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RESEARCH ARTICLE

Impact of Jeevamrit and Ghanjeevamrit on soil properties and productivity of kiwi fruit

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Abstract

Kiwi fruit (*Actinidia deliciosa* Chev.) cultivation is gaining popularity in mid-hills of Himachal Pradesh. An experiment was conducted at Krishi Vigyan Kendra Solan, Himachal Pradesh to study the influence of natural farming system on crop yield, fruit weight, total sugar, physico-chemical and biological properties of soil and to find out the most effective doze of inputs viz., Ghanjeevamrit and Jeevamrit. We studied the application of jeevamrit and ghanjeevamrit with nutrient management practices in kiwifruit cropping sequence under natural farming system. Jeevamrit and ghanjeevamrit were prepared using desi-cow urine and dung. These natural farming ingredients are widespread among farmers for improving soil biology and productivity. Among different treatments, T_5 (Ghanjeevamrit 2.0 t/ha + Jeevamrit 20 %) was found superior in terms of yield, crop equivalent yield, number of leaves, leaf area, pH, organic carbon, bulk density and microbial count. However, T_2 (Ghanjeevamrit 1.5 t/ha + Jeevamrit 20 %) was found best in terms of available nitrogen, phosphorus and potash contents in the soil and it was statistically on par with T_5. Intercrop combination of pea and mash was found superior in terms of crop equivalent yield, physico-chemical and biological properties of soil as compared to intercrop combination of rajmash and radish. Bacterial count varied from 14.56 x 10^7 to 23.38 x 10^7, fungal count from 2.36 x 10^4 to 5.70 x 10^4 while, actinomycetes from 5.36 x 10^4 to 8.70 x 10^4 among different treatments.

Keywords: intercropping; kiwi fruit; natural farming; soil quality; yield

Introduction

Kiwi fruit (*Actinidia deliciosa* Chev.) originated in China and thus is often referred as Chinese gooseberry. The fruit has significant demand in India because of its easy cultivation process, appealing taste, distinctive health and nutritive benefits, lower costs and high profit potential. The fruit has immense nutritional value serving as an abundant source of essential nutrients including vitamin C and an array of minerals such as sodium, potassium, calcium, magnesium, manganese, iron, copper and zinc (1). In Himachal Pradesh, kiwi cultivation is gaining popularity in mid-hills and valley areas of the district Solan, Shimla, Sirmaur and Kullu due to favourable agro-climatic conditions, easy production technology and huge post-harvest potential of the crop.

As no significant disease and insect pests are reported in kiwi fruit, hence it has great advantage of being grown through natural farming practices thus, retaining its health and nutritive value unlike the conventional farming system wherein, excessive use of chemical fertilizers and pesticides reduce the nutritional value of the fruit besides being cost intensive and detrimental to soil health. The indiscriminate use of pesticides and chemical fertilizers is a widespread practice among cucumber growers seeking higher marketable yields. While this approach may boost short-term productivity, it has led to serious long-term challenges, particularly for soil health and fertility. Overuse of chemical inputs contributes to declining agricultural productivity, depletion of natural resources and reduced soil fertility. Moreover, it poses significant threats to terrestrial and aquatic ecosystems, exacerbates climate change and endangers human health and well-being (2, 3). On the other hand, natural farming is a low cost, climate resilient and low input-based farming system wherein, all the inputs (nutrients, fungicides, insect repellents) are made up of natural herbs and locally available inputs, thereby, reducing the use of industrial pesticides hence, cutting down the cost of cultivation to a greater extent.

Conventional farming with the use of chemical inputs has contributed to higher costs and reduced incomes for the farmers whereas in Natural Farming (NF) a substantial decrease in input cost has been achieved (4). Early researchers also reported the decrease in input cost in range of 14.34 to 45.55 % with increase in net return by 11.8 to 21.55 % over conventional farming (CF), thus validating superiority of NF over the CF (5). Recent studies reveals that the net returns in natural farming were 27.41 % higher as compared to conventional farming of apples where samples were collected from 110 apple orchards spread over across the state. This contributed to the reduction in cultivation costs which was 56.53 % lower than CF (6).

