



Effect of Green Manuring, Jeevamrut and Ghan-jeevamrut on Growth, Yield, Quality and Economics of Banana cv. Grand Naine

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Authors' contributions

This work was carried out in collaboration among all authors. Author DPS designed the analysis, collected the data, performed the analysis and wrote the paper. Author NIS conducted the research, contributed to experimental design and critical revised the manuscript. Author HHS provided technical guidance and editorial suggestions. Author HMR assisted in data collection and analysis, and also reviewed and refined the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

The present investigation was conducted during the year 2023-24 and 2024-25 at Horticulture farm, College of Horticulture, Anand Agricultural University, Anand. The experiment was laid out in a Randomized Block Design with seven treatments and three replications. The treatment consists of single, double and triple green manuring of dhaincha and sunhemp with Ghanjeevamrut applied as a basal dose per pit as per treatment 160, 240 and 320 g/plant, Jeevamrut 160, 240 and 320 ml/plant were applied to the plant in every 21 days interval. The higher value of fruit yield (90.73 t/ha), number of fingers per hand (17.51), weight of finger (161.01 gram), ascorbic acid (4.53 mg/100 g pulp) were recorded significantly with triple green manuring by dhaincha + ghanjeevamrut 160 g/plant + soil application of jeevamrut 160 ml/plant at sowing & every 21 days interval and the highest plant height (194.81 cm) and net realization (514186 Rs/ha) with benefit cost ratio (1.91) were significantly found with RDF [FYM: 10 kg/plant, NPK: 300:100:200 g/plant/year]. While minimum days required for shooting was found non-significant result.

Keywords: Dhaincha, sunhemp; green manuring; jeevamrut; ghan-jeevamrut.

1. INTRODUCTION

Banana (*Musa paradisiaca* L.) is a major fruit crop in India, widely cultivated due to its high nutritional value and economic importance. However, its cultivation relies heavily on chemical fertilizers, which are costly and environmentally harmful. With increasing concerns about soil health and sustainability, there is a need to explore organic nutrient management practices (Pooja Shree et al., 2024). Organic inputs like green manures and fermented bio-nutrients such as Jeevamrut, Ghanjeevamrut, and Beejamrut offer a promising alternative to chemical fertilizers (Palekar, 2006). Therefore, the present study was undertaken to evaluate the effect of green manuring, jeevamrut and ghan-jeevamrut on growth, yield, quality and economics of banana cv. Grand Naine.

Green manuring is an age-old practice as that of agriculture where in crops are incorporated into soil primarily as a soil amendment and as a source of plant nutrients for other crops, which lost importance as the use of mineral fertilizers became widespread. Use of green manure cover crops for soil fertility is the most promising technologies to improve the structure of heavy, light and sandy soil and unproductive land can be converted into fertile ones with green manuring. Green manure crop fixes atmospheric nitrogen and add a lot of organic matter to the soil. Organic matter when decompose, adds macro and micro-nutrients as well as improves the soil organic carbon content. Green manures can be used as alternatives to mineral fertilizers particularly for subsistence farmers whose resource base is scares. Green manuring can serve both to extend the period of soil cover as well as reduce the dependence on inorganic

fertilization. Eco-friendly agricultural practices focus on increasing the carbon content in soil (e.g., by green manuring) and minimizing the dependence in chemical fertilization. (Hargrove, 1986; Sharma & Mitra, 1988).

Sunhemp, Dhaincha, Clusterbean, Cowpeas, and Berseem and Senji are the most commonly used green manure crops. For green manuring, fast-growing legumes of vegetative growth should be used. *Crotalaria juncea* (sunhemp) and *Sesbania aculeata* (dhaincha) are the common green manures which produce relatively higher biomass and accumulate more nitrogen. (Rupper, 1987).

