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Effect of Natural Farming on Wheat Productivity and Physico-chemical and Biological Properties of a Vertisol of Vidisha District of Madhya Pradesh

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ABSTRACT

The experiment was conducted during the month of October in the Rabi season of 2023–24 at the Research Field of the College of Agriculture, Ganj Basoda, District Vidisha, Madhya Pradesh, India to evaluate the effect of natural farming on the productivity of wheat and soil health. The experiment was laid out in a Randomized Block Design (RBD) with eight treatments (organic inputs) and three replications. The treatments included T_1 (Control), T_2 (Ghanjeevamrit @ 5 q ha^{-1} before sowing), T_3 (Jeevamrit @ 20% foliar application at 21-day intervals), T_4 (Mulching @ 10 t ha^{-1}), T_5 (Ghanjeevamrit+Jeevamrit), T_6 (Ghanjeevamrit+Mulching), T_7 (Jeevamrit+Mulching), and T_8 (Ghanjeevamrit+Jeevamrit+Mulching). The highest grain and straw yields of wheat were recorded under Ghanjeevamrit+Jeevamrit+Mulching treatment, whereas the lowest grain and straw was observed in the Control plot. Similarly, yield attributes such as number of grains per spike and test weight were the highest under Ghanjeevamrit+Jeevamrit+Mulching, indicating improved crop performance with integrated natural farming inputs. It was also observed that treatment Ghanjeevamrit+Jeevamrit+Mulching resulted in the highest microbial count and dehydrogenase enzyme activity, suggesting an enhancement for soil biological health. These findings suggest that the combined application of Ghanjeevamrit, Jeevamrit, and Mulching can enhance both crop yield and soil health, making it a promising strategy for sustainable crop production.

KEYWORDS: Natural farming, wheat productivity, enzymatic activities, soil health, Vertisol

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1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important cereal crops worldwide and serves as a staple food for nearly 40% of the global population. However, the rapidly increasing demand for wheat due to population growth in India and across the world has intensified reliance on chemical fertilizers, particularly nitrogen, phosphorus, and potassium, following the Green Revolution. Although these inputs enhanced productivity, their prolonged and excessive use has negatively impacted soil health by reducing organic carbon, increasing salinity, and altering soil pH (Dwivedi et al., 2019, Patidar et al., 2021, and Sharma et al., 2021). As a sustainable alternative, the text discusses the growing use of fermented liquid organic products such as Panchagavya, Jeevamrit, Beejamrit, Ghanjeevamrit (Kulkarni et al., 2019), and Vermiwash, which have gained attention as sustainable alternatives for improving soil fertility and crop productivity (Palekar, 2006). These preparations are rich in macro- and micronutrients, beneficial microorganisms, vitamins, amino acids, and plant growth-promoting substances such as indole acetic acid (IAA) and gibberellic acid (GA). Soil biological properties are key indicators of soil health, and fertile soils are characterized by diverse populations of bacteria, fungi, and actinomycetes that enhance nutrient cycling through enzyme activity (Saharan et al., 2023, and Tekam et al., 2024). Indigenous cow dung-and cow urine-based formulations have been reported to significantly improve soil microbial populations, enzyme activities, and antagonistic microorganisms that suppress plant pathogens. The effectiveness of these natural farming practices is cited by Sreenivasa et al. (2009) and Khadse et al. (2019). They found that indigenous formulations like cow dung and urine-based products positively impact soil biological properties. The cow-based products improve soil properties and increase beneficial microbial populations, which act as antagonists against plant pathogens (Patel et al., 2013). Natural farming, including organic agricultural practices, offers a holistic and sustainable management approach aimed at improving soil health, enhancing ecosystem balance (Devarinti et al., 2016), and reducing dependence on market-based chemical inputs (Gupta et al., 2021, Chunchu et al., 2021, and Choudhary et al., 2022). This approach emphasizes the efficient use of on-farm resources and the stimulation of natural biological processes to sustain crop productivity (Kumar et al., 2022, and Verma et al., 2024). In wheat cultivation during the rabi season, natural farming primarily relies on four key components: Ghanjeevamrit, Jeevamrit, Beejamrit, and mulching (Al-Amin et al., 2017). These inputs collectively contribute to improved soil fertility, biological activity, and nutrient availability. Ghanjeevamrit, prepared from indigenous cow dung and urine along with besan, jaggery, and native soil, enriches the soil with diverse microbial consortia that enhance nutrient mineralization and organic matter decomposition. Jeevamrit, a liquid organic formulation, plays a vital role in regulating soil pH, supplying essential micronutrients, and increasing the population of beneficial microorganisms, including nitrogen-fixing, phosphorus-solubilizing, and potash-solubilizing bacteria, thereby improving nutrient use efficiency and crop growth (Meshram et al., 2018; Yaduwanshi et al., 2021; Thakur et al., 2025). Beejamrit is mainly used as a seed treatment to protect seedlings from soil-borne pathogens and to promote early root development. Natural farming practices prioritize minimal external inputs and focus on strengthening soil ecosystems through the activity of beneficial microorganisms, earthworms, and natural nutrient cycling processes (Das et al., 2023, Patel et al., 2018, and Sarvade et al., 2025). Therefore, recognizing the environmental and economic benefits of natural farming, states such as Himachal Pradesh and Andhra Pradesh have set targets to transition toward fully natural agricultural systems by 2022 and 2027, respectively (Khurana and Kumar, 2020). In view of these considerations, the present study was undertaken to evaluate the impact of natural farming practices on wheat productivity and soil health in a vertisol.

