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Effect of cow based bioenhancers on growth yield and quality of *kharif* groundnut under organic condition

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Abstract

A field investigation was done in *kharif* season 2024 which was conducted on medium black calcareous soil consist of pH 7.8 and Electrical Conductivity of 0.51 dS/m on Certified Organic Farming Plot of Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat) to study effect of cow based bioenhancers on growth yield and quality of *kharif* groundnut under organic condition (Cv. GJG-32). The study was done in randomized block design and it was replicated three times. The experiment included ten different treatments in combination with soil application of organic manures viz., FYM and Vermicompost, foliar spray of cow based bioenhancers viz., *Panchgavya*, Cow urine, *Jivamrit* and seed treatment with *Beejamrit*. From the result of study, it can be summarized that among various treatments application of FYM 5 t/ha followed by *Panchgavya* 3% foliar spray at 25 and 50 DAS conveyed maximum value of parameters of growth like plant height, total number of branches per plant at harvest and root nodules per plant at 45 DAS, yield and yield attributes such as no. of pods and mature pods per plant, yield of pod (2538 kg/ha) and haulm (3690 kg/ha) over control.

Keywords: *Beejamrit*, cow based bioenhancers, cow urine, growth, *Jivamrit*, *kharif* groundnut, organic, *Panchgavya*, yield

Introduction

The oilseed sector has been one of the most vibrant components of world agriculture. In India, among different agricultural commodities oilseeds stands second largest after cereals. Groundnut crop is the world's thirteenth most essential valuable food crop and fourth most dominant oilseeds crop. It is a prominent oilseed found in tropical and subtropical regions (Kumar *et al.*, 2017) ^[1]. Groundnut, contributes significantly to nutritional security because its seed contains about 50% edible oil. The remaining 50% portion of the seed contains high quality protein (21.4 to 36.4%), carbohydrates (6.0 to 24.9%), calcium, phosphorus, magnesium, zinc, iron, riboflavin, vitamin E, niacin, folacin, thiamine and potassium were suggested by Das, (1997) ^[2]. Groundnuts are versatile oilseed crop and it is great commercially cash crop for both home as well as international market in number of under developed and advanced nations. According to data of FAOSTAT, (2023) ^[3] broadly, groundnut covers about 327 lakh hectares of agricultural land with the production of 539 lakh tonnes and productivity of 1648 kg per hectare. In India, during year 2022-23 total agricultural area under crop was 5.23 million hectares having production of 9.26 million tonnes and 1770 kg/ha. Productivity. Indian agriculture is well known for its multiple functions from facilitating environmental and food safety, employment generation and livelihood to nutritional (Sharma *et al.*, 2025) ^[4]. The global population is projected to rise nearly 10 billion by 2050, intensifying the need for food (Kumari *et al.*, 2024) ^[5]. The total groundnut area, production and productivity of Gujarat were 1.63 million hectares, 4.51 million tonnes and 2757 kg/ha, respectively (Anonymous, 2023) ^[6]. In Gujarat, districts where groundnut is widely cultivated are Junagadh, Rajkot, Banaskantha, Dwarka, Amreli, Jamnagar, Bhavnagar, Gir, Somnath and Kutch. Organic farming is not only about producing healthy food and fiber without the use of synthetic farm chemicals but also it ensures animal welfare and environment sustainability. The main organic farming principle is that allowing Mother Nature to give us food that nature intended. In recent years, one study shows that there has been extensive awareness worldwide on the excess use of artificial fertilizers and other chemicals which leads to environmental pollution and pest

