Vegetable Science (2026) 53(1): 195-202
doi: 10.61180/vegsci.2026.v53.i1.26
ISSN- 0970-6585 (Print), ISSN- 2455-7552 (Online)
www.isvsvegsci.in

RESEARCH ARTICLE

Soil physico-chemical properties and microbial dynamics under natural farming inputs

Ujjwal Raj, Kuldeep Singh Thakur, Upender Singh, Subhash C. Verma and Manisha*

Abstract

Soil health is fundamental for sustaining agricultural productivity and maintaining ecological balance. The increasing environmental concerns associated with intensive agricultural practices have encouraged the exploration of alternative farming systems that promote soil health and ecological sustainability. Natural farming is one such approach which emphasizes the use of locally prepared biological inputs to enhance soil fertility while minimizing reliance on synthetic fertilizers. The present study was conducted during 2023 cropping season at the Subhash Palekar Natural Farming (SPNF) research farm of Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan (HP), to evaluate the effect of natural farming formulations on soil physiochemical and microbial properties. The experiment consisted of twelve treatment combinations involving three levels of *ghanjeevamrit* (0, 1.0, 1.5 t/ha) and four concentrations of *jeevamrit* spray (0, 10, 15 and 20%), arranged in a factorial randomized complete block design with three replications. Soil parameters including pH, electrical conductivity, organic carbon, available nitrogen, phosphorus, potassium and microbial populations were also analyzed. The results indicated that G_2J_2 and G_2J_3 showed relatively better performance in improving nutrient availability and microbial counts, this showed that natural farming inputs improved soil fertility and microbial activity compared to the control.

Keywords: Soil health, natural farming, soil fertility, ecological balance, sustainability.

Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan (HP), India

***Corresponding author;** Email: 9418136@gmail.com

Citation: Raj, U., Thakur, K.S., Singh, U., Verma, S.C., & Manisha. (2026). Soil physico-chemical properties and microbial dynamics under natural farming inputs. Vegetable Science, 53(1), 195-202.

Source of support: Nil

Conflict of interest: None.

Received: 03/05/2026; **Revised:** 21/06/2026; **Accepted:** 29/07/2026

Introduction

Soil is a fundamental natural resource, supporting a variety of ecosystem goods and services, thereby sustaining life on earth. Although the role of soil in crop production has long been acknowledged, broader recognition of its ecological functions- such as carbon sequestration, water purification, groundwater recharge, control over population of pathogens, biological nitrogen fixation and biodiversity conservation has emerged only in the recent past. The complexity of soil processes has led researchers to regard soil not merely as a component of ecosystems but as an ecosystem in its own (Laishram et al., 2012). However, modern input- intensive agriculture, driven by synthetic fertilizers, pesticides and extensive monocropping has substantially increased food production. This yield-oriented strategy has imposed serious environmental issues, a decline in biodiversity and weakened the essential ecosystem functions, which are necessary for sustainable agriculture (Tscharntke et al., 2021). Therefore, farmers are exploring alternative farming practices which are affordable, economical and eco-friendly.

Natural farming is an approach that emphasizes on ecological self- reliance and minimizes dependence on externally purchased farm inputs. Instead of commercial fertilizers and pesticides, farmers adopt locally prepared botanical extracts and innovative crop management practices for the natural regulation of pests and diseases. By reducing the need for costly agrochemicals, this system lowers production expenses, enhances farm profitability and contributes to improved soil health. Furthermore, most inputs required for natural farming are inexpensive and easily accessible within local communities, which further reduces financial burden on farmers (Food and Agriculture Organization, 2020). The SPNF framework is built upon four foundational components- *jeevamrit*, *beejamrit*, *wapasa* and *acchadana*. Unlike conventional farming, Natural farming does not depend on chemical or external organic fertilizers. Instead, soil nutrients become available through natural biological processes, where microbes and earthworms decompose organic matter and release nutrients in plant- available forms. This natural process supports soil biological activity, enhances agrobiodiversity, conserves water and lowers environmental impacts such as carbon and nitrogen emissions. Microbial formulations like *jeevamrit* and *beejamrit* serve as key inputs for enriching soil health. These inoculants supply beneficial microorganisms that improve soil fertility and stimulate plant growth. The system focuses on multiplying and sustaining these native microbial populations without relying on synthetic inputs.

