



Minimising Agrochemicals Dependency Through Native Fermented Concoctions: Integrated Nutrient Management Practice for Broccoli Production

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Abstract: Minimising agrochemical dependency to maintain soil fertility and productivity in broccoli (*Brassica oleracea* L. var. *italica* Plenck), an integrated nutrient management approach is a prerequisite. Standardizing doses, including inorganic fertilizers and native fermented concoctions, needs to be established for better results. Application of 90% of the recommended dose of nutrients (RDN) as 112.5 N:67.5 P:46.8 K kg ha⁻¹ + cow manure of 20 t ha⁻¹ + 5% jeevamrit [10 kg of cow dung, 10 L of cow urine, 2 kg chickpea flour, handful of soil, 2 kg of jaggery (made by boiling, filtering, and condensing sugarcane juice to prepare blocks) in 200 L of water and fermented for 7 days] @ 1.5 Lm⁻² biweekly and 5% jeevamrit foliar application at a 20-day interval produced tallest plants (58.58 cm), number of leaves per plant (17.86), days to the formation of 50% marketable heads (86.00), number of secondary heads per plant (12.93), weight of the central head per plant (417.55 g), head size (130.88 cm²), marketable yield per plot (12.61 kg) and per hectare (18.67 Mt) and harvest duration (41.17 days). Black rot incidence was least due to treatment with 100% RDN [(125N: 75P: 52K kg ha⁻¹) + cow manure 20 t ha⁻¹] + Beejamrit (mixed 5 kg cow dung + 5 L cow urine + 250 g lime + handful soil in 20 L water) (20.68 %) used for seed treatment. All native fermented concoctions proved to be beneficial for sustainable vegetable production.

Keywords: Broccoli, Beejamrit, Jeevamrit, Ghana Jeevamrit

The hunger and poverty intensify globally, strategic planning in agriculture is crucial for food security and poverty alleviation. The Pradhan Mantri Dhan Dhanya Yojana, a recent initiative, promotes sustainable farming in 100 low productivity districts to enhance the income of 17 million farmers, with Integrated Nutrient Management (INM) playing key role in supporting their transition towards improved yields and sustainable agricultural practices (Ministry of Finance 2025, The Indian Express 2025).

Historic evidence supports the use of native natural fertilizers and soil amendments for enhancing productivity by securing soil fertility. However, modern agriculture, propelled by scientific advancements and food security concerns, has transitioned to an industrial model reliant on agrochemicals (Verma et al., 2020, Das et al., 2022, Saharan et al., 2023, Goss et al., 2013, Pandian et al., 2024;). While Green Revolution increased production and profitability, it also brought health issues and economic burdens (Rahman 2015, Ameen and Raza 2018, Bjornlund & Bjornlund, 2024, Swastika et al., 2024). This industrial farming model has led to severe social, environmental and economic consequences ranging from health impacts and loss of crop diversity to soil fertility decline and financial strain (Horrigan et al., 2002, Alletto et al., 2022). Despite these challenges, scientific research often influenced by corporate interests

continues to promote agrochemicals (Aktar et al., 2009, Lin et al., 2011, Popp et al., 2013, Ncube, 2020, Ahmad et al., 2024). This has increased farmers' reliance on market-driven agricultural inputs under the guise of improving soil and crop health. However, natural farming, which reduces dependence on chemicals and utilizing locally available resources (Jallow et al., 2017, Khan et al., 2021).

In contrast, natural farming is a chemical-free alternative, using farm-based inputs like cow dung, fermented plant concoctions and improved agronomic practices (Laishram et al., 2022, Vashishat et al., 2023). Key components of natural farming include Beejamrit (a seed treatment solution), Jeevamrit (a liquid bio-fertilizer and pest repellent, also available in solid form as Ghanjeevamrit), Achhaddan (live or dead mulching) and Whapsa (soil aeration and moisture management techniques) enhance soil health, yield and disease resistance (Devakumar et al., 2014, Bhadu et al., 2021).