Recently, Government of India lunched National Mission on Natural Farming (NMNF) given more emphasis on natural farming and for promotion of its special initiation started. In the Gujarat, farmers are started and motivated to cultivate fruit crops though natural farming. Four main pillars of natural farming *i.e.*, use of cover crops or green manuring as an Acchadana (Mulching), use of Beejamrut Ghan-jeevamrut, Jeevamrut and Whapasa (Soil aeration), For pest and diseases control *i.e.*, Agniastra, Brahmastra, Neemastra and Dashparni ark are important for nutrient and diseases management, but lack of scientific information regarding its are not available and banana is high nutrient require fruit crops so farmers are yet not initiated to cultivate it.

2. MATERIALS AND METHODS

The Experiment was conducted at Horticulture Farm, College of Horticulture, Anand Agricultural University, Anand during the year 2023-24 and 2024-25. The experiment was laid out in a

Randomized Block Design with seven treatments and repeated thrice. The experimental plot was prepared by deep ploughing and harrowing. Pits of 30 cm³ were dug out by tractor drawn digger at a spacing of 1.8 m × 1.8 m and well decomposed FYM @ 10 kg pit⁻¹ was applied prior to planting in all the treatments. The seeds of dhaincha and sunhemp green manuring were broadcasted insitu between the banana plants as per the experimental treatments Single, Double and triple after 45 to 50 days of sowing, the fully green biomass of the dhaincha and sunhemp produce were incorporated in to the soil by ring method. Banana tissue culture plant was dipped in beejamrut solution for 15 minutes before planting, Ghanjeevamrut applied as a basal dose per pit as per treatment 160, 240 and 320 g/plant, Jeevamrut was incubate for 7 days, then after as per treatment 160, 240 and 320 ml/plant were applied to the plant in every 21 days. The various treatments followed for the experiment were as under **T₁**: Triple green manuring by Sunhemp + ghanjeevamrut 160 g/plant + soil application of jeevamrut 160 ml/plant at sowing & every 21 days interval, **T₂**: Triple green manuring by Dhaincha + ghanjeevamrut 160 g/plant + soil application of jeevamrut 160 ml/plant at sowing & every 21 days interval, **T₃** : Double green manuring by Sunhemp + ghanjeevamrut 240 g/plant + soil application of jeevamrut 240 ml/plant at sowing & every 21 days interval, **T₄**: Double green manuring by Dhaincha + ghanjeevamrut 240 g/plant + soil application of jeevamrut 240 ml/plant at sowing & every 21 days interval, **T₅**: Single green manuring by Sunhemp + ghanjeevamrut 320 g/plant + soil application of jeevamrut 320 ml/plant at sowing & every 21 days interval, **T₆**: Single green manuring by Dhaincha+ ghanjeevamrut 320 g/plant + soil application of jeevamrut 320 ml/plant at sowing & every 21 days interval, **T₇**: RDF (FYM: 10 kg/plant, NPK: 300:100:200 g/plant) with three replication.

3. METHODOLOGY ADOPTED IN RECORDING OBSERVATIONS

3.1 Plant Height (cm)

The height of plant was measured from ground level to the top most points of contact petioles of

two youngest fully expanded leaves as suggested by Lahav (1972). Then average value across the six plants was expressed in centimeter (cm).

3.2 Days Required for Shooting

The number of days taken from planting to shooting was recorded and average days of all six plants were calculated.

3.3 Number of Fingers per Hands

The number of fingers of each harvested hand was physically counted and mean number of fingers per hand was calculated.

3.4 Finger Weight (g)

The finger was separated from the top third hand and weighed on electronic weighing machine and weight was noted in gram.

3.5 Fruit Yield (t ha⁻¹)

The data on yield per net plot was recorded and multiplied by multiple factor computed on area basis to give the final data for total yield in tonnes per hectare.