Soil microbes play a critical role in nutrient recycling and stimulate plant growth (Sreenivasa et al., 2010). The microbial communities include beneficial bacteria, nitrogen fixers, phosphorous solubilizers, fungi and actinomycetes, which together enhance nutrient mobilization and produce plant growth- promoting substances along with essential micronutrients (Devakuamar et al., 2014). Indicators such as soil texture, bulk density, porosity, pH, electrical conductivity, soil organic carbon, macro- and micro nutrients availability and microbial biomass are widely accepted as reliable measures of soil fertility and soil health (Sharma et al., 2023). In this context, the present study focuses on acomprehensive assessment of key soil physical, chemical and biological parameters to determine soil fertility status and to understand how management practices influence overall soil quality. Such analysis provides scientific insights necessary for optimizing crop production while conserving soil resources for future generations.

Materials and Methods

The experiment was carried out during the 2023 cropping season at the SPNF research farm of Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan, HP, to evaluate the influence of natural farming inputs on soil health and microbial dynamics. The experiment consisted of two factors, namely *ghanjeevamrit* and *jeevamrit*, arranged in a factorial combination. Factor 1 included three levels of *ghanjeevamrit* applications: G_0 (no *ghanjeevamrit* application), G_1 (*ghanjeevamrit* applied at 1.0 t/ha) and G_2 (*ghanjeevamrit* applied at 1.5 t/ha). Factor 2 comprised four concentrations of *jeevamrit* spray: J_0 (no *jeevamrit* spray), J_1 (*jeevamrit* spray at 10%), J_2 (*jeevamrit* spray at 15%) and J_3 (*jeevamrit* spray at 20%). The combination of three levels of *ghanjeevamrit* and four levels of *jeevamrit* resulted in twelve treatment combinations in total. A factorial randomized complete block design with the three replications was adopted, and all plots were managed uniformly except for treatments variations. Before giving the treatments, soil samples were composited from 0 to 15 cm depth and analysed to determine initial fertility status, including soil pH, which was determined using 1:2 soil water suspension by an electrical digital pH meter (Jackson, 1973), EC which was determined by using the supernatant extract of a suspension mixture employing a conductivity meter (Jackson, 1973), organic carbon which was determined by dichromate oxidation and titration with the ferrous ammonium sulphate method of Walkley and Black (1934) and available N was determined by the alkaline potassium permanganate method of Subbiah and Asija (1956) and available P and K was determined by the method suggested by Olsen et al., 1954. Biological evaluations was performed by enumerating bacteria, fungi and actinomycetes using serial dilution plating (Subba Rao, 1999), where soil suspension were diluted, inoculated onto solid media, incubated and colony numbers calculated as cfu per gram of soil. Table 1 showed the physio-chemical and microbial analysis of soil before planting the crops. The data recorded was analysed by using MS-Excel & OPSTAT. The mean value of data was subjected to analysis of variance as described by Panse and Sukhatme (2000) for randomized complete block design (Factorial).

Results and Discussion

Soil pH

Soil pH plays a critical role in regulating nutrient availability, microbial activity and overall soil fertility, thereby influencing

Table 1: Physio- chemical properties and microbial analysis of soil before planting the crops

Parameters	*Result*
Soil pH	6.93
Soil EC (dSm^{-1})	0.21
Soil OC (%)	0.93
Available N (kg ha^{-1})	278.4
Available P (kg ha^{-1})	48.01
Available K (kg ha^{-1})	294.7
Total microbial count	
Bacteria (10^7 cfu/g of soil)	92.00
Fungi (10^2 cfu/g of soil)	7.00
Actinomycetes (10^2 cfu/g of soil)	11.00

crop growth and productivity (Barrow et al., 2023). The data recorded from present investigation revealed that individual effect of *ghanjeevamrit* on soil pH ranged from 7.00 to 7.04 and it ranged from 6.99 to 7.05 in case of *jeevamrit*. The data related to soil pH is presented in Tables 1 and 2. The highest pH value was recorded 7.11 for the treatment G_1J_0 (*Ghanjeevamrit* @ 1.0 t/ha + No *Jeevamrit*) followed by G_2J_3 (7.07). The lowest value was obtained in G_0J_0 (6.94). Most essential nutrients remain readily available within the pH range of 6.0 to 7.5. The slight increase in soil pH has been observed in some of the treatments which may be attributed to the addition of organic materials and microbial metabolites present in these formulations, which can influence soil buffering capacity and microbial activity. Poddar et al. (2017) and Nagar et al. (2016) also observed similar results in their studies.