2. MATERIALS AND METHODS

The study was conducted during the month of October in the Rabi season of 2023–24 at the Research Field of the College of Agriculture, Ganj Basoda (23.85°N 77.95°E), Vidisha District, Madhya Pradesh, to assess the effect of natural farming on the productivity of wheat and soil health. The average minimum temperature in January ranges from 19.0°C to 24.1°C, the average maximum temperature in April varies between 37.8°C and 39.7°C. The average yearly seasonal rainfall in this area is 139 mm, mostly falling between June and September. The average relative humidity was between 20 to 92% in the mornings and 25 to 96% in the evenings. The present experiment consisted of eight treatments, *i.e.*, T_1 (Control), T_2 (Ghanjeevamrit @ 5 q ha^{-1} before sowing), T_3 (Jeevamrit @ 20% foliar application at 21-day intervals), T_4 (Mulching @10 t ha^{-1}), T_5 (Ghanjeevamrit+Jeevamrit), T_6 (Ghanjeevamrit+Mulching), T_7 (Jeevamrit+Mulching), and T_8 (Ghanjeevamrit+Jeevamrit+Mulching), which was laid out in Randomized Block Design (RBD) with three replications.

The soil of the experimental site was classified as sandy clay loam, with a pH of 7.48, EC 0.17 dS m^{-1}, organic carbon 4.0 g kg^{-1}, available nitrogen 202 kg ha^{-1}, phosphorus 17.6 kg ha$^{-1,}$ and potassium 281 kg ha^{-1}. Wheat crop variety HI-1544 was grown in the research field, and the growing period of this variety is 115–120 days. The different growth parameters, such as plant height, number of tillers, and dry matter accumulation, were recorded at 30, 60, 90 DAS, and harvest. The yield attributes of the crop were evaluated at harvest to assess the influence of different treatments on productivity. The number of grains spike^{-1} was determined by counting the spikes from five randomly selected plants in each plot, and their mean value was recorded. The seed test weight was determined by weighing 1000 randomly selected, clean, and winnowed seeds from each plot, and the values were expressed in grams. Following threshing, the cleaned produce from each plot was weighed to determine the grain yield, which was then converted to kilograms per hectare. The straw yield was calculated by subtracting the grain yield from the total biological yield.

