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Influence of Various Methods of Sowing and Organic Manures on the Productivity of Wheat (*Triticum aestivum* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The study was conducted at the certified organic experimental farm of SHUATS Model of Organic Farm (SMOF) at NAI, Prayagraj, in the winter rabi season of 2020-21. The primary objective was to scrutinize the nuanced impact of diverse sowing methods and organic manures on the yield attributes of wheat (*Triticum aestivum* L.). This comprehensive investigation consisted of nine treatments, each replicated three times and arranged in a randomized block design. Noteworthy findings emerged, revealing that Row sowing coupled with Poultry manure (5 t/ha), Panchagavya 3% FS, and Jeevamrut 500 l/ha FS resulted in the tallest plant height (78.30 cm). Moreover, the optimal combination of SWI with Poultry manure (5 t/ha), Panchagavya 3% FS, and Jeevamrut 500 l/ha FS exhibited the highest number of tillers per plant (10.53) and the maximum dry weight per plant (18.00 g/plant). Better yield performance, however, was achieved by Row sowing in

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conjunction with Poultry manure (5 t/ha), Panchagavya 3% FS, and Jeevamrut 500 l/ha FS, where it not only showcased the highest grain yield (3.16 t/ha) and straw yield (4.48 t/ha) but also demonstrated superiority in gross return (Rs. 1,44,000.00/ha), net returns (Rs. 95,940.00/ha), and an impressive benefit-cost ratio of 1.99. These outcomes underscore the paramount importance of precision in agricultural practices for achieving enhanced productivity and economic viability.

Keywords: Organic; manures; sowing methods; economics.

1. INTRODUCTION

Wheat ranks second in cereal production in the world and is the most widely grown food crop (Meena and Singh, 2013). Wheat has become India's second largest-grown crop and staple food after rice. Which ranks first both in acreage and production (758.3 million tonnes) among the grain crops of the world [1]. After the green revolution, chemical fertilizers increased crop production and productivity, but the long-term supply of organic fertilizers without adding organic fertilizers affects soil health and leads to deficiencies of critical soil micronutrients. in improving the quality and quantity of agricultural production. In the future, excessive use of inorganic fertilizers will leave residues on crops, fruits, and vegetables and cause human and animal health problems. Overcome food shortages and help nature instead of destroying it. The use of chemicals over crop requirements threatens human health and causes inequality in natural resources (Mitilesh and Ibrahim, 2017). The use of organic fertilizers promises to overcome secondary and micronutrient deficiencies and reduce productivity by increasing beneficial effects on soil's physical and biological properties [2]. Planting techniques are very important in agronomic practice because proper crop management in the field not only ensures an optimal plant population but also allows the plant to use land and other input resources more efficiently. System of Wheat Intensification (SWI) is another method of cultivation based on the principle of System of Rice Intensification (SRI). This is a new method of wheat cultivation that requires plants to plant at a distance of 22.5 cm to 22.5 cm and has a high potential to provide wheat yield for one drop of water and wheat agriculture income and other uses. [3]. The role of leafy seed imbibition or panchagavya in the production of many cultivated crops is well established in India. These organic formulations contain trace elements found in liquid fertilizers and several plant growth regulators (eg, auxins, gibberellins, and cytokinins) [4,5]. In doing so, the effects of different tillage practices and organic fertilizers on the growth and yield of wheat were investigated and the economics of different treatment combinations of Capsicum was investigated.

2. MATERIALS AND METHODS

The experiment was conducted during Rabi season 2020-21 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). SMOF is located at 25 degrees 39'42" N, 81 degrees 67'56" E, and 98 m altitude during Rabi 2020 season on sandy loam soil. SMOF was developed under the National Project of Organic Farming (NPOF) by the Department of Agronomy, an area of two hectares was certified by Lacon Quality Certification (Pvt.) Ltd. to be almost neutral in soil reaction (pH 7.0), organic carbon (0.375%), available nitrogen (168.75 kg/ha), available phosphorus (17.4 kg/ha), and available potassium (231.7 kg/ha). “The climate of the region is semi-arid subtropical. Treatment combination T_1- Broadcasting + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS, T_2- Row sowing + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS, T_3- SWI + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS, T_4- Broadcasting + Poultry manure (5 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS, T_5- Row sowing + Poultry manure (5 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS, T_6- SWI + Poultry manure (5 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS, T_7- Broadcasting + Vermicompost (4 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS, T_8- Row sowing + Vermicompost (4 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha Were used FS, T_9- SWI + Vermicompost + Panchagavya 3% FS + Jeevamrut 500 l/ha FS, or Nine treatments were replicated three times in a randomized block design”. [11] Data regarding growth parameters i.e. plant height (cm), number of tillers/plant, dry weight (g), yield, and economy were recorded by standard observation process. Data were statically analyzed using analysis of variance (ANOVA) as used in the Randomized Block Design (RBD) of Gomez and Gomez, 1984.