Electrical conductivity (dS/m)

The data recorded for different treatments revealed that the individual effect of *ghanjeevamrit* on soil conductivity ranged from 0.197 to 0.220 dS/m and in case of *jeevamrit* it ranged from 0.193 to 0.214 dS/m. The highest value of EC was recorded G_1J_1 (*Ghanjeevamrit* @ 1.0 t/ha +*Jeevamrit* spray @ 10%) having value (0.243 dS/m) followed by G_1J_2 (0.230 dS/m). The lowest value was observed for treatment G_0J_2 (0.186 dS/m). The data recorded for electrical conductivity of the soil is presented in Tables 1 and 2. Organic amendments often contribute small amounts of soluble salts, which can temporarily increase soil EC during the mineralization process. However, the changes in EC remained non-significant, which may be due to low salt content of these natural inputs. Moreover, microbial activity stimulated by these natural farming formulations may enhance nutrient cycling without causing excessive accumulation of soluble salts. These results are in line with the earlier findings of Kumari et al. (2019) and Rai et al. (2014) who also observed a non significant soil EC with the addition of organic manures.

Organic carbon (%)

The data recorded for organic carbon showed a significant impact of varying levels of *ghanjeevamrit* and *jeevamrit* individually. However, the effect of their interaction was found non- significant. The data on different levels of *ghanjeevamrit* showed that the maximum percentage of organic carbon (1.15) was recorded for the treatment G_2 (*Ghanjeevamrit* @ 1.5 t/ha) which was statistically at par with G_1 (*Ghanjeevamrit* @ 1.0 t/ha) having 1.12 % of organic carbon. However, the treatment G_0 (No *Ghanjeevamrit*) was recorded for the minimum percentage of organic carbon (1.08).

The data for different levels of *jeevamrit* showed that the maximum percentage of organic carbon (1.17) was observed for treatment J_3 (*Jeevamrit* @ 20%) which was statistically at par with J_2 (*Jeevamrit* spray @ 15%). J_0 was observed with the minimum percentage of organic carbon (1.03).

The interaction effect of *ghanjeevamrit* and *jeevamrit* on organic carbon was found non–significant. However, the maximum and the minimum percentage of organic carbon was 1.21 and 0.99 for treatment G_2J_3 (*Ghanjeevamrit* @ 1.5t/ha + *Jeevamrit* @ 15%) and G_0J_0 (No *Ghanjeevamrit* + No *Jeevamrit*) respectively. The data related to organic carbon is presented in Table 2. This increased organic carbon content might be possible due to organic matter from mulch decomposition, intercrop biomass and decomposition of fallen leaves was added to the system. These materials supply additional carbon substrates to the soil, which can contribute to the accumulation of soil organic matter and improve the carbon pool in the soil system. These results align with the earlier findings of Nagar et al. (2016). Similar results were also observed by Poddar et al. (2017) in their studies. Other than this the rise in soil organic carbon can also be attributed to the high carbon content of the natural farming formulations used, like *beejamrit*, *jeevamrit* and *ghanjeevamrit*. Similar findings were observed earlier by Patel et al. (2018) in their studies, they also observed that the application of organic growth stimulants like *jeevamrit* and *panchgavya* to the soil increased organic carbon level, thereby enhancing organic matter content. Sharma et al. (2016) in their studies also used cow urine in all fermented liquid organic manures led to an increase in soil organic matter content when applied to the soil.

Available nitrogen

The different levels of *ghanjeevamrit* showed significant results, treatment G_2 was recorded with maximum available nitrogen (298.98 kg/ha) followed by treatment G_1 (*Ghanjeevamrit* @ 1.5 t/ha) having 293.68 kg/ha. However, the minimum nitrogen content (286.97 kg/ha) was recorded in G_0 (No *Ghanjeevamrit*). Among different levels of *Jeevamrit*, the maximum and the minimum available nitrogen 302.19 kg/ha and 280.72 kg/ha was observed for treatment J_3 (*Jeevamrit* @ 20%) and J_0 (No *Jeevamrit*) respectively. The data observed for different treatment combinations showed that the maximum available nitrogen (307.57 kg/ha) was found in G_2J_2 (*Ghanjeevamrit* @ 1.5 t/ha + *Jeevamrit* spray @ 15 %) followed by G_2J_3 (*Ghanjeevamrit* @ 1.5 t/ha + *Jeevamrit* @ 15%) which is 305.32 kg/ha, minimum available nitrogen (279.40 kg/ha) was recorded for treatment G_0J_0 (No *Ghanjeevamrit* + No *Jeevamrit*). The effect of varying dosages of *ghanjeevamrit*, *jeevamrit*, their interactions on available N in soil is presented in Table 3.

Increased microbial activity accelerated the decomposition of organic residues and promotes nitrogen mineralization, thereby increasing the availability of nitrogen in the soil.