For the soil analysis, the composite samples were haphazardly collected from 0–15 cm soil depth at initial and treatment wise with after harvest of the crop. These samples were air-dried, crushed, and sieved through a 2 mm sieve. The soil pH was measured using a pH meter with a glass electrode in a 1:2 soil: water suspension (Jackson, 1973). The same suspension's supernatant solution was used to determine the electrical conductivity (EC) with an EC meter (Jackson, 1973). Soil organic carbon was determined using the rapid titration method developed by Walkley and Black (1934). Available N (Subbiah and Asija, 1956), available P (Olsen et al., 1954), and available K (Muhr et al., 1965) were determined. Total microbial population count (bacteria, fungi, and actinomycetes) by serial dilution/pour plate method (Xu and Zheng, 1986). The dehydrogenase activity was measured according to Burns (1978) instructions. The generated data on growth attributes, yield attributes, and crop yield, physico-chemical and biological properties of soil were statistically analyzed to draw inferences by the standard procedure outlined by Panse and Sukhatme (1970).

3. RESULTS AND DISCUSSION

3.1. *Effect of natural farming on growth attributes*

3.1.1. *Plant height*

The study on wheat plant height (Table 1) at different growth stages (30, 60, 90 DAS, and at harvest) revealed that the treatment comprising Ghanjeevamrit @ 5 q ha^{-1} before sowing+Jeevamrit @ 20% (foliar application at 21-day intervals)+Mulching @ 10 t ha^{-1} (T_8) recorded the maximum plant height across all stages. The enhanced growth might be attributed to the foliar application of nutrient-rich Jeevamrit containing growth hormones, biofertilizers, and essential macro-and micronutrients in liquid form, which likely stimulated metabolic activity and cell elongation. These results indicate that the integrated application of Ghanjeevamrit, Jeevamrit, and mulching plays a significant role in promoting wheat growth. Similar observations were reported by Chaudhary et al. (2022), who observed increased plant height under the combined application of Ghanjeevamrit, Jeevamrit, and mulching. Likewise, Sutar et al. (2018) recorded significantly higher plant height in field bean with the application of Jeevamrit. Furthermore, Singh et al. (2023) reported that wheat plant height was significantly influenced by different nutrient management practices at 120 DAS.

3.1.2. *Total number of tillers*

The results of the study revealed that the combined application of organic treatments significantly increased the number of tillers per square meter in wheat compared

Table 1: Effect of natural farming on growth and yield attributes of wheat crop

Treatment	Plant height (cm)				Tillers (m^{-2})			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T_1: Control	11.2	40.3	62.1	63.2	50.4	101.3	120.2	114.5
T_2: Ghanjeevamrit @ 5 q ha^{-1}	12.0	46.3	64.6	65.0	56.6	109.8	127.1	121.5
T_3: Jeevamrit @ 20%	11.5	46.1	66.3	67.6	59.9	118.9	132.4	123.1
T_4: Mulching 10 t ha^{-1}	11.6	53.3	65.3	65.9	60.8	117.6	136.4	127.9
T_5: Ghanjeevamrit @ 5 q ha^{-1}+Jeevamrit @ 20%	12.4	66.0	68.6	69.8	68.1	131.1	150.2	143.2
T_6: Ghanjeevamrit @ 5 q ha^{-1}+Mulching	12.2	63.0	67.2	68.6	64.4	120.6	139.7	131.1
T_7: Jeevamrit @ 20%+Mulching	11.9	52.6	67.6	68.2	65.9	124.9	144.5	138.4
T_8: Ghanjeevamrit @ 5 q ha^{-1}+Jeevamrit @ 20%+Mulching	12.8	69.0	71.3	72.1	71.0	134.4	154.7	151.0
SEm±	0.10	1.02	1.61	1.17	0.95	1.41	2.44	2.89
CD (p=0.05)	0.31	3.03	4.89	3.35	2.9	4.3	7.41	8.77

Table 1: Continue...

