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Effect of different organic formulations on growth and yield of soybean

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Abstract
A field experiment was conducted during *kharif* season 2017 to Study the effect of organic formulations on growth, yield and soil nutrient dynamics in soybean at experimental farm, Department of Soil Science and Agricultural Chemistry, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The experiment was laid out with twelve treatments replicated three times in randomized block design. The treatment consisted of T_1- RDF (100% NPK through fertilizer), T_2- Panchagavya only, T_3 -Jeevamruth only, T_4- Beejamruth only, T_5-Panchgavya + Beejamruth, T_6- Beejamruth + Jeevamruth, T_7 - Panchgavya + Jeevamruth, T_8 -RDF + Beejamruth + Panchgavya, T_9 - RDF + Beejamruth + Jeevamruth, T_{10} - RDF+ Beejamruth + Jeevamruth+ Panchgavya, T_{11} - Beejamruth + Jeevamruth+ Panchgavya and T_{12} - 100% N through FYM. The growth and yield attribute like plant height, leaf area, number of nodules per plant, seed yield and straw yield were significantly improved by application of RDF+ Beejamruth + Jeevamruth+ Panchgavya.

Keywords: Organic formulations, growth, yield, soybean

Introduction
Soybean (*Glycine max* L. Merrill) is an important oilseed pulse crop of the world. It became miracle crop of 20th century and designated as "Golden Bean". Soybean is the cheapest source of protein and it is called "Poor man's meat". 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 percent minerals and 2 per cent phospholipids. In addition, soybean is legume crop and having considerable potential to fix atmospheric nitrogen.

It is grown throughout the world with the largest production in United States, China, Brazil, Indonesia, Japan, Korea, and Argentina. In India, the area under soybean is 101.83 lakh ha with total production as 83.504 lakh MT and productivity of 822 kg ha^{-1} (Anonymous, 2017) [1]. Madhya Pradhesh, Maharashtra and Rajashtan are the major soybean growth states. In Maharashtra, it is grown over an area of 34.00 lakh hectares with total production of 29.00 lakh MT with an average productivity of 841 kg ha^{-1} (Anonymous, 2017) [1].

Any improvement in agricultural system that results in higher production should reduce the negative environment impact of agriculture and enhance the sustainability of the system. One such approach is the effectiveness of conventional mineral fertilizers. Some organic formulations like Panchagavya, Beejamruth, Jeevamruth, Amritmitti and Amritjal obtained from cow and plant are used in agricultural and horticultural crop and many beneficial effect in the term of enhancement of yield and quality of have been reported (Gore and Shreenivasa, 2011) [3].

Material and Methods
A field experiment was conducted during *kharif* season 2017 to study the effect of organic formulations on growth, yield and soil nutrient dynamics in soybean at Research Farm of Soil Science and Agricultural Chemistry, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The initial soil pH was 7.91, EC-0.24 dSm^{-1}, Organic Carbon- 4.10 g kg^{-1}, Calcium carbonate -4.05%, available nitrogen-151.00 kg ha^{-1}, Phosphorus -12.51, Potassium- 510.18 kg

ha^{-1}. The initial micronutrient status was DTPA Copper-1.12, Mangnease-5.43, Zinc-0.52 and Ferrous – 3.10 mg kg^{-1}. The soil was clayey in texture, moderately alkaline in reaction, medium in available nitrogen, phosphorus and sufficient in available potassium and low in sulphur and iron.

The field experiment was carried out on soybean crop (Variety MAU-158) in kharif season during year 2017-18. After completion of preparatory tillage operations, the experiment was laid out in randomized block design comprising (12) treatments and replicated (3) times.