Available phosphorus

The different doses of *ghanjeevamrit* showed significant results. The maximum (60.55 kg/ha) and the minimum

Table 2: Effect of varying dosages of *ghanjeevamrit*, *jeevamrit*, their interactions on soil pH, EC and organic carbon

Treatments	*J_0 (No Jeevamrit)*			*J_1 (Jeevamrit spray @ 10 %)*			*J_2 (Jeevamrit spray @ 15 %)*			*J_3 (Jeevamrit spray @ 20 %)*			*Mean*		
	pH	*EC (dS/m)*	*Organic carbon (%)*	*pH*	*EC (dS/m)*	*Organic carbon (%)*	*pH*	*EC (dS/m)*	*Organic carbon (%)*	*pH*	*EC (dS/m)*	*Organic carbon (%)*	*pH*	*EC (dS/m)*	*Organic carbon (%)*
G_0 (No *Ghanjeevamrit*)	7.02	0.187	0.99	7.06	0.210	1.09	7.00	0.186	1.10	6.98	0.213	1.14	7.02	0.199	1.08
G_1 (*Ghanjeevamrit* @ 1.0 t/ha)	7.11	0.200	1.05	6.99	0.243	1.10	7.02	0.230	1.16	7.04	0.207	1.18	7.04	0.220	1.12
G_2 (*Ghanjeevamrit* @ 1.5 t/ha)	7.01	0.193	1.06	6.94	0.190	1.12	6.98	0.207	1.21	7.07	0.197	1.19	7.00	0.197	1.15
Mean	7.05	0.193	1.03	6.99	0.214	1.12	7.00	0.208	1.15	7.03	0.206	1.17			

Factors	$CD_{(0.05)}$			SE±(m)		
	pH	EC	Organic carbon	pH	EC	Organic carbon
Ghanjeevamrit	NS	NS	0.044	0.032	0.0081	0.015
Jeevamrit	NS	NS	0.051	0.037	0.0093	0.017
Ghanjeevamrit × Jeevamrit	NS	NS	NS	0.064	0.0162	0.030

Table 3: Effect of varying dosages of *ghanjeevamrit*, jeevamrit, their interactions on available N, P and K in soil

Treatments	*J_0 (No Jeevamrit)*			*J_1 (Jeevamrit spray @ 10 %)*			*J_2 (Jeevamrit spray @ 15 %)*			*J_3 (Jeevamrit spray @ 20 %)*			*Mean*		
	N	*P*	*K*	*N*	*P*	*K*	*N*	*P*	*K*	*N*	*P*	*K*	*N*	*P*	*K*
G_0 (No *Ghanjeevamrit*)	279.40	49.27	295.53	282.09	52.47	301.29	289.17	54.71	306.45	297.23	57.18	311.74	286.97	53.41	303.75
G_1 (*Ghanjeevamrit* @ 1.0 t/ha)	279.73	50.40	310.95	292.53	55.95	305.99	298.47	58.16	315.53	304.00	59.23	322.66	293.68	55.94	313.79
G_2 (*Ghanjeevamrit* @ 1.5 t/ha)	283.03	52.97	310.35	299.99	58.76	318.82	307.57	60.55	323.41	305.32	60.30	316.60	298.98	58.14	317.29
Mean	280.72	50.88	305.61	291.54	55.73	308.70	298.40	57.81	315.13	302.19	58.90	317.00			

Factors	$CD_{(0.05)}$			SE±(m)		
	N	P	K	N	P	K
Ghanjeevamrit	2.96	1.38	3.86	1.01	0.47	1.32
Jeevamrit	3.42	1.59	4.46	1.17	0.54	1.52
Ghanjeevamrit × Jeevamrit	5.93	NS	7.72	2.02	0.94	2.63

(53.41 kg/ha) available phosphorus was observed in G_2 (*Ghanjeevamrit* @ 1.5 t/ha) and G_0 (No *Ghanjeevamrit*). The data which was recorded for different levels of *jeevamrit* showed treatment J_3 (*Jeevamrit* spray @ 20%) with the maximum available phosphorus (58.90 kg/ha) and the minimum phosphorus (50.88 kg/ha) was observed in J_0 (No *Jeevamrit*). The interaction effect of *ghanjeevamrit* with *jeevamrit* levels showed non- significant effect and recorded the highest in G_2J_2 (*Ghanjeevamrit* @ 1.5 t/ha + *Jeevamrit* spray @ 15%) having value (60.55 kg/ha). The lowest (49.27 kg/ha) available phosphorus was observed for G_0J_0. The effect of varying dosages of *ghanjeevamrit*, *jeevamrit*, their interactions on available P in soil is presented in Table 3.

