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Abhisek Kabat
Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar, Odisha, India

Sweta Rath
Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar, Odisha, India

B Kabat
College of Agriculture, Odisha University of Agriculture and Technology (OUAT), Bhawanipatna, Odisha, India

RL Moharana
College of Agriculture, Odisha University of Agriculture and Technology (OUAT), Bhawanipatna, Odisha, India

N Ranasingh
College of Agriculture, Odisha University of Agriculture and Technology (OUAT), Bhawanipatna, Odisha, India

BP Gantayat
College of Agriculture, Odisha University of Agriculture and Technology (OUAT), Bhawanipatna, Odisha, India

Simly Das
College of Agriculture, Odisha University of Agriculture and Technology (OUAT), Bhawanipatna, Odisha, India

T Majhi
College of Agriculture, Odisha University of Agriculture and Technology (OUAT), Bhawanipatna, Odisha, India

Corresponding Author:
Abhisek Kabat
Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar, Odisha, India

Assessing the role of various organic inputs and bio-stimulants on the growth, yield and quality traits of green gram (*Vigna radiata* L.) in an *Alfisols*

Abhisek Kabat, Sweta Rath, B Kabat, RL Moharana, N Ranasingh, BP Gantayat, Simly Das and T Majhi

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Abstract
A field experiment was carried out in summer season 2025 at Chatabar Research Farm, Institute of Agricultural Sciences of Siksha 'O' Anusandhan (Deemed to be University) in Khurdha district of Odisha to investigate the role of various organic inputs and bio-stimulants on the growth, yield, and quality traits of green gram (*Vigna radiata* L.) in Alfisols. Green gram, a protein-rich pulse crop critical to food and nutritional security in India, faces yield stagnation in regions like Odisha due to imbalanced nutrient management and degraded soil health. In response to concerns over chemical-intensive agriculture, this study explored the efficacy of integrated organic nutrient management strategies on green gram cultivation under *Alfisols* of Eastern India. The field experiment involved 12 treatments comprising combinations of farmyard manure (FYM), vermicompost, biofertilizers (*Rhizobium* and phosphate-solubilizing bacteria), *Jeevamruth*, and seaweed extract, laid out in a Randomized Block Design with three replications. The objective was to assess the impact of organic inputs and biostimulants on plant growth dynamics, physiological traits, yield attributes, productivity, post-harvest soil fertility, and economic viability. The treatment B11—comprising FYM, vermicompost, *Rhizobium*, PSB, *Jeevamruth*, and seaweed extract—consistently outperformed all others, recording the highest plant height, chlorophyll content, leaf area index, and total dry matter at all stages. It also led to significantly higher yield attributes (number of pods per plant, seeds per pod and test weight), maximum grain yield (995 kg/ha) and haulm yield (3484 kg/ha). Soil analysis post- harvest showed marked improvements in organic carbon, available nitrogen, phosphorus, and potassium in B11, validating its role in enhancing soil health. Furthermore, this treatment yielded the highest net return (Rs 37590/ha) and benefit-cost ratio (1.85), indicating superior economic efficiency. The findings underscore that holistic organic nutrient modules, especially those integrating multiple bio-resources, can substantially enhance productivity and sustainability of pulse-based farming systems in ecologically fragile zones. This research offers a promising organic strategy for small holder farmers, promoting environmentally sound and economically viable agriculture under low-input conditions.