3.6 Ascorbic Acid (mg 100 g⁻¹ pulp)

The titrimetric method described by Ranganna (1986) was adopted. A 10 g of the pulp was transferred to a 100 ml volumetric flask and volume made up with 4 % oxalic acid solution. After 30 minutes, the suspension was filtered through Whatman No. 1 filter paper. Before actual titration the 2, 6 - Dichloropheno indophenol dye solution was standardized by titrating against standard ascorbic acid solution and the dye factor was calculated. Five milliliters of the aliquot was taken from the filtrate against standardized dye solution through a burette. Titration was continued till the light pink colour persisted for 15 seconds. Ascorbic acid content was calculated adopting the following formula.

$$\text{Absorbic acid} \left(\frac{\text{mg}}{100 \text{ g}} \right) = \frac{\text{Titre} \times \text{Dye factor} \times \text{Volume made up} \times 100}{\text{Aliquot of extract taken for estimation} \times \text{Volume of sample taken for estimation}}$$

3.7 Economics

The gross income in terms of rupees per hectare was worked out on the basis of mean yield for each treatment and the prevailing market prices of banana bunch. The cost of different treatments was worked out by considering the prices of labour employed for the treatments and all treatment cost. The net income was worked out by deducting cultivation cost and the cost required for different treatments from the gross income per hectare for respective treatments and recorded accordingly and BCR was calculated by following formula,

$$\text{Benefit Cost Ratio} = \frac{\text{Net income (Rs ha}^{-1}\text{)}}{\text{Cost of cultivation (Rs ha}^{-1}\text{)}}$$

4. RESULTS AND DISCUSSION

4.1 Plant Height at Shooting Stage

The plant height (cm) was recorded at shooting stage and presented in Table 1. The data showed that there is a significant effect of different treatment on plant height and this data displayed in Table 1.

An analysis of the data in Table 1 indicates that recommended dose of fertilizer (FYM: 10 kg/plant, NPK: 300:100:200 g/plant/year) had significantly maximum plant height (194.81 cm). The minimum plant height (166.94 cm) was found with Single green manuring by Sunhemp + ghanjeevamrut 320 g/plant + soil application of jeevamrut 320 ml/plant at sowing & every 21 days interval].

The probable reason for the maximum plant height in banana in recommended dose of fertilizer (FYM: 10 kg/plant, NPK: 300:100:200 g/plant/year) due to supply of nutrients in readily available and soluble form with split of nitrogen that plant can absorb them quickly through roots and used them for rapid cell division. Results were in conformity with respect to increase in plant height was found by Bhoomika *et al.* (2024) by the application of 100 % RDF (FYM: 10 kg plant-1, NPK: 300:90:200 g plant-1 year-1)

4.2 Days Required for Shooting

The days required for shooting was recorded at shooting stage and presented in Table 1. The data showed that there is a non-significant effect of different treatment on days required for shooting and this data displayed in Table 1.

An analysis of the data in Table 1 indicates that different treatments of green manuring, jeevamrut and ghanjeevamrut showed non-significant result. The minimum number of days required for shooting (267.44) was recorded with RDF (FYM: 10 kg/plant, NPK: 300:100:200 g/plant/year), while maximum days required for shooting (293.07) with Single green manuring by Sunhemp + ghanjeevamrut 320g/plant + soil application of jeevamrut 320 ml/plant at sowing & every 21 days interval.

The probable reason for the non-significant effect on days required for shooting due to banana has a long vegetative phase, and slight differences in nutrient regime do not drastically alter the timing of reproductive events. The genetic control and growth physiology dominate over nutritional influence for flowering time or may be all treatments provided sufficient nutrients, and these phenological stages are mainly governed by genetic and climatic factors rather than nutrient levels alone. A similar observation was also recorded Carvalho-Neta *et al.* (2022) in banana intercropping with lemon grass.

4.3 Number of Fingers Per Hand

The number of fingers per hand was presented in Table 1. The data showed that there is a significant effect of different treatment on number of fingers per hand and this data displayed in Table 1. An analysis of the data in Table 1 indicates that triple green manuring by dhaincha + ghanjeevamrut 160 g/plant + soil application of jeevamrut 160 ml/plant at sowing & every 21 days interval resulted significantly maximum number of fingers per hand (17.51). while minimum number of fingers per hand (13.84) recorded with Single green manuring by Sunhemp + ghanjeevamrut 320 g/plant + soil application of jeevamrut 320 ml/plant at sowing & every 21 days interval.

