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Assess the effect of organic nutrient sources on growth, yield and economics of wheat in Semi-Arid region of Rajasthan

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Abstract
An experiment was conducted during *rabi* season of 2024-25 at Agricultural Farm Mewar University Gangrar, Chittorgarh, (Rajasthan), to study the "Effect of Organic Sources of Nutrient on Growth and Yield of Wheat (*Triticum aestivum* L.) in Southern Rajasthan". The soil of the experimental site was sandy loam in texture, slightly saline in reaction, low in available nitrogen, medium in available phosphorus, and high in availability of potassium and sufficient in micronutrients. The experiment was laid out in randomized block design with three replications. The experiment comprised of ten treatments (Control, 50% FYM, 50% FYM + 50% vermicompost, 75% FYM + 25% vermicompost, 25% FYM + 75% vermicompost, 50% FYM + 50% vermicompost + panchgavya spray, 75% FYM + 25% vermicompost + panchgavya spray, 25% FYM + 75% vermicompost + panchgavya spray, 100% FYM + panchgavya spray and 100% vermicompost + panchgavya spray. Wheat variety Raj 4037 was used as test crop. Application of 100% Vermicompost + panchgavya spray recorded significantly higher growth attributes, yield and economics of wheat crop as comared to control and remained treatments.

Keywords: Wheat, growth, yield, economic and organics

Introduction
Wheat is one of the most widely consumed cereal grains in the world. Major wheat-producing countries include China, India, the USA, and France. India ranks fourth globally in both area under cultivation and total production. Among all the states, Uttar Pradesh has the largest area under wheat cultivation and the highest total production. However, Punjab leads in average productivity, followed by Haryana. In Rajasthan, wheat cultivation is mainly concentrated in the districts of Ganganagar, Hanumangarh, Alwar, Bundi, Baran, Kota and Jaipur. At the moment, the total cultivated area under organic certification process (registered under National Programme for Organic Production) is 4.33 million ha. This includes 2.65 million ha cultivable area and another 1.68 million ha for wild harvest collection with total organic production 34.96 million tonne include with farm production of 0.34 million tonne and wild harvested production 0.0027 million tonne (APEDA, NPOP Anonymous 2023).
Wheat (*Triticum aestivum* L.) is a native of South-west Asia and stood one of the most important staple food crop (Parewa *et al*., 2019) [2] that has been labelled as "King of Cereals". Wheat is a good supplement for nutritional requirement of human body as it contains 8.0-15.0 percent protein, 60-68 percent starch, 1.5-2.0 percent fat, 2.0-2.5 percent cellulose and 1.5-2.0 percent minerals. Wheat is the world's leading cereal crop cultivated over an area 221.11 million ha with a production of 773.43 million tonnes (Anonymous, 2023) [1] and China is a major wheat producing country and contributed to 10.65 percent (23.57 million ha) and 17.31 percent (137.00 million tonnes) of the world total wheat harvest area and yield production in 2023, respectively (Anonymous, 2023) [1]. In India, it is cultivated in almost all parts of the country and occupied 31.89 million ha with the production of 113.29 million tonnes and with an average productivity of 3560 kg/ha (Anonymous, 2023) [1]. The major wheat producing states are Uttar Pradesh, Madhya Pradesh, Punjab, Rajasthan, Haryana and Bihar In Rajasthan production of wheat is about 10.41 million tonnes from an area around 2.78 million ha with average productivity of 3676 kg/ha (Anonymous, 2023) [1].

Under organic farming, continuous incorporation of crop residues, animal dung, urine-based manures (FYM & vermicompost), biofertilizers, special liquid organic manures (*viz*. panchgavya) are essential to maintain the activity of micro-organisms and other life forms in the soil (Kumar *et al*., 2017) [3]. Liquid organic manures are produced by simple fermentation processes using organic wastes as carbon substrates. (Phibunwatthanawong and Riddech 2019) [4].