Keywords: Green gram, organic input, *Rhizobium.* FYM, vermicompost, *Rhizobium*, PSB, Jeevamruth, seaweed, yield, soil health, economic efficiency

Introduction
Green gram (*Vigna radiata* L.), commonly known as mungbean, is one of the most important short-duration pulse crops grown extensively across India. It is a rich source of high-quality protein (approximately 20-25%), essential amino acids, and minerals, making it a staple component in the predominantly vegetarian diets of Indian households. Apart from its nutritional significance, green gram plays an important ecological role in sustainable agriculture systems due to its capacity to fix atmospheric nitrogen in association with Rhizobium species, thus enhancing soil fertility and reducing dependency on synthetic nitrogen fertilizers (Choudhary, 2019) [4]. Owing to its short growth period, drought tolerance, and adaptability to diverse agro-ecological conditions, green gram is widely cultivated as a catch crop, intercrop, or in sequential cropping systems in both irrigated and rainfed regions. According to the Agricultural Market Intelligence Centre (2022), during the 2021-22 season, green gram was cultivated on approximately 4.04 million hectares in India, producing 3.15 million tonnes at an average productivity of 783 kg/ha. However, the *kharif* season of 2022-23 saw a decline in area to 3.337 million hectares, with a production of 1.75 million tonnes. As per the 2022-23 advance estimates, the total area under mungbean (including *kharif* and rabi) was 5.11 million hectares,

with production at 2.978 million tonnes and an average productivity of 583 kg/ha. Odisha accounted for nearly 0.242 million hectares (5% of India‘s area), producing 0.079 million tonnes of mungbean with an average yield of just 327 kg/ha (Directorate of Pulses Development, 2024). These figures reveal a stark yield gap in Odisha compared to the national average, underscoring the need for location-specific, resource-efficient management practices. Concurrently, there has been growing concern over the adverse impacts of chemical-intensive agriculture on soil health, environmental quality, and food safety. The excessive use of chemical fertilizers and pesticides has been linked to declining soil organic matter, nutrient imbalance, reduced microbial activity, and contamination of water bodies (Panneerselvam *et al*., 2013) [16]. This has prompted renewed interest in organic farming systems, which seek to enhance ecosystem health by relying on ecologically based inputs such as organic manures, microbial inoculants, and natural biostimulants. Organic nutrient management is particularly suited for pulses like green gram, which have modest nutrient requirements and symbiotic relationships with nitrogen-fixing bacteria (Dixit *et al*., 2020) [8].

Organic inputs such as farmyard manure (FYM), vermicompost, and biofertilizers (Rhizobium, phosphate-solubilizing bacteria or PSB) supply essential nutrients and enhance soil microbial dynamics. Jeevamruth, a traditional fermented liquid bio-culture prepared using cow dung, cow urine, jaggery, and legume flour, is widely used in India to promote microbial proliferation and nutrient mineralization in the soil (Palekar, 2006) [15]. Seaweed extracts, rich in growth hormones (auxins, cytokinins), vitamins, and micronutrients, have been shown to enhance physiological efficiency, root development, and resistance to abiotic stress in several crops (Kumar and Sahoo, 2011) [12]. When applied together, these components may exhibit synergistic effects, enhancing nutrient uptake, improving photosynthesis, and boosting crop yield without compromising soil health (Kumar *et al*., 2021) [11]. Despite the promising benefits of integrated organic systems, there is limited field-based research assessing their holistic impact on growth, yield, and soil health in green gram, particularly under the agro-ecological conditions of Odisha. The Alfisols of eastern India are typically low in organic carbon and available phosphorus, which restricts crop productivity under conventional input-starved conditions. Therefore, the present investigation titled ―Integrated Organic Nutrient Management in Green Gram (*Vigna radiata* L.) under an *Alfisols* of Eastern India‖ was undertaken to evaluate the effects of organic manures (FYM, vermicompost), biofertilizers (Rhizobium, PSB), and biostimulants (Jeevamruth, seaweed extract) on growth traits (plant height, leaf area, branches), physiological efficiency (chlorophyll content, root biomass, root volume), yield components (pods per plant, seeds per pod, test weight), seed yield, and post- harvest soil nutrient status.

This study aims to develop an efficient and ecologically sound organic production module for green gram that enhances both productivity and soil health under eastern India's low-input conditions. The findings are expected to support smallholder farmers in Odisha and contribute to national efforts to promote sustainable, climate-resilient pulse production.