Treatments details

Twelve treatments were formulated to evaluate the effect of organic formulations on growth, yield and soil nutrient dynamics in soybean. The details of treatment are as follows

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Treatment	Treatments detail
T_1	RDF (100% NPK through fertilizer)
T_2	Panchagavya only
T_3	Jeevamruth only
T_4	Beejamruth only
T_5	Panchgavya + Beejamruth
T_6	Beejamruth + Jeevamruth
T_7	Panchgavya + Jeevamruth
T_8	RDF + Beejamruth + Panchgavya
T_9	RDF + Beejamruth + Jeevamruth
T_{10}	RDF+ Beejamruth + Jeevamruth+ Panchgavya
T_{11}	Beejamruth + Jeevamruth+ Panchgavya
T_{12}	100% N through FYM

Results and Discussion

Effect of organic formulations on growth of soybean

Plant height

The data of plant height of soybean at various growth stages as influenced by different organic formulations are presented in Table 1. Plant height showed significant differences due to the effect of different treatments of organic formulation at various growth stages. The data presented in Table 1 revealed that the plant height at flowering, pod development and harvesting stages was varied from 65.41 to 79.89 cm, 98.70 to 118.43 cm and 101.20 to 121.24 cm with an average of 70.64, 104.34 and 106.13 cm, respectively. Significantly maximum height with RDF + Beejamruth + Jeevamruth + Panchagavya (T_{10}) treatment followed by T_8, T_9 and T_1 treatment and treatment T_{10} is significantly superior over rest of the treatments. However, minimum plant height was noticed in treatment T_4 i.e. application of Beejamruth only at all the growth stages of crop. The significant increase in plant height with application of organic formulation along with chemical fertilizer can be attributed to the fact that these organic formulations enhance plant vigour and strenghthen the stalk and enhance the cell division and cell elongation resulting in increasing positive effect of growth parameter. The higher plant height may be due to the positive effect of application of Panchagavya, Beejamruth, and Jeevamruth along with chemical fertilizer on the vegetative growth and accumulation of metabolic material. Similar result have been reported by Palve *et al* (2011) [4] and Tharmaraj *et al* (2011) [10].

Table 1: Effect of organic formulations on plant height at various growth stages of soybean

Treatments detail	Plant height (cm)		
	Flowering	Pod development	Harvesting
T_1: RDF (100% NPK through fertilizer)	72.60	107.04	107.24
T_2: Panchagavya only	67.24	94.98	101.92
T_3: Jeevamruth only	66.37	99.47	101.63
T_4 : Beejamruth only	65.41	98.70	101.20
T_5: Panchgavya + Beejamruth	69.68	102.04	102.67
T_6 : Beejamruth + Jeevamruth	68.87	99.77	102.43
T_7 : Panchgavya + Jeevamruth	69.49	101.63	102.58
T_8 : RDF + Beejamruth + Panchgavya	73.94	109.61	110.69
T_9 : RDF + Beejamruth + Jeevamruth	72.92	109.57	110.60
T_{10} : RDF+ Beejamruth + Jeevamruth+ Panchgavya	79.89	118.43	121.24
T_{11} : Beejamruth + Jeevamruth+ Panchgavya	71.28	106.33	106.33
T_{12} : 100% N through FYM	70.07	104.55	106.14
Mean	70.64	104.34	106.13
SE ±	2.60	4.05	3.08
CD at 5%	7.64	11.89	9.06
CV	6.38	6.73	5.04

Leaf area

The result on leaf area as influenced by the application of organic formulation at various growth stages of soybean are presented in Table 2. There was continuous build up of leaf area in soybean with advancing growth stages. The results also indicated that the application of organic formulations along with the recommended dose of fertilizer significantly influenced leaf area of soybean at various growth stages over single application of organic formulations and RDF. Leaf area varied from 30.94 to 50.15 cm^2, 56.16 to 75.08 cm^2 and 57.91 to 84.66 cm^2 at flowering, pod development and harvesting stage of soybean. The highest leaf area was recorded with T_{10} (RDF + Beejamruth + Jeevamruth + Panchagavya) treatment followed by T_8 (RDF + Beejamruth + Panchagavya) treatment at all stages of growth in soybean during the year of experimentation. These results opined that the inclusion of organic formulations with recommended dose of fertilizer has synergetic effect. The increase in leaf area per plant with increasing age in present investigation is in accordance with the findings reported by Sanjutha *et al* (2008) [9] and Patil *et al* (2016) [7].