Materials and Methods

The experiment was conducted at Agricultural Farm Mewar University Gangrar, Chittorgarh, Rajasthan. during *rabi* 2024-25. It is situated at 10'57" N Latitude and 75'20" Longitude at an altitude of 267 meter above mean sea level. The region falls under Agro-climatic Zone IV (Humid South Plains) of Rajasthan. The soil of experimental field is medium black clay loam, neutral alkaline in reaction with low in available nitrogen (314 kg/ha), medium in available phosphorus (22.3 kg/ha) and high in accessible potassium (398 kg/ha). The experiment was carried out in RBD design, comprising of 10 treatments with three replication. Control, 50% FYM, 50% FYM + 50% vermicompost, 75% FYM + 25% vermicompost, 25% FYM + 75% vermicompost, 50% FYM + 50% vermicompost + panchgavya spray, 75% FYM + 25% vermicompost + panchgavya spray, 25% FYM + 75% vermicompost + panchgavya spray, 100% FYM + panchgavya spray and 100% vermicompost + panchgavya spray. Wheat variety RAJ 4037 was sown at 22.5 cm row spacing. Farmyard manure and vermicompost doses were calculated according to the treatments for each plot. Farmyard manure was incorporated 15 days before sowing in the respective plots as per the treatment specifications. The data were subjected to statistical analysis by appropriate analysis of variance as described by Panse and Sukhatme (1985) [5].

Results and Discussion

Growth attributes

The data presented in Table 1 indicated that, application of various organic sources significantly increased the growth attributes *viz.,* plant height, dry matter accumulation, number of tillers/plant and ear length of wheat over control. showed highest plant height at harvest (109.4 cm), dry matter accumulation at harvest (111.15 g/m row length), number of tillers/plant (7.62) and ear length (8.68) under the application of 100% Vermicompost + panchgavya spray at 45 DAS (100.7) as compared to control and followed with 100% FYM + panchgavya spray, and 25% FYM + 75% vermicompost + panchgavya spray. It might be due to clearly indicated the need for adding organic manures to soil, which increased the availability of nutrients over a long period, have positive effect on growth parameters. Liquid organic manures contain microbial populations and plant growth-promoting substances that help improve plant growth and metabolic activities. FYM and vermicompost and panchgavya spray helps in decomposition, promotes an increase in the soil microbial population, and affects the growth and yield of crops. The combined use of these, a form of organic manure, and inorganic fertilizer will increase nutrient use efficiency and reduce environmental stress. These results are closely conformity by Shivkumar *et al*. (2011) [7], Verma *et al.* (2018) [9], Neelam *et al.* (2015) [6].

Yield attributes and yield

The results indicated that in Table 2 revealed that yield attributes and yield *viz.,* number of grains/spike, test weight, grain yield and straw yield were recorded significantly maximum with 100% Vermicompost + panchgavya spray as compared to control and followed with 100% FYM + panchgavya spray, and 25% FYM + 75% vermicompost + panchgavya spray. Number of grains/spike (43.25), test weight (41.72 g), grain yield 5225 (kg/ha) and straw yield (7850 kg/ha) were registered with the application of 100% Vermicompost + panchgavya spray which was statistically at par with 100% FYM + panchgavya spray, and 25% FYM + 75% vermicompost + panchgavya spray and lowest in control. Whereas, harvest index was not influenced with organic sources of nutrients. The final yield of any crop species depends on the source and sink relationship and on different components of sink *viz.,* number of grains/spike and test weight. The synthesis, accumulation and translocation of photosynthates depend upon efficient photosynthetic structure as well as source to sink relation and also on plant growth and development during early stage of crop growth. Since, final yield is a function of all components of source and sink operating at different phenophase of growth during life cycle of plant. Similar results were reported by similar result finding by Desai *et al.* (2015) [11] and Dalvi *et al.* (2020) [12].

Economics

A perusal of data presented in Fig. 1 showed that gross return, net return and B:C ration of wheat crop observed under the application 100% vermicompost + panchgavya spray (₹125413/ha, ₹79313/ha and B:C ration 1.72) which was statically at par with 100% FYM + panchgavya spray, and 25% FYM + 75% vermicompost + panchgavya spray. However, minimum gross return was recorded with control. Economics of different treatments clearly revealed that the application of benefit cost ratio was significantly affected by different organic sources of nutrients. Kumari *et al*, (2022a) [10].