outbreaks. (Naresh *et al.*, 2018) ^[7]. Employing high doses of fertilizers to achieve more yields is indispensable (Sharma *et al.*, 2020) ^[8] under intensive cropping, but blanket application of chemical fertilizers is considered as one of the major constraints to sustain crop production (Sharma *et al.*, 2021; Sharma *et al.*, 2025 and Kumari *et al.*, 2025) ^[9, 4, 10]. Recently next-generation precision farming technologies to enhance sustainable crop production and environmental sustainability (Yadav *et al.*, 2026a and Kumari *et al.*, 2026) ^[11, 12]. With the global population steadily increasing, there is a growing need to boost agricultural productivity in order to ensure sufficient food supply for future generations (Gt *et al.*, 2025) ^[13]. According to Jarvan *et al.* (2017) ^[14] in alternative agricultural systems, farmyard manure is one of the most valuable organic fertilizers for preserving fertility of soil prior to the invention of chemical fertilizers in the middle of the nineteenth century, the only known sources of plant nutrients added to the soil were farmyard manure and compost (Hack, 1982) ^[15]. Regular addition of organic materials, especially composted ones, boosted aggregate stability and decreased soil bulk density, which in turn enhanced soil physical qualities (Diacono and Montemurro, 2010) ^[16].

The application of cattle manure resulted in significant enhancement of soil organic carbon, macro-aggregate stability and amount of carbon protected within this aggregate. If animal manure is added in soil, it may increase biodiversity in the soil, which helps to cause alteration in composition, size and activity of soil micro flora, fauna and enzyme activities (Watts *et al.*, 2010) ^[17]. An earlier analysis revealed that in terms of production, by addition of each tonne of farmyard manure is similar to 3 kg of fertilizer nutrients for single crops and 5 kg for double cropping. According to Gaur, (1986) ^[18] 1, 000 tonnes of fresh cow dung might theoretically include 15 tonnes of nitrogen and 4 tonnes each of P and K. Inputs such as cow-based bio-enhancers, organic manure and bio-fertilizer play a pivotal role in enhancing crop production supported study by Sharma *et al.* (2026) ^[19]. Organic matter encourages the creation of soil crumb, which makes the soil friable and permits proper air and water flow as well as rainwater absorption, acting on the physical 5 qualities of the soil. The application of organic liquid amendments such as *Panchgavya* and *Jeevamrit* results in superior growth of plant, crop yield, and quality. *Panchgavya* is a potent stimulant that enhanced not only yield and quality but also improved biological efficiency of the crop. (Gore *et al.*, 2011) ^[20]. Additionally, multi-omics like metagenomics, meta-transcriptomics, and bioinformatics techniques offer wonderful insights into soil microbial micro environment, ecology, minerals and nutrient cycling in oilseed cropping patterns (Yadav *et al.* 2026b and Kumari *et al.*, 2026) ^[21, 12].

Materials and Methods

A field experiment was carried out during *kharif* season of 2024 on Certified Organic Farming Plot of Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat). The soil of experimental location was with clayey texture and it was slightly alkaline in reaction having pH value of 7.8 and Electrical Conductivity of 0.51 dS/m. Initial Soil Organic Carbon (SOC) content of was calculated 0.61% and initially the nutrient status of soil was low in available nitrogen (236 kg/ha) and range of available phosphorus (26.74 kg/ha) and potash (249 kg/ha) were medium. During experimental study ten treatments were arranged in Randomized Block Design: T₁ (Absolute control), T₂ (100% RDF), T₃ (FYM 10 t/ha), T₄ (FYM 5 t/ha + *Panchgavya* 3% foliar spray at 25 and 50 DAS), T₅ (FYM 5 t/ha + Cow urine 3% foliar

spray at 30 and 60 DAS), T₆ (FYM 5 t/ha + seed treatment with *Beejamrit* 300 ml/kg + foliar spray of *Jivamrit* 1250 L/ha at 30 and 60 DAS), T₇ (Vermicompost 2 t/ha), T₈ (Vermicompost 1t/ha + *Panchgavya* 3% as foliar spray at 25 and 50 DAS), T₉ (Vermicompost 1t/ha + Cow urine 3% as foliar spray at 30 and 60 DAS), T₁₀ (Vermicompost 1t/ha + seed treatment with *Beejamrit* 300 ml/kg + foliar spray of *Jivamrit* 1250 L/ha at 30 and 60 DAS) which replicated thrice. The crop was sown on 10th July during *kharif* season 2024. Sowing of groundnut variety “GJG-32” was done by keeping row to row distance of 45 cm and plant to plant distance of 10 cm which was maintained by thinning during crop season. A seed rate of 100 kg/ha was used for sowing. All cow-based formulations were prepared on farm according to the method given by National Centre for Organic Farming, Ghaziabad (NCOF, 2006) ^[22]. Knapsack sprayer was used for foliar application which has spray volume of 500 l/ha. The initially prepared and filtered solution of cow based bioenhancers were sprayed on the crop foliage as per treatments. The crop was grown according to organic standards in the plot which is organically converted. To control pest and disease infestation organic or bio-pesticides were used as protection measures during crop growing season.