Under natural farming system, multilayer cropping system is followed where, leguminous crops are invariably used as intercrops to meet nitrogen requirement of the plants. So far, very little information is available on the influence of natural farming practices on kiwi fruit yield and soil parameters (7). Hence, the present study was conducted to assess the influence of natural farming system in kiwi fruit on crop yield, soil chemical and physical parameters and to work out the most effective doze of inputs viz., Ghanjeevamrit and Jeevamrit for higher productivity and soil parameters.

Materials and Methods

The study was carried out at the experimental farm of Krishi Vigyan Kendra, Solan at an elevation of 1400 m above msl, with a latitude of 30°97′02″ N and a longitude of 77°10′54″ E during 2023 in sub-temperate, sub-humid and mid-hill agro-climatic zones in the state of Himachal Pradesh (Zone-II) in the existing plantation of 20 years old kiwi fruit vines of cultivar Allison. The vines are, T-bar trained, with rows-oriented north–south at a spacing of 4.0 m × 6.0 m (416 vines/ha), with female: male ratio of 9:1. The average annual rainfall in this area was about 1100 mm, out of which 85 % of rainfall is received from June to September.

The experiment was laid out in split plot design having four replications per treatment. The treatments includes:T_1-Ghanjeevamrit 1.5 t/ha + Jeevamrit 10 %, T_2-Ghanjeevamrit 1.5 t/ha + Jeevamrit 20 %, T_3-Ghanjeevamrit 1.5 t/ha + Jeevamrit 0.0 %, T_4-Ghanjeevamrit 2.0 t/ha + Jeevamrit 10 %, T_5-Ghanjeevamrit 2.0t/ha + Jeevamrit 20 %, T_6-Ghanjeevamrit 2.0 t/ha + Jeevamrit 0.0 %, T_7-Ghanjeevamrit 0.0 t/ha + Jeevamrit 10 %, T_8-Ghanjeevamrit 0.0 t/ha + Jeevamrit 20 %, T_9-Ghanjeevamrit 0.0 t/ha + Jeevamrit 0.0 %.

In natural farming system, the main crop was intercropped with pea, *Pisum sativum* (Pb 89), Radish (*Raphanus sativus*-Japanese White) in *rabi* season and mash, *Vigna mungo* (Him Mash 1) and Rajmash (*Phaseolus vulgaris* L.-Baspa) during *kharif* season. Ghanjeevamrit was applied thrice i.e. first doze at the time of basin preparation, second at flowering and third at fruiting stage while Jeevamrit was applied at an interval of 15 days (8). All the seeds of intercrops i.e. pea, radish, mash and rajmash were treated with beejamrit before sowing. For disease management, indigenous plant and cow dung-urine based formulations i.e. Jeevamrit (5 %), khattilassi (5 %) and saunthastr (5 %) were sprayed at an interval of 15 days while, Darekastra (5 %), Bramhastra @ 3 % and Agniastra @ 3 % were used for pest management (9). Besides these treatments, dry grass mulching was applied and irrigation channels were prepared to create Wapsa. Wapsa refers to a soil condition where there's a balance of both air and moisture, promoting efficient water use and reducing the need for irrigation. Treatments with no application of Jeevamrit and Ghanjeevamrit are taken as control, to assess the influence of natural farming practices on yield and soil parameters of kiwi fruit.

An illustrative leaf sample of 50 completely matured and extended current season leaves were used to record average data on leaf area (10) and number of leaves per tree. The average fruit weight was estimated on electronic top pan balance and total sugar (%) content was determined with Erma hand refractometer (0-32° Brix).

Soil sampling from the depths of 0-30 cm was done before the start of the experiment (February 2023) and after harvesting of kiwi fruits in the month of October 2023. Each sample was air dried, pulverised in pestle and mortar and passed through 2 mm sieve, to analyse the soils for different physico-chemical (bulk density, particle density, porosity, available N P K, pH, EC and organic carbon) and biological properties (total microbial count). Bulk density was calculated by core sampler method (11).

Various soil chemical properties were determined in the laboratory by using standard methods. Soil pH and EC is calculated by using Potentiometric and Wheat stone bridge circuit method (12); Organic Carbon (OC) (g/kg) by Rapid titration method (13); Available N (kg/ha) by Alkaline potassium permanganate method (14); available P (kg/ha) by Olsen's method (15, 16) and available K (kg/ha) by Flame photometric method (1N NH_4OAC extractable) (17). Soil microbes (Fungi, actinomycetes and bacteria) were isolated from the kiwi fruit rhizosphere using specific growth media by serial dilution technique (18-20). Treatment means for various parameters were compared for significant differences ($P<0.05$) using SPSS-18.

