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RP Amipara
PG Research Scholar, Gujarat Natural Farming and Organic Agricultural University, Halol, Panchmahal, Gujarat, India

Dr. JC Shroff
Associate Professor, Department of Agronomy, B.A. College of Agriculture, Anand Agricultural University, Anand, Gujarat, India

Bhaumik D Makwana
PG Research Scholar, Gujarat Natural Farming and Organic Agricultural University, Halol, Panchmahal, Gujarat, India

Corresponding Author:
RP Amipara
PG Research Scholar, Gujarat Natural Farming and Organic Agricultural University, Halol, Panchmahal, Gujarat, India

Influence of different organic sources on growth, yield and quality of *kharif* soybean (*Glycine max* L)

RP Amipara, Dr. JC Shroff and Bhaumik D Makwana

Abstract
Background: A special mention should be made of soybeans because they are the most valuable pulse and oilseed crop in the world and can help the nation overcome its crisis in the production of edible oil. An extremely significant source of plant nutrition is organic nutrient sources. They give plants both macro and micronutrients. Utilizing organic resources helps to maintain and sustain soil fertility, boost crop yield, and improve the physical, chemical, and biological aspects of the soil in an environment that is ecologically compatible, socially acceptable, and economically feasible. To investigate how nutrient management affects soybean growth, yield, and quality, a field experiment was conducted.
Method: During the Kharif season of 2021, a field experiment was done on loamy sand soil at Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand. The experiment consisted of three replications with ten treatments using a randomised complete block design which included different organic sources *viz*., FYM, Vermicompost, *Jeevamrit*, vermi-wash and Bio NP consortium in different combinations with different compositions.
Result: Among all the different treatments application of 25% N through FYM + 50% N through Vermicompost + *Jeevamrit* (500 l/ha Foliar spray at 30 and 45 DAS) gave significantly higher results on growth attributes *viz*., plant height, plant dry matter accumulation, root dry biomass and yield attributes *viz*., number of pods/plant, seed index. same treatment was also recorded significantly higher seed yield, haulm yield as well as Nitrogen content in seed, haulm and protein content in seed.

Keywords: Soybean, FYM, vermicompost, *Jeevamrit*, vermi-wash and bio NP consortium

Introduction
To address the crisis in the nation's production of edible oil, soybeans, the most valuable pulse and oilseed crop in the world, need to be specifically mentioned. A good source of protein for the human diet as well as a feedstock for biofuels, it serves as a crop for oil seed production as well as feed for livestock and aquaculture. "Gold of the Soil" is another name for it. Since it contains 40–42% protein and 20–22% cholesterol-free oil, soybean, also referred to as the "Golden Bean" of the 20th century, has become an important oilseed crop in India.
Organic manures maintain a good nutritional balance and the physical characteristics of the soil while also acting as a substrate for the growth of microorganisms. It is understood that enhancing the soil's productivity requires a combination of sources for organic matter. Implementing FYM and other compost can help increase the amount of organic matter in the soil because organic manures are a rich source of nutrients and have a high organic matter content. Vermiwash, a liquid vermicompost extract, contains micro- and macronutrients as well as a number of plant growth hormones, enzymes, and vitamins that encourage plant growth, productivity, and defense to viruses and diseases. Application of consortium bio-inoculants of *rhizobium* with PGPR improved nodulation and biological nitrogen fixation ability through the production of flavonoids, phytohormones and soil enzyme activities in legumes (Medeot *et al*. 2010) [9]. *Jeevamrit* contain small amount of macro and micronutrients as well as growth hormones which is helpful to enhance the growth and yield of crops.

Materials and Methods
The field experiment was conducted at Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand in the Plot No. 10 (A) during the *Kharif* season of 2021. The soil of experimental field was loamy sand in texture. the soil of experimental plot was low in nitrogen while, medium in organic carbon, available phosphorus and available potash. The soil is free from any kind of salinity and sodicity. The experiment was laid out in randomized block design with ten treatment which includes T_1:100% N through FYM, T_2:100% N through

Vermicompost, T_3: 50% N through FYM + 50% N through Vermicompost, T_4: 25% N through FYM + 50% N through Vermicompost + *Jeevamrit*, T_5:25% N through FYM + 50% N through Vermicompost + Bio - NP Consortium, T_6: 25% N through FYM + 50% N through Vermicompost + Vermiwash, T_7: 50% N through FYM + 25% N through Vermicompost + *Jeevamrit*, T_8:50% N through FYM + 25% N through Vermicompost + Bio-NP Consortium, T_9:50% N through FYM + 25% N through Vermicompost + Vermiwash and T_{10}:Control.

The nitrogen equivalent to recommended dose of nitrogen (30kg N) were applied through FYM was manually incorporated in soil before 10 days of sowing while vermicompost added at the time of sowing. *Jeevamrit* was sprayed at 30 and 45 DAS which was taken 12.5 lit/ha and diluted in 300 litre of water at 30 DAS whereas 50 litre of *Jeevamrit* was diluted in 500 litre of water at 50 DAS. Vermiwash 10% was sprayed, 30 lit./ha at 30 DAS and 50 lit./ha at 45 DAS as well as Bio-NP consortium was applied, 1 lit./ha each at 30 and 45 DAS by drenching method during evening hours. The soybean variety (NRC 37) was grown by adopting standard package of practices as suggested by the competent authority of Department of Agronomy, Anand Agricultural University, Anand.

