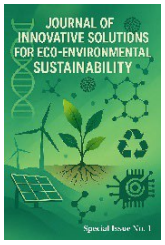
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Research Article

Effectiveness of Natural Farming and Organic Inputs on Agronomic Performance of French Bean

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ABSTRACT

The present study was undertaken to evaluate the effect of natural farming inputs on the growth of French bean (*Phaseolus vulgaris* L.). The field experiment was conducted during 2024 at Department of Horticulture, School of Agriculture, ITM University, Gwalior. The experiment consisted of nine treatments in randomized block design with three replications. The treatments were used T_1- Control, T_2- RDF (60:120:50 kg ha^{-1}), T_3- Vermicompost + 70% R.D.F., T_4- Beejamrit (1 litre/kg seed) + Jeevamrit (100 %) at weekly interval, T_5- Beejamrit (1 litre/kg seed) + Ghanjeevamrit (100 %), T_6- Beejamrit (1 litre/kg seed) + Jeevamrit (75 %) + Ghanjeevamrit (25 %), T_7- Beejamrit (1 litre/kg seed) + Jeevamrit (50 %) + Ghanjeevamrit (50 %), T_8- Beejamrit (1 litre/kg seed) + Jeevamrit (25 %) + Ghanjeevamrit (75 %) and T_9- Beejamrit (1 litre/kg seed) + Jeevamrit (80 %)+ Ghanjeevamrit (80%). Treatment no. 7 i.e. Beejamrit (1 litre/kg seed) + Jeevamrit (50 %) + Ghanjeevamrit (50 %) showed fastest 50 % germination and 50 % flowering days. Beejamrit (1 litre/kg seed) + Jeevamrit (50 %) + Ghanjeevamrit (50 %) stands out with the highest means among all treatments for leaf area and number of pods per plant. Maximum bacterial count was recorded in treatment with Beejamrit (1 litre/kg seed) + Ghanjeevamrit (100 %).

1. Introduction

French bean (*Phaseolus vulgaris* L.) is one of the world's most widely cultivated bean species with chromosome number $2n = 2x = 22$ belonging to family Fabaceae. It is commonly known by various names such as kidney bean, haricot bean, green bean, snap bean and navy bean. It is a dual- purpose crop that is grown as pulse (grain) and consumed in the immature stage as a tender vegetable [1]. It is highly nutritious vegetable crops consumed as tender pods, shelled beans and dry beans are used for preparation of a variety of dishes while the foliage is used as animal fodder [2]. It is a short duration crop, suitable for farmers seeking production in a short period of time. With proper irrigation, they can be grown throughout the year and can also be used as an intercrop in orchards because of its short duration [3]. French bean can be cultivated at low capital investment thereby generating high income. As French bean suits well to different cropping systems, the farmers should be encouraged to take up French bean for fetching good returns over capital [4]. French bean is a highly protein enriched food and is therefore known as "Vegetarian meat". Fresh pods contain about 1.7% protein, while the seeds have a significantly higher protein content of 21.1% [5]. It also contains Vitamin A, B, C, folates, minerals such as calcium, potassium, selenium, iron, phosphorous, sodium, zinc, omega 3 fatty acids, dietary fibres, amino acids and antioxidants such as lutein and beta-carotene which is anti-inflammatory [6]. Dry seed contains 69.9% carbohydrates, 1.7% fat, 381 mg Ca, 425 mg P and 12.4 mg Fe per 100 g edible part [7]. French bean has multi-facet benefits. It is known to cure diabetes, cardiac diseases, constipation and diarrhoea [8], and helps in preventing cholesterol, asthma, rheumatoid arthritis, osteoarthritis and colon cancer [9]. The world area under cultivation is 35.92 million hectares, with a total production of 27.72 million metric tonnes. In India, the cultivated area is 256 thousand hectares, producing 2520 thousand metric tonnes [10].

