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Effect of different organic sources of nutrients on growth parameters of organic summer green gram

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Abstract
This scientific study aimed to assessment of different organic sources of nutrients for organic summer green gram cultivation. A field experiment was conducted during summer season of the year 2020-21 on organic certified plot A-7 at Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand. Different sources of organic manures were tested using randomized block design with four replications. The study revealed that different organic sources of nutrients remained not changed to plant population and they had no significant influence on plant population. In growth attributes, treatment T_{10} (50% N through neem cake followed by Seed treatment of *Rhizobium*) at 30 DAS and T_8 (50% N through vermicompost followed by Seed treatment of *Rhizobium*) recorded significantly higher plant height at 60 DAS and harvest as compared to other treatments, respectively. Significantly higher dry weight of nodules was obtained with the application of treatment T_4 (100% N through vermicompost). Higher number of branches/plant at 60 DAS and at harvest was obtained with the application of treatment T_{10}. Higher values recorded as a result in these treatments due to microbial activities, which enhance vegetative growth and nodule formation in the plant.

Keywords: Green gram, organic, FYM, vermicompost, *Rhizobium*, growth parameters

1. Introduction
Pulses plays an important role in Indian agriculture and India is one of the largest producers (25% of global production), a consumer (27% of world consumption) and an importer (14%) of pulses in the world [1]. Pulses contain a high percentage of quality protein (~24%) nearly three times as much as cereals [2]. In India, the production of summer green gram has increased significantly over the years of past decade [3], which is shown in Figure 1. The important mungbean-growing Indian states are Orissa, Maharashtra, Andhra Pradesh, Tamil Nadu, Uttar Pradesh Madhya Pradesh, Rajasthan and Bihar.
In Gujarat State, the green gram cultivation area is 4.13 lakh hectares with an annual production of 4.12 lakh tons and average productivity of 558 kg/ha.

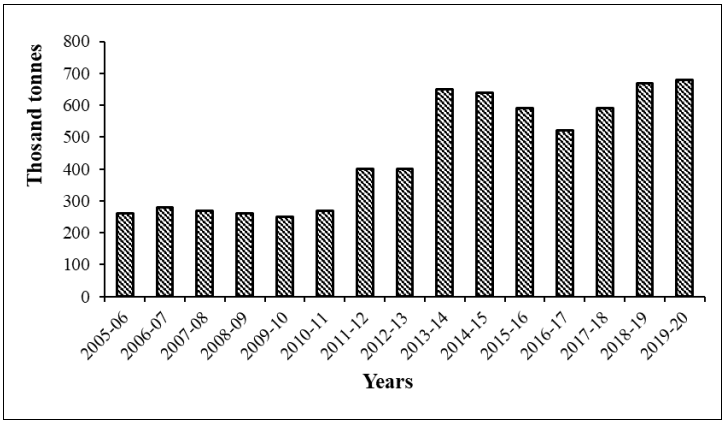

Fig 1: Summer green gram production in India over the years

Green gram is an important food legume grown in tropical and subtropical regions. It is a short duration *kharif* pulse crop that can be grown as a catch crop between the *rabi* and *kharif* seasons. During summer, it can also be used as a green manure crop. It is primarily a *kharif* crop but with the development of early maturing varieties, it has also proved to be an ideal crop for spring and summer season. Its foliage is used as fodder after removing the mature pods.

The imbalance and continuous use of chemical fertilizers have adverse effects on soil's physicochemical and biological properties and thereby affecting sustainable crop production [4]. Intensive farming practices which produce high yields and quality require extensive use of chemical fertilizers which are costly and create environmental issues [5]. Therefore, there has been a recent resurgence of interest in eco-friendly, sustainable and organic agricultural practices [6]. Organic manures are a good source of plant nutrients and can serve as an alternative practice to mineral fertilizers for plants [7]. It supplies macronutrients (i.e., nitrogen, phosphorus, potassium, sulphur) along with micronutrients such as Fe, Mn, Cu, Zn, and Mo in most available forms to the plants through biological decomposition.

