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# Nutrient Management Through Organic Sources in Summer Green Gram

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## ABSTRACT

**Background:** Pulses are source of supplementary protein to daily diets based on cereals and starchy food for predominant vegetarian population. So, pluses are therefore often regarded as poor man's meat. Greengram is third most important pulse crop growing after chickpea and pigeon pea in India. For maintain soil health, better quality crop production, organic fertilizer managements play important role.

**Methods:** The experiment on nutrient management thought organic sources in summer green gram conducted with aim to know the effect of organic nutrient management on the growth, yield and quality of green gram at College Agronomy Farm, B.A. College of Agriculture, Anand Agricultural University, Anand during summer season of 2018 to 2020 in sandy loam soil of middle Gujarat. There were ten treatments of organic sources including no manures (control) treatment. They were replicated four times in randomized block design.

**Result:** Three years experiment data revealed that application of vermicompost @0.5t/ha+Bio NP (Rhizobium and PSB) reported higher plant height at harvest, number of pods per plant, test weight, seed yield, harvest index and net return and BCR. Green gram haulm yield and soil microbial count was significantly higher in treatment $T_6$ (FYM @ 2.0 t/ha+Bio NP (Rhizobium and PSB), treatment $T_8$ (Castor cake @ 0.25 t/ha+Bio NP (Rhizobium and PSB), reported higher potassium content in haulm, Response of organic manures treatments found non-significant in case of initial plant population, plant height and number of branches per plant at 30 DAS, protein content, micronutrient content in seed, haulm and soil, except Mn in seed, heavy metal content in seed, haulm and soil, after harvest soil nutrient EC, organic carbon and available $K_2O$, whereas same results also observed in case of nutrient content in seed and haulm.

**Key words:** Castor cake, FYM, Heavy metals, Micronutrient content, Organic manures, Seed yield, Vermicompost.

## INTRODUCTION

Pulses are one of the distinct health benefit food crops globally due to their low fat contain and higher protein content (Xavier *et al*., 2023). Pulses are an important group of crops in India, which is also responsible for yielding large financial gains by amounting for a large part of the exports (Anon., 2022). As a major crop, catch crop, cover crop, green manure crop, intercrop and mixed crop, pulses hold a special place in every known farming system, which contributes to their significant significance in agriculture (Sodavadiya *et al.,* 2023). India is one of the agricultural country and food is very important need for our country because growth of population (Vaithiyanathan and Sundaramoorthy, 2016). Pulses are commonly known as food legumes which are secondly to cereals in production and consumption in India (Makwana *et al*., 2020). Green gram has high nutrients and antioxidants properties and due to high nutritive value like 25% protein, 56.7% carbohydrates, 4.1% fibers, 3.5% minerals, 10.4% moisture, 1.3% fat and appreciable amount of *riboflavin, thiamine* and little amount of Vitamin B complex (Lokhande *et al.,* 2018). Green gram is staple meal that has a large amount of protein content (Laxshman *et al*., 2023) and it is most important pulse crop grown in India, Central Asia as well as Gujarat (Kumar *et al*., 2021). It is the main source of protein particularly for vegetarians and contributes about 14% of the total protein of average Indian diet. Due to its wide used as a vegetable, pulse, fodder and green manures crop and high adaptability, it is grown in two seasons. India is the major producer of green gram in the world and it is grown in almost all the states. It is grown on about 40.38 lakh hectares with a total production of 31.5 lakh tonnes with a productivity of 783 kg/ha (It is less than global average) and contributes 11% to the total pulse production in the year 2021-22. Total pulses production during 2022-23 is estimated at 260.58 Lakh tonnes which is higher by 14.02 Lakh tonnes than the last five years' average pulses production of 246.56 Lakh tonnes.