Treatment	Dry matter accumulation (g m^{-2})				No. of grains per spike^{-1}	Test weight (g)
	30 DAS	60 DAS	90 DAS	At harvest		
T_1: Control	21.0	40.2	104.0	110.1	37.05	35.15
T_2: Ghanjeevamrit @ 5 q ha^{-1}	27.4	48.5	113.4	116.0	38.93	37.63
T_3: Jeevamrit @ 20%	25.5	55.2	121.5	128.5	39.34	37.09
T_4: Mulching 10 t ha^{-1}	30.2	51.7	116.7	120.1	37.30	37.29
T_5: Ghanjeevamrit @ 5 q ha^{-1}+Jeevamrit @ 20%	32.4	63.0	124.2	133.4	40.27	39.97
T_6: Ghanjeevamrit @ 5 q ha^{-1}+Mulching	34.6	67.8	137.2	145.2	39.60	38.63
T_7: Jeevamrit @ 20%+Mulching	30.9	59.1	122.2	131.0	39.93	39.17
T_8: Ghanjeevamrit @ 5 q ha^{-1}+Jeevamrit @ 20%+Mulching	38.4	74.4	144.8	152.1	41.58	41.56
SEm±	0.47	0.85	2.11	1.72	0.95	35.15
CD (p=0.05)	1.41	2.57	6.39	5.29	NS	37.63

to the control and single-component treatments (Table 1). The highest tiller count (146 tillers at harvest) was observed in the treatment comprising Ghanjeevamrit @ 5 q ha^{-1} before sowing+Jeevamrit @ 20% foliar spray at 21-day intervals+Mulching @ 10 t ha^{-1} (T_8), followed by Ghanjeevamrit @ 5 q ha^{-1} before sowing+Jeevamrit @ 20% foliar spray (T_5) and Ghanjeevamrit @ 5 q ha^{-1} before sowing+Mulching @ 10 t ha^{-1} (T_6), which also exhibited notable improvements in tiller production. The superior performance of these combinations may be attributed to the synergistic effects of organic inputs, where Ghanjeevamrit and Jeevamrit enhance soil microbial activity and nutrient availability, while mulching conserves soil moisture, minimizes temperature fluctuations, and suppresses weed growth-creating favourable conditions for tiller development. Similar observations were reported by Chaudhary et al. (2022), and Singh et al. (2023) revealed that the number of effective tillers in wheat was significantly higher under inorganic nutrient management, which remained statistically at par with the natural farming nutrient management treatment comprising Beejamrit+ Jeevamrit+mulching.

3.1.3. Dry matter accumulation

The data presented in Table 1 on dry matter accumulation in wheat at different growth stages (30, 60, 90 DAS, and at harvest) indicated that the combined treatment of Ghanjeevamrit @ 5 q ha^{-1} before sowing+Jeevamrit @ 20% (foliar application at 21-day intervals)+Mulching @ 10 t ha^{-1} (T_8) recorded the maximum dry matter accumulation, achieving 148.8 g m^{-2} at harvest, which was significantly higher than the control (T_1) that accumulated 104 g m^{-2}. The superior performance of T_8 can be attributed to the integrated effect of organic amendments and mulching, which likely improved nutrient availability, soil moisture conservation, and microbial activity, thereby promoting enhanced vegetative growth and biomass production. These results are in close agreement with the findings of Chaudhary et al. (2022), who reported that organic amendments such as Jeevamrit and Panchgavya significantly improved plant growth and dry matter accumulation. Similarly, Somdutt et al. (2023) reported that the application of FYM+vermicompost (50% each) along with Jeevamrut applied twice (at 30 and 45 DAS) significantly increased dry matter accumulation (36.71 g) in soybean at Rahuri, Maharashtra.