As per standard procedure, observation on plant growth, yield attributes and yield were taken. The data of experiment which was collected during investigation was subjected to statistical analysis by adopting Fishers method of Analysis of Variance (ANOVA), as per the method of Gomez and Gomez, (2010) ^[23]. Critical Difference (CD) value was calculated whenever the ‘F’ test was found significant at 5% level.

Results and Discussion

Growth parameters

Plant height

With the progression of crop season, plant height increased up to physiological maturity. It is evident from the data shown in Table 1 that the plant height recorded at harvest was significantly affected by soil application of various organic manures and foliar spray of cow based bioenhancers. Significantly highest plant height (32.93 cm) was measured with FYM 5 t/ha + *Panchgavya* 3 percent foliar application at 25 and 50 DAS (T₄) which was statistically at par with (T₂) (31.65 cm), T₆ (30.62 cm), T₈ (30.24 cm), T₇ (29.26 cm), T₃ (29.22 cm) and T₁₀ (29.17 cm) respectively. However, significantly lower plant height (23.41 cm) was documented under treatment T₁ (Absolute control). The increased in plant height might be due to application of FYM with *Panchgavya* in combination which have synergistic effect on plant growth and development. FYM resulted in production of growth stimulating substances which enhanced the nutrient availability for longer duration and thus have beneficial influences on growth parameters. Foliar application of *Panchgavya* increased the growth rate of crop since it contains the proper micro and macro nutrients, plant growth hormones and bio-fertilizers in form of liquid formulation. The rapid cell division and elongation were favored by presence of growth enzymes in *Panchgavya*. our findings supported by Patel *et al.* (2021) ^[24] and Mushar *et al.* (2023) ^[25].

Number of branches per plant at harvest

Significant differences were recorded in number of branches per plant at harvest due to the application of different treatments. According to results shown in Table 1, treatment application FYM 5 t/h with *Panchgavya* 3 percent as foliar spray at 25 and 50 DAS (T₄) resulted significantly the greater number of branches per plant at harvest (7.76). The treatment was statistically

comparable with treatments T₂ (7.42), T₆ (7.24), T₈ (6.95), T₁₀ (6.85), T₇ (6.35) and T₃ (6.34). On the other hand, treatment Absolute control (T₁) gave the lowest number of branches per plant at harvest (5.05). The notable a greater number of branches per plant is due to antagonizing action of auxin responsible for apical dominance which suppress terminal bud growth and then energy of plant is translocated towards the auxiliary buds and helps in stimulation of lateral branches. Beneficial effect of FYM may be due to the influences of organic matter in enhancing physio-chemical properties and biological environment of soil conducive to optimum plant growth. The results supported by Panchal *et al.* (2017)^[26] and Sutar *et al.* (2019)^[27].

