60
S.E. _±	0.91	1.12	1.30	0.61	0.51
CD at 5%	2.72	3.36	3.89	1.84	1.53
General Mean	26.74	35.45	33.39	38.31	85.84

At 45 DAS, application of Farm yard manure (FYM) (50 %) + Vermicompost (VC) (50%) + Jeevamrut 2 times (30 and 45 DAS) was at par with Farm yard manure (FYM) (50 %) + Vermicompost (VC) (50%) and recorded significantly higher mean number of compound leaves per plant during experimentation. The number of compound leaves per plant of soybean was found to be maximum at 60 days after sowing and then there was drastic reduction in leaf number due to senescence and defoliation of matured leaves. Similar findings were reported by Jain *et al.* (1995) and Honale (1996).

At 60, 75 DAS and at harvest, the mean leaf area per plant was significantly higher with the application of Farm yard manure (FYM) (50 %) + Vermicompost (VC) (50%) + Jeevamrut 2 times (30 and 45 DAS) which was at par with the application of Farm yard manure (FYM) (50 %) + Vermicompost (VC) (50 %). Absolute control treatment was found at par with the application of Farm yard manure (FYM) 5 t ha⁻¹, Jeevamrut 2 times (30 and 45 DAS) alone and recorded significantly the lowest mean leaf area per plant.

At harvest, application of Farm yard manure (FYM) (50 %) + Vermicompost (VC) (50 %) + Jeevamrut 2 times (30 and 45 DAS) was at par with Farm yard manure (FYM) (50 %) + Vermicompost (VC) (50 %) and recorded significantly higher mean value for the plant spread per than rest of the treatments. Absolute control treatment was found at par with the application of Farm yard manure (FYM) 5 t ha⁻¹, Jeevamrut 2 times (30 and 45 DAS) alone and recorded significantly lowest mean plant spread per plant. The mean plant spread per plant of soybean was found to be maximum at 60 days after sowing and then there was drastic reduction in leaf number due to

senescence and defoliation of matured leaves. Similar findings were reported by Jain *et al.* (1995) and Honale (1996).

At 60, 75 DAS and at harvest, the mean total dry matter a per plant was significantly higher with the application of Farm yard manure (FYM) (50 %) + Vermicompost (VC) (50%) + Jeevamrut 2 times (30 and 45 DAS) which was at par with the application of Farm yard manure (FYM) (50 %) + Vermicompost (VC) (50%) and recorded significantly higher mean total dry matter plant during experimentation. Absolute control treatment was found at par with the application of Jeevamrut 2 times (30 and 45 DAS) alone and recorded significantly lowest mean total dry matter per plant. This might be due to optimum supply and availability of nutrients through organic source which help in better uptake of nutrient resulted into more synthesis of nucleic acid and amino acid, amide substances in growing region and meristematic tissue ultimately enhancing cell division and thereby increased all the growth attributes in these treatments. This is in conformity with the findings of Sharma and Mishra (1997), Shrinivas and Uma (1995) and Gopal Krishna and Palaniappan (1992).

The formation of root nodules per plant was significantly increased with increased levels of organic input application in conjunction with FYM, vermicompost and Jeevamrut. FYM provided the micronutrients like molybdenum along with all other essential elements which might have acted as co-enzyme for formation of root nodules as well as enhance the *rhizospher* counts. These results are inconformity with those reported by Dev and Tilak (1976), Prabhakaran and Ravi (1996).

Table No. 3 Yield contributing characters of soybean as influenced by different organic input treatments

Treatment	Pod number plant ⁻¹	Pod weight plant ⁻¹ (g)	number Grain plant ⁻¹	Grain weight plant ⁻¹ (g)	100 grain weight (g)
T ₁ : Control	30.23	12.51	86.61	6.02	12.10
T ₂ : Farm yard manure (FYM) 5 t ha ⁻¹	39.69	18.85	108.03	7.06	12.14
T ₃ : Vermicompost (VC) 2 t ha ⁻¹	42.32	19.09	122.70	8.31	12.34
T ₄ : FYM + VC (50+50)	50.95	23.61	154.35	8.98	13.10
T ₅ : FYM + Jeevamrut 2 times (30 and 45 DAS)	40.51	17.62	116.92	7.24	13.12
T ₆ : VC + Jeevamrut 2 times (30 and 45 DAS)	43.34	19.73	129.21	8.61	12.81
T ₇ : FYM + VC (50+50) + Jeevamrut 2 times (30 and 45 DAS)	58.53	27.15	163.20	9.50	14.20
T ₈ : Jeevamrut 2 times (30 and 45 DAS)	36.32	15.03	102.40	6.50	12.11
S.E.±	2.38	1.75	3.04	0.70	0.56
CD at 5%	7.12	5.21	9.12	2.09	1.68
General Mean	42.74	19.20	122.93	7.78	12.74