3.2. Effect of natural farming on yield attributes and yield of wheat crop

3.2.1. Grains spike^{-1}

The treatment Ghanjeevamrit @ 5 q ha^{-1} before sowing+Jeevamrit @ 20% (foliar application at 21-day intervals)+Mulching @ 10 t ha^{-1} (T_8) recorded the maximum number of grains spike^{-1} (41.56), which was significantly superior to all other treatments (Table 1). The lowest grain number per spike (35.15 grains spike^{-1}) was observed in the control (T_1). The combined application of Ghanjeevamrit, Jeevamrit, and mulching exhibited a synergistic effect on enhancing the yield attributes of wheat. This integrated treatment likely optimized nutrient availability, improved soil structure, and stimulated microbial activity, collectively contributing to improved grain development and overall productivity. The superior performance of this combination can be ascribed to its holistic approach in maintaining soil fertility, balanced nutrient supply, and favourable rhizosphere conditions, which are essential for achieving higher grain yields (Sutar et al., 2018, Chaudhary et al., 2022 and Reveena et al., 2025). Similar results were reported by Singh et al. (2023), who observed that integrated nutrient management practices resulted in a higher number of grains per spike in wheat compared with the natural farming nutrient management treatment comprising Beejamrit + Jeevamrit+mulching.

3.2.2. Test weight of wheat

The results on test weight (1000 grain) are presented in Table 1 and indicate that different natural farming treatments did not have a significant effect. The highest test weight (41.8 g) was recorded under Ghanjeevamrit @ 5 q ha^{-1} before sowing+Jeevamrit @ 20% foliar spray at 21-day intervals+Mulching @ 10 t ha^{-1} (T_8), while the lowest was observed in the control (T_1, 37.05 g). However, no statistically significant differences were detected among treatments, suggesting that this combination did not notably enhance test weight compared to the control or individual treatments. This combination appears to create a mutually beneficial effect that improves soil fertility, enhances nutrient availability, and promotes better grain filling. The superior performance of the combination treatment compared to individual treatments and the control suggests that integrating multiple organic farming practices can lead to more substantial improvements in crop yield attributes. Similarly, Patel et al. (2021) reported a significantly higher test weight in summer pearl millet with the application of 75% RDN along with foliar sprays of Panchagavya @ 4% and Jeevamrut @ 500 l ha^{-1}, applied with irrigation at 30 and 45 DAS. Furthermore, Reveena et al. (2025) reported that maize intercropped with lobia or soybean, along with the application of Jeevamrut at 14-day intervals, proved to be the most effective treatment for enhancing test weight and other yield attributes.

3.2.3. Grain and straw yields of wheat

The grain and straw yields of wheat as influenced by different treatments are depicted in Table 2. The highest grain and straw yields (2535 and 3575 kg ha^{-1}, respectively) were recorded under Ghanjeevamrit @ 5 q ha^{-1} before sowing+Jeevamrit @ 20% foliar application at 21-day intervals+Mulching @ 10 t ha^{-1} (T_8), which was significantly higher than the control (1873 and 2987 kg ha^{-1}, respectively). These results suggest that a synergistic effect might be due to these organic treatments, potentially enhancing nutrient availability, water retention, and overall plant health throughout the growth cycle of wheat. The treatments that were statistically comparable in yield performance. Comparable results were documented by Chaudhary et al. (2022), who reported that the combined application of Ghanjeevamrit, Jeevamrit, and mulching significantly enhanced wheat grain yield over two consecutive years compared with the absolute control, a trend also supported by Tekam et al. (2024) and Verma et al. (2024). Likewise, Patel et al. (2021) observed significantly higher grain and straw yields in summer pearl millet with the application of

Table 2: Effect of natural farming on grain and straw yields of wheat

Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1: Control	1873	2986
T_2: Ghanjeevamrit @ 5 q ha^{-1}	2131	3238
T_3: Jeevamrit @ 20%	2154	3271
T_4: Mulching 10 t ha^{-1}	2089	3177
T_5: Ghanjeevamrit @ 5 q ha^{-1} +Jeevamrit @ 20%	2382	3573
T_6: Ghanjeevamrit @ 5 q ha^{-1} +Mulching	2268	3331
T_7: Jeevamrit @ 20%+Mulching	2378	3339
T_8: Ghanjeevamrit @ 5 q ha^{-1}+ Jeevamrit @ 20%+Mulching	2535	3575
SEm±	37.7	78.8
CD (p=0.05)	114.5	239.2

75% RDN along with foliar sprays of Panchagavya @ 4% and Jeevamrut @ 500 l ha^{-1}, applied with irrigation at 30 and 45 DAS.

