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Response of fertility levels and enriched compost on yield and economics of soybean cultivation in subhumid region of Rajasthan

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Abstract
The experiment was conducted during *kharif* season of 2018 at the Instructional Farm, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan. The experiment consisted of 12 treatments comprising two fertility levels with one control viz., Control (F0), 50% RDF (F1) and 100% RDF (F2) and three enriched compost level with one control viz., Control (EC0), enriched compost 2 t/ ha (EC1), enriched compost 4 t/ ha (EC2) and enriched compost 6 t/ ha (EC3). The experiment was laid out in factorial randomized block design (FRBD) and replicated thrice. The results revealed that 100% RDF recorded significantly higher biological yield, grain yield, harvest index, cost of cultivation, gross returns and benefit cost ratio. Among enriched compost levels grain yield, biological yield, cost of cultivation and gross returns were higher under application of 6 t/ ha enriched compost but harvest index and benefit cost ratio was higher with application of 4 t/ ha enriched compost. Thus it can be concluded that application of 100% RDF with 4 t/ ha enriched compost in soybean is productive as well as profitable.

Keywords: fertility levels, enriched compost, yield, returns

Introduction
Soybean (*Glycine max* L. Merril) is the world's most important seed legume contributing to 25% and 66.7% of the world's edible oil and protein concentrate for livestock feeding respectively. Soybean protein is called as complete protein because of its amino acid composition and its well known nutritive use for heart disease and diabetes patients. India's contribution to world soybean area is 10% and soybean grain is 4% which indicates poor soybean productivity (1.1 t/ha) in India (Agarwal *et al.*, 2013) [2]. Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, Telangana and Gujarat are the leading producers of soybean and Rajasthan covers 8.37% of area and 8.81% of production of all India (Agricultural statistics at a glance, 2020) [3]. Soybean is mainly grown under rainfed conditions in Rajasthan and even under adverse climatic conditions, minimum agricultural inputs and management practices, it fetches profitable returns to the farmers. In fact, soybean is one of the most climate resilient crops for the rainfed *kharif* season because despite aberrant weather conditions in recent past time, the crop has maintained its performance (Agarwal *et al.*, 2013) [2]. But as the soybean productivity is low integrated crop management practices including proper and profitable nutrient management is required for the crop. Continuous use of fertilizers alone as nutrient sources has depleted the soil organic carbon status, and created problems of soil acidity and environmental pollution leading to poor soil fertility and declining crop productivity. The application of organic manure along with chemical fertilizers is a widely accepted strategy to improve the soil fertility through increasing SOC stock and supplying more nutrients to crops as neither organic manures nor chemical fertilizers alone can increase the crop productivity over the years (Meena *et al.*, 2019) [7]. Combined application of enriched compost along with inorganic source of fertilizers ensures higher productivity with better returns due to lesser expenditure on costly fertilizer inputs (Abhishek *et al.*, 2021) [1]. Further due to non availability of literature regarding effect of enriched compost with fertilizers on soybean production and economics in sub humid region of Rajasthan an experiment entitled Response of fertility levels and enriched compost on yield and economics of soybean was carried out.