Present scenario about high quality nutrient demand and soil health are major key factors for organic food and production. Excess and imbalance used of nutrients has

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caused nutrient mining from soil, deteriorated crop productivity and ultimate affected on soil health. Organic farming minimizes the use of external inputs and aims to optimization of crop productivity rather than its maximization through renewal and strengthening of ecological processes and functions of farm ecosystem (Shukla *et al*., 2011).

Fertilizers alone cannot sustain land productivity in modern farming (Perli *et al*., 2022). The application of integrated organic manure like FYM and vermicompost alone with biofertilizers may serve as a source of nutrients and complexing agents. FYM, vermicompost, castor cake and biofertilizers (Bio NP) are good organic manures and its very useful for improving soil structure, aeration, water holding capacity of soil (Gohain and Kikon, 2017). Further, they increase the availability of macro and micronutrients to the plants through enhanced biological processes, increases solubility of nutrients and alters soil salinity, sodicity and pH (Alabadan *et al*., 2009). Numerous compounds including humic acid and fulvic acids and a variety of substances including organic acid, polyphenols, amino acids and polysaccharides of organic materials forms stable complexes with native nutrients and also act as chelating agent, with prevent the nutrients from precipitation, fixation, oxidation and leaching (Chaudhary *et al*., 2023).

Biofertilizer is a easy, cheapest and safest way of adding and supplying nitrogen to green gram in soil through well-known symbiotic nitrogen fixation. Biofertilizers are the source of increasing the productivity and sustainability of the soil. They increase soil fertility and help plant growth by increasing their numbers and biological activities (Susngi *et al*., 2023).

In moder farming system fertility and soil sustainability is no longer. Increasing agricultural sustainability and productivity with environmental safety by used of lots of organic matter by adding organic materials. All organic manures has significant role in production, quality and soil health. Fulfil the present demand of valuable food is organically produced end used materials. Application of organic materials improved soil structure, texture, nutrient mineralization and biological activity, finally we get quality food. Presently selected organic materials easy available in near by area/rural by use of these organic materials they supply and increase availability of nutrients for plant, improved soil physical, chemical and biological condition of soil by these ways improve nutrients availability in soil as well as improved quality of green gram by these points locally available organic manures was selected.

In present situation people are very serious about health and diet. The demand of organically grown vegetable and pulses are increased day by day. The major key factors of consumer demand for organic food are the health consciousness and the willingness to pay for the high-priced produce (Lal *et al*., 2022).

## MATERIALS AND METHODS

An experiment on nutrient management through organic sources in summer green gram was conducted at College Agronomy Farm, Department of Agronomy, B.A.College of Agriculture, Anand Agricultural University, Anand, (Gujarat) during summer season of 2018 to 2020. The experiment was laid out in randomized block design with ten treatments and four replications during summer season. The ten treatments included $T_1$: No manure (Control), $T_2$: FYM @ 4.0 t/ha, $T_3$: Vermicompost @ 1.0 t/ha, $T_4$: Castor cake @ 0.5 t/ha, $T_5$: Bio NP (*Rhizobium* and PSB), $T_6$: FYM @ 2.0 t/ha+Bio NP (*Rhizobium* and PSB), $T_7$: Vermicompost @ 0.5t/ha+Bio NP (*Rhizobium* and PSB), $T_8$: Castor cake @ 0.25 t/ha+Bio NP (*Rhizobium* and PSB), $T_9$: FYM @ 2.0 t/ha+Vermicompost @ 0.5 t/ha and $T_{10}$: FMY @ 2.0 t/ha+Castor cake @ 0.25 t/ha. Bio NP (*Rhizobium* and PSB)