A composite soil sample was analysed before the start of experiment which has a pH of 7.13, EC 0.38 dS/m and contains 9.2 g/kg organic carbon, 301.54 kg/ha, 49.4 kg/ha and 275.91 kg/ha available N, P, K respectively. The physical properties of soil viz. bulk density, particle density and porosity were 1.34 mg/m^3, 2.30 mg/m^3 and 41.72 %, respectively. The bacterial, fungal and actinomycetes count was 14.25 x10^7, 3.18 x 10^4 and 3.82 x 10^4 cfu/g of soil, respectively.

Results and Discussion

Growth parameters

Substantial difference in number of leaves per plant and leaf area was recorded with the application of different dozes of Ghanjeevamrit and Jeevamrit (Table 1). Maximum number of leaes per plant (405) were obtained in T_5 (Ghanjeevamrit 2.0 t/ha + Jeevamrit 20 %) followed by T_2 (Ghanjeevamrit 1.5 t/ha + Jeevamrit 20 %) (387) while minimum number of leaves (285.63) in T_9 (Ghanjeevamrit

Table 1. Influence of natural farming practices on number of leaves and leaf area

Treatments	No. of leaves			Leaf area (m^2)		
	Mash+ Pea	Rajmash + Radish	Mean	Mash+ Pea	Rajmash + Radish	Mean
T_1 (G* 1.5 t/ha + J* 10 %)	355.00	349.75	**352.38**	4.05	3.94	**3.99**
T_2(G 1.5 t/ha + J 20 %)	388.50	385.50	**387.00**	4.80	4.71	**4.76**
T_3(G 1.5 t/ha + J 0 %)	318.25	317.50	**317.88**	3.46	3.33	**3.39**
T_4(G 2.0 t/ha + J 10 %)	370.00	366.50	**368.25**	4.34	4.29	**4.31**
T_5(G 2.0 t/ha + J 20 %)	409.75	400.25	**405.00**	5.05	4.88	**4.96**
T_6 (G 2.0 t/ha + J 0 %)	325.00	310.50	**317.75**	3.65	3.52	**3.59**
T_7(G 0 t/ha + J 10 %)	334.00	323.25	**328.63**	3.60	3.46	**3.53**
T_8(G 0 t/ha + J 20 %)	340.00	330.00	**335.00**	3.84	3.77	**3.81**
T_9(G 0 t/ha + J 0 %)	288.25	283.00	**285.63**	3.19	3.06	**3.13**
Mean	347.64	340.69		4.00	3.88	
	SE	**CD** (P=0.05)		**SE**	**CD** (P=0.05)	
Main Plot (I)	2.03	6.45		0.03	0.09	
Sub Plot (T)	7.21	14.50		0.10	0.21	
MS (I*T)	10.20	NS		0.15	NS	
G*	**Ghanjeevamrit**					
J*	**Jeevamrit**					

0.0 t/ha + Jeevamrit 0.0 %). Among intercrop combination, pea and mash intercropping was better in terms of number of leaves. However, interaction between different treatments and intercrops was found non-significant. The average leaf area/plant followed a similar trend where maximum leaf area (4.96 m^2) was exhibited by T_5 followed by T_2 (4.76 m^2) and minimum in T_9 (3.13 m^2). Among intercrop combination, pea and mash intercropping was again found better in terms of leaf area as well however, interaction was non-significant. Application of Ghanjeevamrit @ 2 t/ha + Jeevamrit @ 20 % counts for improved soil health and microbial activity which in turn resulted in higher number of leaves and leaf area in T_5. Increased leaf area may be linked to improvements in photosynthetic rate, resulting in increased yield of the crop.

Physico-chemical properties of soil

The experimental soil was neutral (pH 7.13) with normal EC (0.38 dS/m), medium organic carbon (9.2 g/kg) and medium available N (301.54 kg/ha), P (49.40 kg/ha) and K (275.91 kg/ha) and with the bulk density of 1.34 mg/m^3. Biological properties of soil at the start of experiment revealed that bacterial count was 14.27 x 10^4, fungal count 2.31 x 10^3 and actinomycetes 5.33 x 10^3 cfu.