Overuse of chemical fertilizers has degraded soil and increased health risks including nitrate accumulation in crops like broccoli (Webb and Buratini, 2018). Fermented organic concoctions like Jeevamrit (Enhance mineralization, boost microbial activity), Beejamrit (protects against seed borne diseases through antibacterial and antifungal properties) and Ghanjeevamrit (improve soil fertility) offer a sustainable

alternative. These manures enhance soil fertility, crop vigour and organic matter decomposition (Devakumar et al., 2014, Hammad et al., 2019;).

These cost-effective, locally sourced inputs support sustainable agriculture and aim to revive pre-Green Revolution practices prioritizing environment and farmer well-being (Vashishat et al., 2021, Shraddha et al., 2023, Vashishat et al., 2024;). This study evaluates the integrated effects of bio-enhancers and chemical fertilizers on yield and quality of broccoli, contributing to the broader movement toward sustainable and eco-friendly agricultural practices.

MATERIAL AND METHODS

The experiment was conducted at Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India, during winter seasons of 2018-2019 and 2019-2020. The experimental farm lies at 30° 52' north latitude and 77° 11' east longitude. The farm's location is in a sub-humid, sub-temperate, and mid-hill climatic zone. The field experiment was conducted with 3 replications arranged in a randomised complete block design. The two-year field experiment was conducted with ten treatments, T₁- RDN {(125N: 75P: 52K kg ha⁻¹) + FYM 20 t ha⁻¹}; T₂- T₁ + Bj (Seed treatment with Beejamrit); T₃ - 90% RDN + 5% Jeevamrit soil drenching at fortnightly interval (0.5 Lm⁻²); T₄- 90% RDN + 5% Jeevamrit soil drenching at fortnightly interval (1.0 Lm⁻²); T₅ - 90% RDN + 5% Jeevamrit soil drenching at fortnightly interval (1.5 Lm⁻²); T₆- 90% RDN + 5% Jeevamrit soil drenching at fortnightly interval (0.5 Lm⁻²) + Jeevamrit foliar spray starting at 20 days after planting at 20 days interval; T₇- 90% RDN + 5% Jeevamrit soil drenching at fortnightly interval (1.0 Lm⁻²) + Jeevamrit foliar spray starting at 20 days after planting at 20 days interval; T₈- 90% RDN + 5% Jeevamrit soil drenching at fortnightly interval (1.5 Lm⁻²) + Jeevamrit foliar spray starting at 20 days after planting at 20 days interval; T₉ - 90% RDN + Ghana Jeevamrit soil application at 15 and 45 DAP @ 200 kg ha⁻¹; T₁₀- 90% RDN + Ghana Jeevamrit soil application at 15 and 45 DAP @ 200 kg ha⁻¹ + Jeevamrit 5 % foliar spray starting at 20 days after planting at 20 days interval.

All the organic preparations were prepared according to the method given by Devvrat (2017). Beejamrit was prepared by mixing cow dung (5 kg), cow urine (5 L), lime (250 g), soil (handful) and water (20 L) and was left out for 24 hours for the fermentation process to carry out (Fig. 1). Twice daily, the mixture was stirred. This mixture was added with the seeds, thoroughly mixed, and then allowed to dry in the shade. For Jeevamrit in a plastic drum, fresh cow manure (10 kg) and cow urine (10 L) were added. Water was combined with jaggery (2 kg), pulse flour (2 kg), and living soil (Handful) to

create a final volume of 200 L (Fig. 2). Twice daily, mix all the ingredients in a clockwise motion (morning and evening). The solution was filtered on the fifth day, and the filtrate was prepared for soil drench by diluting it. For soil drenching, Jeevamrit @ 5 per cent (5 L per 100 L of water) was applied at fort nightly interval. The very first application was given from seventh day of sowing and last application implemented fifteen days before harvesting. For foliar application the filtrate was diluted with water and 5 % solution was applied at 20 days interval. Ghana Jeevamrit is the paste prepared from cow dung (100 kg), jaggery (1 kg), gram flour (2 kg), cow urine (1 L) and handful of soil. This paste was covered with a gunny bag for two days, and water was poured on top of it to keep it moist so that appropriate fermentation could occur (Fig. 3). At 15 and 45 days after transplanting, it was formed into a ball about the size of a walnut and applied in the field near the roots of the plant.