The availability of a large amount of farmyard manure (FYM) being rich in organic matter necessitates the need for supplementing with fertilizers. Green manuring seems to be difficult under an intensive cropping system so recycling different organic wastes in the form of compost would also be a good source of organic manures. Organic inputs have also been found to be a good carrier for the flourishment of microorganisms resulting in sustained soil productivity and enzymatic activity of soils. It is a well-known fact that organic materials such as FYM and vermicompost accelerate the process of decomposition as well as the ready energy source for microbial proliferation. Improvement in physical properties of the soil, organic carbon and available nitrogen, phosphorus and potassium has been well documented [8].

The integrated uses of organic manures mainly compost, vermicompost and castor cake produces a higher yield along with maintaining the overall soil nutrient status. Organic nutrient management practice for green gram under rainfed conditions results in increased soil fertility and enhanced NPK uptake by the crop registering superior crop growth and seed and stover yields [9].

Different organic treatments influence agronomic parameters of green gram notably *viz*. plant dry weight, number of branches/plants, plant height. The agronomic parameters considered for the evaluation of plant growth response were found to change significantly under different treatments.

2. Materials and Methods

2.1 Experimental Site

The investigation "An assessment of different organic sources of nutrients for organic summer green gram cultivation" was carried out during the summer season of the year 2021 at Certified Organic Farm A-7, College Agronomy Farm, BACA, Anand Agricultural University, Anand (Gujarat).

2.2 Climate and Weather Condition

In Anand city, monsoon commences by the third week of June and retreats by the middle of September with an average rainfall of 864 to 870 mm received entirely from the south-west monsoon current. In general, rainfall is adequate in this region but the partial failure of rain once in three or four years is very common. July and August are the months of heavy precipitation and there is no rainfall in winter and summer in almost all parts of Gujarat.

2.3 Salient Features of the Variety

The green gram variety GM-6 (Gujarat Moong 6) (NMK-15-12) was selected for sowing in the experiment. It was released from Pulses and Castor Research Station, Navsari Agricultural University, Navsari for general cultivation under rainfed conditions in Gujarat state. This variety is resistant to wilt and yellow vein mosaic virus diseases.

2.4 Experimental Details

2.4.1 Details of treatments

Ten treatments comprising different organic sources were included in the experiment. The details of the treatments and NPK content in different inputs are given in Table 1.

Table 1: Description of the given treatment

Treatment No.	Treatment details
T_1	No manures (Control)
T_2	*Rhizobium* (5.0 mL/kg seed treatment and 1.0 L/ha soil application)
T_3	100% N through FYM
T_4	100% N through vermicompost
T_5	100% N through castor cake
T_6	100% N through neem cake
T_7	50% N through FYM followed by Seed treatment of *Rhizobium*
T_8	50% N through vermicompost followed by Seed treatment of *Rhizobium*
T_9	50% N through castor cake followed by Seed treatment of *Rhizobium*
T_{10}	50% N through neem cake followed by Seed treatment of *Rhizobium*

Note:

1. All the organic manures were applied 10 days before sowing in the respective treatment
2. *Rhizobium* was applied at 5.0 mL/kg as a seed treatment in the respective treatment while PSB 1.0 L/ha applied as a common soil application except for treatment T_1.

2.5 Other Experimental Details

1. Experimental design : Randomized Block Design
2. Number of Replications : 04 (Four)
3. Number of Treatments : 10 (Ten)
4. Total number of plots : 40 (Forty)

2.6 Experimental Observations

The experimental observations were recorded on five randomly selected plants from each net plot and tagged for recording growth parameters. The details of growth parameters studied during the investigation are given in Table 2.

Table 2: Observations recorded

S. No.	Parameters	Sample size	Time of observation
Growth parameters			
1.	Plant population	Per meter row length/net plot	15 DAS & at harvest
2.	Plant height (cm)	5 plants/ net plot	30, 60 DAS, and at harvest
3.	Number of branches per plant	5 plants/ net plot	60 DAS and at harvest
4.	A dry weight of root nodules per plant (mg)	5 plants/ gross plot	50 DAS
5.	Plant dry biomass (g)	5 plants/ gross plot	At 50 DAS
6.	Root dry biomass (g)	5 plants/ gross plot	At 50 DAS

3. Results and Discussion

Growth parameters

3.1 Plant population at 15 DAS and harvest

The data showed that different organic sources of nutrients remained not changed to plant population (Table 3) and maximum plant population/meter row length at 15 DAS and harvest (10.70 and 10.54, respectively) was observed in treatment T_{10} (50% N through NC + *Rhizobium* seed treatment) and T_8 (50% N through VC + *Rhizobium* seed treatment), respectively. While minimum plant population (9.66 and 9.68, respectively) with treatments T_3 and T_1 (Control), respectively.