Materials and Methods

The physic-chemical properties of initial soil sample of the experimental plot have been presented in table 1. Soil was sandy loam in texture, slightly acidic in reaction (pH 6.2) with soluble salts content of 0.32 dSm^{-1}. The organic carbon content was low, bulk density was 1.51 g/cm^3, $KMnO_4$ extractable N was low; Olsen’s P and NH_4OAc-K were medium in status. The organic source of fertilizer was the target input for the present study.

Table 1: Initial physic-chemical properties of the experimental plot

Parameters	Test value	Status
Soil type	Sand 72.9%	Sandy loam
	Silt 22.8%	
	Clay 4.3%	
pH	6.2	Slightly acidic
EC(dSm^{-1})	0.32	Normal
Bulk density(g/cm^3)	1.51	-
Organic carbon (%)	0.47	Low
$KMnO_4$ oxidisable N (kg ha^{-1})	211.5	Low
Bray’s P (kg ha^{-1})	17.2	Medium
NH_4OAc-K ($kgha^{-1}$)	164.4	Medium

The total rainfall in the months of growing period was 37.2 mm. There was not much change in maximum temperature which ranged from 27.3^{0}C to 36.1^{0}C also with the minimum temperature ranging from 16.0^{0}C to 23.6^{0}C. Mean maximum and mean minimum temperature was 31.6^{0}C and 19.8^{0}C, respectively during the cropping period. The average relative humidity was nearly over 90% during morning hours and in the afternoon it was ranging between 36 to 44% throughout the growing season. Mean sunshine hour during entire growing period was fairly averaged to 8.7 hr/day. More or less the weather was favorable during growing period.

During third week of January, ploughing of land was done by tractor, well pulverized and experimental plot was levelled. The layout of the experiment was done with 36 sub plots of 4.0 m X 3.0 m size each. It was undertaken with the provision of drainage channels. The layout was planned in randomized block design with twelve treatments and three replications. The green gram variety IPM 410-3 (Sikha) of 60 days duration was sown in line with a seed rate of 25 kg per ha on 20th of January, 2025 with a row to row and plant to plant spacing of 25 cm and 10 cm, respectively.

The test crop green gram received organic source of nutrients (50% though FYM and 50% though Vermicompost) as control. Therefore, FYM @ 2 t/ha and Vermicompost (VC) @ 1 t/ha were applied as basal and incorporated in the soil before sowing in all the treatments. Bio-fertilizer PSB and *Rhizobium* were applied as seed inoculation @ 20g each per kg of seed prior to sowing. *Jeevamrut* @ 10% solution and Seaweed extract @ 3% solution were sprayed through foliar application at 10, 20 and 30 Days after Sowing (DAS) to the respective treatments from B1 to B11 as mentioned in table 2. Hand weeding, inter row hoeing and thinning operation were carried out within 15 days after sowing and plant protection measures were carried out by using neem based biopesticide as and when required to raise a good crop. The composition of organic inputs used in the experiment has been mentioned in table 3.

Table 2: Treatment details of the experiment

Treatments	Description
B0	Control (FYM - 50% + Vermicompost - 50%)
B1	Control + seed inoculation with *Rhizobium*
B2	Control + seed inoculation with Phosphorus solubilising bacteria
B3	Control + foliar spray with 10% Jeevamrutha
B4	Control + seed inoculation with *Rhizobium* and PSB
B5	Control + *Rhizobium* + PSB +10% Jeevamrut

B6	Control + PSB + 10% *Jeevamrut*
B7	Control + 3% seaweed extract foliar spray
B8	Control + *Rhizobium* + 3% seaweed extract foliar spray
B9	Control + PSB + 3% seaweed extract foliar spray
B10	Control + 10% jeevamrut foliar spray +3% seaweed extract foliar spray
B11	Control + *Rhizobium* + PSB + 10% jeevamrut + 3% seaweed extract foliar spray