Seed of broccoli cv. Palam Samridhi were sown for seedlings. Regular watering, hoeing, and weeding were done from time to time. Approximately 1 month old seedling of broccoli were transplanted on 8 October 2018 and 14 October 2019 with the plot size of 3.0 × 1.8 m and a spacing of 60 × 45 cm. The cv. Palam Samridhi is a green-coloured type

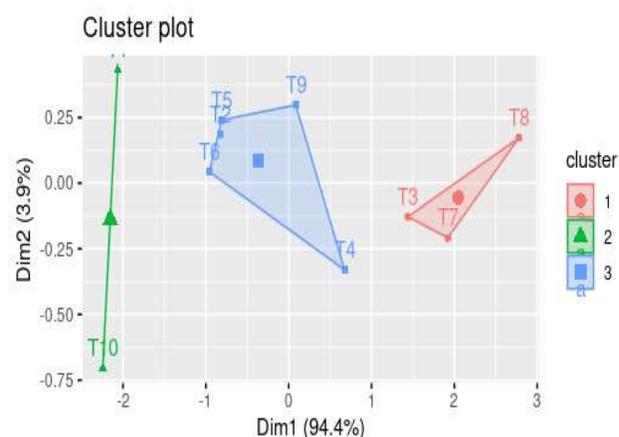


Fig. 1. Plant height cluster plot

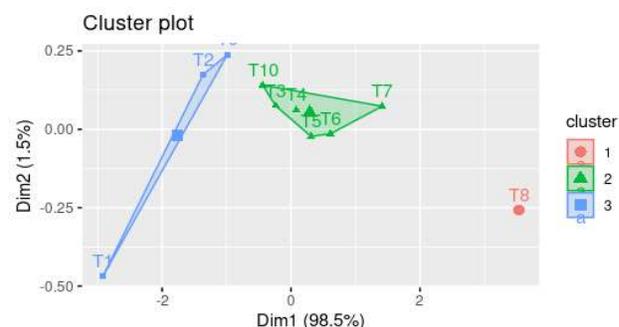


Fig. 2. Number of secondary heads per plant

that matures by 75 to 80 days after transplanting and has a net head weight of 300 to 400 g. Average yield ranges from 15000-20000 kg ha⁻¹. Calculations were done on the basis of treatments with manure, urea, SSP and MOP and desired quantity were incorporated as the basal dose. Urea was applied in split doses; the first at sowing and the remaining half again in 2 splits, first 1 month after sowing and 1 month after the first application. Five plants were randomly selected from each plot. Plant height was recorded at harvest, based on the distance from the ground to the apex of the longest leaf. Days from seedling transplanting to when 50% of plants in plots had marketable heads were determined. For head size polar and equatorial diameters of each head were measured. Numbers of days between the first central head harvest and the last secondary head harvest in each randomly chosen plant per plot was used to calculate harvest duration. Occurrence and severity of black rot, were periodically noted. Black rot disease severity was determined using 10 randomly chosen leaves from 5 plants in each plot that were at various heights (from top to bottom). According to William et al. (1972), an illness rating was performed, and the Mc Kinney (1923) method was used to compute percent disease severity. The scale for disease ratings was 0 to 9 with 0 = no visible signs; 1 = leaf marginal necrosis; 3 = small lesions in a V on the leaf; 5 = a V-shaped lesion covering half of the leaf; 7 = a V-shaped lesion reaching the midrib, and 9 = severe chlorosis and necrosis. Per-cent disease severity was determined by dividing the sum of all disease ratings by total number of ratings multiplied by maximum disease grade.

The cost of cultivation was determined. Multiplying yield by sale rate determined, gross income. The sum of fixed cost per hectare, the risk factor, the management factor, and cost of treatment per hectare was used to compute total cost of cultivation. The whole cost of cultivation was subtracted from

gross income to determine net income. Benefit cost ratio was produced by dividing net income by the total cost of cultivation (Sharma et al., 2008).

All the parameters investigated were recorded over the course of two years and subjected to statistical analysis. Pooled treatment means were compared in OPSTAT utilizing the Duncan Multiple Range Test (DMRT) at a significance level of 5% [Duncan 1955].