Potassium (Kg/ha)

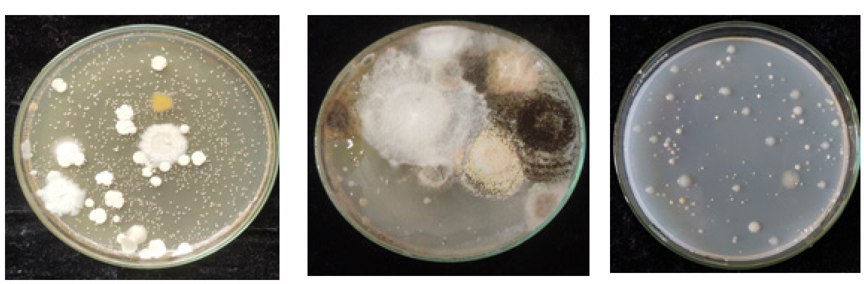
The different levels of *ghanjeevamrit* showed significant results and the maximum available potassium (317.29 kg/ha) was observed in G_2 (*Ghanjeevamrit* @ 1.5 t/ha), which was statistically at par with G_1 (313.79 kg/ha). However, the minimum (303.75 kg/ha) available potassium was recorded in treatment G_0 (No Ghanjeevamrit). Among different levels of *Jeevamrit*, significantly higher potassium (317.00 kg/ha) was observed under treatment J_3 (*Jeevamrit* spray @ 20%) which was statistically at par with treatment J_2 (*Jeevamrit* spray @ 15%) and minimum potassium content (305.61 kg/ha) was recorded under treatment J_0 (No *jeevamrit*). The data which was observed for interaction between different levels of *Ghanjeevamrit* and *Jeevamrit* showed that maximum available potassium (323.41 kg/ha) was observed in G_2J_2 (*Ghanjeevamrit* @ 1.5 t/ha + *Jeevamrit* spray @ 15%) which was statistically at par with G_1J_3 (322.66 kg/ha), G_2J_1 (318.82 kg/ha) and G_2J_3 (316.60 kg/ha). However, the minimum available potassium (295.53 kg/ha) was recorded in G_0J_0 (No *Ghanjeevamrit* + No *Jeevamrit*). The effect of varying dosages of *ghanjeevamrit*, *jeevamrit*, their interactions on available K in soil is presented in Table 3. The solution gives all the necessary nutrients, vitamins and amino acids that also helps in breakdown organic waste. *Jeevamrit*, with lots of microbes is good for encouraging microbial growth in the soil which ultimately makes nutrients in plant available form. As already observed in the earlier study by Chandrakala et al. (2011) that combined application of *beejamrit* +*jeevamrit* + *panchagavya* resulted in significantly higher uptake of nitrogen, phosphorous and potassium. Additionally, the combined use of FYM with *beejamrit* + *jeevamrit* + *panchagavya* led to significantly higher dehydrogenase activity in capsicum plants.

Bacterial counts (10^7 cfu/g of soil)

The different levels of *ghanjeevamrit* showed significant results. The highest bacterial population (108.58 × 10^7 cfu/g soil) was recorded in G_1 (*Ghanjeevamrit* @ 1.0 t/ha), which was statistically at par with G_2 (107.75 × 10^7 cfu/g soil). However, G_0 (No *Ghanjeevamrit*) was observed with the minimum bacterial population (102.50 × 10^7 cfu/g soil). The data which was observed for different levels of *jeevamrit* revealed that the highest bacterial population (111.56 × 10^7 cfu/g soil) was found in J_3 (*Jeevamrit* spray @ 20%) which was statistically at par with J_2 (*Jeevamrit* spray @ 15%). However, the minimum bacterial population (100.33 × 10^7 cfu/g soil) was found in J_0 (No *Jeevamrit*). The interaction effect of *ghanjeevamrit* with *jeevamrit* levels showed non- significant effect and maximum bacterial population (117.67 × 10^7 cfu/g soil) was recorded in G_1J_3 (*Ghanjeevamrit* @ 1.0 t/ha + *Jeevamrit* spray @ 20%) followed by G_2J_2 (114.33 × 10^7 cfu/g soil). However, the lowest bacterial population (97.33 × 10^7 cfu/g soil) was observed in G_0J_0.The data related to bacterial population in soil is presented in Table 4 and Figure 1 (A) represented the bacterial population grown in nutrient agar. These natural farming formulations provide readily available carbon sources and energy for microbial growth, which promotes the proliferation of soil bacteria.