Table 3: Composition of Organic inputs and Bio-stimulants

Inputs	Test value		
Organic source	N%	P%	K%
FYM	0.52	0.34	0.81
Vermicompost	1.23	1.06	1.60
Bio stimulants	Composition		
Jeevamrut	Cow dung 10 kg, Cow urine 10 liters, Water 200 liters, Jaggery (Gud) 2 kg, Pulse flour (Besan) 2 kg and small amount of farm soil mixed thoroughly to fermentation		
Seaweed extract	S 200 ppm, Mg 500 ppm, Ca 500 ppm, Na 5000 ppm, K 200 ppm, B 20 ppm, Fe 20 ppm, Traces of N, P, Mn, Cu, Zn, I, Co, Se, Cytokinins, Auxins, gibberllins, protein, vitamins, etc.		

At 20, 40 and at harvest i.e. 60 DAS plant growth parameters like average plant height, number of branches per plant, dry matter production, Leaf Area Index (LAI) and leaf chlorophyll content were recorded by taking from plant samples (5 No.) from each sub plots. Plants were washed thoroughly with de-ionized water first, dried under shade and kept in a labeled paper bag. Collected plant samples then oven dried in hot air oven at 70^0 C till a constant weight was obtained. Then the average dry weight per plant was calculated for record. Effective nodules were counted in each treatment at 7^{th} week of plant age by uprooting randomly selecting 5 numbers of plants from each sub plots. Then plants were washed in clean water, effective nodules were counted, averaged and data were recorded. Further the nodules were detached and dried to take average nodule dry weight.
After full maturity (60 days), crop from each plot was harvested by uprooting. Ten plants from each sub plot were selected randomly for count of average number of pods per plant and average number of seeds per pod treatment wise. Similarly, treatment wise pod samples and haulm were collected separately, sun dried and weight was recorded for haulm yield. Then seeds were separated from pod and weight was taken to calculate seed yield and seed index. Then harvest index was calculated taking economic yield and biological yield into account. Similarly the roots were separated to take root dry weight, root volume and root to shoot ratio. Data with respect to soil as well plant parameters for various treatments were analysed for variance following standard statistical procedure outlined by Gomez and Gomez (1984) [10].Various economic indices *viz*. cost of cultivation, gross return and net return for different treatments were worked out and expressed in Rs ha^{-1}.

Results and discussion

Effect of various organic inputs and bio-stimulants on growth parameters of green gram at different stages of growth

Data related to the effect of various organic inputs and bio-stimulants on growth parameters of green gram at different stages of growth i.e on plant height, average number of branches per plant, dry matter production, root dry weight, Leaf Area Index (LAI), Leaf Chlorophyll Content (LCC) each at 20 Days After Sowing (DAS), 40 DAS and at harvest and effective nodules per plant at 40 DAS have been presented in table 4. Results obtained from field experiments revealed that all the plant growth parameters were significantly influenced by the different combinations of organic nutrient management practices and bio-stimulants at all growth stages. A consistent increase was observed with the advancement in crop age across all treatments. Treatment, B11 (FYM + Vermicompost + *Rhizobium* + PSB + 10% *Jeevamrut* + 3% Seaweed Extract) was found to be significantly superior to all other treatments in terms of all plant growth parameters like plant height, average number of branches per plant, dry matter production, root dry weight and LAI, LCC at all growth stages and effective nodules per plant at 40 DAS. It was followed by treatment B10 and B9, while the control (B0) recorded the lowest value.
This result corroborated with the study by Singh and Pareek (2003) [18] reported that the seed inoculation with PSB and *Rhizobium* resulted in superior plant height, number of branches per plant, total plant dry matter, number of nodules, and dry weight of nodules per plant in mung bean compared to untreated seeds. Dhakal *et al.* (2015) [6] and Verma *et al.* (2017) [20] reported that combining *Rhizobium*, PSB, and organic amendments increased SPAD chlorophyll content, dry matter accumulation, and nodulation. The results of Barik and Gulati, Kundu *et al.*, (2013) [13], Biswash *et al.*, (2014) [3] and Dhakal *et al.*, (2016) [5] showed that application of organic nutrients along with BioNP consortia (*Rhizobium* + PSB) and jeevamrut in green gram showed superiority in nodulation activity. Foliar applications of seaweed extract significantly enhanced the growth, yield and quality parameters compared to the control (Pramanick *et al.*, 2013) [17].