The unique chemical-free farming method known as Natural Farming (NF) is considered an agroecological approach. Using jeevamrit and beejamrit is the foundation of Natural Farming

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techniques [11]. Jeevamrit is a liquid fermented mixture of cow dung, cow urine, jaggery, pulse flour, and bund soil that has been mixed with water. When applied to the field or foliage, it contains a lot of beneficial microbes that act as a bio stimulant, encouraging the activity of both phyllospheric and soil microorganisms [12]. While French bean (*Phaseolus vulgaris* L.) is extensively cultivated worldwide for its nutritional value and adaptability to diverse cropping systems and Natural Farming (NF) practices like jeevamrit and beejamrit have gained recognition for enhancing soil microbial activity and crop yields through chemical-free means, current literature primarily focuses on their individual applications or standalone effects. Limited studies explore optimized combinations and proportions of jeevamrit—a liquid microbial ferment—and ghanjeevamrit—its solid counterpart—for French bean cultivation, particularly regarding pod yield, nutrient uptake, and soil health under varying application rates.

This gap hinders farmers' ability to adopt precise, cost-effective NF protocols tailored to short-duration crops like French bean. The present study addresses this by systematically evaluating multiple combinations and proportions of jeevamrit and ghanjeevamrit, assessing their impacts on growth parameters, yield, and agro-economic returns compared to conventional methods. These findings aim to provide evidence-based guidelines for sustainable French bean production.

2. Material and methods

2.1 Geographic, climatic data and soil characteristics

The experimental field is situated in the northern part of Madhya Pradesh and situated in gird zone at the latitude of 26.13° north and longitude 76.14° east with an altitude of 211.52 meters above the average sea level of the surrounding area, the site was chosen to study how natural farming inputs influence the yield and quality of french bean (*Phaseolus vulgaris* L.). The chemical properties of the soil are presented in (Table 1). The field experiment was conducted using French bean variety Kashi Sampann in a Randomized Block Design with 9 treatments replicated 3 times, resulting in 27 plots. Each plot measured $2\,m \times 1.5\,m$, with a spacing of 45×15 cm and a seed rate of 75 kg/ha. Farmyard manure was applied at 20 t/ha, alongside the recommended dose of NPK at 60:120:50 kg/ha.

Table 1. Physio-chemical properties of experimental site

Properties	Value obtained	Method employed
Soil pH	7.42	Digital pH meter
Soil EC	0.35 dS/m	Electrical conductivity meter
Microbial count	45.33	Serial dilution

According to the treatment plot, 70% of the recommended dose of fertilizer (RDF) was combined with vermicompost and combined into the soil during field preparation to ensure uniform distribution across the root zone. Farmyard manure (FYM) was applied separately in selected plots. Different amounts of ghanjeevamrit (25%, 50%, 75%, 80% and 100%) of the recommended dosage were added to the soil at weekly intervals, also mixed near the root zone or evenly spread around the base of the plants. In addition, jeevamrit was applied to the foliage at the same concentration levels (25%, 50%, 75%, 80% and 100%) as part of the treatment schedule. Beejamrit, Ghanjeevamrit, and Jeevamrit were prepared according to the standardized protocol outlined in [13]. Jeevamrit was prepared by combining 1 kg fresh cow dung, 1 liter cow urine, 10 g lime, a handful of soil, and 2 liters water in a plastic drum, followed by mixing jaggery, pulse flour, and live soil into water to achieve a final volume of 200 liters. The mixture was stirred clockwise for 2 minutes each morning and evening using a wooden stick for one week to ensure proper fermentation. After filtration, the solution was ready for use. Jeevamrit was applied as a soil drench at 5%, 10%, and 15% concentrations according to the treatments, at 1.5 L/m², with applications at 21-day intervals. Ghanjeevamrit was prepared using 100 kg cow dung from indigenous cows, 10 liters cow urine, 1 kg jaggery, 2 kg pulse flour, and a handful of live soil. All ingredients were thoroughly mixed and formed into a heap, covered with gunny bags, and stored in a shady place for 48 hours. The mixture was then spread on a clean surface, shaped into balls, and sun-dried. Once dried, the balls were crushed into powder form, packed into sacks, and stored in a cool, dry place for later use. The nutrient composition of natural farming formulations revealed that jeevamrit contained 1.54% N, 0.17% P, and 0.29% K, while ghanjeevamrit had higher levels at 1.59% N, 0.58% P, and 0.96% K].