The application of different treatments had a significant effect on the physical and chemical properties of soil. Minimum bulk density was observed in (T_5) Ghanjeevamrit 2.0 t/ha + Jeevamrit 20 % and (T_2) Ghanjeevamrit 1.5 t/ha + Jeevamrit 20 % (1.27 mg/m^3) which was statistically on par with (T_4) Ghanjeevamrit 2.0 t/ha + Jeevamrit 10 % and (T_1) Ghanjeevamrit 1.5 t/ha + Jeevamrit 10 %. Bulk density w.r.t. intercrops and interaction between treatments and intercrops was non-significant (Table 2). Continuous application of Ghanjeevamrit (2 t/ha) and Jeevamrit (20 %) starting from December2022 till the month of harvest i.e. October 2023 at an interval of 15 days has resulted in improved bulk density in the soil which helped in the uptake of nutrients thereby, improving yield. By and large similar trends have also reported in tomato (21).

Mean value of the pH varied from 7.03 to 7.38, maximum being in case of T_5 (7.38) which was statistically at par with T_2 (7.34) while, minimum in control i.e. 7.03. However, pH values w.r.t. intercrops and interaction between treatments and intercrops was non-significant (Table 2). Mean EC value among different treatments varied from 0.20 dS/m to 0.32 dS/m, maximum in case of T_1 (0.32 dS/m) while minimum in T_9 (0.20 d/Sm). However, EC values w.r.t. intercrops and interaction between treatments and intercrops was non-significant. Organic Carbon varied from 9.59 g/kg to 14.56 g/kg among different treatments. Maximum OC contents were recorded for T_5 (14.56 g/kg) which was statistically at par with T_2 (12.88 g/kg) while, minimum in T_9 (9.59 g/kg). Higher organic carbon contents were obtained in intercrop combination-1 (pea + mash). Soil pH was found in neutral range in all the treatments and EC was recorded in normal range with the application of different dozes of Ghanjeevamrit and Jeevamrit.

Table 2. Influence of natural farming practices on bulk density, pH, EC and organic carbon of soil

Treatments	Bulk density (Mg/m3)			pH (1:2)			EC (d Sm^{-1})			Organic Carbon (g/kg)		
	Mash+ Pea	Rajmash + Radish	Mean	Mash+ Pea	Rajmash + Radish	Mean	Mash+ Pea	Rajmash + Radish	Mean	Mash+ Pea	Rajmash + Radish	Mean
T_1 (G* 1.5 t/ha + J* 10 %)	1.29	1.28	**1.29**	7.26	7.22	**7.24**	0.32	0.31	**0.32**	12.35	11.78	**12.06**
T_2(G 1.5 t/ha + J 20 %)	1.27	1.27	**1.27**	7.48	7.20	**7.34**	0.28	0.27	**0.27**	13.08	12.68	**12.88**
T_3(G 1.5 t/ha + J 0 %)	1.31	1.30	**1.31**	7.12	7.14	**7.13**	0.22	0.22	**0.22**	10.45	10.00	**10.23**
T_4(G 2.0 t/ha + J 10 %)	1.28	1.28	**1.28**	7.27	7.19	**7.23**	0.27	0.23	**0.25**	12.58	11.75	**12.16**
T_5(G 2.0 t/ha + J 20 %)	1.27	1.27	**1.27**	7.38	7.37	**7.38**	0.23	0.24	**0.23**	14.85	14.28	**14.56**
T_6 (G 2.0 t/ha + J 0 %)	1.30	1.29	**1.30**	7.13	7.06	**7.09**	0.26	0.27	**0.26**	11.33	11.03	**11.18**
T_7(G 0 t/ha + J 10 %)	1.31	1.30	**1.31**	7.12	7.11	**7.12**	0.21	0.20	**0.20**	10.38	10.10	**10.24**
T_8(G 0 t/ha + J 20 %)	1.30	1.29	**1.29**	7.10	7.05	**7.07**	0.28	0.27	**0.27**	11.43	10.85	**11.14**
T_9(G 0 t/ha + J 0 %)	1.34	1.34	**1.34**	7.05	7.01	**7.03**	0.21	0.20	**0.20**	9.78	9.40	**9.59**
Mean	1.30	1.29		7.21	7.15		0.25	0.24		11.80	11.32	
	SE	**CD** (P=0.05)		**SE**	**CD** (P=0.05)		**SE**	**CD** (P=0.05)		**SE**	**CD** (P=0.05)	
Main Plot (I)	0.004	NS		0.03	NS		0.00	NS		0.14	0.44	
Sub Plot (T)	0.005	0.01		0.06	0.12		0.02	0.04		0.87	1.75	
MS (I*T)	0.007	NS		0.08	NS		0.02	NS		1.23	NS	
G*	**Ghanjeevamrit**		**J***	**Jeevamrit**								