RESULTS AND DISCUSSION

Growth parameters: Treatment T₈ (90 % RDN (125N: 75P: 52K kg/ha) + FYM 20 @ t/ha) + 5 % Jeevamrit @ 1.5 L/m² at fortnightly interval + 5 % Jeevamrit foliar spray at an interval of 20 days) improved plant height and number of leaves (Table 1). The plant height cluster plot visually groups the data based on height (Fig. 4). Cluster 1 (Red), Cluster 2 (Green) and Cluster 3 (Blue) represent plants with relatively high, low and moderate plant height respectively.

Yield parameters: Minimum days to 50 % maturity of marketable heads was in T₈ whereas maximum days was recorded in T₉ (Table 2). In the first year, 2018-19, T₈ had the fewest days to 50% marketable head, whereas treatment T₁ had the highest. The different trend was seen in 2019–20,

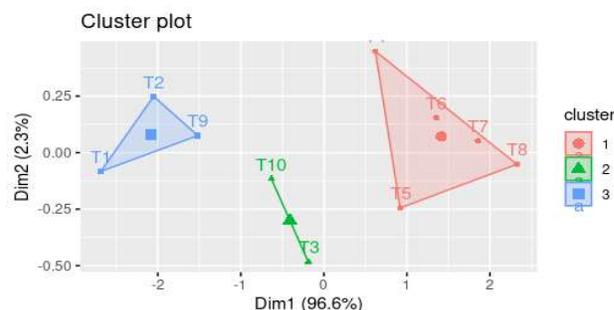


Fig. 3. Weight of central head

Table 1. Effect of native fermented amendments under an INM system on plant height and number of leaves in broccoli

Treatment	Plant height (cm)			Number of leaves		
	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
T ₁	51.00 ^f	51.90 ^c	51.45 ^e	14.25 ^c	14.49 ^b	14.37 ^b
T ₂	52.96 ^{de}	53.52 ^{bc}	53.24 ^{de}	15.33 ^{bc}	15.48 ^b	15.41 ^b
T ₃	55.93 ^{bc}	57.57 ^a	56.62 ^{abc}	15.37 ^{bc}	15.38 ^b	15.38 ^b
T ₄	55.33 ^{bc}	55.57 ^b	55.45 ^{bc}	15.62 ^{bc}	15.71 ^b	15.67 ^b
T ₅	53.08 ^{de}	53.52 ^b	53.30 ^{de}	15.66 ^{bc}	15.75 ^b	15.71 ^b
T ₆	52.33 ^{ef}	53.78 ^b	56.06 ^{bc}	15.77 ^{bc}	15.84 ^b	15.81 ^b
T ₇	56.34 ^{ab}	58.33 ^a	57.34 ^{ab}	16.07 ^b	16.10 ^{ab}	16.09 ^b
T ₈	57.76 ^a	59.39 ^a	58.58 ^a	18.13 ^a	17.59 ^a	17.86 ^a
T ₉	54.29 ^{cd}	54.86 ^b	54.57 ^{cd}	14.78 ^{bc}	14.63 ^b	14.71 ^b
T ₁₀	50.39 ^f	52.03 ^c	51.21 ^e	15.33 ^{bc}	15.43 ^b	15.38 ^b

Figures with same letter in column do not differ significantly

with treatment T₈ having the fewest number of days to emergence of 50% marketable heads, and treatment T₉ having the most days. Number of secondary heads per plant were highest in T₈ while the least was obtained in T₁. Treatment T₈ produced the most secondary heads throughout the 2018-19 growing season, whereas T₁ had least number of secondary heads. Similar pattern was seen in 2019-20. The Cluster plot (Fig. 5) visualises that Cluster 1 (Red) includes plants with a significantly high number of secondary heads, Cluster 2 (Green) represents those with a moderate number and Cluster 3 (Blue) contains plants with a low number of secondary heads.