3. RESULTS AND DISCUSSION

3.1 Effect on Growth Parameters

It is observed from Table 1, that the plant height increased with crop growth duration. At 20DAS T_5 recorded a maximum plant height of (3.08 cm), whereas T_5 recorded a maximum plant height in the rest of the growth stages *i.e*., at 40, 60, 80 DAS, and harvest of 9.87, 54.99, 77.20, and 78.30 cm respectively. At 40, 60, 80DAS and at harvest T_2 - Row sowing + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS and T_8 - Row sowing + Vermicompost (4 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS was found statistically at par to T_5 - Row sowing + Poultry manure (5 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS. The broadcast method resulted in the shortest plants compared to those recorded in the SWI and Row planting treatments. Planting with a high plant density facilitates adequate air, moisture, sunlight, and nutrient supply, which leads to the development of a proper root system from the early harvest [6]. Data regarding the number of tillers/plants was recorded at all growth intervals *i.e*., 40, 60, 80, and at harvest (Table 2) treatment T_6 *i.e*. SWI + Poultry manure (5 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS recorded maximum no. of tillers per plant 3.86, 8.56, 10.66 and 10.53, respectively. However, T_3 - SWI + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS and T_9 - SWI + Vermicompost (4 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS was found statistically at par to T_6 - SWI + Poultry manure (5 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS at 60, 80 and at harvest. Several tillers were influenced significantly by different spacing and planting methods. SWI technique decreases the competition between the plants for light, water, space, and nutrients hence there is an increased number of tillers (Zeng *et al*., 2013). Table 3. Data about dry weight/plant was recorded and shown in Table 3. "Significantly maximum dry weight/plant at 20, 40, 60, 80, and harvest were noticed at 0.14, 1.83, 8.27, 13.18 and 18.00 g/plant, respectively with treatment T_6, *i.e*. SWI + Poultry manure (5 t/ha) + Panchagavya 3% FS +Jeevamrut 500 l/ha. At 20DAS, T_9 - SWI + Vermicompost (4 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS, T_5 - Row sowing + Poultry manure (5 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS and T_2 - Row sowing + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS at 60 and 80DAS T_2 - Row sowing + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS and at harvest T_3 - SWI + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS, T_9 - SWI + Vermicompost (4 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS, T_2 - Row sowing + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS and T_1 - Broadcasting + FYM (12 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha was found statistically at par to T_6 - SWI + Poultry manure (5 t/ha) + Panchagavya 3% FS + Jeevamrut 500 l/ha FS" [11]. Similar results were found by [7] "the cause of the rapid increase of Dry weight at crop harvest or ripening stage was possibly due to the emergence of several new tillers per plant and more fertile spike per plant".

3.2 Yield

Data related to grain and straw yield were evaluated and tabulated in Table 4. "Maximum Grain yield (3.16 t/ha) and Straw yield (4.48 t/ha) were influenced significantly with the application of treatment T_5 - Row sowing + Poultry manure (5 t/ha) + Panchagavya 3% + Jeevamrut 500 l/ha which superior over all the treatments except with the application of treatment T_2 - Row sowing + FYM (12 t/ha) + Panchagavya 3% + Jeevamrut 500 l/ha in both parameters grain yield (2.99 t/ha) and straw yield (4.31 t/ha) were followed similar trend. Similar findings were reported in the higher yield may be because these organic manures supply direct available nutrients such as nitrogen to the plants and these organic manures improve the portion of water holding stable aggregates of the soil" [8].

3.3 Economics

As shown in Table 4. organic sources of nutrients increased economic stability and returns, the cost of cultivation of wsheat crop recorded numerically higher (₹ 64,235.00/ha) value for the treatment of application of SWI + Vermicompost (4 t/ha) + Panchagavya 3% + Jeevamrut 500 l/ha and numerically minimum cost of cultivation was recorded with application of SWI + Poultry manure (5 t/ha) + Panchagavya 3% + Jeevamrut 500 l/ha (₹ 46,835.00/ha). Numerically highest gross return (₹1,44,000.00/ha), net return (₹ 95,940.00/ha), and B: C ratio (1.99) were obtained with the application of Row sowing + Poultry manure (5 t/ha) + Panchagavya 3% + Jeevamrut 500 l/ha among all the treatments [9-11].