Different Ghanjeevamrit and Jeevamrit treatments recorded a wide range of available N which indicated that different treatments exerted a marked influence on the available N in the soil that varied from 309.13 to 396.50 (kg/ha), maximum (396.5 kg/ha) being in case of T_2 which was statistically at par with T_5 (382.88 kg/ha) while, minimum in T_9 (309.13 kg/ha). Intercrop combination 1 (pea + mash) (Table 3) was found to be superior intercrop combination- 2 (radish+ rajmash) w.r.t. available nitrogen in the soil. However, interaction between treatments and intercrop combinations was observed to be non-significant. Although maximum available phosphorus contents in soil were recorded for T_5 (61.35 kg/ha) however, it was statistically at par with T_2, T_1, T_4 and T_8 treatments. Minimum value (50.19 kg/ha) was recorded for T_9 treatment. Again, intercrop combination-1 (pea + mash) was found to be superior to intercrop combination-2 (radish+ rajmash) w.r.t. available phosphorus contents in the soil.

However, interaction between treatments and intercrop combinations was observed to be non-significant. Mean value of potassium varied from 274.64 to 386.73 kg/ha. Maximum potash contents were recorded in T_2 (386.73 kg/ha) which was statistically at par with T_5 (377.16 kg/ha) while, minimum (274.64 kg/ha) was observed in control i.e. T_9 treatment. Like available nitrogen and phosphorus contents in soil, intercrop combination-1 (pea + mash) was found superior than intercrop combination-2 (radish + rajmash) w.r.t. available potash contents i.e. 337.17 kg/ha and 334.97 kg/ha, respectively. However, interaction between treatments and intercrop combinations was observed to be non-significant showing that there was no effect of intercrop combinations on available potash contents in soil w.r.t. different treatments of Ghanjeevamrit and Jeevamrit. Higher available NPK contents in soil in the treatment T_5 might be due to rapid mineralization of available pool of nitrogen due to higher microbial activity in this treatment with application of Jeevamrit and Ghanjeevamrit. Higher available nitrogen in soil with application of either Jeevamrit alone or in combination with Ghanjeevamrit was reported in wheat (22) and chickpea (23). In case of Ghanjeevamrit + Jeevamrit, it increased the release of organic acid during mineralization that helped in the solubility of native phosphates, thus increased available phosphorus pool in the soil. Due to higher microbial activity and nutrient contents in the soil, the uptake of nutrients (NPK) was higher with the application of Ghanjeevamrit + Jeevamrit + mulching which might be ascribed to the rapid mineralization of native and applied nutrients. The results are well supported by earlier findings where it has been reported that jeevamrit promotes immense biological activity in soil and enhance nutrient availability to crop (21).

Biological properties of soil

Bacterial count varied from 14.56 x 10^7 to 23.38 x 10^7, fungal count from 2.36 x 10^4 to 5.70 x 10^4 while, actinomycetes from 5.36 x 10^4 to 8.70 x 10^4 w.r.t. different treatments (Table 4). Bacterial count was maximum (23.38 x 10^7) in T_5 however, it was statistically at par with T_2, T_1, T_4 and T_8 treatments while, minimum (14.56 x 10^7). It varied in different intercrop combinations as well however, found to be non-significant in interaction studies. Maximum fungal count was recorded for T_5 (5.70 x 10^4) which was statistically at par with T_2 and T_4 treatments and minimum in T_9 (2.36 x 10^4). There was significant difference in fungal count w.r.t. intercrop combinations although, interaction studies were found to be non-significant. Actinomycetes count was maximum (8.70 x 10^4) in T_5 which was statistically at par with T_2 and T_4 treatments, minimum being in case of T_9 (5.36 x 10^4). Intercrop combination-1 (pea + mash) was found superior to intercrop combination-2 (radish + rajmash) w.r.t. actinomycetes count though interaction between treatments and intercrop combination was non-significant. Microbial count is determined by inherent physical and chemical characteristics as well as management practices of the crop. The results of present experiment reflect that microbial population was higher in the treatment (T_5), where OC contents were found higher. The results are in accordance with findings of Rana (22) which revealed that soil microflora (bacteria= 3.03 %; fungi= 12.5 %; actinomycetes= 12.4 %) was significantly higher in NF as compared to conventional farming system. As organic matter is the food of microbes that explains the higher count in this treatment (24,26).