Materials and Methods

The experiment was conducted at the Instructional Farm, Rajasthan College of Agriculture, Udaipur, Rajasthan situated at an altitude of 579.5 meters above mean sea level under the agro-climatic zone-IVa (Sub-humid Southern Plain and Aravalli Hills) of Rajasthan during *kharif* season of 2018. Zone of experiment have typical sub-tropical climatic condition characterized by mild winters and moderate summers associated with high relative humidity during the month of July to September. The mean annual rainfall of the region is 680 mm, most of which is contributed by south west monsoon from July to September. The soil of the experimental field was clay loam in texture, slightly alkaline (pH 8.18) in reaction, medium in available nitrogen (270.84 kg ha^{-1}) and phosphorus (18.52 kg ha^{-1}) while high in available potassium (390.14 kg ha^{-1}). Further it was deficient in available iron (3.64 mg kg^{-1}) and zinc (0.90 mg kg^{-1}) but had sufficient available manganese (3.42 mg kg^{-1}) and copper (2.44 mg kg^{-1}) content. The experiment was laid out in factorial randomized block design (FRBD) and replicated thrice. The experiment consisted of 12 treatments comprising two fertility levels with one control viz., Control (F0), 50% RDF (F1) and 100% RDF (F2) and three enriched compost level with one control viz., Control (EC0), enriched compost 2 t/ ha (EC1), enriched compost 4 t/ ha (EC2) and enriched compost 6 t/ ha (EC3). The RDF of fertilizer for soybean crop is 20 kg (N) and 40 kg (P_2O_5) in Typic *Haplustepts* soils of Udaipur region. Fertilizer application was made as per the treatments. The source of N and P were urea and DAP, applied in field as per recommendation of the treatments as basal at time of sowing of crop. Enriched compost was prepared by mixing ground rock phosphate @ 4 kg per 100 kg of air-dried maize straw with phosphate solubilizing bacteria (PSB) and cow dung as per standard procedure to enhance the solubility of phosphorus and decomposition rate of plant materials. It was applied 15 days before sowing of crop and mixed out in soil properly. Sowing of JS-9560 variety of soybean was done in 30 cm apart lines. Other agronomic practices were followed as per soybean crop cultivation package of practices for the region. Biological and grain yield were recorded under each plot. Straw yield of soybean was obtained by subtracting the grain yield from biological yield. Later the yield recorded under each plot was converted into kg ha^{-1}. For economics, the cost of cultivation for treatment was subtracted from gross returns and net profit was worked out. Statistical analysis of the data recorded for different parameters was done with the help of analysis of variance (ANOVA) technique for factorial randomized block design and the results are presented at 5% level of significance (P=0.05).

Results and Discussion

Effect on yield: Data on yield under the influence of different fertility levels and enriched compost presented in table 1 and fig 1 reveals that grain yield, biological yield and harvest index varied significantly. Significant higher grain yield and biological yield and harvest index were recorded under the 100% RDF (17.4 q/ ha, 43.57 q/ha) over 50% RDF (14.2 q/ ha, 36.52 q/ ha) and control (9.8 q/ ha, 27.97 q/ha) respectively. However, harvest index was significantly higher with the 100% RDF (39.87%) over control (34.67%) but the results were at par with 50% RDF (38.04%). Application of higher dose of nutrients might have resulted in higher nutrient uptake contributing to better growth and dry matter accumulation and thus yield. Similar results have been recorded by Jangir *et al.*, 2009 [6] and Begum *et al.*, 2015 [4]. Data presented in table 1 and fig. 1 indicates the variable trend in grain yield, biological yield and harvest index with increasing enriched compost levels. Biological yield increased significantly with increasing enriched compost levels and thus 6 t/ ha enriched compost (43.20 q/ ha) reported statistically higher yield over control and application of 2 and 4 t ha^{-1} enriched compost. Grain yield also increased with increasing levels of enriched compost and thus 6 t/ ha enriched compost (17.2 q/ ha) reported significantly higher grain yield over control and 2 t/ ha enriched compost but the results were at par with 4 t/ ha enriched compost. In contrast harvest index increased upto application rate of 4 t/ ha and thereafter decreased. Application of 4 t/ ha enriched compost recorded significantly higher harvest index over control and 2 t/ ha enriched compost but the results were at par with 6 t/ha enriched compost. Supply of enriched compost improves the physiochemical and biological properties of soil including availability of almost all essential plant nutrients for the growth and development of plant. Thus balanced nutrition under favorable environment might have facilitated in better growth and development of plant and further have augmented crop yield. Results are in agreement with findings of Biswas, 2011 [5] and Meena *et al.*, 2021 [8].