Table 2. Details of the treatments used in study

Treatment codes	Treatment Details
T_1	Control
T_2	RDF (60:120:50 kg ha-1)
T_3	Vermicompost + 70% R.D.F.
T_4	Beejamrit (1 litre/kg seed) + Jeevamrit (100 %) at weekly interval
T_5	Beejamrit (1 litre/kg seed) + Ghanjeevamrit (100 %)
T_6	Beejamrit (1 litre/kg seed)+ Jeevamrit (75 %) + Ghanjeevamrit (25 %)
T_7	Beejamrit (1 litre/kg seed)+ Jeevamrit (50 %) + Ghanjeevamrit (50 %)
T_8	Beejamrit (1 litre/kg seed)+ Jeevamrit (25 %) + Ghanjeevamrit (75 %)
T_9	Beejamrit (1 litre/kg seed) + Jeevamrit (80 %) +Ghanjeevamrit (80%)

2.2 Observations recorded characteristics

The growth parameters are like days to 50 % germination, shoot length (cm), root length (cm), days to 50 % flowering, plant height (cm) at 30, 45 and 60 days after sowing, leaf area plant^{-1} (cm^2). Yield and quality attributes like number of green pods per plant, length of pod (cm), diameter of pod (cm), yield per plant (g), yield per plot (kg), yield (q/ha), total soluble solids (^{o}Brix), ascorbic acid (mg/100g) and total bacterial count (10^6) CFU.

2.3 Statistical analysis methods

The data recorded was be analyzed using MS-Excel and OPSTAT as per the design of experiment. The data recorded on different parameters has been statistically analyzed by using randomized block design (RBD) given by [14]. The least significant difference (RBD) method was used to test the differences between treatment means at the 5% level of probability.

3. Result and discussions

Data were subjected to Analysis of Variance (ANOVA) using Randomized Block Design (RBD) principles, with treatment

means compared using Critical Difference (CD) at 5% level of significance ($p \leq 0.05$). ANOVA assumptions of normality (tested via Shapiro-Wilk or Kolmogorov-Smirnov) and homogeneity of variances (tested via Levene's or Bartlett's test) were verified prior to analysis. Data pertaining to number of days to 50% germination which has range between (7.26) to (10.64) days. The number of days to 50% germination was significantly highest in T_1 10.64 to rest of the treatments which was found statistically at par with T_2 (8.31), T_3 (8.21), T_6 (8.10), T_8 (8.38), T_9 (8.18) (Table 3). Combined application of jeevamrit with vermicompost, FYM and ghanjeevamrit showed earliness in 50 % germination as compared with sole application of jeevamrit. The earliness in germination might be due to the treatment of seeds with beejamrit solution and application of jeevamrit ameliorate the negative inhibition and improve the metabolic process of seeds from germination to seedling emergence [15,16,17] has also reported early germination in french bean and vegetable pea where seeds were treated with beejamrit solution.

The shoot length range between (30.29 cm) to (22.83 cm). However, maximum shoot length 30.29 cm was recorded in T7 beejamrit (1 litre/kg seed) + jeevamrit (50 %) + ghanjeevamrit (50 %), which was found to be statistically at par with T_6 (27.38), T_8 (27.50), T_9 (26.02) (Table 3). Ghanjeevamrit, the solid version of jeevamrit, serves as a slow-release natural amendment. When applied to the soil, it continuously enriches soil microbial diversity and improves soil structure and moisture retention [18]. Over time, this results in improved root development and sustained nutrient release, contributing to steady shoot growth throughout the vegetative phase observed significantly greater shoot length in french bean under ghanjeevamrit treatment compared to both control and traditional farmyard manure applications [19].

The data recorded of root length has range between (18.30 cm) to (12.83 cm). Maximum root length 18.30 cm was recorded in T_7 beejamrit (1 litre/kg seed) + jeevamrit (50 %) + ghanjeevamrit (50 %), which was followed by T_4 (13.70), T_5 (13.54), T_6 (13.90) and T_8 (13.50) (Table 3). An outcome of higher availability of macronutrients in the soil which promoted strong root growth and resulted in better N fixation with overall improved growth of plant in treatment. These factors in turn led to higher photosynthetic activity and the translocation of carbohydrates from source to sink, which improved plant development and ultimately increased the root growth of plant. Jeevamrit enhanced solubilization and uptake of nutrients and enhance plant growth [20].