The increase in plant height could be attributed to the better proliferation of roots and increased nodulation due to higher phosphorus availability. Phosphorus also promotes the formation of new cells, cell elongation and plant vigor and hastens leaf development, which helps in harvesting more solar energy, and better utilization of nitrogen which in turn leads to a higher plant height of green gram. Similar observations were also made by Patel *et al*. (2016) [10] and Singh *et al*. (2018) [11] in green gram.

3.2 Plant height (cm)

The data presented in Table 3 showed that treatment T_{10} (50% N through NC + *Rhizobium* seed treatment) at 30 DAS (27.62 cm) recorded significantly higher plant height. While, treatment T_8 (50% N through VC + *Rhizobium* seed treatment) recorded significantly higher plant height of 62.90 cm at 60 DAS as compared to other treatments. However, it remained at par (61.12 cm, 59.82 cm, 59.70 cm and 59.29 cm, respectively) with treatment T_5, T_7 and T_9, respectively. Treatment T_8 recorded a significantly higher plant height of 69.00 cm at harvest as compared to other treatments. However, it remained at par (68.95 cm and 67.72, respectively) with treatment T_9 and T_5, respectively at harvest. These results conform with the findings of Patel & Pathak (2002) [12].

Table 3: Plant population and plant height of green gram as influenced by different organic sources

Treatment	Plant Population (No. per meter row length)		Plant Height (cm)		
	15 DAS	At harvest	At 30 DAS	At 60 DAS	At harvest
T_1: No manure (Control)	9.76±0.20	9.68±0.12	25.12±0.68	54.12±0.54	60.70±4.02
T_2: *Rhizobium* seed treatment + 1.0 L/ha soil application	10.05±0.32	9.80±0.32	24.70±0.22	55.02±1.82	61.75±3.42
T_3: 100% N through FYM	9.95±0.62	9.66±0.51	25.17±0.22	56.17±1.86	62.27±1.42
T_4: 100% N through vermicompost (VC)	9.94±0.55	9.79±0.66	25.30±0.22	57.07±3.56	64.42±2.22
T_5: 100% N through castor cake (CC)	10.06±0.65	9.74±0.46	25.62±0.17	61.12±1.13	67.72±1.92
T_6: 100% N through neem cake (NC)	10.26±0.38	9.91±0.36	26.70±0.67	57.55±3.99	58.80±0.50
T_7: 50% N through FYM + *Rhizobium* seed treatment	10.35±0.31	10.05±0.26	26.45±0.17	59.70±3.14	67.35±2.34
T_8: 50% N through VC + *Rhizobium* seed treatment	10.54±0.28	10.16±0.32	26.65±0.44	62.90±3.12	69.00±0.75
T_9: 50% N through CC + *Rhizobium* seed treatment	10.43±0.25	10.25±0.33	27.37±0.48	59.29±2.37	68.95±1.08
T_{10}: 50% N through NC + *Rhizobium* seed treatment	10.70±0.13	10.38±0.26	27.62±0.28	59.82±6.51	64.17±9.38
S.Em ±	0.20	0.19	0.18	1.62	1.89
CD (P=0.05)	NS	NS	0.54	4.70	5.50
CV (%)	4.09	3.99	2.14	5.56	5.88

(Mean ± SD; *n*=4)

3.3 Dry weight and Number of branches/plants

Table 4 presents data on dry weight of nodules (mg/plant) of green gram recorded at 35-40 DAS and the numbers of branches/plant at 60 DAS and at harvest as influenced by different organic sources of nutrients in summer green gram. A significantly higher dry weight of nodules (44.25 mg/plant) was obtained with the application of treatment T_4 (100% N through VC) and remained at par with treatments T_9, T_{10}, T_6, T_8, T_7 and T_5. Similar findings were obtained by Gupta *et al*., (2004) [13].

A significantly higher number of branches/plant (7.76) at 60 DAS was obtained with the application of treatment T_{10} (50% N through NC + *Rhizobium* seed treatment) and remained at par (7.47) with treatment T_7. A significantly higher number of branches/plant (7.92) at harvest was obtained with the application of treatment T_{10} (50% N through NC + *Rhizobium* seed treatment) and remained at par (7.88, 7.62, and 7.56, respectively) with treatments T_7, T_9 and T_8, respectively at harvest.

