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Effect of Organic and Inorganic Sources on Growth and Yield of Soybean (*Glycine max* L. Merrill)

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Abstract— *A Kharif 2024 field trial at Rajasthan College of Agriculture, Udaipur, compared four RDF levels (0–100%) with organic treatments: vermicompost (2–6 t/ha) combined with decreasing jeevamrut foliar sprays. While 100% RDF yielded strong growth, nutrient uptake, and yields (seed: 1,140 kg/ha; haulm: 2,095 kg/ha; biological: 3,236 kg/ha), the top organic treatment—6 t/ha vermicompost + 4% jeevamrut—matched or slightly exceeded these results (seed: 1,141 kg/ha; haulm: 2,085 kg/ha; biological: 3,226 kg/ha). Importantly, it also significantly improved soil health indicators—organic carbon, available N, P, K, microbial populations, and enzyme activities—making it a sustainable and effective alternative to full inorganic fertilization.*

Keywords— ***Organic, inorganic sources, vermicompost, jeevamruth, soybean***

I. INTRODUCTION

Soybean is chief source of vegetable oil, protein and animal feed, within India. Brazil is largest producer of Soybean in world. Origin of Soybean is said to be in China. Soybean is recognized as the "Golden Bean" of the 20th century. Although Soybean is a legume crop, still it is widely used as oilseed.(Surve *et al.,* 2020). In India, Soybeans are grown across 130 lakh hectares, producing 125 lakh tonnes with a productivity rate of 980 kg per hectare in 2024. India is fifth largest Soybean producing country and area covered by Soybean in India is 10% of world area. Among the states, Madhya Pradesh stood first with 53.35 lakh ha followed by Maharashtra (50.72 lakh ha), Rajasthan (11.44 lakh ha), Karnataka (4.11 lakh ha), Gujarat (2.66 lakh ha) and Telangana (1.89 lakh ha). Almost 80% is produced in the states of Madhya Pradesh. Other chief states are Maharashtra, Rajasthan and Andhra Pradesh. Rajasthan having 11.3 lakh hectare of area, 14.1 lakh tonnes of production with a productivity of 1248 kg per hectare in 2024.

The use of organic manure can preserve and improve soil physical, chemical, as well as biological fertility and it also increases soil and plant productivity. The combine use of organic manure and NPK inorganic fertilizers can rise the weight of roots and yield of Soybean by 98%. (Kuntyastuti *et al.,* 2020)

Instead of using conventional farm-based products, there is a growing request for organic liquid nutritive formulations alike jeevamrut which support quick build-up of soil fertility as well as improves activity of soil microflora. Despite several advantages with organic liquid formulations, these have not been exploited widely in crop production. (Bhadu *et al.,* 2023)

II. MATERIAL AND METHODS

A filed experiment was conducted during *kharif* season of 2024 at Instructional farm of Rajasthan college of agriculture, Udaipur, Rajasthan. It was observed that soil of experimental site was clay loam having available Nitrogen-

--- , available phosphorous ----, and available potassium ---. The rainfall received during the growing period was --- . The treatment has Four organic sources (control, Vermicompost 2 t/ha + 10% jeevamrut foliar spray, Vermicompost 4 t/ha + 6% jeevamrut foliar spray, Vermicompost 6 t/ha + 4% jeevamrut foliar spray) and RDF levels (100%, 75%, 50%). The experiment was laid out in FRBD design with three replications. Soybean var. JS- 20-116 was sown in last week of june. Soybean was harvested on 11 october 2024 yield and yield attributes were recorded at harvest