Fungal counts (10^2 cfu/g of soil)

The results showed significant impact of varying levels of *ghanjeevamrit* and *jeevamrit* both individually. However, the effect of their interaction was found non- significant. The maximum fungal population (18.08 × 102 cfu/g of soil) was recorded for treatment G_2 (*Ghanjeevamrit* @ 1.5 t/ha)



(A) Bacteria-10^7 cfu/g of soil (B) Fungi-10^2 cfu/g of soil (C) Actinomycetes-10^2 cfu/g of soil

Figure 1: Microbial colonies isolated from soil samples using the serial dilution spread plate technique. (A) Bacterial colonies grown on Nutrient Agar, (B) Fungal colonies grown on Potato Dextrose Agar (PDA), (C) Actinomycetes colonies grown in Kenknight and Munaier's medium (KNM)

Table 4: Effect of varying dosages of *ghanjeevamrit, jeevamrit*, their interactions on microbial (bacteria, fungi, actinomycetes) count in the soil

Treatments	*J_0 (No Jeevamrit)*			*J_1 (Jeevamrit spray @ 10 %)*			*J_2 (Jeevamrit spray @ 15 %)*			*J_3 (Jeevamrit spray @ 20 %)*			*Mean*		
	Bacteria	*Fungi*	*Actino-mycetes*	*Bacteria*	*Fungi*	*Actino-mycetes*	*Bacteria*	*Fungi*	*Actinomycetes*	*Bacteria*	*Fungi*	*Actino-mycetes*	*Bacteria*	*Fungi*	*Actino-mycetes*
G_0 (No *Ghanjeevamrit*)	97.33	7.67	12.67	102.00	9.67	17.00	104.67	10.00	15.33	106.00	12.00	15.33	102.50	9.83	15.08
G_1 (*Ghanjeevamrit* @ 1.0 t/ha)	101.33	13.33	16.33	109.00	13.00	20.33	106.33	14.00	23.33	117.67	15.00	22.67	108.58	13.83	20.67
G_2 (*Ghanjeevamrit* @ 1.5 t/ha)	102.33	16.33	17.67	103.33	17.67	19.33	114.33	19.67	21.33	111.00	18.67	20.00	107.75	18.08	19.58
Mean	100.33	12.44	15.56	104.78	13.44	18.89	108.44	14.56	20.00	111.56	15.22	19.33			

	$CD_{(0.05)}$			SE±(m)		
	Bacteria	Fungi	Actinomycetes	Bacteria	Fungi	Actinomycetes
Ghanjeevamrit	4.98	1.75	3.38	1.70	0.60	1.15
Jeevamrit	5.74	2.02	NS	1.96	0.69	1.33
Ghanjeevamrit × Jeevamrit	NS	NS	NS	3.39	1.19	2.31

and the minimum fungal population (9.83 × 102 cfu /g of soil) was recorded in treatment G_0 (No *Ghanjeevamrit*). The data recorded for different levels of *Jeevamrit* revealed that treatment J_3 (*Jeevamrit* @ 20%) showed the highest fungal population (15.22 × 102 cfu /g of soil) which was statistically at par with J_2 (*Jeevmarit* @ 15%) and J_1 (*Jeevamrit* @ 10%), respectively. However, J_0 was registered the minimum fungal population (12.44 × 102 cfu /g of soil). The data which was recorded for the interaction effect of different levels of *Ghanjeevamrit* and *Jeevamrit* showed maximum fungal population in G_2J_2 (*Ghaneevamrit* @ 1.5 t/ha + *Jeevamrit* @ 15 %) having fungal population (19.67 × 102 cfu /g of soil) followed by G_2J_3 (18.67 × 102 cfu /g of soil). However, the lowest fungal population (7.67 × 102 cfu /g of soil) was observed in G_0J_0. The data related to fungal population in soil is presented in Table 4 and Figure 1(B) represented the fungal population grown in potato dextrose agar. Fungi play an important role in the decomposition of complex organic materials such as cellulose, lignin and other plant residues, thereby contributing to nutrient cycling and organic matter turnover in soil ecosystems. The increased availability of organic substrates following the application of these inputs may therefore stimulate fungal growth and activity in the soil environment.