The probable reason for the increased in number of fingers per hand due to continuous nutrient supply of NPK + micronutrients and higher C/N ratio support flower initiation and ovule development. Similar results were found by Bhoomika *et al.* (2024).

4.4 Weight of Finger (g)

The weight of finger was presented in Table 1. The data showed that there is a significant effect of different treatment on weight of finger and this data displayed in Table 1.

An analysis of the data in Table 1 indicates that triple green manuring by dhaincha + ghanjeevamrut 160 g/plant + soil application of jeevamrut 160 ml/plant at sowing & every 21 days interval resulted significantly maximum weight of finger (161.01 g), while minimum weight of finger (126.09 g) recorded with Single green manuring by Sunhemp + ghanjeevamrut 320 g/plant + soil application of jeevamrut 320 ml/plant at sowing & every 21 days interval.

The probable reason for the maximum weight of finger with triple green manuring of dhaincha and jeevamrut might sustained nutrients availability throughout fruit development, microbial activity improves nutrient uptake and hormone production, improved soil moisture and root health ensures better translocation of carbohydrates to fruits boosting fruit set and filling. which enhanced physiological and biochemical activities resulting in bigger fruit size. Similar results were found by Manju and Pushpalatha (2022) in banana cv. Nendran and Bhoomika et al. (2024) in banana cv. Grand Naine.

4.5 Fruit Yield (t/ha)

The fruit yield was presented in Table 2. The data showed that there is a significant effect of different treatment on fruit yield and this data displayed in Table 2.

An analysis of the data in Table 2 indicates that triple green manuring by dhaincha + ghanjeevamrut 160 g/plant + soil application of jeevamrut 160 ml/plant at sowing & every 21 days interval] recorded significantly highest values for fruit yield (90.73 t/ha), whereas lowest value was found with Single green manuring by Sunhemp + ghanjeevamrut 320 g/plant + soil application of jeevamrut 320 ml/plant at sowing & every 21 days interval].

The probable reason for the maximum fruit yields it might be due to triple green manuring by dhaincha with ghanjeevamrut 160 g/plant + soil application of jeevamrut 160 ml/plant at sowing & every 21 days interval repeated improves soil porosity, moisture-holding capacity, maintain **continuous soil fertility and** every incorporation of green manure **recharge soil microbes** and organic matter resulted higher yield attributed parameters contributing higher yield. Similar

results were found by Bhoomika and Ahlawat (2025) in banana cv. Grand Naine, Meghwal et al. (2021) in banana cv. Nendran, Kavitha et al. (2022) in banana cv. Ney poovan and Jhade et al. (2020) in papaya.

4.6 Ascorbic Acid (mg/100 g pulp)

The ascorbic acid was presented in Table 1. The data showed that there is a significant effect of different treatment on ascorbic acid and this data displayed in Table 1.

An analysis of the data in Table 1 indicates triple green manuring by dhaincha + ghanjeevamrut 160 g/plant + soil application of jeevamrut 160 ml/plant at sowing & every 21 days interval obtained significantly higher ascorbic acid (4.53 mg/100 g pulp), whereas minimum ascorbic acid (4.13 mg/100 g pulp) was recorded with RDF (FYM: 10 kg/plant, NPK: 300:100:200 g/plant/year).

Due to triple green manuring of dhaincha improved soil fertility, enhanced microbial activity, and optimized plant metabolism, all of which contributed to significantly higher ascorbic acid content in banana pulp Similar results were found by Athani and Hulamani (2000) in banana, Marathe et al. (2012) in pomegranate, Kumar et al. (2017) in mango cv. Dashehari and Patel et al. (2020) in mango cv. Amrapali.

4.7 Economics

The economics was presented in Table 2, economics is a major consideration for the farmers while taking a decision regarding adoption of new technology, hence the cost of cultivation, maximum net realization and benefit cost ratio were computed which was indicated in Table 2. Considering economics of both the years, recommended dose of fertilizer (FYM: 10kg/plant, NPK: 300:100:200 g/plant/year) has the highest net realization i.e. Rs. 514186 with BCR (1:1.91) followed by Single green manuring by Dhaincha+ ghanjeevamrut 320 g/plant + soil application of jeevamrut 320 ml/plant at sowing & every 21 days interval with net realization i.e. Rs. 481191 and BCR (1:1.79) is due to application cost increases in application of green manuring and also in application of jeevamrut which was done in every 21 days interval.