**Table 1:** Initial soil status and micronutrient analysis process (Average of three years).

| Parameter | Value* | Method and its reference |
|---|---|---|
| pH | 8.23 | Potentiometric method, Jackson (1973) |
| EC (1:25) dS/m | 0.18 | Conductometric method, Jackson (1973) |
| Organic carbon (%) | 0.45 | Rapid titration method, Walkley and Black (1934) |
| Available $P_2O_5$ (kg/ha) | 14 | Spectrophotometric method, Olsen *et al.* (1954) |
| Available $K_2O$ (kg/ha) | 214 | Flame photometric method, Jackson (1973) |
| Fe | | |
| Zn | | Wet Digestion (HNO3: HClO4-4:1) (Atomic |
| Mn | | Absorption Spectrophotometry) Jackson, 1973 |
| Cu | | |
| Cd | | |
| Co | | Wet Digestion ($HNO_3$: HClO4-4:1) (Atomic |
| Cr | | Absorption Spectrophotometry) Jackson, 1973 |
| Ni | | |
| Pb | | |

*It is mean value of three-year initial soil samples analysis.

applied 1.0 liter/ha with organic sources. Green gram variety Gujarat Anand Mung 5 (GAM 5) was used in experiment, seed was sown in 5 cm depth in soil. The gross plot size of each plot was 18.0 $m^2$. Spacing of green gram during summer season was 30 cm between two rows. Before primary tillage, soil samples taken for initial soil status was taken every year (Table 1). The standard meteorological data regarding temperature, relative humidity, rainfall *etc* are reported in Fig 1 and 2. An experiment soil was slightly alkaline (8.23) in nature, low in EC (0.18 dS/m), deficit in organic carbon (0.45) and available $P_2O_5$ (14 kg/ha) and medium in $K_2O$ (214 kg/ha). Organic sources *i.e* FYM, Castor cake and Vermicompost were applied 15 days before sowing of green gram. During the experiment period overall weather conditions were very favorable for crop growth and development. All organic manures analysis was carried out before sowing for its nutrient content (Table 2). According to analysis value, calculated required quantity of organic manures and applied in respective plot. In the experiment, follow standard agronomical package of practices for successful green gram production. Selected and tagged five plants from each net plot area randomly and observation were received on growth and yield attributes and yields. Plant protection measures also play a significant role in control of pest and diseases and used organic pesticide and insecticide to prevent damage of crop during experimentation for controlling of sucking and chewing pest initiation used pure material of *neemastra* and 7-8 lit of *brahmastra* and *agniastra* dilute in 200 lit of water with 7-8 days interval spraying for efficient control of all type of insects and pest. After harvesting green gram, collect seed samples collected individual plot for analysis of quality parameters, content as well as uptake of nutrients. Soil nutrient status is also important observation in organic system, so soil samples from each plot were collected to measure soil