Actinomycetes counts (10^2 cfu /g of soil)

The data recorded for different levels of *Ghanjeevamrit* showed significant impact with maximum actinomycetes count (20.67 × 102 cfu /g of soil) recorded for treatment G_1 (*Ghanjeevamrit* @ 1.0 t/ha). However, G_0 (No *Ghanjeevamrit*) is recorded with minimum population (15.08 × 102 cfu/g of soil). The varying levels of *Jeevamrit* showed non-significant effect on actinomycetes count. However, the range varied from 20.00 × 102 cfu /g of soil to 15.56 × 102 cfu /g of soil. The interaction effect of varying levels of *Ghanjeevamrit* and *Jeevamrit* were recorded and among them G_1J_2 (*Ghanjeevamrit* @ 1.0 t/ha + *Jeevamrit* @ 15 %) was observed with maximum actinomycetes count (23.33 × 102 cfu /g of soil) followed by G_1J_3 (22.67 × 102 cfu /g of soil). However, the lowest actinomycetes count (12.67 × 102 cfu/g of soil) was recorded in G_0J_0. The data related to actinomycetes population in soil is presented in Table 4 and Figure 1 (C) represented the actinomycetes population grown in Kenknight and Munaier's medium (KNM). The increased actinomycetes population under natural farming inputs may be due to the higher availability of organic matter and favorable soil conditions created by these inputs. Similarly, Devakumar et al. (2014) in their study concluded that consistent use of *Jeevamrit* in the SPNF system, contains beneficial microorganisms, which are linked to increased soil microorganism populations and enhanced nutrient availability. Jenny and Malliga (2016) similarly noted an increase in bacterial count attributed to the presence of *Jeevamrit*.

Conclusion

The application of natural farming inputs, particularly *ghanjeevamrit* and *jeevamrit*, can positively influence soil fertility and microbial activity. The varying treatments receiving higher doses of these inputs showed improvements in soil organic carbon, available nitrogen, phosphorous and potassium when compared with control. In addition to nutrient enrichment, the microbial populations of bacteria, fungi and actinomycetes also increased significantly, which indicated improved soil biological activity. Therefore, highlighted the role of these formulations in stimulating nutrient cycling and enhancing soil microbial dynamics and thus, may serve as an effective and eco- friendly strategy for maintaining soil fertility and promoting sustainable agricultural production.

References

Barrow, N.J. & Hartemink, A.E. (2023). The effects of pH on nutrient availability depend on both soils and plants. Plant Soil 487, 21–37.

Chandrakala, M., Hebsur, N.S. & Nalina, C.N. (2011). Effect of FYM and fermented liquid manures on yield and economics of chilli (*Capsicum annum* L.). Res. J. Agric. Sci, 2(3), 722-724.

Devakumar, N., Subha, S., Gouder, S.B. & Rao, G.E. (2014). Microbial analytical studies of traditional organic preparations beejamrutha and jeevamrutha. In: Proceedings of 4th ISOFAR Scientific conference, Rahmann, G. and Aksoy, U. (eds). Istanbul, Turkey, 13-15 October 2014. Building Organic Bridges, Istanbul. pp. 639-642.

FAO. (2020). The agroecological grassroots movement revolutionising Indian farms. https://www.fao.org/newsroom/story/The-agroecological-grassroots-movement-revolutionising-Indian-farms/en

Jackson, M.L. (1973). Soil Chemical Analysis. Printice Hall of India Pvt. Ltd., New Delhi. pp. 111-127.

Jenny, S. & Malliga, P. (2016. Assessment of different concentrations of organic manure on the growth and yield of *Solanum Lycopersicum* L. (Tomato). Int. J. Innov. Res. Technol. Sci. Eng, 5(3), 3722-3731.

Kumari, R., Thakur, K.S. & Lalhruaitluangi, N. (2019). Effect of different organic nutrient sources on soil properties in onion (*Allium cepa* L.). Int. J. Curr. Microbiol. Appl. Sci., 8(4), 1783 1792.

Laishram, J., Saxena, K.G., Maikhuri, R.K. & Rao, K.S. (2012). Soil quality and soil health: A review. Int. J. Ecol. Environ. Sci., 38(1), 19–37

Nagar, R.K., Goud, V.V., Kumar, R. & Kumar, R. (2016). Effect of organic manures and crop residue management on physical, chemical and biological properties of soil under pigeonpea based intercropping system. Int. J. Farm Sci., 6(1),101-113.

Olsen, S.R., Cole, C.V., Watanable, F.S. & Dean, L.A. (1954). Estimation of available phosphorous in soil by extraction with sodium bicarbonate. USDA circulation. 939: 1-19.

Panse, V.G. & Sukhatme, P.V. (2000). Statistical Methods for Agricultural Workers. Indian council of Agricultural Research Publication, New Delhi. Pp 89-87.

Patel, D.M., Patel, I.M., Patel, B.T., Singh, N.K. & Patel, C.K. (2018). Effect of *panchgavya* and *jeevamrit* on yield, chemical and biological properties of soil and nutrient uptake by kharif Groundnut (*Arachis hypogaea* L.). Int. J. Chem. Stud., 6(1), 804-806.

Poddar, R., Kumar, S. & Kundu, R. (2017). Production potential and impact on soil health as influenced by chickpea-spices based intercropping system. J. Crop Weed, 13(1), 189-91.