Maximum weight of the central head was in T₈ and minimum in T₁. Similar pattern was observed in both growing seasons (Table 3). The maximum head size was in T₈. The Cluster plot accurately represents that Cluster 1 (T₅, T₆, T₇, T₈) had a high central head weight, Cluster 2 (T₃, T₁₀) represents

those with a moderate central head weight and Cluster 3 (T₁, T₂, T₉) contains plants with a low central head weight (Fig. 6). Minimum head size was in T₁. Both growing seasons saw a continuation of this pattern. Maximum harvest duration was registered in the treatment T₈. Minimum harvest duration was observed in T₁. Similar pattern was followed in both the growing seasons.

Disease resistance: Disease known as black rot, transmitted through both soil and seeds, was seen. There were substantial difference between the treatments over the 2018-19 growing season (Table 4). The treatment T₂, was determined to have the least amount of black rot severity. However, T₁ showed the highest level of black rot severity. The second year, or 2019-20, did not see the occurrence of black rot disease.

Yield and economics: There were substantial disparities between various treatments (Table 5). Pooled analysis of

Table 2. Effect of native fermented amendments under an INM system on days to 50 % marketable heads and number of secondary heads per plant in broccoli

Treatment	Days to 50 per cent marketable heads			Number of secondary heads per plant		
	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
T ₁	92.00 ^a	89.33 ^{ab}	90.67 ^a	10.93 ^d	10.67 ^e	10.80 ^d
T ₂	89.33 ^{abcd}	87.00 ^{bc}	88.17 ^{abc}	11.07 ^{cd}	11.67 ^d	11.37 ^{cd}
T ₃	90.00 ^{abcd}	88.33 ^{ab}	89.17 ^{abc}	11.33 ^{bcd}	12.13 ^{cd}	11.73 ^{bc}
T ₄	89.67 ^{abcd}	88.00 ^{abc}	88.83 ^{abc}	11.40 ^{bcd}	12.27 ^{bcd}	11.83 ^{bc}
T ₅	88.33 ^{bcd}	87.33 ^{abc}	87.83 ^{abc}	11.47 ^{bcd}	12.33 ^{bcd}	11.90 ^{bc}
T ₆	88.00 ^{bcd}	86.67 ^{bc}	87.33 ^{bc}	11.53 ^{bc}	12.47 ^{bc}	12.00 ^{bc}
T ₇	87.67 ^{cd}	86.33 ^{bc}	87.00 ^{bc}	11.67 ^b	12.87 ^b	12.27 ^b
T ₈	87.00 ^d	85.00 ^c	86.00 ^c	12.20 ^a	13.67 ^a	12.93 ^a
T ₉	91.33 ^{ab}	90.33 ^a	90.83 ^a	11.13 ^{bcd}	11.87 ^{cd}	11.50 ^c
T ₁₀	91.00 ^{abc}	88.67 ^{ab}	89.83 ^{ab}	11.27 ^{bcd}	12.07 ^{cd}	11.67 ^{bc}

Figures with same letter in column do not differ significantly

Table 3. Effect of native fermented amendments under an INM system on weight of central head, head size and harvest duration in broccoli

Treatment	Weight of central head (g)			Head size (cm ²)			Harvest duration (days)		
	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
T ₁	327.37 ^g	345.21 ^g	336.29 ^f	113.67 ^e	119.87 ^g	116.77 ^f	32.33 ^e	33.67 ^d	33.00 ^e
T ₂	339.43 ^{fg}	354.17 ^{fg}	346.80 ^{ef}	115.82 ^e	120.98 ^{fg}	118.40 ^f	33.00 ^e	35.00 ^{cd}	34.00 ^{de}
T ₃	371.63 ^{de}	381.53 ^d	376.58 ^d	121.02 ^{bcd}	125.13 ^{cde}	123.08 ^{cde}	34.67 ^{bcd}	37.33 ^{bc}	36.00 ^{cde}
T ₄	380.67 ^{cd}	399.73 ^c	390.20 ^c	122.04 ^{abc}	125.90 ^{bcd}	123.97 ^{bcd}	36.33 ^{bcd}	37.67 ^{bc}	37.00 ^{bcd}
T ₅	388.57 ^{bc}	400.73 ^c	394.65 ^c	123.66 ^{abc}	126.38 ^{bc}	125.02 ^{bcd}	36.67 ^{abcd}	38.00 ^{bc}	37.33 ^{bc}
T ₆	397.60 ^b	406.30 ^{bc}	401.95 ^{bc}	124.39 ^{abc}	126.85 ^{bc}	125.62 ^{bc}	37.00 ^{abc}	38.33 ^b	37.67 ^{bc}
T ₇	401.60 ^{ab}	418.37 ^{ab}	409.98 ^{ab}	124.92 ^{ab}	128.83 ^b	126.88 ^b	37.67 ^{ab}	41.67 ^a	39.67 ^{ab}
T ₈	414.60 ^a	420.50 ^a	417.55 ^a	125.96 ^a	135.81 ^a	130.88 ^a	39.67 ^a	42.67 ^a	41.17 ^a
T ₉	347.10 ^f	363.57 ^{ef}	355.33 ^e	117.31 ^{de}	122.37 ^{efg}	119.84 ^{ef}	33.67 ^{de}	35.67 ^{bcd}	34.67 ^{cde}
T ₁₀	364.37 ^e	374.84 ^{de}	369.61 ^d	120.48 ^{cd}	123.41 ^{def}	121.95 ^{de}	34.00 ^{cde}	36.33 ^{bcd}	35.17 ^{cde}