III. RESULTS AND DISCUSSION

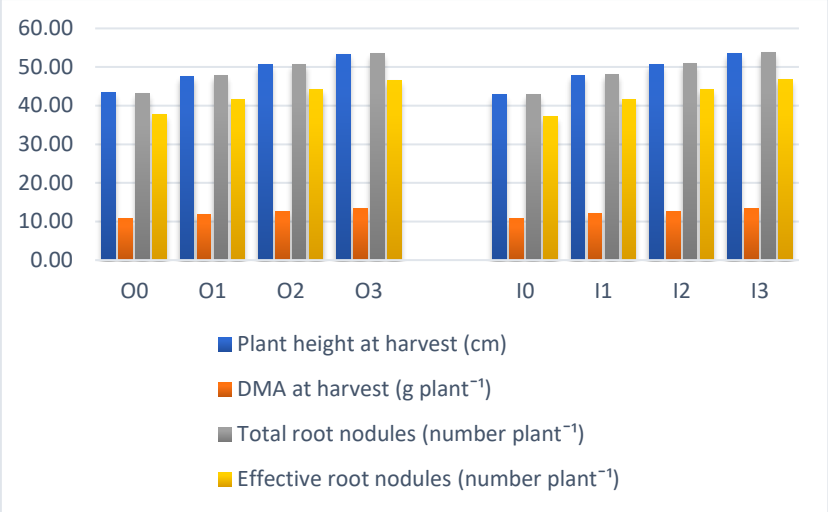
Growth attributes

Among the organic sources Vermicompost 6 t/ha + 4% *jeevamrut* foliar spray resulted in maximum growth attributes over other organic sources. Plant height (53.32 cm), Dry matter at harvest (13.33 g/plant), root nodules per plant total (53.58) effective (46.59) was recorded highest. After control Vermicompost 2 t/ha + 10% jeevamrut foliar spray was recoded lowest in organic sources. The increased plant height and dry matter accumulation observed under organic sources are a direct result of balanced and regular nutrient supply, improved soil aeration and enhanced soil microbial activity. (Kumar *et al*., 2021), the organic acids released during the decomposition of vermicompost improve soil pH buffering and phosphate solubilization, both crucial for efficient root nodule development and function (Chaudhary *et al*., 2021). Similarly, foliar application of *Jeevamrut*, a fermented liquid bio-enhancer prepared using indigenous cow dung, cow urine, jaggery, gram flour and fertile soil, introduces a rich microbial population into the plant phyllosphere and rhizosphere.

In inorganic levels 100% RDF showed highest values of all the growth parameters over other inorganic sources. Plant height (53.40 cm), Dry matter at harvest (13.35 g/plant), root nodules per plant total (53.66) effective (46.66) was recorded highest. After control 50% was recorded lowest in inorganic sources. The improvement in total and effective root nodules under higher RDF levels can be attributed to enhanced phosphorus availability, which is essential for nodule initiation, development and nitrogenase enzyme activity. Although excessive nitrogen can suppress nodulation, a balanced nitrogen application, as part of RDF, improves early plant vigor and root biomass, indirectly facilitating better nodule formation. This observation aligns with the findings of Jain *et al*. (2021).

Table : Effect of Organic and Inorganic Sources on Growth parameters of Soybean

Growth parameters				
	Plant height (cm)	**DMA at harvest (g/plant)**	**Root nodules (number per plant)**	
			Total	**Effective**
Organic sources				
O_0	43.37	10.84	43.27	37.63
O_1	47.65	11.91	47.71	41.49
O_2	50.56	12.64	50.72	44.10
O_3	53.32	13.33	53.58	46.59
SEm±	0.89	0.22	0.92	0.80
C.D. at 0.05	2.56	0.64	2.65	2.30
Inorganic sources				
I_0	42.92	10.73	42.81	37.23
I_1	47.90	11.98	47.97	41.71
I_2	50.68	12.67	50.84	44.21
I_3	53.40	13.35	53.66	46.66
SEm±	0.89	0.22	0.92	0.80
C.D. at 0.05	2.56	0.64	2.65	2.30



YIELD ATTRIBUTES:

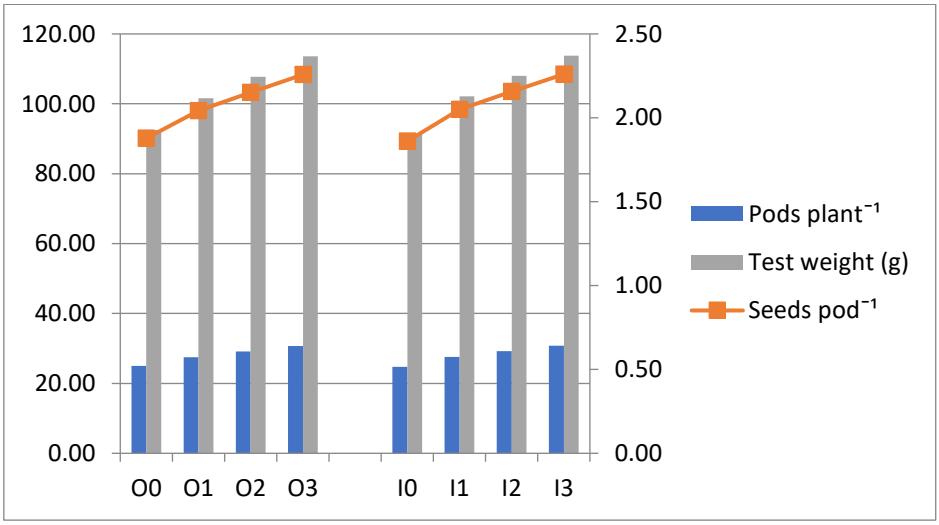
The data revealed that pods per plant and seeds per pod found significantly among the organic treatments. The pod per plant in soybean varied from 25.02 to 30.71 under organic treatments in which highest (30.71) is under Vermicompost 6 t/ha + 4% *jeevamrut* foliar spray and seeds per pods is 2.26 and its range is 1.88 to 2.26. The test weight of soybean varied from 92.57 to 113.61 with maximum observed in Vermicompost 6 t/ha + 4% *jeevamrut* foliar spray. The improved yield attributes such as number of pods per plant, seeds per pod and test weight under organic sources are a reflection of balanced plant nutrition and enhanced physiological processes. A balanced nutrient regime, particularly nitrogen and phosphorus, plays a pivotal role in flower initiation, pod development and seed formation. Nitrogen is fundamental for protein synthesis, cell division and expansion, while phosphorus is essential for energy transfer processes like ATP synthesis, which governs flower and seed development (Patel *et al*., 2023).