Effect of various organic inputs and bio-stimulants on the yield attributes, yield and economics of green gram at harvest

The yield and yield attributes of green gram, including number of pods per plant, number of seeds per pod, test weight, seed and haulm yield, harvest index and economics were significantly influenced by the application of various organic treatments as presented in Table 5. The number of pods per plant was significantly affected by the treatments. The maximum number of pods (18.1) was recorded in treatment B11 (FYM + Vermicompost + *Rhizobium* + PSB + 10% *Jeevamrut* + 3% Seaweed Extract), which was significantly superior to all other treatments. This was followed by B10 (16.6), B9 (15.3), and B5 (14.9), all of which were statistically at par and significantly better than the control. The control treatment B0 recorded the lowest number of pods (11.1), reflecting limited reproductive potential under minimal input conditions. Similar to pod number, the number of seeds per pod was significantly influenced by the treatment combinations. The highest number of seeds per pod (7.6) was recorded in B11, followed by B9 and B4 (7.5), which were at par. These treatments showed considerable improvement over the control (6.1), reflecting enhanced pollination efficiency and seed development likely facilitated by improved plant vigour and nutrient uptake. Test weight (weight of 100 numbers of seed) was significantly influenced by the organic treatments. The highest test weight (34.5 g) was recorded in B11, which was significantly higher than all other treatments. This was followed by B10 (32.6 g), B9 (30.4 g) and B5 (30.3 g). The lowest test weight was recorded in the control (28.2 g), suggesting limited assimilate translocation and seed filling under suboptimal nutrient regimes. The increase in test weight under B11 and B10 can be attributed to the continuous supply of nutrients, particularly nitrogen and micronutrients, facilitated by *Rhizobium*, PSB, *Jeevamrut*, and seaweed extract, which collectively support better seed filling and nutrient partitioning. Overall, the treatment B11 consistently outperformed others across all yield attributes, underscoring the importance of integrating microbial inoculants, organic manures, and bio- stimulants in enhancing reproductive efficiency and seed quality in green gram. Similar results have been reported by Singh and Pareek (2003) [18] that seed inoculation with PSB + *Rhizobium* resulted in a higher number of pods per plant, pod length, test weight, and the number of seeds per pod in mungbean.

The yield of green gram, including seed yield, haulm yield and harvest index were significantly influenced by the application of various organic treatments, as presented in Table 5. The treatment B11 (FYM + Vermicompost + *Rhizobium* + PSB + 10% *Jeevamrut* + 3% Seaweed Extract) recorded the highest seed yield (995 kg ha⁻¹), significantly superior to all other treatments. This was followed by B10 (988 kg ha⁻ ¹), B9 (868 kg ha⁻¹) and B5 (864 kg ha⁻¹), which were statistically at par and superior to treatments with only one or two organic components. The lowest seed yield (625 kg ha⁻¹) was recorded in the control (B0), which included only FYM and vermicompost. Haulm yield followed a similar trend. The highest haulm yield was recorded in B11 and the lowest being in the control. Harvest index (HI), representing the proportion of total biomass converted into economic yield, was also highest in B11, B10, B9 & B5 (0.22) and there was significant difference between the treatments. The control recorded the lowest HI of 0.19 indicating poor yield efficiency. Overall, the results affirm that integrated nutrient management using organic manures, microbial bio-inoculants, and biostimulants maximizes both vegetative and reproductive efficiency in green gram. The treatment B11 emerged as the most productive and efficient, offering a sustainable and ecologically sound approach to enhance pulse productivity under organic cultivation systems. Similar observations were made by Makwana *et al.*, 2020 revealed that yield parameters *viz.*, No. of pods, seed yield, haulm yield, test weight, harvest index were recorded higher in treatment with 0.5 t ha^{-1} vermicompost + seed treatment with BioNP (*Rhizobium* + PSB) + jeevamrut spraying.