Table 3. Effect of natural farming inputs on days to 50% germination, shoot length, root length, days to 50% flowering, plant height (cm), leaf area palnt^{-1} (cm^2), number of green pods per plant of french bean

Treatments	Days to 50% germination	Shoot length (cm)	Root length (cm)	Days to 50% flowering	Plant height (cm)	Plant height (cm)	Plant height (cm)	Leaf area plant^{-1} cm^2	No. of green pods per plant
					30 days	45 days	60 days		
T_1	10.64^{a}	22.83^{c}	12.83^{bc}	40.21^{a}	10.61^{bc}	20.07^{c}	22.26^{d}	25.03^{c}	20.07^{g}
T_2	8.31^{ab}	24.77^{bc}	14.30^{ab}	37.24^{ab}	12.25^{b}	23.75^{bc}	24.86^{c}	28.37^{bc}	24.35^{ef}
T_3	8.21^{ab}	23.76^{bc}	12.98^{bc}	36.83^{b}	12.59^{b}	24.83^{b}	26.11^{c}	30.18^{b}	23.99^{f}
T_4	7.94^{b}	24.04^{bc}	13.70^{b}	37.48^{ab}	13.97^{ab}	26.24^{ab}	28.08^{b}	34.11^{ab}	28.98^{b}
T_5	7.67^{b}	25.02^{b}	13.54^{b}	36.26^{b}	12.34^{b}	25.59^{b}	28.76^{ab}	30.95^{b}	25.65^{cd}
T_6	8.10^{ab}	27.38^{ab}	13.90^{b}	36.24^{b}	12.50^{b}	26.65^{ab}	28.25^{ab}	27.79^{bc}	25.03^{de}
T_7	7.26^{b}	30.29^{a}	18.3^{a}	35.24^{bc}	16.38^{a}	31.61^{a}	36.66^{a}	37.27^{a}	31.71^{a}
T_8	8.38^{ab}	27.50^{ab}	13.50^{b}	36.05^{b}	12.31^{b}	24.15^{bc}	26.43^{bc}	29.64^{b}	26.55^{c}
T_9	8.18^{ab}	26.02^{ab}	13.42^{b}	36.31^{b}	11.88^{bc}	23.63^{b}	25.57^{c}	28.42^{bc}	27.52^{b}
SEm (±)	0.50	1.10	0.82	0.80	0.89	1.23	0.80	1.47	0.45
CD 5%	1.07	2.34	1.75	1.70	1.89	2.61	1.70	3.12	0.96

Significant at 5% level of significance ($p \leq 0.05$)

Data pertaining to number of days to 50% flowering which has range between (35.24) to (40.21) days. Minimum number of days to 50% flowering was recorded in T_7 (35.24), while the maximum number of days to 50% flowering was recorded in T_1 (40.21), Which was followed by T_2 (37.24) and T_4 (37.48) (Table 3). Jeevamrit with vermicompost, FYM and ghanjeevamrit showed earliness in 50 % flowering as compared to sole application of jeevamrit. The earliness in flowering might be because of combined application of bio-organic nutrient sources increase the population and activity of microbes in soil which was beneficial for nitrogen fixation, phosphate solubilization and they help in transport of growth promoting substances like cytokinin to the axillary buds. Eventually they make a better sink for faster mobilization of photosynthates and early transformation of plant parts from vegetative phase to reproductive phase [21, 22]. These findings are consistent with those who reported the earliness of flowering in pea crop by the combined application of organic nutrient sources [23, 24].

Plant height (cm) at 30 days was observed significantly different and its range showed between (16.38 cm) to (10.21 cm). Maximum plant height (30 days) 16.38 cm was recorded in T_7, which was found statistically at par with T_4 (13.97 cm). While the minimum plant height (30 days) 10.21 cm was recorded in T_1. The jeevamrit and ghanjeevamrit had significant influenced on plant height (45 days cm). Plant height range between (31.61cm) to (20.07 cm). Maximum plant height 31.61 cm was recorded in T_7, which was found statistically at par with T_4 (26.24 cm), T_6 (26.65 cm). While the minimum plant height (20.07 cm) was observed in T_1.

Plant height range between (36.66 cm) to (22.26 cm). Maximum plant height (60 days cm) 36.66 cm was recorded in T_7, while the minimum plant height was recorded in T_1. The similar results have been reported on enhancement of plant height in pea crop with application of organic nutrient source [25]. The plant height of field bean was significantly increased with the application of jeevamrit@ 1000 l/ha. The application of jeevamrit@ 1500 l/ha recorded significantly taller plants of field bean which was at par with Jeevamrit@1000 l/ha [26, 27].