Number of root nodules per plant at 45 DAS

Further glance of data (Table) revealed that number of root nodules per plant at 45 DAS significantly affected by application of various treatment. Data revealed that the number of root nodules per plant at 45 DAS (50.96) was counted under treatment T₄ (FYM 5 t/ha with *Panchgavya* 3 percent as foliar spray at 25 and 50 DAS). This was found statistically on par with treatment T₂ (49.75), T₆ (48.65), T₈ (47.70), T₁₀ (46.88), T₇ (46.06) and T₃ (45.87). In contrast treatment T₁ (Absolute control) showed lowest number of root nodules per plant at 45 DAS (41.33) which differed considerably from the other treatments. The increase in number of root nodule per plant might be due to the better availability of nutrients. The presence of plant hormones such as Indole Acetic Acid and Gibberellic Acid in *Panchgavya* could create boost in the plant immune system and also helped to enhance the secretion of growth regulator in cell system. The results of present research were in strongly agreement with Avuduithai *et al.* (2010)^[28] and Kumar *et al.* (2011)^[29].

Yield and yield attributes

Number of pods and mature pods per plant

The number of pods and mature pods (Table 2) per plant of *kharif* groundnut was significantly impacted by application various cow based bioenhancers with organic manures. Significantly the highest number of pods per plant (26.47) and mature pods per plant (24.97) was counted under treatment T₄ (FYM 5 t/ha with *Panchgavya* percent as foliar application at 25 and 50 DAS). In terms of statistics, this treatment was comparable with T₂, T₆, T₈, T₁₀, T₇ and T₃. The treatment T₁ (Absolute control) produced minimum number of pods and mature pods per plant. This might

be due to the fact that FYM improves soil structure, water retention and aeration and creating a more favorable environment for growth and development whereas *Panchgavya* contains a range of beneficial microorganisms and nutrients. When used as foliar spray, it stimulates plant metabolism, enhance photosynthetic activity which helps to improve nutrient uptake from both soil and foliar sources. The enhanced metabolic processes and nutrient uptake due to *Panchgavya* may lead to increased photosynthetic activity which allows plants to produce more carbohydrates, which can be diverted to pod development and other growth processes. These results are in accordance with Singh *et al.* (2012)^[30] in chickpea and Siddappa (2015)^[31] in field bean.

Pod and haul yield

Crop yield is the complex function of physiological processes and biochemical activities, which modify plant anatomy and morphology of the growing plants. The data (Table 2) revealed that significantly highest pod (2538 kg/ha) and haulm yield (3690 kg/ha) of *kharif* groundnut was recorded with treatment T₄ (FYM 5 t/ha with *Panchgavya* 3 percent as foliar spray at 25 and 50 DAS). This treatment was statistically similar with (T₂) 100% RDF, (T₆) FYM 5 t/ha + seed treatment with *Beejamrit* 300 ml/kg + foliar spray of *Jivamrit* 1250 l/ha at 30 and 60 DAS, (T₈) Vermicompost 1t/ha + *Panchgavya* 3% as foliar spray at 25 and 50 DAS, (T₁₀) Vermicompost 1t/ha + seed treatment *Beejamrit* 300 ml/kg with foliar spray of *Jivamrit* 1250 l/ha at 30 and 60 DAS, (T₇) Vermicompost 2 t/ha and (T₃) FYM 10 t/ha. Conversely the treatment T₁ (Absolute control) recorded significantly the lowest pod and haulm yield. FYM supply nutrient for longer time which helps in enhancing physio-chemical and biological properties of soil which would have resulted into favorable soil atmosphere and ultimately higher yield. Besides this, application of FYM with *Panchgavya* increased the supply of easily assimilated major as well as micronutrient to plants and mobilized nutrients from unavailable into available form. Which results in more availability of nutrients from growth promoting substance produced by microbes present in *Panchgavya*. In conclusion enhancement in crop production led to good source-sink relationship, which in turn to increase the pod and haulm yield of groundnut crop.

These results are in confirmation with the findings of Singh *et al.* (2022)^[32] and Chaudhary *et al.* (2023)^[33].