Table 1. Effect of methods of sowing and organic manures on plant height (cm) of wheat

Treatments	Plant height (cm)				
	20 DAS	40 DAS	60 DAS	80 DAS	At harvest
Broadcasting + FYM 12 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.54	7.58	48.76	70.33	72.57
Row sowing + FYM 12 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.92	9.75	54.61	76.93	77.80
SWI + FYM 12 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.72	8.83	51.27	71.23	72.90
Broadcasting + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.16	7.23	49.82	72.60	74.43
Row sowing + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	3.08	9.87	54.99	77.20	78.30
SWI + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.65	8.65	51.13	72.34	73.70
Broadcasting + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.33	7.18	46.52	68.70	70.26
Row sowing + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.82	8.73	52.35	75.23	76.76
SWI + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.46	8.23	49.74	69.63	71.93
SEm (±)	0.18	0.46	1.17	1.29	1.24
CD (5%)	-	1.37	3.50	3.85	3.68

Table 2. Effect of methods of sowing and organic manures on no. of tillers per plant of wheat

Treatments	No. of tillers per plant			
	40 DAS	60 DAS	80 DAS	At harvest
Broadcasting + FYM 12 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.53	4.70	5.54	5.43
Row sowing + FYM 12 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	3.00	5.80	7.50	7.41
SWI + FYM 12 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	3.80	8.43	10.40	10.26
Broadcasting + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.43	5.53	5.94	5.70
Row sowing + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	3.13	5.90	7.61	7.47
SWI + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	3.86	8.56	10.66	10.53
Broadcasting + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.20	5.06	5.80	5.58
Row sowing + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.66	5.66	7.34	7.23
SWI + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	3.70	8.16	10.34	10.23
SEm (±)	0.20	0.13	0.21	0.13
CD (5%)	0.63	0.41	0.64	0.41

Table 3. Effect of methods of sowing and organic manures on dry weight (g/plant) of wheat

Treatments	Dry weight (g/plant)				
	20 DAS	40 DAS	60 DAS	80 DAS	At harvest
Broadcasting + FYM 12 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	0.08	1.41	5.92	11.03	16.94
Row sowing + FYM 12 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	0.10	1.53	6.54	11.90	17.01
SWI + FYM 12 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	0.09	1.69	7.75	12.57	17.59
Broadcasting + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	0.07	1.36	5.62	10.92	16.04
Row sowing + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	0.11	1.59	7.04	11.69	16.71
SWI + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	0.14	1.83	8.27	13.18	18.00
Broadcasting + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	0.06	1.24	4.87	10.30	15.14
Row sowing + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	0.08	1.45	6.34	11.03	16.02
SWI + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	0.12	1.63	7.39	11.77	17.05
SEm (±)	0.01	0.04	0.26	0.37	0.35
CD (5%)	0.04	0.11	0.77	1.10	1.05

Table 4. Yield and economics of wheat by different methods of sowing and organic manures

Treatment	Grain yield (t/ha)	Straw yield (t/ha)	Cost of cultivation (INR ha^{-1})	Gross returns (INR ha^{-1})	Net returns (INR ha^{-1})	B: C Ratio
Broadcasting + FYM 12 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.28	3.55	52,235.00	1,03,500.00	51,265.00	0.98
Row sowing + FYM 12 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.99	4.31	52,060.00	1,35,000.00	82,940.00	1.59
SWI + FYM 12 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.75	3.95	50,835.00	1,26,000.00	75,165.00	1.47
Broadcasting + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.2	3.44	48,235.00	99,000.00	50,765.00	1.05
Row sowing + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	3.16	4.48	48,060.00	1,44,000.00	95,940.00	1.99
SWI + Poultry manure 5 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.66	3.92	46,835.00	1,21,500.00	74,665.00	1.59
Broadcasting + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.12	3.37	64,235.00	94,500.00	30,265.00	0.47
Row sowing + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.51	3.78	64,060.00	1,12.500.00	48,440.00	0.75
SWI + Vermicompost 4 t/ha + Panchagavya 3% + Jeevamrut 500 L/ha	2.37	3.63	62,835.00	1,08,000.00	45,165.00	0.71
SEm (±)	0.05	0.05				
CD (5%)	0.17	0.17				

4. CONCLUSION

In summary, the findings of this study significantly demonstrate that the optimal combination for achieving maximum grain yield (3.16 t/ha), net returns (Rs 95,940.00/ha), and a commendable benefit-cost ratio (1.99) involves the strategic implementation of Row sowing in conjunction with PM (5 t/ha), Panchagavya at 3%, and Jeevamrut at 500 l/ha. This superior performance sets this specific treatment apart from all other interventions examined in the study. These results not only contribute valuable insights into agricultural practices but also emphasize the significance of precision in cultivation methodologies for enhanced productivity and economic returns.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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