Leaf area plant^{-1} (cm^2) range between 37.27 to 25.03. Maximum Leaf area plant^{-1} (cm^2) was recorded in T_7 (37.27). The

increase in leaf area plant might be due to increased availability of nitrogen from natural formulation viz. jeevamrit. Inoculation of plant beneficial microorganisms through jeevamrit in the root zone and available nitrogen content in soil might have resulted in increased vegetative growth. Micro-organisms inoculation in rhizosphere might have resulted in production of plant growth regulators and biological nitrogen fixation which further improved the vegetative growth of plants [28]. Better development of root system and synthesis of plant growth hormones might have resulted in better growth of crop plants [29,30].

Number of green pods per plant ranges between (31.71) to (20.07). Maximum number of green pods per plant was 31.71 recorded in T_7 jeevamrit and ghanjeevamrit in equal amounts (50% each). While the lowest number of green pods per plant 20.07 was recorded in T_1. While the combination of vermicompost and jeevamrit recorded highest pod yield per plant, jeevamrit with FYM and ghanjeevamrit, these treatments nutrient sources enhanced root nodulation through improved root development and nutrient availability, leading in vigorous plant growth and dry matter production which resulting in better flowering, fruiting and pod formation [31].These findings lend support to the observations in pod yield per plant in pea crop [32,22,33,34].

Significant variation on length of pod was observed in the experiment, which is presented in Figure 1. Maximum length of pod 13.58 cm was recorded in T_8, Beejamrit (1 litre/kg seed) + Jeevamrit (25 %) + Ghanjeevamrit (75 %), which is followed by T_7 (13.55 cm). The pod length varies from 13.58 cm to 10.35 cm. The considerable increment in pod length maybe attributable to greater concentrations of the nutrients N (0.16 %), P (0.02 %), and K (0.123 %) which was supplied through jeevamrit, soil application [35].

The data recorded on diameter of pod is presented in Figure 1. The diameter of pod range between (0.83 cm) to (0.75 cm). Maximum diameter of pod 0.83 cm was recorded in T_2, while the minimum diameter of pod 0.75 cm was recorded in T_3. This effect of increase in pod diameter might be due to the good vegetative growth already attained by the plants which in turn might have increased the total food reserve ultimately increasing the pod diameter, reported similar findings with french bean [36, 37,38].

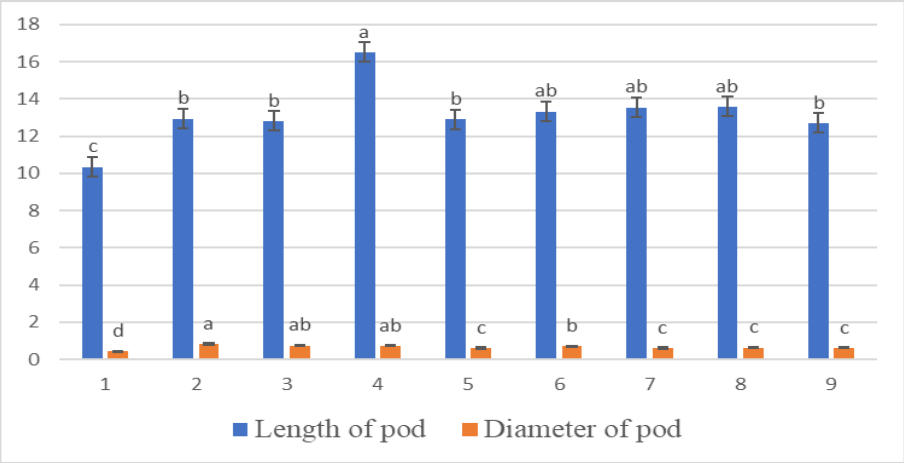


Figure 1. Effect of beejamrit, jeevamrit and ghanjeevamrit on length of pod and diameter of pod in french bean. Values in each column followed by the same letter are not significantly different.