The treatment B11 (FYM + vermicompost + *Rhizobium* + PSB + 10% *Jeevamrut* + 3% seaweed extract) recorded the highest gross return of Rs 81590 ha⁻¹, owing to its superior seed yield performance (995 kg ha⁻¹). This was followed by B10 and B9 with gross returns of Rs 81024 ha⁻¹ and Rs 71157 ha⁻¹ respectively. The lowest gross return of Rs 51250 ha⁻¹ was observed in the control treatment (B0), which included only FYM and vermicompost. In terms of net returns and benefit cost ratio, B11 again topped the data with Rs 37590 ha⁻¹ and 1.85, respectively indicating its profitability over other treatments. Ghosh and Joseph (2006) reported similar observation that the net returns and benefit cost ratio were higher when mungbean seed was inoculated with PSB + *Rhizobium* over control.

Effect of various organic inputs and bio-stimulants on residual physico-chemical properties of green gram plot

Soil physico-chemical characteristics and available nutrient status after harvest of green gram crop treated with different organic sources presented in table 6. Parameters such as soil pH, electrical conductivity (EC), organic carbon content, bulk density and available nitrogen (N) phosphorus (P) and potassium (K) were notably improved by the use of organic manures, microbial inoculants and foliar application of biostimulants. Among the treatments, B11 (FYM + Vermicompost + *Rhizobium* + PSB + 10% *Jeevamrut* + 3% Seaweed Extract) recorded the highest improvement across most soil parameters enhancing soil physical conditions, making the system more sustainable and resilient. Treatment B11 consistently outperformed others and can be recommended as an effective strategy for maintaining soil fertility under organic green gram cultivation. Finding from Tarafder *et al*. (2020) [19] noted that the soil total N, available P, exchangeable K, Ca, Mg, and available S, Zn, Fe, Cu, and B were increased with the increased levels of organic manures. Additionally, organic inputs enhanced soil physical properties, such as aggregate stability and bulk density, along with improving biological soil properties as reported by (Bahadur and Tiwari, 2014) [2].

Conclusion

From the present experiment it has been concluded that organic nutrient management involving FYM, vermicompost, bio-fertilizers (*Rhizobium* + PSB), *Jeevamrut*, and seaweed extract significantly improved growth, physiological efficiency, yield performance, and economic returns of green gram grown in an *Alfisols*. The B11 (FYM + Vermicompost + *Rhizobium* + PSB + 10% *Jeevamrut* + 3% Seaweed Extract) treatment emerged as the best-performing module, offering a viable organic farming strategy that boosts productivity while enhancing soil health and minimizing external inputs. The study demonstrates that adopting such bio-based approach is not only feasible for small holder farmers in Odisha but also essential for promoting sustainable, low-input agriculture in rainfed and nutrient-deficient regions for organic green gram cultivation.

Table 4: Effect of various organic inputs and bio-stimulants on growth parameters of green gram at different stages of growth