Table 1. Effect of green manuring, jeevamrut and ghan jeevamrut on growth, yield and quality parameters of banana cv. Grand Naine (Pooled data of 2023-24 and 2024-25)

Code	Treatment Details	Plant height (cm)	Days required for shooting	Number of fingers per hand	Weight of finger (g)	Ascorbic acid (mg/100 g pulp)
T ₁	Triple green manuring by Sunhemp + ghanjeevamrut 160 g/plant + soil application of jeevamrut 160 ml/plant at sowing & every 21 days interval	170.63	289.51	14.63	128.68	4.38
T ₂	Triple green manuring by Dhaincha + ghanjeevamrut 160 g/plant + soil application of jeevamrut 160 ml/plant at sowing & every 21 days interval	187.28	272.76	17.51	161.01	4.53
T ₃	Double green manuring by Sunhemp + ghanjeevamrut 240 g/plant + soil application of jeevamrut 240 ml/plant at sowing & every 21 days interval	185.76	274.74	17.07	154.66	4.52
T ₄	Double green manuring by Dhaincha + ghanjeevamrut 240 g/plant + soil application of jeevamrut 240 ml/plant at sowing & every 21 days interval	176.53	283.35	14.78	136.47	4.44
T ₅	Single green manuring by Sunhemp + ghanjeevamrut 320g/plant + soil application of jeevamrut 320 ml/plant at sowing & every 21 days interval	166.94	293.07	13.84	126.09	4.31
T ₆	Single green manuring by Dhaincha+ ghanjeevamrut 320g/plant + soil application of jeevamrut 320 ml/plant at sowing & every 21 days interval	183.41	280.06	16.57	147.71	4.47
T ₇	RDF (FYM: 10kg/plant, NPK: 300:100:200 g/plant/year)	194.81	267.44	15.90	147.02	4.13
T	S. Em. ±	5.27	8.37	0.50	4.10	0.06
	C. D. (P=0.05)	15.24	NS	1.44	11.85	0.20
	C.V. %	7.95	8.17	8.68	7.63	4.20

Table 2. Effect of green manuring, jeevamrut and ghan jeevamrut on Fruit yield and economics of banana cv. Grand Naine

Treatments	Fruit yield (t/ha)	Common cost of cultivation (Rs./ha)	Treatment cost (Rs./ha)	Total cost of cultivation (Rs./ha)	Gross realization (Rs./ha)	Net realization (Rs./ha)	Benefit cost ratio
T ₁	63.63	268004	158105	426109	954450	210191	0.78
T ₂	90.73	268004	158105	426109	1360950	481191	1.79
T ₃	84.42	268004	132528	400532	1266300	443668	1.65
T ₄	66.21	268004	132528	400532	993150	261568	0.97
T ₅	59.61	268004	110108	378112	894150	217988	0.81
T ₆	83.51	268004	132188	400192	1252650	434908	1.62
T ₇	83.12	268004	49010	317014	1246800	514186	1.91

(Pooled data of yield 2023-24 and 2024-25)

5. CONCLUSION

From the two years of experiment, it can be concluded that application of triple green manuring by Dhaincha + ghanjeevamrut 160 g/plant + soil application of jeevamrut 160 ml/plant at sowing & every 21 days interval increased yield, yield parameters and quality parameters of banana cv. Grand Naine. Growth parameter and higher net realization with benefit: cost ratio was observed under of RDF (FYM: 10kg/plant, NPK: 300:100:200 g/plant/year).

6. FUTURE SCOPE

The present findings indicate that organic nutrient management can significantly enhance banana growth, yield, and quality. Future studies may focus on long-term effects on soil fertility, standardization of organic input doses, economic viability at farm scale, and integration with sustainable cropping systems to promote eco-friendly banana production.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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