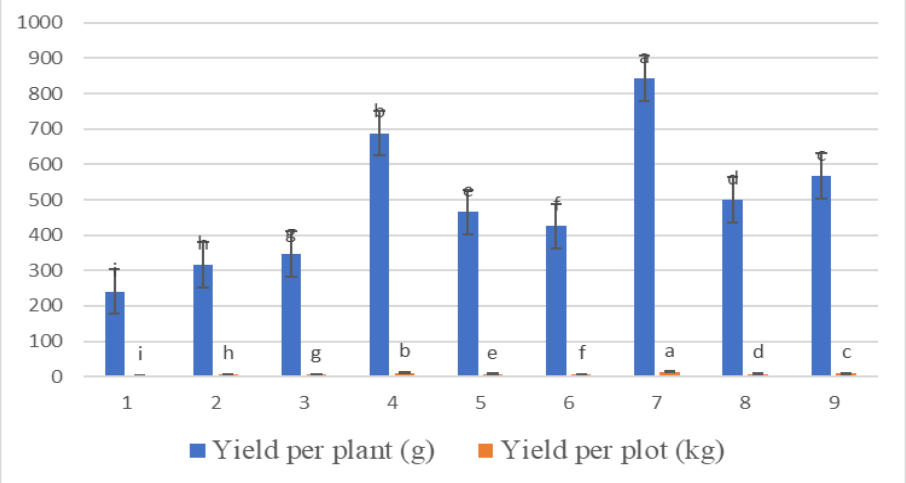


Figure 2. Effect of beejamrit, jeevamrit and ghanjeevamrit on yield per plant (g) and yield per plot (kg) in french bean. Values in each column followed by the same letter are not significantly different.

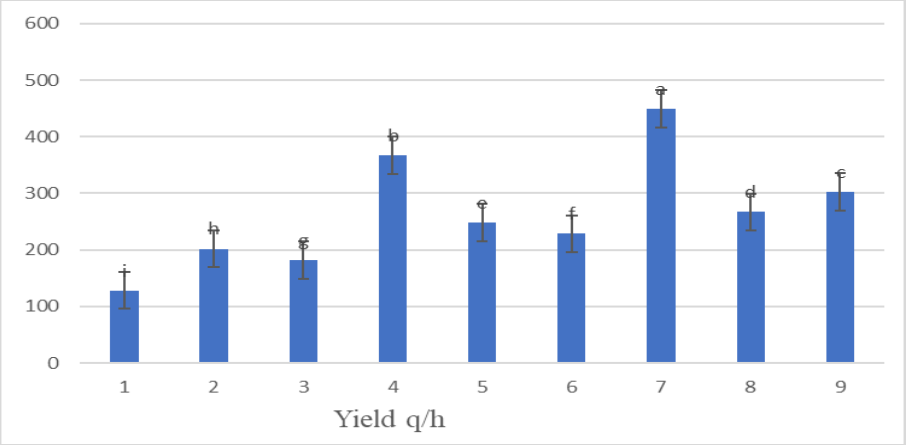


Figure 3. Effect of beejamrit, jeevamrit and ghanjeevamrit on yield q/h in french bean. Values in each column followed by the same letter are not significantly different.

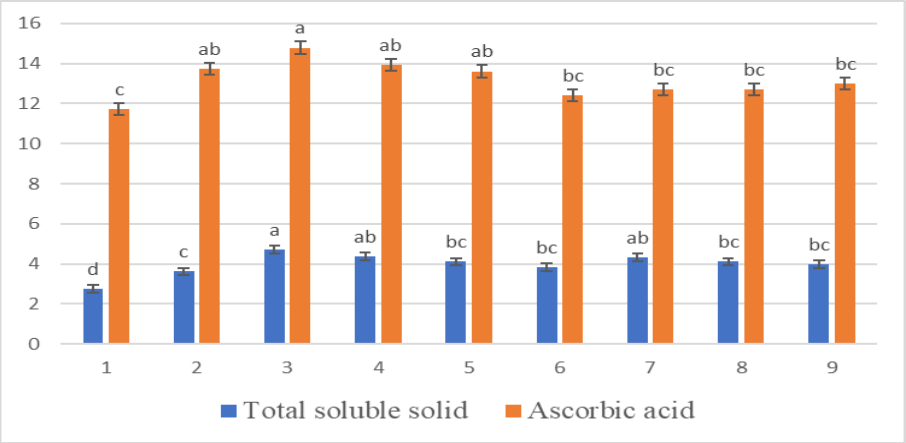


Figure 4. Effect of beejamrit, jeevamrit and ghanjeevamrit on total soluble solid and ascorbic acid in french bean. Values in each column followed by the same letter are not significantly different.