Better performance of treatments T_{10} (50% N through NC + *Rhizobium*) with respect to a number of branches might be due to lesser C: N ratio of neem cake and castor cake which resulted in mineralization and increased availability of nitrogen to the plant throughout the crop growth period. These results are similar with the findings of Patel & Pathak (2002) [12].

Table 4: Dry weight of nodules and number of branches/plant at 60 DAS and at harvest of green gram as influenced by different organic sources of nutrients

Treatment	Dry weight of nodules (mg/plant) at 35-40 DAS	Number of branches/plant	
		At 60 DAS	At harvest
T_1: No manure (Control)	35.33±0.26	6.44±0.29	6.63±0.23
T_2: *Rhizobium* seed treatment + 1.0 L/ha soil application	36.70±0.42	6.58±0.31	6.82±0.20
T_3: 100% N through FYM	42.10±1.43	6.49±0.33	6.65±0.27
T_4: 100% N through vermicompost (VC)	44.25±3.57	6.76±0.14	6.94±0.08
T_5: 100% N through castor cake (CC)	40.80±3.17	7.01±0.01	7.14±0.09
T_6: 100% N through neem cake (NC)	43.50±2.82	6.88±0.53	7.08±0.30
T_7: 50% N through FYM + *Rhizobium* seed treatment	40.83±4.35	7.47±0.29	7.88±0.18
T_8: 50% N through VC + *Rhizobium* seed treatment	41.05±3.42	7.28±0.24	7.56±0.31
T_9: 50% N through CC + *Rhizobium* seed treatment	43.93±1.94	6.58±0.33	7.62±0.61
T_{10}: 50% N through NC + *Rhizobium* seed treatment	43.63±2.26	7.76±0.37	7.92±0.35
S.Em ±	1.24	0.15	0.14
CD (P=0.05)	3.62	0.44	0.42
CV (%)	6.06	4.45	4.04

(Mean ± SD; *n*=4)

3.4 Plant dry biomass and root dry biomass

The data recorded in Table 5 revealed that higher plant and root dry biomass (29.07 g/plant and 30.44 g/plant) was obtained with the application of treatment T_{10} (50% N through NC + *Rhizobium* seed treatment) and remained at par (26.37 g/plant and 28.67 g/plant in plant and root dry biomass, respectively and 25.26 g/plant in plant dry biomass and 26.60 g/plant in root dry biomass, respectively with treatments T_9 and T_7, respectively. These results are in close agreement with Khoja *et al*. (2002) [14] and Tagore *et al*. (2013) [15].

Table 5: Plant dry biomass and Root dry biomass of green gram as influenced by different organic sources of nutrients

Treatment	Plant dry biomass (g/plant)	Root dry biomass (g/plant)
	At 35-40 DAS	
T_1: No manure (Control)	20.02±0.83	16.73±0.17
T_2: *Rhizobium* seed treatment + 1.0 L/ha soil application	20.94±0.82	17.52±0.30
T_3: 100% N through FYM	21.95±2.13	18.24±0.68
T_4: 100% N through vermicompost (VC)	21.80±2.23	22.46±4.55
T_5: 100% N through castor cake (CC)	22.09±1.33	24.51±3.20
T_6: 100% N through neem cake (NC)	23.95±4.25	23.34±5.62
T_7: 50% N through FYM + *Rhizobium* seed treatment	25.26±2.98	26.60±1.28
T_8: 50% N through VC + *Rhizobium* seed treatment	23.45±1.63	23.39±5.58
T_9: 50% N through CC + *Rhizobium* seed treatment	26.37±4.73	28.67±6.04
T_{10}: 50% N through NC + *Rhizobium* seed treatment	29.07±0.78	30.44±7.43
S.Em ±	1.31	2.01
CD (P=0.05)	3.82	5.83
CV (%)	11.23	15.67

4. Conclusion

The productivity of crops largely depends on the balanced application of different organic sources along with bio fertilizers. The data obtained in this study suggest that higher yield and gross realization could be achieved with the application of 50% N (10 kg/ha) through NC + *Rhizobium* seed treatment (5 mL/kg) under the organic condition with maintaining soil health.

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