However the inorganic treatments shows the highest number of pods per plant (30.75) was attained with the application of 100% RDF which was significantly improved by 5.30 and 11.37 per cent over application of 75 and 50% RDF, respectively. seeds per pod (2.26) was attained with the application of 100% RDF which was significantly at par with 75% RDF (2.16). The improvement was noticed by 10.24 per cent over application of 50% RDF. The highest test weight (113.78g) was recorded with the application of 100% RDF which significantly increases by 5.32 and 11.38 per cent over application of 75 and 50% RDF, respectively. The increase in biological yield under vermicompost and *Jeevamrut* treatments is essentially the cumulative effect of improved vegetative and reproductive growth, nutrient use efficiency and soil biological health. The microbial consortia introduced through *Jeevamrut* enhance nitrogen fixation, phosphate solubilization and nutrient mobilization, creating a biologically active rhizosphere that supports robust plant growth and higher biomass accumulation (Chaudhary *et al*., 2021). Similarly, Meena *et al*. (2022) noted that the synergistic effect of vermicompost and liquid organic formulations like *Jeevamrut* significantly increased pod setting, seed filling and seed weight in leguminous crops.

Table: Effect of Organic and Inorganic Sources on yield attributes of Soybean

Treatment	Yield attributes		
	Pods/plant	Seeds/pod	Test weight (g)
Organic sources			
O_0	25.02	1.88	92.57
O_1	27.47	2.04	101.63
O_2	29.13	2.15	107.78
O_3	30.71	2.26	113.61
SEm±	0.51	0.03	1.87
C.D. at 0.05	1.46	0.10	5.41

Inorganic sources			
I_0	24.76	1.86	91.63
I_1	27.61	2.05	102.15
I_2	29.20	2.16	108.03
I_3	30.75	2.26	113.78
SEm±	0.51	0.03	1.87
C.D. at 0.05	1.46	0.10	5.41



YIELD:

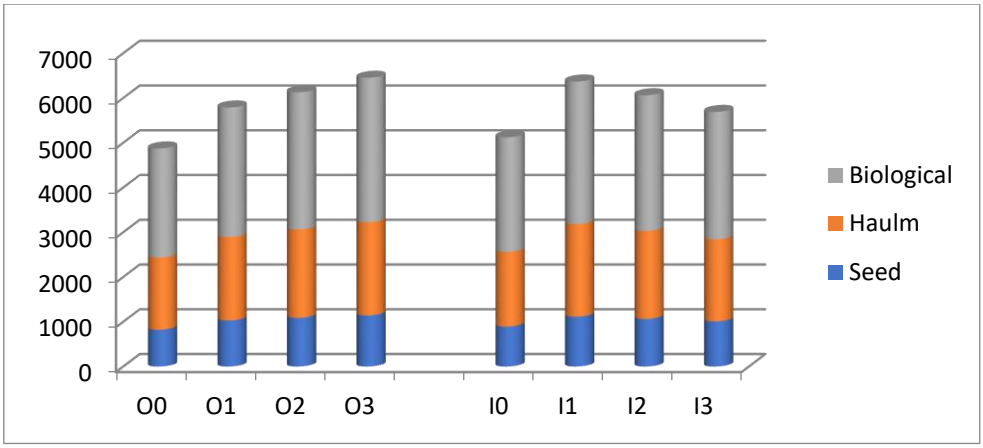
Organic treatments recoded significantly higher seed yield (1141 kg/ha), halum yield (2085 kg/ha) and biological yield (3226 kg/ha) with harvesting index (35.75%) on application of Vermicompost 6 t/ha + 4% *jeevamrut* foliar spray than control, Vermicompost 2 t/ha + 10% jeevamrut foliar spray, Vermicompost 4 t/ha + 6% jeevamrut foliar spray.

The improved performance under application of 100% RDF in seed yield (1114 kg/ha), halum yield (2071 kg/ha) and biological yield (3185g/ha) with harvesting index (35.26) over all other inorganic treatments. The enhanced biological yield recorded under 100% RDF application is the cumulative result of improved seed and straw yields driven by better vegetative growth, nutrient uptake and reproductive efficiency Jadhav *et al*. (2020) Furthermore, the positive response of yield attributes to inorganic fertilizers can also be attributed to the efficient nutrient absorption and utilization due to the solubility and mobility of chemical fertilizers, which immediately replenish soil nutrient pools and match the crop's peak nutrient demand periods Sharma *et al*. (2020)

Table : Effect of Organic and Inorganic Sources on yield and harvest index of Soybean

Treatments	Yield			
	Seed	Haulm	Biological	Harvest index (%)
Organic sources				
O_0	823	1614	2436	33.77
O_1	1029	1865	2894	35.57
O_2	1087	1978	3065	35.50
O_3	1141	2085	3226	35.39
SEm±	18	33	37	0.56
C.D. at 0.05	52	96	106	NS

Inorganic sources				
I_0	894	1668	2562	34.83
I_1	1008	1836	2844	34.96
I_2	1064	1967	3031	35.06
I_3	1114	2071	3185	35.39
SEm±	18	33	37	0.56
C.D. at 0.05	52	96	106	NS



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