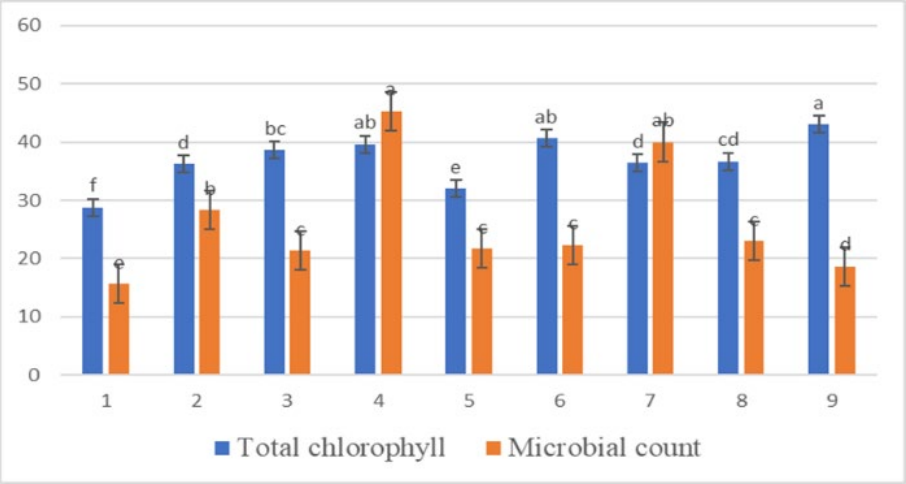


Figure 5. Effect of beejamrit, jeevamrit and ghanjeevamrit on total chlorophyll and microbial count in french bean. Values in each column followed by the same letter are not significantly different.

Yield per plant (g) was significantly influenced in all the treatments taken in the experiment, which is presented in Figure 2. Maximum yield per plant was recorded in T_7 (843 g) which was significantly superior than rest other treatments. The results of present study are also similar with those of [26] in field bean, who recorded significantly higher grain yield with the application of jeevamrit @ 1500 l/ha. Further, [25] also reported similar results in cowpea with the use of Jeevamrit at 1000 l/ha.

Yield per plot (kg) was significantly influenced in all the treatments taken in the experiment, which is presented in Figure 2. Maximum yield per plot (kg) was recorded in T_7 (13.48 kg) which was significantly superior than rest other treatments, while the minimum yield per plot 3.48 kg was recorded in T_1 which is significantly inferior to all other treatments. These results are in

accordance with the findings of [39] in pea where significantly higher yield was recorded with the combined application of jeevamrit with panchagavya and vermicompost. This may be due to better vegetative growth (number of branches, plant height and leaf area) and a greater number of fruits per plant [40,41,42].

Yield q/h was significantly influenced in all the treatments taken in the experiment, which is presented in Figure 3. Maximum yield was recorded in T_7 (499.39 q/ha) which was significantly superior than rest other treatments, while the minimum yield 128.03 q/ha was recorded in T_1 which was significantly inferior to all other treatments. The treatments comprised of vermicompost with jeevamrit resulted in maximum pod yield per hectare as compared with sole jeevamrit, jeevamrit with FYM and ghanjeevamrit or with combined application of natural and fertilizers. This was due to the synergistic impact of bio-organic nutrient sources that include all necessary macro and micronutrients for crop growth and yield and plays a vital role in vegetative and reproductive development of the plant [34]. These results are in accordance in pea where significantly higher yield was recorded with the combined application of jeevamrit with panchagavya and vermiwash [39]. These result findings are under the confirmation of pod yield per hectare in pea crop by the application of different nutrient sources [22,33].

Total soluble solids (oBrix) ranges between (4.71) to (2.74) which is presented in Figure 4, maximum total soluble solid 4.71 was recorded in T_3, which was found to be statistically at par with T_2 (3.62). Jeevamrit with vermicompost had the highest TSS content compared to jeevamrit with FYM, ghanjeevamrit, and solitary application of jeevamrit. Bio-organic nutrient sources may promote plant growth by enhancing physiological processes like carbohydrate and sucrose synthesis, resulting in sweeter grains [43].