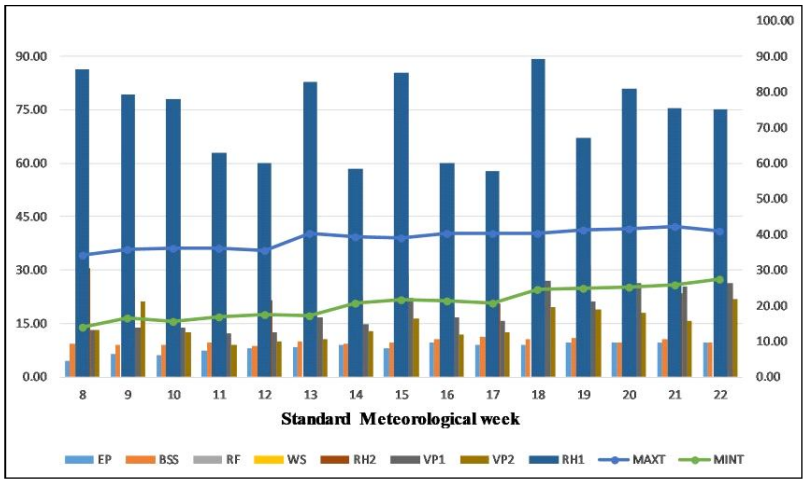


**Fig 1:** Weather parameters of Anand during crop growing season summer 2018.

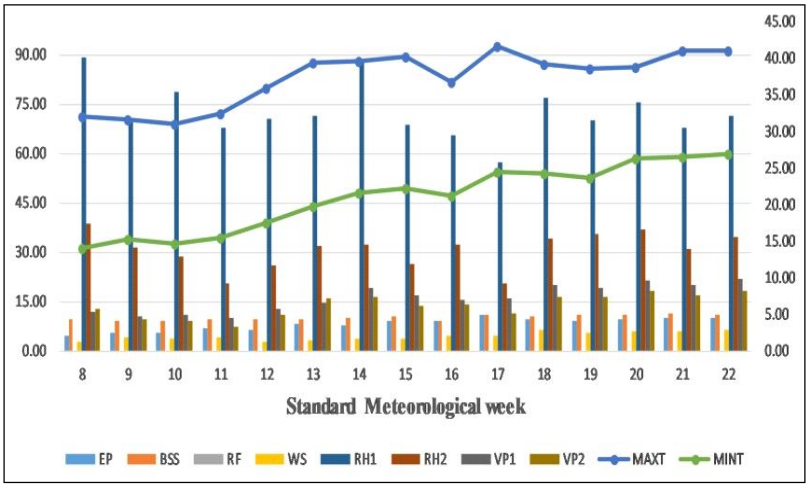


**Fig 2:** Weather parameters of Anand during crop growing season summer 2019.

macro and micronutrient as well as heavy metal status in soil. Standard analytical process followed to analyze plant and soil nutrient analysis (Table 1). In summer season, applied irrigation at 8-10 days interval and gave irrigation.

At critical growth stage of green gram to reduce economical losses. The replicated primary data collected from the experiment plots for statistical analysis of different growth and yield related aspects as described in randomized complete block design. The data were subjected to statistical analysis by applying the techniques of analysis of variance (Gomez and Gomez, 1984).

## RESULTS AND DISCUSSION

### Effect of treatments on growth attributes

Application of various organic manure treatments exhibited positive results. Growth measurements on the above ground part were performed 30 days after sowing after the fertilization treatments. Data obtained in relation to plant population, plant height and number of branches/plant are presented in Table 3. It was evident from analyzed data that plant population recorded at 30 DAS and at harvest was not found significantly due to different treatments. Growth parameters like plant height and number of branches/plant significantly affected by different treatments. At 30 DAS, plant height and number of branches/plant did not differ significantly by different organic manure treatments, while treatment $T_7$ (Vermicompost @ 0.5t/ ha+Bio NP (*Rhizobium* and PSB) reported significantly higher plant height (42.74 cm) and $T_6$ (FYM @ 2.0 t/ha+Bio NP [*Rhizobium* and PSB]) noted significantly higher number (3.67) of branches /plant at harvest. Plant height is a nutrient responsive trait so growth and growth attributes of green gram improved by application of organic manures, it might be due to organic manures has multiple benefits due to the balanced supply of nutrients including macro and micronutrients. Organic manure increases the production of new cells, fosters plant vigour and speeds up leaf growth, all of which contribute to better plant height, it also increased soil nutrient availability due to increase soil microbial activities (Han *et al*., 2016). The added organic manures would have improved the soil physical condition and better nutrient availability which resulted in better plant growth and supply of balanced nutrients and their availability of major essential nutrients in sufficient quantities. These results are in conformity with the results of Sathe (2007), Choudhari *et al*., (2001), Band *et al*., (2007) and Sachan and Krishna (2021) in French bean.