Table 1: Effect of organic sources of nutrients on growth attributes of wheat

Treatments	Plant height (cm)	DMA (g/mrl)	No. of tillers/plant	Ear length (cm)
Control	85.54	57.64	4.42	6.61
50% FYM	92.23	72.13	6.11	7.32
50% FYM + 50% vermicompost	94.24	76.18	6.22	7.59
75% FYM + 25% vermicompost	96.05	82.26	6.32	7.62
25% FYM + 75% vermicompost	99.32	88.51	6.51	7.67
50% FYM + 50% vermicompost + panchgavya spray	102.66	95.15	6.93	7.83
75% FYM + 25% vermicompost + panchgavya spray	101.12	92.82	6.71	7.9
25% FYM + 75% vermicompost + panchgavya spray	104.52	98.35	7.22	8.3
100% FYM + panchgavya spray	107.81	106.93	7.43	8.6
100% vermicompost + panchgavya spray	109.47	111.15	7.62	8.68
S.Em.±	1.87	4.657	0.18	0.16
CD (P=0.05)	5.69	13.81	0.51	0.48

Table 2: Effect of organic sources of nutrients on yield attributes and yield of wheat

Treatments	No. of grains/ear	Test weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
Control	32.55	34.55	3310	5310	38.40
50% FYM	35.24	37.24	3750	5880	38.94
50% FYM + 50% vermicompost	36.12	38.12	3895	5900	39.77
75% FYM + 25% vermicompost	37.42	38.42	3965	6100	39.39
25% FYM + 75% vermicompost	38.72	39.72	4490	6785	39.82
50% FYM + 50% vermicompost + panchgavya spray	39.64	40.64	4720	7365	39.06
75% FYM + 25% vermicompost + panchgavya spray	38.83	40.42	4575	7105	39.17
25% FYM + 75% vermicompost + panchgavya spray	41.7	41.12	4920	7430	39.84
100% FYM + panchgavya spray	42.62	41.33	5110	7690	39.92
100% vermicompost + panchgavya spray	43.25	41.72	5225	7850	39.96
S.Em.±	0.74	0.74	138.56	136.15	0.54
CD (P=0.05)	2.22	2.22	415.5	408.45	NS

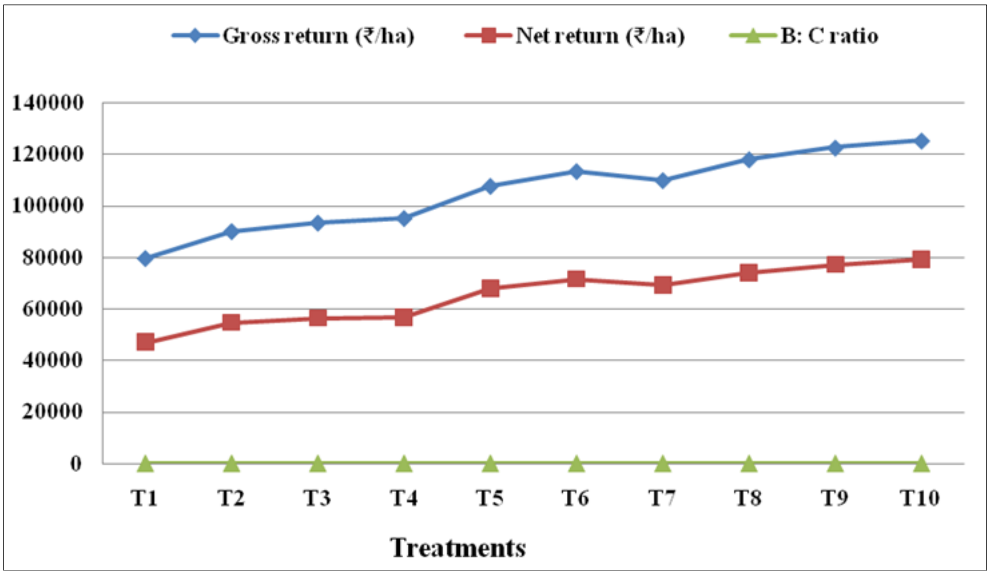

Fig 1: Effect of organic sources of nutrients on economics of wheat

Conclusion

On the basis one year study, it is inferred that higher grain yield (5225 kg/ha) and net returns (₹79313/ha) was observed under 100% vermicompost + panchgavya spray and benefit cost ratio was recorded the significantly higher (1.72) as compared to other organic sources and found statistically at par with 100% FYM + panchgavya spray, and 25% FYM + 75% vermicompost + panchgavya spray.

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