data revealed that maximum marketable yield was in T_8 , whereas, minimum marketable yield per plot was in T_1 . Similar pattern was observed in 2019-19 and 2019-20. The cluster analysis, based on marketable yield per plot, revealed three distinct groups. Cluster 1 (Blue) had low marketable yield per plot, Cluster 2 (Yellow) consists of samples with medium marketable yield per plot and Cluster 3 (Grey) has

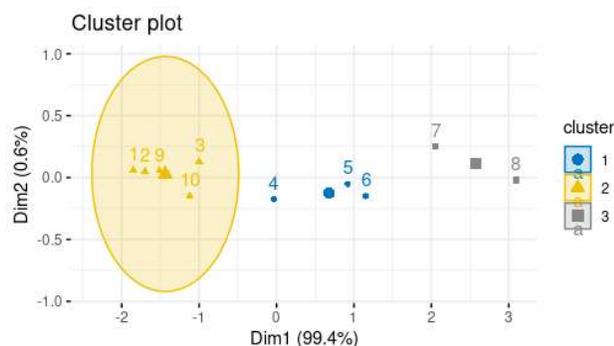


Fig. 4. Marketable yield per plot

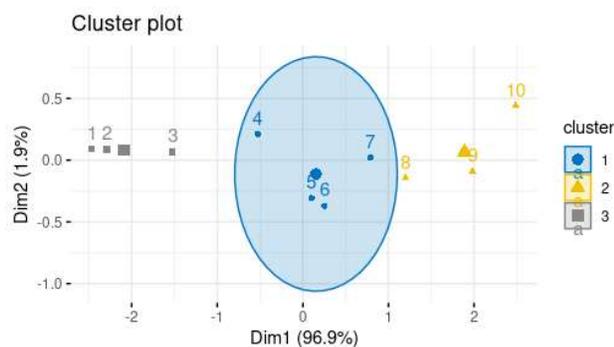


Fig. 5. Marketable yield per hectare

Table 4. Effect of native fermented amendments under an INM system on severity of black rot in broccoli

Treatment	Severity of black rot (%)
T_1	23.31 (4.93) *
T_2	20.68 (4.65)
T_3	21.95 (4.79)
T_4	22.47 (4.84)
T_5	22.63 (4.86)
T_6	22.91 (4.89)
T_7	22.21 (4.81)
T_8	22.04 (4.80)
T_9	22.78 (4.87)
T_{10}	22.61 (4.85)
CD (p=0.05)	NS

high Dim 1 score, indicating high yield (Fig. 7). Figure 8 differentiates yield levels, based on their Dim 1 values, explaining most of the variability. Cluster 1 (Blue), represents medium yield, Cluster 2 (Yellow) high yield and Cluster 3 (Grey) low yield per hectare. Pooled data disclosed that the maximum net income of ₹ 2,45,840 was obtained in T_8 (90 per cent of recommended dose of fertilizers + 5 per cent drenching with Jeevamrit @ 1.5 litres m^{-2} + 5 per cent foliar spray with Jeevamrit) with net income of ₹ 2,34,757.