Table 1: Effect of various treatments on growth parameters of *kharif* groundnut crop

Treatments	Plant height (cm)	No. of branches per plant	No. of root nodules per plant
	(At harvest)	(At harvest)	(At 45 DAS)
T ₁ Absolute control	23.41	5.05	41.33
T ₂ 100% RDF	31.65	7.42	49.75
T ₃ FYM 10 t/ha	29.22	6.34	45.87
T ₄ FYM 5 t/ha + 3 percent as foliar spray with <i>Panchgavya</i> at 25 and 50 DAS	32.93	7.76	50.96
T ₅ FYM 5 t/ha + 3 percent as foliar spray by Cow urine at 30 and 60 DAS	26.74	5.91	43.52
T ₆ FYM 5 t/ha + Seed treatment <i>Beejamrit</i> 300 ml/kg and foliar spray of <i>Jivamrit</i> 1250 L/ha at 30 and 60 DAS	30.62	7.24	48.65
T ₇ Vermicompost 2 t/ha	29.26	6.35	46.06
T ₈ Vermicompost 1t/ha + 3 percent as foliar spray <i>Panchgavya</i> at 25 and 50 DAS	30.24	6.95	47.70
T ₉ Vermicompost 1t/ha + Cow urine 3 percent as foliar spray at 30 and 60 DAS	27.15	5.95	44.06
T ₁₀ Vermicompost 1t/ha + Seed treatment with <i>Beejamrit</i> 300 ml/kg + foliar spray of <i>Jivamrit</i> 1250 L/ha at 30 and 60 DAS	29.17	6.85	46.88
S.E.m. ±	1.38	0.32	1.80
C.D. at 5%	4.12	0.97	5.36
CV%	8.27	8.63	6.72

Table 2: Effect of various treatments on yield and yield attributes of *kharif* groundnut crop

	Treatments	No. of pods per plant	No. of immature pods per plant	No. of mature pods per plant	Pod yield (kg/ha)	Haulm yield (kg/ha)	Harvest index
T ₁	Absolute control	20.62	18.94	1.68	1855	2861	39.33
T ₂	100% RDF	25.54	24.02	1.52	2486	3604	40.82
T ₃	FYM 10 t/ha	23.31	21.66	1.65	2183	3230	40.42
T ₄	FYM 5 t/ha + 3 percent as foliar spray of <i>Panchgavya</i> at 25 and 50 DAS	26.47	24.97	1.50	2538	3690	40.72
T ₅	FYM 5 t/ha + 3 percent as foliar spray by Cow urine at 30 and 60 DAS	21.07	19.47	1.60	2005	3032	38.90
T ₆	FYM 5 t/ha + <i>Jivamrit</i> 1250 L/ha foliar spray and <i>Beejamrit</i> 300 ml/kg Seed treatment application at 30 and 60 DAS	24.82	23.27	1.54	2414	3533	40.56
T ₇	Vermicompost 2 t/ha	23.55	21.89	1.66	2242	3309	40.36
T ₈	Vermicompost 1t/ha + <i>Panchgavya</i> 3% as foliar spray at 25 and 50 DAS	24.03	22.47	1.56	2361	3459	40.54
T ₉	Vermicompost 1t/ha + 3 percent as foliar spray by Cow urine at 30 and 60 DAS	21.70	20.07	1.63	2098	3144	40.84
T ₁₀	Vermicompost 1t/ha + Seed treatment with <i>Beejamrit</i> 300 ml/kg + foliar spray of <i>Jivamrit</i> 1250 L/ha at 30 and 60 DAS	23.63	22.05	1.58	2297	3389	40.61
	S.Em. ±	1.16	1.17	0.09	128.46	166.83	1.80
	C.D. at 5%	3.45	3.48	NS	382	495	NS
	CV%	8.59	9.29	10.05	9.89	8.69	7.76

Conclusion

Concluded that on the basis of our result obtained from one year of research data, it seems quite logical profitable and higher *kharif* groundnut production with better soil health under organic condition can be obtained by application of FYM 5 t/ha followed by 3 percent foliar application of *Panchgavya* at 25 and 50 DAS (T₄) or application of vermicompost 1t/ha followed by *Panchgavya* 3% as foliar spray at 25 and 50 DAS (T₈) in *kharif* groundnut (Cv. GJG-32) crop under the medium black calcareous soil of South Saurashtra Agro-climatic region.

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