Table No. 4. Yield of soybean as influenced by different organic input treatments

Treatment	Grain yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)	Biological yield (q ha ⁻¹)	Harvest index (%)
T ₁ : Control	18.90	25.19	44.09	42.86
T ₂ : Farm yard manure (FYM) 5 t ha ⁻¹	20.14	26.45	46.59	43.22
T ₃ : Vermicompost (VC) 2 t ha ⁻¹	21.13	26.95	48.08	43.94
T ₄ : FYM + VC (50+50)	23.57	29.55	53.12	44.37
T ₅ : FYM + Jeevamrut 2 times (30 and 45 DAS)	20.54	26.59	47.13	43.58
T ₆ : VC + Jeevamrut 2 times (30 and 45 DAS)	22.80	27.19	49.99	45.60
T ₇ : FYM + VC (50+50) + Jeevamrut 2 times (30 and 45 DAS)	24.72	31.24	55.96	44.17
T ₈ : Jeevamrut 2 times (30 and 45 DAS)	20.13	25.38	45.31	44.42
S.E.±	0.52	0.71	0.96	--
CD at 5%	1.54	2.12	2.87	--
General Mean	21.49	27.31	48.78	44.02

Yield attributing characters

Application of Farm yard manure (50 %) + Vermicompost (50 %) + Jeevamrut 2 times (30 and 45 DAS) recorded significantly higher mean number of pods per plant than rest of the treatment of organic inputs application alone or in combination to soybean crop. The mean pod weight per plant was found significantly higher with the application of Farm yard manure (50 %) + Vermicompost (50 %) + Jeevamrut 2 times (30 and 45 DAS) which was at par with the application of Farm yard manure (50 %) + Vermicompost (50 %).

Application of Farm yard manure (50 %) + Vermicompost (50 %) + Jeevamrut 2 times (30 and 45 DAS) which was at par with the application of Farm yard manure (50 %) + V.C. (50 %) and recorded significantly higher value for the mean number of grain per plant than rest of the treatments of organic inputs utilized for soybean crop. The higher grain yield per plant might be attributed due combined use and organic sources causing sustained nutrient supply to the crop and better utilization of nutrient through microbial activity that involved in nutrient transformation and fixation. Similar finding were reported by Bacchav (1994), Dev and Tilak (1976).

The mean grain weight per plant was found significantly higher with the application of Farm yard manure (50 %) + Vermicompost (50 %) + Jeevamrut 2 times (30 and 45 DAS) which was at par with the application of Farm yard manure (50 %) + Vermicompost (50 %) and Vermicompost + Jeevamrut 2 times (30 and 45 DAS).

The data regarding 100 seed weight of soybean, influenced significantly due to application of different organic inputs alone or in combination with each other. The mean hundred seed weight of soybean was 12.74 g.

The 100 grain weight per plant was found significantly higher with the application of Farm yard manure (50 %) + Vermicompost (50 %) + Jeevamrut 2 times (30 and 45 DAS) which was at par with the application of Farm yard manure (50 %) + Vermicompost (50 %) and Vermicompost + Jeevamrut 2 times (30 & 45 DAS).

The grain yield of soybean was significantly higher with the application of Farm yard manure (50 %) + Vermicompost (50 %) + Jeevamrut 2 times (30 and 45 DAS) compared to the rest of the treatments of organic inputs used alone or in combination with each other. Significantly lowest grain yield was reported with the treatment of absolute control which was found at par with the application of Farm yard manure and Jeevamrut 2 times (30 & 45 DAS) alone.

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