Table 1: Effect of fertility levels and enriched compost on biological yield and harvest index of soybean

Treatment	Biological yield (q/ ha)	Harvest Index (%)
Fertility levels (kg/ ha)		
F1: Control	27.97	34.64
F2: 50% RDF	36.52	38.04
F3: 100% RDF	43.57	39.87
SEm±	0.84	0.82
CD(P=0.05)	2.47	2.40
Enriched Compost levels (t/ ha)		
C1: Control	27.53	33.06
C2: 2 t ha-1	33.63	36.92
C3: 4 t ha-1	39.74	40.44
C4: 6 t ha-1	43.20	39.64
SEm±	0.97	0.95
CD(P=0.05)	2.86	2.77

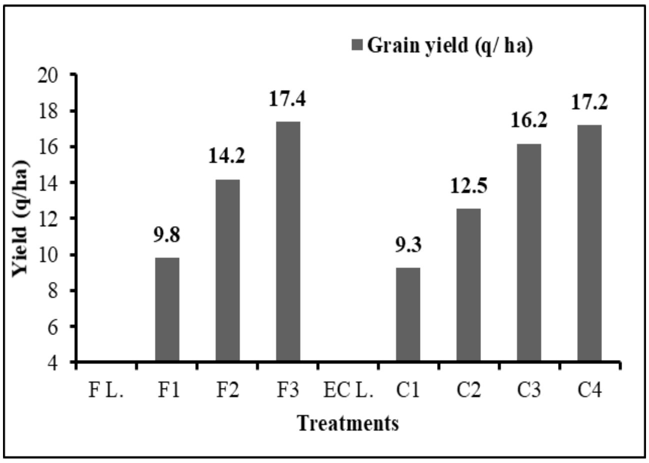

Fig 1: Effect of fertility levels and enriched compost on grain yield of soybean (FL. Fertility levels *viz.*, F1 control, F2 50% RDF and F3 100% RDF; EC L. Enriched compost levels *viz.*, C1 control, C2 2 t/ ha, C3 4 t/ ha and C4 6 t/ ha).

Effect on economics - A perusal of data presented in fig.2 shows that the cost of cultivation as well as gross returns increased with increasing fertility and enriched compost levels. Among fertility levels 100% RDF recorded highest cost of cultivation (22660 ₹) and gross returns (68468 ₹) in comparison to 50% RDF and control. Returns per rupee invested or benefit cost ratio also depicted similar pattern and was recorded maximum with 100% RDF. Among different enriched compost levels, application of 6 t/ ha enriched compost reported highest cost of cultivation and gross returns in comparison to control, 2 t/ha and 4 t/ha enriched compost application. However benefit cost ratio increased with increasing enriched compost levels upto 4 t/ha and thus 4 t/ ha enriched compost application recorded highest benefit cost ratio in comparison to control, 2 t/ha and 6 t/ ha enriched compost application. It was predictable because with increasing levels of input production increases and likewise cost of cultivation too increases. However among enriched compost levels it was 4 t/ ha dose which resulted in maximum return per rupee invested and after that increase in enriched compost dose was not profitable. Meena *et al.*, 2021 [8] reported similar findings in black gram.

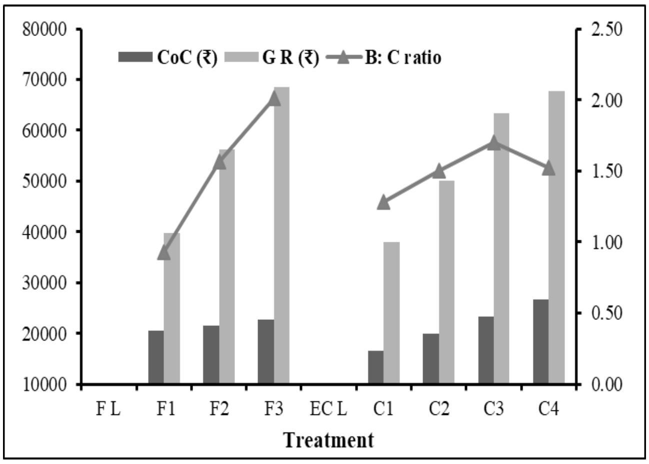

Fig 2: Effect of fertility levels and enriched compost on economics of soybean cultivation (FL. Fertility levels *viz.*, F1 control, F2 50% RDF and F3 100% RDF; EC L. Enriched compost levels *viz.*, C1 control, C2 2 t/ ha, C3 4 t/ ha and C4 6 t/ ha).

Conclusion

From the above findings it can be concluded that combined application of fertilizer and enriched compost give better results. Thus it can be inferred from the study that the combined application of 100% RDF + 4 t ha^{-1} enriched compost may be an optimum dose to get higher yield and benefit from soybean crop.

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