Table 3. Influence of natural farming practices on available N, P and K of soil

Treatments	Available N (kg/ha)			Available P (kg/ha)			Available K (kg/ha)		
	Mash+ Pea	Rajmash + Radish	Mean	Mash+ Pea	Rajmash + Radish	Mean	Mash+ Pea	Rajmash + Radish	Mean
T_1 (G* 1.5 t/ha + J* 10 %)	377.00	374.25	**375.63**	56.75	55.13	**55.94**	337.22	335.93	**336.57**
T_2(G 1.5 t/ha + J 20 %)	397.25	395.75	**396.50**	60.50	56.25	**58.38**	387.65	385.82	**386.73**
T_3(G 1.5 t/ha + J 0 %)	326.50	323.75	**325.13**	51.50	50.75	**51.13**	319.87	315.27	**317.57**
T_4(G 2.0 t/ha + J 10 %)	374.50	371.25	**372.88**	58.25	57.16	**57.71**	371.89	368.63	**370.26**
T_5(G 2.0 t/ha + J 20 %)	386.75	379.00	**382.88**	61.50	61.21	**61.35**	378.52	375.80	**377.16**
T_6 (G 2.0 t/ha + J 0 %)	336.75	332.25	**334.50**	52.95	51.12	**52.04**	318.19	309.99	**314.09**
T_7(G 0 t/ha + J 10 %)	334.25	331.75	**333.00**	51.65	50.29	**50.97**	305.95	311.89	**308.92**
T_8(G 0 t/ha + J 20 %)	348.75	347.25	**348.00**	55.75	54.94	**55.35**	340.05	337.40	**338.73**
T_9(G 0 t/ha + J 0 %)	310.50	307.75	**309.13**	50.53	49.85	**50.19**	275.23	274.06	**274.64**
Mean	354.69	351.44		55.49	54.08		337.17	334.97	
	SE	**CD** (P=0.05)		**SE**	**CD** (P=0.05)		**SE**	**CD** (P=0.05)	
Main Plot (I)	0.62	1.97		0.42	1.34		0.53	1.68	
Sub Plot (T)	7.57	15.22		3.38	6.80		7.94	15.96	
MS (I*T)	10.70	NS		4.78	NS		11.22	NS	
G*	**Ghanjeevamrit**								
J*	**Jeevamrit**								

Table 4. Influence of natural farming practices on microbial count of soil (cfu/g)

Treatments	Bacteria (cfu/g)X 10 ^{7}			Fungi (cfu/g) X 10 ^{4}			Actinomycetes (cfu/g) X 10 ^{4}		
	Mash+ Pea	Rajmash + Radish	Mean	Mash+ Pea	Rajmash + Radish	Mean	Mash+ Pea	Rajmash + Radish	Mean
T_1 (G* 1.5 t/ha + J* 10 %)	22.42	22.17	**22.29**	4.33	4.11	4.22	7.28	7.11	**7.19**
T_2(G 1.5 t/ha + J 20 %)	23.70	23.05	**23.37**	4.82	4.43	4.63	7.87	7.58	**7.73**
T_3(G 1.5 t/ha + J 0 %)	20.32	20.10	**20.21**	4.21	4.17	4.19	7.19	7.17	**7.18**
T_4(G 2.0 t/ha + J 10 %)	22.90	22.45	**22.67**	4.71	4.39	4.55	7.96	7.39	**7.68**
T_5(G 2.0 t/ha + J 20 %)	23.50	23.27	**23.38**	5.78	5.62	5.70	8.78	8.62	**8.70**
T_6 (G 2.0 t/ha + J 0 %)	21.25	21.07	**21.16**	4.30	4.36	4.33	7.30	7.36	**7.33**
T_7(G 0 t/ha + J 10 %)	21.72	21.35	**21.53**	3.79	3.55	3.67	6.79	6.55	**6.67**
T_8(G 0 t/ha + J 20 %)	22.05	21.77	**21.91**	4.27	4.19	4.23	7.27	7.19	**7.23**
T_9(G 0 t/ha + J 0 %)	14.70	14.42	**14.56**	2.40	2.33	2.36	5.40	5.33	**5.36**
Mean	21.39	21.07		4.29	4.13		7.31	7.14	
	SE	**CD** $_{(0.05)}$		**SE**	**CD** $_{(0.05)}$		**SE**	**CD** $_{(0.05)}$	
Main Plot (I)	0.46	1.46		0.04	0.14		0.04	0.12	
Sub Plot (T)	7.67	15.42		0.65	1.30		0.64	1.29	
MS (I*T)	10.84	NS		0.91	NS		0.91	NS	
G*				**Ghanjeevamrit**					
J*				**Jeevamrit**					