Results and Discussion

A. Effect of different treatments on growth attributes

The data on growth attributing characters of soybean was displayed in Table 1 shows that plant height, dry matter accumulation and root dry biomass was differed significantly due to various treatments. Plant height recoded at 30DAS was did not influence significantly by different treatments but significantly taller plants at 60 DAS (54.62 cm) and at harvest (91.47) was recorded in application of 25% N through FYM + 50% N through Vermicompost + *Jeevamrit.*

Dry matter accumulation and root dry biomass recorded at 45 DAS was found significantly higher under treatment T_4 (25% N through FYM + 50% N through Vermicompost + *Jeevamrit*). Which might be due to that appropriate proportion of FYM and vermicompost helped to supply sufficient nutrient required by plant. Additionally, the application of Jeevamrit is essential for boosting the direct metabolic activity of plants, which leads to increased meristematic activity and apical development, which improves plant height, branches/plant, and the number of leaves /plant, all of which improve dry matter accumulation. Similar results were obtained by Daravath & Takankharb (2017) [3], Sutar *et al.* (2018) [14] and Aritonang and Sidauruk (2020) [1].

B. Effect of different treatments on yield attributes and yield

Data regarding yield attributes and yield of soybean was influenced by different organic manures treatments is illustrated in Table 3. Length of pod and number of seeds/pod was not significantly influenced due to different treatments. Significantly higher number of pods/plant (122), seed index (9.74 g), seed yield (2568 kg/ha) and haulm yield (4173 kg/ha) were recorded under application of 25% N through FYM + 50% N through Vermicompost + *Jeevamrit* (T_4) followed by treatment T_7 *i.e.* 50% N through FYM + 25% N through Vermicompost + *Jeevamrit.* The application of solid and liquid organic manures in the right proportions improved nutrient availability and had a positive impact on the physical and biological characteristics of the soil, leading to improved yield attributes and ultimately higher yields. The results are in close agreement with the observations of Esakkiammal *et al.* (2015) [5], Potkile *et al.* (2017) [11], Kumar (2018) [6], Patel *et al.* (2018) [10], Sutar *et al.* (2018) [14], Verma and Sirothia (2020) [17].

C. Effect of different treatments on quality of soybean

The quality parameters as influenced by organic manures treatments recorded at harvest are presented in Table 3. Nitrogen content (%) in seed, haulm and protein content in seed recorded significantly higher under application of 25% N through FYM + 50% N through Vermicompost + *Jeevamrit* (T_4). The remarkable increase in protein content under these treatments might be due to continues supply of nitrogen through different organic sources and nitrogen is the constituent of amino acids which is known to be building blocks of protein. These results are in close conformity with the results of Aruna and Narsareddy (1999) [2], Virkar & Tumbare (2011) [16], Satyanarayana & Rameshkumar (2015) [12], Kumar *et al.* (2019) [7] and Sutar *et al.* (2019) [13].

Table 1: Plant height, Dry matter accumulation and root dry biomass as influenced by different treatments

Treatment	Plant height (cm)			Dry matter accumulation	Root dry biomass
	At 30 DAS	At 60 DAS	At harvest	(g/plant) At 45 DAS	
T_1	28.07	46.13	75.51	11.38	0.85
T_2	33.06	48.79	76.97	13.95	0.95
T_3	29.33	48.54	78.44	12.63	0.99
T_4	32.53	58.29	92.45	14.10	1.20
T_5	30.60	50.95	83.98	12.79	1.02
T_6	31.00	51.78	87.07	13.65	1.07
T_7	29.47	54.62	91.47	13.11	1.14
T_8	29.53	48.92	73.06	12.27	0.86
T_9	28.60	47.15	80.88	12.70	1.02
T_{10}	27.73	45.50	68.67	10.94	0.83
SEm ±	1.40	2.33	3.82	0.46	0.04
CD (P=0.05)	NS	6.93	11.38	1.36	0.13
CV%	8.13	8.07	8.20	6.22	7.81

Table 2: Yield attributes and yield as influenced by different treatments

Treatment	No. of pods/ plant	Length of pod (cm)	No. of seeds/ pod	Seed index (g)	Seed yield	Haulm yield
					kg/ha	
T_1	103	3.34	2.48	8.10	2169	3559
T_2	104	3.37	2.55	8.73	2191	3595
T_3	103	3.31	2.46	7.90	2084	3545
T_4	122	3.45	2.66	9.74	2568	4173
T_5	110	3.34	2.55	8.51	2184	3595
T_6	115	3.41	2.57	9.08	2343	3731
T_7	119	3.38	2.50	9.16	2527	4125
T_8	102	3.31	2.44	8.28	2178	3576
T_9	106	3.32	2.49	8.35	2183	3587
T_{10}	90	3.24	2.35	6.79	1358	2593
SEm ±	4.07	0.18	0.12	0.36	110	189
CD (P=0.05)	12.11	NS	NS	1.08	327	562
CV%	6.57	9.38	8.02	7.41	8.76	9.09

Table 3: Nitrogen content in seed, haulm and protein content in seed as influenced by different treatments

Treatment	Nitrogen content (%)		Protein Content (%) in seed
	Seed	Haulm	
T_1	5.21	1.60	33.85
T_2	5.56	1.66	36.14
T_3	5.26	1.62	34.21
T_4	6.09	1.79	39.58
T_5	5.63	1.68	36.60
T_6	5.72	1.71	37.30
T_7	5.74	1.74	37.18
T_8	5.34	1.65	34.73
T_9	5.34	1.66	34.74
T_{10}	4.89	1.38	31.77
SEm ±	0.13	0.04	0.82
CD (P=0.05)	0.37	0.12	2.44
CV%	3.99	4.15	3.99

Conclusion

On the basis experiment, it can be concluded that higher growth and yield parameters of soybean along with higher protein content in seed could be achieved with either application of 50% N through FYM + 25% N through Vermicompost + *Jeevamrit* (foliar application at 30 and 45 DAS) or 25% N through FYM + 50% N through Vermicompost + *Jeevamrit* (foliar application at 30 and 45 DAS) under organic condition.

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