Found that employing nutrient sources resulted in a similar increase in TSS in pea as other treatments [44,33]. High TSS in treatment T_3 might be due to increase in photosynthetic activity which resulted in improved levels of carbohydrates of through the way of enzymatic activity as stimulated by plant growth substances produced by application of jeevamrit and other nutrients [45]. Accelerated mobility of photosynthates from source to sink, as well as improved carbohydrate metabolism affected by growth hormones, may have resulted in higher total soluble solids content. Found that applying vermicompost to tomatoes resulted in the highest TSS levels [46].

Ascorbic acid (mg/100g) ranges between (14.79) to (11.73) which is presented in Figure 4, maximum ascorbic acid (mg/100g) was recorded in T_3 (14.79), which was found to be statistically at par with T_5 (13.60), while the minimum value for ascorbic acid 11.73 was recorded in T_1. These inputs also influence ascorbic acid (vitamin C) content, a critical antioxidant compound that contributes to the plant's defence system and human nutritional quality [47]. Ascorbic acid synthesis is closely linked to the plant's metabolic status and availability of micronutrients like copper, zinc, and manganese. Jeevamrit enhances these micronutrients through microbial action which is turn into stimulates antioxidant activity. Found that french bean treated with jeevamrit exhibited a notable increase in ascorbic acid concentration in pods, indicating enhanced nutritional quality [48].

Total chlorophyll (mg/100g) ranges between (43.07) to (28.77) which is presented in Figure 5, the maximum total chlorophyll content 43.07 was recorded in treatment T_9, while the minimum total chlorophyll content 28.77 was recorded in T_1.

The use of natural farming inputs such as beejamrit, jeevamrit, and ghanjeevamrit has been found to significantly enhance the chlorophyll content in french bean (*Phaseolus vulgaris*), thereby improving photosynthetic activity and overall crop performance [49]. These natural formulations are central to the Zero Budget Natural Farming (ZBNF) approach promoted by Subhash Palekar and have been widely recognized for their role in enhancing soil health and plant physiology [29]. Discovered that applying jeevamrit significantly boosted chlorophyll content in tomato plants, which helped to improve photosynthetic efficiency to promote healthier and more vigorous development [50].

Total bacterial count (106) CFU ranges between (45.33) to (15.66) which is presented in Figure 5, maximum bacterial count 45.33 was recorded in T_5. Reported that jeevamrit application increased the bacterial population in rhizosphere soil by providing carbon sources and favourable pH conditions [51]. The population of beneficial rhizobacteria increased significantly compared to control plots. observed that ghanjeevamrit application enriched soil microbial diversity, leading to higher counts of nitrogen-fixing and phosphate-solubilizing bacteria in legume crops [52]. Demonstrated that beejamrit-treated seeds exhibited early colonization by beneficial microbes, which subsequently enhanced root growth and microbial population in the rhizosphere [53]

4. Conclusion

On the basis of the data recorded, it was observed that the performance of beejamrit (**1 litre/kg** seed) + jeevamrit (50%) + ghanjeevamrit (50%) (T_7) was significantly highest for growth, yield and quality parameters. However, the growth parameter i.e., length of pod (cm) was significantly maximum in T_4 beejamrit (**1 litre/kg** seed) + jeevamrit (100%) at weekly interval while, the diameter of pod (cm) significantly maximum with T_5 beejamrit (**1 litre/kg** seed) + ghanjeevamrit (100%). The total chlorophyll content was recorded highest in plants of T_9 beejamrit (**1 litre/kg** seed) + jeevamrit (80 %) + ghanjeevamrit (80%). Whereas the total soluble solids were highest in T_3 [Vermicompost + 70% R.D.F.] with respect to control. Microbial count was recorded highest in T_4 beejamrit (1 litre/kg seed) + jeevamrit (100 %) at weekly interval. Thus, it can be concluded that the treatment combination of beejamrit (**1 litre/kg** seed) + jeevamrit (50%) + ghanjeevamrit (50%) was effective in significantly improving the yield of french bean over the control.

Data Availability Statement

The original contributions presented in the study are included in the article; further inquiries can be directed to the corresponding author.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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