Fruit weight, total sugar and yield of kiwi fruit

A perusal of the data (Table 5) pertaining to effect of natural farming inputs and intercropping exhibited significant effects on fruit weight and total sugar (%) among different treatments and their interactions. Among different treatments, heaviest fruit was yielded in treatment T_5 weighing 76.96 g while the lightest fruit weight was yielded in treatment T_9 weighing 54.88 g. Among interactions between treatments and intercrops, heaviest fruit weight of 77.74 g was reported in intercrops combination 1 with treatment T_5 which was statistically on par with intercrops combination 2 with treatment T_5. The application of different treatments exerted significant influence on the total sugar (%) content in kiwifruit. Among different treatments, highest total sugar was recorded in 5.90 % in treatment T_5 while the lowest was recorded in T_9 (4.06 %). Intercrop combination 1 shows statistically higher TSS content of 5.25 % compared to intercrop combination 2 (5.14 %). Our results got support from the previous works which reported that the increase in total sugar may be attributed to the conversion of reserved starch and other insoluble carbohydrates into soluble sugars (27, 28).

Table 6 indicates that different dozes of Ghanjeevamrit and Jeevamrit exhibited remarkable difference in yield of kiwi fruit. Maximum average yield (122.01 q/ha) was obtained in T_5Ghanjeevamrit 2.0 t/ha + Jeevamrit 20 %) which was statistically at par with T_2 (Ghanjeevamrit 1.5 t/ha + Jeevamrit 20 %) i.e. 117.76 q/ha and least in T_9 (79.7 q/ha). Better yield (100.38 q/ha) was recorded for intercrops combination 1 as compared to intercrops combination 2 (98.2 q/ha). Interaction between different treatments and intercrops was found to be non-significant which implies that there is no effect of different intercrop combinations over yield. Further, crop equivalent yield was found to be maximum in T_5(144.73q/ha) followed by T_2 (129.75 q/ha) while, minimum in T_9 (86 q/ha). Intercrop combination-1 (pea + mash) was superior in terms of yield (112.86 q/ha) as compared to Intercrop combination-2 (radish+rajmash) (112.05 q/ha). However, again interaction between treatments and intercrop combination was found to be non-significant. Application of Ghanjeevamrit + Jeevamrit + intercropping (Pea + mash) produced significantly higher yield of kiwi fruit. This may be due to increased availability of nutrients due to build-up of soil micro flora resulting from increased bacteria, fungi, actinomycetes, P solubilizes and N

Table 5. Influence of natural farming practices on fruit weight (g) and Total sugar (%)

Treatments	Fruit weight (g)			Total sugar (%)		
	Mash+ Pea	Rajmash + Radish	Mean	Mash+ Pea	Rajmash + Radish	Mean
T_1 (G* 1.5 t/ha + J* 10 %)	64.49	63.52	64.01	5.68	5.68	5.68
T_2(G 1.5 t/ha + J 20 %)	73.53	72.63	73.08	5.82	5.79	5.81
T_3(G 1.5 t/ha + J 0 %)	59.27	59.03	59.15	4.19	4.10	4.15
T_4(G 2.0 t/ha + J 10 %)	70.08	67.49	68.78	5.75	5.72	5.74
T_5(G 2.0 t/ha + J 20 %)	77.74	76.18	76.96	5.92	5.88	5.90
T_6 (G 2.0 t/ha + J 0 %)	60.39	60.06	60.22	4.89	4.39	4.64
T_7(G 0 t/ha + J 10 %)	61.63	60.69	61.16	5.29	5.22	5.25
T_8(G 0 t/ha + J 20 %)	62.76	66.67	64.71	5.62	5.43	5.52
T_9(G 0 t/ha + J 0 %)	51.10	58.67	54.88	4.09	4.04	4.06
Mean	64.55	64.99		5.25	5.14	
	SE	**CD** $_{(P=0.05)}$		**SE**	**CD** $_{(P=0.05)}$	
Main Plot (I)	0.47	NS		0.01	0.03	
Sub Plot (T)	1.12	2.25		0.04	0.08	
MS (I*T)	1.59	3.19		0.06	0.12	
G*				**Ghanjeevamrit**		
J*				**Jeevamrit**		