### Effect of treatments on yield attributes and yield

Present data indicated that the response of different organic nutrient management treatments on number of pods/plant was found non-significant (Table 3). An application of vermicompost @ 0.5t/ha+Bio NP [(*Rhizobium* and PSB)] ($T_7$) reported significantly higher test weight (43.73 g) (Table 3) than rest of treatments except treatments $T_8$, $T_3$, $T_9$ and $T_6$. These might be due to better crop growth, efficient dry matter accumulation and partitioning as well as better translocation to the sink, leading to the formation of large sized seed (Kumar *et al*., 2021). Seed yield is more

**Table 2:** Initial organic manures analysis.

| Inputs | 2018 | | | 2019 | | | 2020 | | |
|---|---|---|---|---|---|---|---|---|---|
| | N% | P% | K% | N% | P% | K% | N% | P% | K% |
| FYM | 0.78 | 0.30 | 0.66 | 0.80 | 0.35 | 0.58 | 0.85 | 0.19 | 0.34 |
| CC | 3.58 | 0.56 | 0.77 | 3.81 | 0.67 | 0.45 | 5.24 | 0.44 | 0.85 |
| VC | 1.65 | 1.28 | 0.24 | 1.68 | 0.74 | 0.71 | 1.36 | 0.36 | 0.85 |

FYM : Farm yard manure, CC: Castor cake and VC: Vermicompost.

**Table 3:** Effect of organic treatments on growth and yield attributes of summer green gram (Pooled of Three years).

| Treat. | Plant population | | Plant height (cm) | | No. of branches/plant | | No of pods/plant | Test wt. (g) |
|---|---|---|---|---|---|---|---|---|
| | At 30 DAS | At harvest | At 30 DAS | At harvest | At 30 DAS | At harvest | | |
| $T_1$ | 262 | 239 | 15.91 | 33.99 | 2.70 | 2.92 | 19.75 | 40.17 |
| $T_2$ | 269 | 228 | 16.44 | 35.44 | 2.72 | 3.01 | 19.90 | 40.18 |
| $T_3$ | 278 | 253 | 16.40 | 40.17 | 2.69 | 3.39 | 21.82 | 41.76 |
| $T_4$ | 282 | 246 | 15.87 | 37.96 | 2.67 | 2.27 | 20.54 | 40.45 |
| $T_5$ | 272 | 250 | 16.73 | 39.09 | 2.83 | 3.03 | 22.23 | 40.84 |
| $T_6$ | 272 | 240 | 15.87 | 38.43 | 2.73 | 3.67 | 20.73 | 41.32 |
| $T_7$ | 277 | 245 | 16.41 | 42.74 | 2.53 | 3.28 | 22.45 | 43.73 |
| $T_8$ | 255 | 241 | 16.37 | 39.85 | 2.79 | 3.21 | 20.50 | 41.78 |
| $T_9$ | 253 | 231 | 17.30 | 38.46 | 2.88 | 3.36 | 22.29 | 41.42 |
| $T_{10}$ | 280 | 247 | 16.83 | 38.44 | 2.66 | 3.32 | 21.41 | 40.40 |
| S.Em.± | 7.74 | 6.64 | 0.50 | 1.05 | 0.098 | 0.08 | 1.13 | 0.56 |
| CD (P=0.05) | NS | NS | NS | 2.97 | NS | 0.24 | NS | 1.66 |

**Table 4:** Yield, harvest index and protein content in seed of greengram as influence by different treatment (Pooled of Three years).

| Treat. | Yield (kg/ha) | | Harvest index (%) | Protein content (%) | Net returns (Rs/ha) | BCR |
|---|---|---|---|---|---|---|
| | Seed | Haulm | | | | |
| $T_1$ | 731 | 1501 | 32.83 | 18.81 | 37001 | 3.36 |
| $T_2$ | 821 | 1493 | 35.51 | 19.20 | 37293 | 2.72 |
| $T_3$ | 1024 | 1636 | 38.03 | 18.55 | 51646 | 3.38 |
| $T_4$ | 933 | 1541 | 37.54 | 20.88 | 45381 | 3.11 |
| $T_5$ | 863 | 1664 | 34.18 | 18.89 | 46204 | 3.91 |
| $T_6$ | 930 | 1776 | 34.42 | 19.75 | 48006 | 3.54 |
| $T_7$ | 1112 | 1669 | 39.67 | 19.95 | 60639 | 4.21 |
| $T_8$ | 968 | 1752 | 35.43 | 19.23 | 50742 | 3.70 |
| $T_9$ | 1031 | 1607 | 38.51 | 19.30 | 52107 | 3.40 |
| $T_{10}$ | 981 | 1573 | 38.01 | 18.38 | 48873 | 3.29 |
| S.Em.± | 50 | 81 | - | 0.78 | - | - |
| CD (P=0.05) | 148 | NS | - | NS | - | - |