Table 2: Effect of organic formulations on leaf area at various growth stages of soybean

Treatments detail	Leaf area (Sq cm)		
	Flowering	Pod development	Harvesting
T_1: RDF (100% NPK through fertilizer)	40.75	70.93	71.95
T_2: Panchagavya only	33.07	60.83	62.09
T_3: Jeevamruth only	32.72	58.12	60.92
T_4 : Beejamruth only	30.94	56.16	57.91
T_5: Panchgavya + Beejamruth	37.68	65.18	67.65
T_6 : Beejamruth + Jeevamruth	34.42	63.26	64.17
T_7 : Panchgavya + Jeevamruth	36.83	64.58	65.17
T_8 : RDF + Beejamruth + Panchgavya	43.71	72.62	74.69
T_9 : RDF + Beejamruth + Jeevamruth	42.88	71.33	72.71
T_{10} : RDF+ Beejamruth + Jeevamruth+ Panchgavya	50.15	75.08	84.66
T_{11} : Beejamruth + Jeevamruth+ Panchgavya	39.60	69.64	70.20
T_{12} : 100% N through FYM	38.61	67.71	68.35
Grand mean	38.44	66.28	68.37
SE ±	1.70	2.12	2.32
CD at 5%	4.99	6.22	6.82
CV	7.66	6.22	6.82

Number of root nodules and fresh weight of root nodules per plant

The data on number of nodules per plant and fresh weight of nodules per plant at 60 DAS as influenced by different treatment of organic formulations are presented in Table 3. Nodulation in soybean was significantly influenced by application of various organic formulations along with RDF. The data narrated in Table 7 shows that the number of nodules per plant and nodules fresh weight were increased significantly due to combination of organic formulations with RDF over RDF and alone application of organic formulations. Significantly higher value of number of nodules and fresh weight of nodules per plant (32.91 and 0.45) was recorded in RDF + Beejamruth + jeevamruth + Panchagavya (T_{10}) treatment while lowest was recorded in T_4 treatment. Similar finding have reported by Devi *et al* (2013) [2].

Table 3: Effect of organic formulation on number of root nodules and fresh weight of root nodules per plant at 60 DAS of soybean

Treatments detail	No. of root nodules	Fresh wt. of root nodules (gm)
T_1: RDF (100% NPK through fertilizer)	28.72	0.34
T_2: Panchagavya only	24.62	0.26
T_3: Jeevamruth only	23.59	0.26
T_4 : Beejamruth only	22.37	0.24
T_5: Panchgavya + Beejamruth	26.91	0.32
T_6 : Beejamruth + Jeevamruth	25.77	0.29
T_7 : Panchgavya + Jeevamruth	25.98	0.31
T_8 : RDF + Beejamruth + Panchgavya	29.47	0.36
T_9 : RDF + Beejamruth + Jeevamruth	29.29	0.35
T_{10} : RDF+ Beejamruth + Jeevamruth+ Panchgavya	32.91	0.45
T_{11} : Beejamruth + Jeevamruth+ Panchgavya	28.60	0.33
T_{12} : 100% N through FYM	27.66	0.32
Grand mean	27.15	0.32
SE ±	1.04	0.02
CD at 5%	3.06	0.07
CV	6.67	11.62