Treatments	Plant height (cm)			No. of Branches plant $^{-1}$			Dry matter production (g m^{-2})			Root dry weight (mg)			Leaf area index			Leaf chlorophyll content			Effective nodules plant $^{-1}$
	20 DAS	40 DAS	At harvest	20 DAS	40 DAS	At harvest	20 DAS	40 DAS	At harvest	20 DAS	40 DAS	At harvest	20 DAS	40 DAS	At harvest	20 DAS	40 DAS	At harvest	40 DAS
B_0 - control (FYM + vermicompost)	7.1	34.9	50.9	0.7	2.6	4.2	18.8	125.9	180.4	150	374	513	0.4	2.1	3.2	1.1	1.6	1.3	35.1
B_1 - B_0 + seed inoculation with *Rhizobium*	7.5	35.5	52.7	0.9	2.8	4.5	21.2	136.9	207.0	152	376	515	0.5	2.2	3.3	1.2	1.7	1.4	36.2
B_2 - B_0 + seed inoculation with PSB	7.9	36.1	54.3	1.0	2.8	4.6	22.8	147.3	225.8	154	377	516	0.6	2.2	3.3	1.3	1.7	1.4	36.5
B_3 - B_0 + Foliar spray with 10% *Jeevamrut*	8.3	36.4	56.1	1.3	2.9	4.9	24.4	159.2	246.9	155	378	518	0.6	2.3	3.6	1.4	1.8	1.5	37.0

B_4 - B_0 + *Rhizobium* + PSB	8.9	37.1	57.4	1.4	3.2	5.0	26.9	173.0	262.5	156	380	519	0.7	2.7	3.9	1.4	1.9	1.6	37.2
B_5 - B_0 + *Rhizobium* + PSB + *Jeevamrut*	9.9	36.7	59.3	1.6	3.5	5.1	28.5	183.4	278.1	157	381	521	0.8	2.8	4.0	1.5	1.9	1.6	37.8
B_6 - B_0 + PSB + *Jeevamrut*	9.5	35.4	56.5	1.2	3.2	4.9	26.7	170.7	260.7	156	379	520	0.6	2.4	3.6	1.4	1.8	1.6	36.7
B_7 - B_0 + 3% seaweed extract foliar spray	9.2	34.3	53.8	0.9	3.1	4.7	25.1	159.2	246.2	154	378	519	0.6	2.3	3.5	1.3	1.7	1.5	36.2
B_8 - B_0 + *Rhizobium* + 3% seaweed extract	9.7	35.5	56.5	1.2	3.4	4.9	29.3	182.0	282.7	155	380	521	0.8	2.6	3.8	1.4	1.8	1.6	37.0
B_9 - B_0 + PSB + 3% seaweed extract	10.1	35.9	59.0	1.4	3.7	5.0	31.5	192.1	304.7	157	381	522	0.9	3.0	4.3	1.4	1.8	1.6	37.9
B_{10} - B_0 + 10% *Jeevamrut* + 3% seaweed extract	10.7	36.8	60.9	1.6	4.2	5.2	33.5	201.6	324.7	158	383	524	1.1	3.0	4.6	1.5	1.9	1.7	48.3
B_{11} - B_0 + *Rhizobium* + PSB + 10% *Jeevamrut* + 3% seaweed extract	11.6	37.7	62.9	1.8	4.6	5.3	34.6	210.6	345.1	160	385	526	1.2	3.2	4.8	1.5	2.0	1.7	49.6
SE(m)±	0.21	0.39	0.43	0.04	0.12	0.08	1.16	1.96	2.71	0.3	0.4	1.2	0.72	1.95	1.65	-	-	-	0.46
CD(0.05)	0.6	1.2	1.3	0.1	0.4	0.2	3.5	5.9	8.1	1.0	1.3	3.5	2.1	5.6	4.9	-	-	-	1.58

Table 5: Effect of various organic inputs and bio-stimulants on the yield, yield attributes and economics of green gram at harvest