The combined application of organic as well as inorganic nutrients enhanced nutrient availability, plant vigour and overall productivity of broccoli. Fermented organic concoctions contributed better soil microbial activity and nutrient assimilation, leading to increased biomass and yield. Plant height and no of leaves per plant are crucial characteristics that connects to other yield-related factors and the morphological framework of plants. While, plant height is primarily governed by genetic factors, but external environmental factors also play a role. The consistent provision of nutrients at regular intervals during all crop growth stages through Jeevamrit, may have enhanced the biological activity of plants, leading to improved cell division, elongation, and increased functional leaf area. These liquid manures could have increased growth and yield-contributing characteristics if combined with chemical fertilisers (Vishwajith and Devakumar 2018). In addition to providing enough food reserves, Jeevamrit treatment increased plant vegetative growth, which may be linked to bioformulations' larger population of benevolent bacteria. These microorganisms contributed to release of accessible nutrients and breakdown of organic materials, which led to increased growth and production (Rathore et al., 2022).

Maximum days to 50% commercial maturity could be because of nitrogen availability in the soil, which delays head initiation. Well rotten manure serves to increase the soil water retention ability and nutrient availability, thereby extending the crop cycle (Negi et al., 2017; Kayesh et al., 2019). The increased number of secondary heads per plant observed in the present study can be due to the presence of macro and micro-nutrients as well as additional hormones in fermented liquid organic manures (panchagavya, jeevamrit, beejamrit and ghana jeevamrit) that promote plant growth. Plant vegetative growth and yield-contributing characteristics may benefit from these nutrients [Kumbar and Devakumar 2016, Tiwari et al., 2017].

Yield improvements were evident through enhanced central head weight, head size, and prolonged harvest duration. The presence of beneficial microorganisms in Jeevamrut and other fermented organic amendments likely contributed to improved physical, chemical, and biological

properties of soil. Jeevamrit serves as a source for constant supply of nutrients to plants; some of these nutrients are inorganic and instantly available to plants, while the majority of the other nutrients are released gradually via the mineralization process, resulting in a constant source of nutrients for plants (Gore and Sreenivasa, 2011, Hameedi et al., 2018). Studies support that application of cow urine and farm yard manure, which are the constituents of jeevamrit, beejamrit, and ghana jeevamrit, may have caused an increase in the diameter of sunflower heads due to the beneficial bacteria in the soil which increased fertilizer use efficiency. Enhanced cell permeability causes the respiration process to accelerate, directly increasing the yield-contributing components. Researchers claim that the presence of minerals like Ca, Mg, and Fe causes the biosynthesis of phytin (isoinsitol hexaphosphate), which significantly influence yield [Manjunatha et al., 2009, Negi et al., 2017, Fazeel et al., 2019].

The severity of black rot was not significantly influenced by treatments, yet fermented liquid manures exhibited potential antifungal and antimicrobial properties that may contribute to disease suppression. Similar results in cauliflower were found, that beejamrut was effective in growth promotion and had similar response in damping off management to the chemical thiram [Khatri, 2020]. The absence of favourable conditions for the bacteria to survive may be the cause that disease did not perpetuated in second growing season.

In the rhizosphere, microorganisms frequently multiply, which may have enhanced nitrogen fixation and boosted nutrient availability. As a result, the availability of antibacterial and antifungal agents also rose [Nileema and Sreenivasa et al., 2011, Hameedi et al., 2018.]. With the addition of jeevamrit, microbes may have improved and served as a catalyst. Antioxidants could have been released in the presence of organic matter, which may have been crucial in

Table 5. Effect of native fermented amendments under an INM system on marketable yield per plot and per hectare in broccoli