Effect of organic formulations on yield of soybean

Seed yield

The data on seed yield of soybean (kg ha^{-1}) as influenced by different treatments are synthesized in Table 4. There was significant increase in the seed yield of soybean due to application of organic formulations along with recommended dose of fertilizer as compared to RDF and application of only organic formulations. The results revealed that the seed yield of soybean varied in the range of 1344.54 to 2368.38 kg ha^{-1}. Significantly highest soybean seed yield was obtained with treatment T_{10} receiving RDF + Beejamruth + Jeevamruth + Panchagavya (2368.38 kg ha^{-1}) followed by treatment T_8 receiving RDF + Beejamruth + Panchagavya (2139.76 kg ha^{-1}) and lowest was found in T_4 treatment (1289.17 kg ha^{-1}). However, the magnitude of increase grain yield under treatment T_{10} receiving RDF+ Beejamruth + Jeevamruth + Panchagavya being about 13.79 percent over only RDF. Significantly higher seed yield of soybean was observed in application of Beejamruth + Jeevamruth +Panchagavya along with RDF due to adequate supply of required nutrient through chemical fertilizer at early stage of plant growth and also due to overall improvement in soil Physico- chemical and biological properties due to combined application of organic formulations and inorganic fertilizers. The better nutrient availability and nutrient uptake increased the growth and yield of crop. These results are in compliance with the finding of Gore and Sreenivasa (2011) [3], Yadhav *et al* (2017) [11], Patil and Padmani (2007) [6], Patel *et al* (2013) [5] and Patil and Udmale (2016) [7].

Table 4: Effect of organic formulations on seed yield of soybean

Treatments detail	Seed yield (kg ha^{-1})	% increase over only RDF
T_1: RDF (100% NPK through fertilizer)	2081.93	-
T_2: Panchagavya only	1378.72	-
T_3: Jeevamruth only	1344.54	-
T_4 : Beejamruth only	1289.17	-
T_5: Panchgavya + Beejamruth	1844.21	-
T_6 : Beejamruth + Jeevamruth	1618.09	-
T_7 : Panchgavya + Jeevamruth	1776.85	-
T_8 : RDF + Beejamruth + Panchgavya	2139.76	2.78
T_9 : RDF + Beejamruth + Jeevamruth	2095.88	0.67
T_{10} : RDF+ Beejamruth + Jeevamruth+ Panchgavya	2368.38	13.79
T_{11} : Beejamruth + Jeevamruth+ Panchgavya	1892.45	-
T_{12} : 100% N through FYM	1888.88	-
Grand mean	1809.90	
SE ±	65.16	
CD at 5%	191.13	
CV	6.23	

Straw yield

The data on straw yield of soybean are presented in Table 2. The Straw yield of soybean ranged from 1223.60 to 2152.00 kg ha^{-1}. The straw yield was highest (2152.00 kg ha^{-1}) with the treatment T_{10} (RDF + Beejamruth + Jeevamruth + Panchagavya). The lowest straw yield was (1223.60 kg ha^{-1}) was recorded in treatment T_4 (Beejamruth). The application of Beejamruth + Jeevamruth + Panchagavya might have resulted in the better availability of nutrient throughout the crop growth. This is mediated through biological processes as noticed by higher microbial activity; soil enzymatic activity and plant growth promoter present it. These result are in combination with the finding of Gore and Sreenivasa (2011) [3], Sahay *et al* (2016) [8], Zadode *et al* (2014) [12], Yadav *et al* (2017) [11] and Patil and Udmale (2016) [7].

Table 5: Effect of organic formulations on straw yield of soybean

Treatments detail	straw yield (kg ha^{-1})	% increase over control
T_1: RDF (100% NPK through fertilizer)	1999.20	-
T_2: Panchagavya only	1288.36	-
T_3: Jeevamruth only	1272.40	-
T_4 : Beejamruth only	1223.60	-
T_5: Panchgavya + Beejamruth	1748.00	-
T_6 : Beejamruth + Jeevamruth	1544.00	-
T_7 : Panchgavya + Jeevamruth	1698.00	-
T_8 : RDF + Beejamruth + Panchgavya	2063.00	3.20
T_9 : RDF + Beejamruth + Jeevamruth	2003.00	0.20
T_{10} : RDF+ Beejamruth + Jeevamruth + Panchgavya	2152.00	7.67
T_{11} : Beejamruth + Jeevamruth+ Panchgavya	1720.40	-
T_{12} : 100% N through FYM	1748.30	-
Grand mean	1705.02	
SE ±	59.39	
CD at 5%	174.19	
CV	6.03	

Conclusion-

The Applications of organic formulations RDF+ Beejamruth + Jeevamruth + Panchagavya significantly enhanced growth and yield of soybean.

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