3.3. Effect of natural farming on soil health

3.3.1. Physico-chemical properties of soil

The data of physico-chemical properties of soil under different natural farming treatments are presented in Table 3, and the results indicated that the soil pH and EC did not vary significantly across treatments, although slight improvements were observed compared to the initial values. In contrast, organic carbon content showed enhancement, with the highest value (0.47%) recorded under the combined treatment of Ghanjeevamrit @ 5 q ha^{-1} before sowing+ Jeevamrit+Mulching @ 10 t ha^{-1} (T_8), which was greater than the control (T_1, 0.40%). Treatments such as T_2 (Ghanjeevamrit, 0.42%), T_3 (Jeevamrit foliar spray, 0.43%), and T_4 (Mulching, 0.44%) also improved OC levels. Similarly, combined treatments T_5 (Ghanjeevamrit+Jeevamrit, 0.44%), T_6 (Ghanjeevamrit+Mulching, 0.46%), and T_7 (Jeevamrit+Mulching, 0.46%) demonstrated enhanced organic carbon, highlighting the effectiveness of integrated natural farming practices in improving soil organic matter (Parihar et al., 2010; Sharma et al., 2021; Pathariya et al., 2022; Saharan et al., 2023; and Tiwari et al., 2024).

The results further revealed that the different natural farming treatments did not significantly affect the levels of available nitrogen, phosphorus, or potassium, although slight improvements were observed under certain treatments. The highest nutrient levels were recorded under

Table 3: Effect of natural farming on soil available nutrients (NPK) after harvest of crop

Treatment	Soil pH	EC (dS m^{-1})	Organic carbon (g kg^{-1})	Available nutrients (kg ha^{-1})		
				N	P	K
T_1: Control	7.61	0.17	0.40	175	14.1	219
T_2: Ghanjeevamrit @ 5 q ha^{-1}	7.63	0.20	0.42	182	17.3	248
T_3: Jeevamrit @ 20%	7.65	0.21	0.43	183	17.7	253
T_4: Mulching 10 t ha^{-1}	7.63	0.21	0.44	181	15.4	241
T_5: Ghanjeevamrit @ 5 q ha^{-1}+Jeevamrit @ 20%	7.64	0.22	0.44	188	20.2	271
T_6: Ghanjeevamrit @ 5 q ha^{-1}+Mulching	7.6	0.21	0.46	186	16.8	259
T_7: Jeevamrit @ 20%+Mulching	7.67	0.22	0.46	187	17.9	255
T_8: Ghanjeevamrit @ 5 q ha^{-1}+Jeevamrit @ 20%+Mulching	7.63	0.23	0.47	191	21.6	277
SEm±	0.02	0.04	0.03	12.11	2.29	14.17
CD (*p*=0.05)	NS	NS	NS	NS	NS	NS

T_1 (Ghanjeevamrit @ 5 q ha^{-1} before sowing+Jeevamrit @ 20% foliar application at 21-day intervals+Mulching @ 10 t ha^{-1}), suggesting that some nutrients remained in the soil post-harvest, likely due to enhanced nutrient retention and microbial activity. Treatments such as Ghanjeevamrit alone (T_2), Jeevamrit alone (T_3), and Mulching alone (T_4) also showed improved nutrient availability compared to the control, though differences among them were not statistically significant. Overall, the soil under study was low in nitrogen and phosphorus but high in potassium, and the findings are consistent with previous data showing that organic amendments, either individually or in combination, can sustain or enhance soil fertility. These results highlight that integrated organic practices in natural farming can promote long-term soil health and nutrient management (Bagde et al., 2023).