Treatment	No of pods Per plant	No of seeds per pod	Test weight (g)	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Harvest Index	Cost of cultivation (Rs/ha)	Gross Return (Rs/ha)	Net return (Rs/ha)	B:C ratio
B_0 - control (FYM + vermicompost)	11.1	6.1	28.2	625	2194	0.19	41500	51250	9750	1.23
B_1 - B_0 + seed inoculation with *Rhizobium*	11.3	6.2	28.8	639	2582	0.20	42050	52406	10356	1.25
B_2 - B_0 + seed inoculation with PSB	11.9	6.6	29.2	699	2731	0.20	42070	57353	15283	1.36
B_3 - B_0 + Foliar spray with 10% *Jeevamrut*	12.7	7.1	29.6	757	2916	0.21	43000	62104	19104	1.44
B_4 - B_0 + *Rhizobium* + PSB	13.5	7.5	30.0	805	3002	0.21	42500	66045	23545	1.55
B_5 - B_0 + *Rhizobium* + PSB + *Jeevamrut*	14.9	7.0	30.3	864	3131	0.22	43250	70840	27590	1.64
B_6 - B_0 + PSB + *Jeevamrut*	12.9	7.4	29.5	768	2990	0.20	43700	62984	19284	1.44
B_7 - B_0 + 3% seaweed extract foliar spray	12.2	7.1	29.1	686	2752	0.20	42450	56282	13832	1.33
B_8 - B_0 + *Rhizobium* + 3% seaweed extract	14.2	7.3	29.8	768	2955	0.21	42900	63015	20115	1.47
B_9 - B_0 + PSB + 3% seaweed extract	15.3	7.5	30.4	868	3151	0.22	43450	71157	27707	1.64
B_{10} - B_0 + 10% *Jeevamrut* + 3% seaweed extract	16.6	7.3	32.6	988	3432	0.22	43850	81024	37174	1.85
B_{11} - B_0 + *Rhizobium* + PSB + 10% *Jeevamrut* + 3% seaweed extract	18.1	7.6	33.5	995	3484	0.22	44000	81590	37590	1.85
SE(m)±	0.31	0.24	0.11	72.0	89.0	-	-	-	-	-
CD(0.05)	0.9	0.7	0.3	195	255	NS	-	-	-	-

Table 6: Effect of various organic inputs and bio-stimulants on residual soil physico-chemical characteristics and nutrient availability after harvest of green gram

Treatments	pH	EC dSm^{-1}	Organic carbon %	Bulk density g/cm^3	Available N kg/ha	Available P kg/ha	Available K kg/ha
Initial Soil physic-chemical properties	6.20	0.32	0.47	1.51	211.5	17.15	164.4
B_0 - control (50% FYM + 50% vermicompost)	6.13	0.26	0.49	1.49	197.3	17.4	166.8
B_1 - B_0 + seed inoculation with *Rhizobium*	6.23	0.28	0.50	1.46	200.4	17.8	169.7
B_2 - B_0 + seed inoculation with PSB	6.27	0.31	0.52	1.45	201.8	18.0	172.1
B_3 - B_0 + Foliar spray with 10% *Jeevamrut*	6.33	0.33	0.54	1.43	206.4	18.3	174.7
B_4 - B_0 + *Rhizobium* + PSB	6.37	0.35	0.55	1.41	208.3	18.5	176.0
B_5 - B_0 + *Rhizobium* + PSB + *Jeevamrut*	6.30	0.38	0.57	1.45	210.4	18.7	178.7
B_6 - B_0 + PSB +*Jeevamrut*	6.30	0.35	0.54	1.43	207.8	18.2	175.7
B_7 - B_0 + 3% seaweed extract foliar spray	6.20	0.32	0.52	1.46	205.8	17.9	173.5
B_8 - B_0 + *Rhizobium* + 3% seaweed extract	6.30	0.37	0.54	1.43	210.2	18.5	176.9
B_9 - B_0 + PSB + 3% seaweed extract	6.33	0.32	0.57	1.42	212.6	18.7	179.1
B_{10} - B_0 + 10% *Jeevamrut* + 3% seaweed extract	6.30	0.31	0.55	1.47	216.5	19.2	182.4
B_{11} - B_0 + *Rhizobium* + PSB + 10% *Jeevamrut* + 3% seaweed extract	6.33	0.32	0.56	1.44	219.1	19.8	185.5

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