Prakash, V., Kumar, N. & Srivastva, A.K. (2005). Viability of relay intercropping of tomato (*Lycopersicum esculentum*) and French bean (*Phaseolus vulgaris*) with maize (*Zea mays*) in North – West Himalaya. Indian. J. Agric. Sci., 75(12), 794-796.

Rai, S., Rani, P., Kumar, M., Rai, A.K. & Shahi, S.K. (2014). Effect of integrated use of vermicompost, FYM, PSB and Azotobacter on physico-chemical properties of soil under onion crop. J. Ecol. Environ., 32(11), 1797-1803.

Sharma, R., Shah, S.C., Adhikari, K.R., Shah, P. & Shrestha, J. (2016). Effect of cattle urine and FYM on yield of broccoli and soil properties. J. Agri. Search., 3(4), 157-160.

Sharma, S., Lishika, B., Shubham & Kaushal, S. (2023). Soil quality indicators: A comprehensive review. Int. J. Plant Soil Sci., 35(22), 315–325.

Sreenivasa, M.N., Naik, N. & Bhat, S.N. (2009). Beejamrutha: A source for beneficial bacteria. Karnataka J. of Agric. Sci., 22(5), 1038-1040.

Subbiah, B.V. & Asija, G.L. (1956). Rapid procedure for the estimation of the available nitrogen in soils. Current Science, 25(10), 259-260.

Subha Rao, N.S. (1999). Soil Microbiology. 4th ed. Oxford & IBH publishing Co., New Delhi. 252p.

Tscharntke, T., Grass, I., Wanger, T.C., Westphal, C. & Batáry, P. (2021). Beyond organic farming: Harnessing biodiversity-friendly landscapes. Trends Ecol. Evol., 36(10), 919–930.

Walkley, A. & Black, T.A. (1934. An experimentation of vegetative method for determining soil organic matter and proposed modification of the chronic acid titration method. Soil Science, 37(6) 38-39.

सारांश

मृदा स्वास्थ्य कृषि उत्पादकता को बनाए रखने तथा पारिस्थितिक संतुलन बनाए रखने के लिए अत्यंत महत्वपूर्ण है। गहन कृषि पद्धतियों से उत्पन्न बढ़ती पर्यावरणीय चिंताओं ने वैकल्पिक कृषि प्रणालियों की खोज को प्रोत्साहित किया है, जो मृदा स्वास्थ्य और पारिस्थितिक स्थिरता को बढ़ावा देती हैं। प्राकृतिक खेती ऐसी ही एक पद्धति है, जो स्थानीय रूप से तैयार जैविक इनपुट्स के उपयोग पर बल देती है, जिससे मृदा उर्वरता में वृद्धि होती है तथा रासायनिक उर्वरकों पर निर्भरता कम होती है। वर्तमान अध्ययन वर्ष 2023 की फसल अवधि के दौरान डॉ. वाई.एस. परमार बागवानी एवं वानिकी विश्वविद्यालय, नौणी, सोलन (हिमाचल प्रदेश) स्थित सुभाष पालेकर प्राकृतिक खेती) अनुसंधान फार्म में किया गया। इसका उद्देश्य प्राकृतिक खेती के घटकों का मृदा के भौतिक-रासायनिक तथा सूक्ष्मजीव गुणों पर प्रभाव का मूल्यांकन करना था। प्रयोग में बारह उपचार संयोजन शामिल थे, जिनमें घनजीवामृत के तीन स्तर (0, 1.0, 1.5 t/ha) तथा जीवामृत स्प्रे की चार सांद्रताएँ (0, 10, 15 और 20 प्रतिशत) शामिल थीं। इसे फैक्टोरियल रैंडमाइज्ड कम्प्लीट ब्लॉक डिजाइन में तीन पुनरावृत्तियों के साथ स्थापित किया गया। मृदा के मानकों जैसे चभ्, विद्युत चालकता, जैविक कार्बन, उपलब्ध नाइट्रोजन, फॉस्फोरस, पोटाश तथा सूक्ष्मजीव जनसंख्या का विश्लेषण किया गया। परिणामों से पता चला कि G_2J_2 और G_2J_3 उपचारों ने पोषक तत्वों की उपलब्धता तथा सूक्ष्मजीवों की संख्या में अपेक्षाकृत बेहतर सुधार दिखाया। इससे स्पष्ट हुआ कि प्राकृतिक खेती के इनपुट्स ने नियंत्रण की तुलना में मृदा उर्वरता और सूक्ष्मजीव सक्रियता में वृद्धि की।