Table 6. Influence of natural farming practices on yield and crop equivalent yield (q/ha) in kiwi fruit

Treatments	Yield (q/ha)		Mean	CEY- kiwi fruit with Mash+ Pea intercrops (q/ha)	CEY- kiwi fruit Rajmash + Radish intercrops (q/ha)	Mean
	Mash+ Pea	Rajmash + Radish				
T_1 (G* 1.5 t/ha + J* 10 %)	101.70	99.79	**100.74**	115.70	107.58	**111.64**
T_2(G 1.5 t/ha + J 20 %)	119.90	115.63	**117.76**	135.13	124.36	**129.75**
T_3(G 1.5 t/ha + J 0 %)	86.60	85.05	**85.82**	96.50	90.78	**93.64**
T_4(G 2.0 t/ha + J 10 %)	106.90	106.68	**106.79**	121.45	114.84	**118.15**
T_5(G 2.0 t/ha + J 20 %)	123.05	120.97	**122.01**	139.58	149.89	**144.73**
T_6 (G 2.0 t/ha + J 0 %)	89.23	87.14	**88.18**	99.79	93.16	**96.48**
T_7(G 0 t/ha + J 10 %)	95.70	93.56	**94.63**	107.08	117.17	**112.13**
T_8(G 0 t/ha + J 20 %)	99.25	96.67	**97.96**	111.88	127.28	**119.58**
T_9(G 0 t/ha + J 0 %)	81.10	78.30	**79.70**	88.60	83.40	**86.00**
	100.38	98.20		112.86	112.05	
	SE	**CD** $_{(P=0.05)}$		**SE**	**CD** $_{(P=0.05)}$	
Main Plot (Intercropping)	0.56	1.79		0.23	0.75	
Sub Plot (Treatment)	2.91	5.85		5.09	10.23	
MS (I*T) Interaction	4.11	NS		7.20	NS	
G*	**Ghanjeevamrit**					
J*	**Jeevamrit**					

fixers population in the soil which resulted in high nutrient uptake, better growth and yield (29, 30).

Conclusion

Considering the health hazards of chemical fertilizers and pesticides, farmers can adopt these environmentally beneficial traditional agricultural inputs as a production alternative. Jeevamrut and ghanjeevamrut are rich in beneficial microorganisms such as nitrogen-fixing and phosphate-solubilizing bacteria. These are low-budget preparation that enriches the soil, helps to grow microorganisms and improves the mineralization of the soil. In the current study, the application of jeevamrut and ghanjeevamrut has the additional advantage of developing disease resistance and enhancing the microbial actions on soil organic matters which in turn improves the soil pH, EC, availability of nutrients and microbiological properties. From the present study we could conclude that natural farming practices significantly improved the soil physical, chemical and biological properties of soil. Addition of Ghanjeevamrit @ 2.0 t/ha and Jeevamrit @ 20 % (T_5) was found the best in terms of yield, crop equivalent yield, leaf parameters and soil properties. Extending the research on jeevamrut and ghanjeevamrut to other areas or crops will assist in establishing its effectiveness and use in agriculture. Further studies can also investigate the optimal formulation and application methods of jeevamrut and ghanjeevamrut to maximize its impact on crop yields and environmental sustainability.

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Authors' contributions

MD collected and analysed the soil samples. AS carried out the experiment, took observations. AS carried out the experiment and took observations AV supervised the experiments and provided the important guidance to conduct the experiment. RSC, contributed by developing the ideas, guided the research by formulating the research concept. ID edited the research article, guided the research by formulating the research concept. JC supervised the experiments and provided the important guidance to conduct the experiment. SV carried out the microbial analysis of soil samples. RK editing the manuscript. B helped in analysing the data. RR helped in securing research funds and providing technical support. PS helped in securing research funds and providing technical support. M helped in revising the manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

Ethical issues: None

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