Treatment	Marketable yield per plot (kg)			Marketable yield per ha (q)		
	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
T ₁	9.95 ^e	10.46 ^d	10.21 ^e	147.47 ^a	154.91 ^d	151.19 ^a
T ₂	10.03 ^e	10.53 ^d	10.28 ^e	148.61 ^a	156.02 ^d	152.32 ^a
T ₃	10.33 ^e	10.91 ^{cd}	10.62 ^{de}	153.07 ^a	161.61 ^{cd}	157.34 ^{de}
T ₄	10.99 ^{cd}	11.19 ^{bc}	11.09 ^{cd}	162.81 ^{cd}	165.80 ^{bc}	164.30 ^{cd}
T ₅	11.39 ^{bc}	11.72 ^b	11.55 ^{bc}	168.67 ^{bc}	173.56 ^b	171.11 ^{bc}
T ₆	11.56 ^{bc}	11.77 ^b	11.67 ^{bc}	171.33 ^{bc}	174.43 ^b	172.88 ^{bc}
T ₇	11.77 ^b	12.44 ^a	12.10 ^{ab}	174.36 ^b	184.27 ^a	179.32 ^{ab}
T ₈	12.44 ^a	12.77 ^a	12.61 ^a	184.32 ^a	189.21 ^a	186.77 ^a
T ₉	10.12 ^e	10.62 ^{cd}	10.37 ^e	149.86 ^a	157.33 ^{cd}	153.59 ^a
T ₁₀	10.44 ^{de}	10.69 ^{cd}	10.56 ^{de}	154.63 ^{de}	158.35 ^{cd}	156.49 ^{de}

Figures with same letter in column do not differ significantly

Table 6. Effect of native fermented amendments under an INM system on economics of broccoli

Treatment code	Yield (q/ha)	Cost of cultivation (₹/ha)	Gross income (₹/ha)	Net income (₹/ha)	B:C Ratio
T ₁	151.19	111573	302383	190810	1.71
T ₂	152.32	112023	304637	192613	1.72
T ₃	157.34	113773	314677	200903	1.77
T ₄	164.30	118143	328607	210463	1.78
T ₅	171.11	121963	342227	220263	1.81
T ₆	172.88	119503	345757	226253	1.89
T ₇	179.32	123873	358630	234757	1.90
T ₈	186.77	127693	373533	245840	1.93
T ₉	153.59	108513	307183	198670	1.83
T ₁₀	156.49	114243	312977	198733	1.74
CD (p=0.05)	6.04				0.11

repelling the infections. Jeevamrit possessed a significant amount of microorganisms and growth hormones, which may have enhanced soil biomass and, in turn, the availability and uptake of nutrients, which further increased crop growth and production (Palekar 2006). Jeevamrit is source of advantageous microflora that has the ability to speed up plant growth, including both vegetative and yield aspects [Rathore et al., 2023]. The application of ghana jeevamrit and jeevamrit boosted groundnut yield, which might be ascribed to an improvement in the soil environment, which may have led to an increase in root distribution and nutrient absorption from the soil's bottom layers. By facilitating simple nutrient transfers that are necessary for growth and development, foliar spraying of organic manures increases output (Anusha et al., 2018). The use of organic manures and fermented liquid bioformulations, there were a greater number of fruits per plant in brinjal, which may have been caused by improved nutrition and photosynthesis transfer and subsequent improved plant in growth and yield (Rathore et al., 2022).

Economically, INM with fermented organic concoctions proved advantageous. The highest marketable yield and economic returns were observed with treatments incorporating Jeevamrit and other organic amendments. The combination of beejamrit, panchagavya, and ghana jeevamrit yielded the highest gross income and net worth with the lowest cultivation costs because these organic manures could be produced on the farm itself at no further expense (Chandrakala et al., 2011).

CONCLUSION

The study stresses the potential of minimizing agrochemical dependency by integrating native fermented concoctions with inorganic fertilizers as a sustainable alternative to conventional fertilization in the production of broccoli. The application of 90% RDN with 5% Jeevamrit (drench + foliar spray) significantly improved growth as well as yield-contributing traits while gradually reducing reliance on synthetic fertilizers without compromising the yield. Additionally, seed treatment with Beejamrit successfully mitigated black rot incidence, highlighting the effectiveness of natural bio-inputs in disease suppression. These findings ensure the paradigm shift towards sustainable nutrient management instead of chemical fertilization. By endorsing these native fermented manures, farmers can also contribute to soil preservation and enrichment and support long-term agriculture resilience while preserving high crop yield.

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