3.3.2. Biological properties of soil

The data on soil microbial counts and dehydrogenase activities of soil, as influenced by various natural farming components, are presented in Table 4. The treatment T_8 exhibited a significantly higher bacterial population, indicating that the combined application of Ghanjeevamrit, Jeevamrit, and mulching creates an optimal environment for microbial activity. This enhancement can be attributed to improved soil structure, moisture retention, and nutrient availability provided by these organic amendments, which collectively support bacterial proliferation. Treatments T_2 through T_7 also showed increased bacterial counts compared to the control, highlighting the positive influence of natural

Table 4: Effect of natural farming on biological properties (microbial count) of soil at the end of the experiment

Treatment	Bacteria (x10^6 cfu g^{-1} soil)	Fungi (x10^3 cfu g^{-1} soil)	Actinomycetes (x10^5 cfu g^{-1} soil)	Dehydrogenase activity (µg TPF g $soil^{-1}$ hr^{-1})
T_1: Control	22.3	10.6	20.0	1.55
T_2: Ghanjeevamrit @ 5 q ha^{-1}	23.6	12.3	21.6	1.68
T_3: Jeevamrit @ 20%	26.0	14.3	24.0	2.11
T_4: Mulching 10 t ha^{-1}	25.3	12.3	23.3	2.01
T_5: Ghanjeevamrit @ 5 q ha^{-1}+Jeevamrit @ 20%	29.5	14.3	25.3	3.02
T_6: Ghanjeevamrit @ 5 q ha^{-1}+Mulching	27.3	14.1	24.2	2.6
T_7: Jeevamrit @ 20%+Mulching	28.0	16.6	25.3	2.47
T_8: Ghanjeevamrit @ 5 q ha^{-1}+Jeevamrit @ 20%+Mulching	32.6	18.7	27.1	3.09
SEm±	0.94	0.58	1.03	0.04
CD (*p*=0.05)	2.86	1.77	3.13	0.13

farming practices on soil health. Similar observations were reported by Bairwa et al. (2021) in soybean fields, where the combined use of Ghanjeevamrit and other organic treatments significantly increased soil microbial populations due to enhanced nutrient availability. These results align with Chaudhary et al. (2022), who reported that the highest bacterial populations in wheat were achieved with the combined application of Ghanjeevamrit, Jeevamrit, and mulching.

The T_8 treatment also recorded the highest fungal population, significantly exceeding the control and other treatments, indicating that this combination provides favorable conditions for fungal growth. Organic amendments likely improved soil structure, moisture retention, and nutrient availability, thereby supporting fungal proliferation. Treatments T_2 to T_7 exhibited increased fungal counts relative to the control, further confirming the beneficial impact of natural farming practices on soil microbial health. These findings are consistent with the observations of Chaudhary et al. (2022), Thakur et al. (2022), and Devi et al. (2025), who reported that Jeevamrit enhanced soil fungal populations. Bharadwaj et al. (2021) similarly noted that fungal populations and soil enzymatic activity in rice paddies increased after Jeevamrit application.

The actinomycetes population data, also presented in Table 4, revealed that T_8 significantly increased counts to 27.1×10^3 cfu g^{-1} soil compared to 20.0×10^3 cfu g^{-1} in the control (T_1). This combination creates a favorable environment for actinomycetes, which play a crucial role in organic matter decomposition and nutrient cycling. Treatments involving single or partial applications also showed progressive increases in actinomycetes, indicating that each organic input positively influences soil microbial health. Comparable results were observed in studies on sesame, soybean, field beans, and wheat by Kushwaha et al. (2017), Meshram et al. (2018), Bairwa et al. (2021) and Tiwari et al. (2024) all of which highlighted that organic nutrient inputs promote microbial diversity and overall soil health.

4. CONCLUSION

The application of Ghanjeevamrit @ 5 q ha^{-1} before sowing+Jeevamrit @ 20% foliar spray at 21-day intervals+mulching @ 10 t ha^{-1} (T_8) significantly enhanced wheat growth and yield parameters, resulted in the highest grain yields, and recorded maximum values for all measured growth and yield attributes. Further, results revealed that organic carbon and available soil N, P, and K were not significantly affected by different treatments. Nevertheless, soil microbial populations were significantly increased under treatment T_8.

5. REFERENCE

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