important in green gram which is the result of the different combinations of many physiological processes based on the environment under which crop was grown. The synthesis, accumulation and translocation of photosynthates depend upon the source to sink relationship and also on the green gram growth during early stage of crop growth. Final yield is a function of all components of source and sink operating at different phenophases during the life cycle of green gram (Banotra *et al*., 2023). Perusal of data presented in Table 4 indicated that greengram seed yield found significant while haulm yield found non-significant influence due to application of different organic manures treatments. Significantly higher seed yield (1112 kg/ha) was noted in treatment $T_7$ (Vermicompost @ 0.5t/ha + Bio NP [(*Rhizobium* and PSB), but it was statistically at par with treatment $T_9$ (FYM @ 2.0 t/ha + Vermicompost @0.5 t/ha), $T_3$ (Vermicompost @ 1.0 t/ha), $T_{10}$ (FMY @ 2.0 t/ha+Castor cake @ 0.25 t/ha) and $T_8$ [Castor cake @ 0.25 t/ha+Bio NP (*Rhizobium* and PSB)]. Treatment $T_7$ [Vermicompost @ 0.5 t/ha+Bio NP (*Rhizobium* and PSB)] reported 52.12 percent higher seed yield over control. Numerically higher haulm yield (1776 kg/ha) was reported in treatment $T_6$ [FYM @ 2.0 t/ha+Bio NP (*Rhizobium* and PSB)]. The effect of organic manure treatments on harvest index was found non-significant but, numerically higher harvest index (39.67%) was observed in treatment $T_7$ [Vermicompost @ 0.5 t/ha +Bio NP [(*Rhizobium* and PSB)]. Higher economical yield of green gram might be due to application of organic manures, release nutrient slowly and the nutrient losses minimized due to increased absorption of nutrients as a result of increased cation exchange capacity that increased with organic matter application. Thus, plant nutrients will be available for a long period in adequate quantity thereby plant can absorb the required nutrients as per its demand resulted in better growth, development and yield components (Shariff *et al.,* 2015). It may be due to cumulative effect of yield attributing characters of green gram on account to increase growth of plant (Banotra *et al*., 2023). Increased availability of major nutrients to plant which enhanced early root growth with deep rooted system and cell multiplication leading to more absorption of other nutrients from deeper layers of soil ultimately resulting increased growth parameters, seed and haulm yields (Makwana *et al.,* 2020). Application of organic manures had a significant positive effect on growth parameters like plant height, number of branches/plant *etc.* The beneficial effect of organic manures on yield attributes was probably due to enhanced supply of macro and micronutrients during entire growing season (Kumawat *et al*., 2010 and Priyadharshini *et al*., 2021).

### Effect of treatments on economics

The practicability and usefulness of a treatment is judged in terms of net returns. Data on economics presented in Table 4 revealed that treatment $T_7$ [Vermicompost @ 0.5t/ha + Bio NP (*Rhizobium* and PSB)] reported maximum net income of 60639/ha along with higher BCR (4.21). Minimum net return (37001 Rs/ha) reported in ($T_1$) No Control treatment while, BCR in 2.72 in treatment $T_2$ (FYM @ 4.0 t/ha).

### FEATURE LINE OF WORK

Furthermore, organic farming practices help in minimizing chemical residues in the soil and the produce, which is beneficial for both the environment and human health. Studies highlighting the importance of organically produced food can indeed raise awareness among consumers about the significance of supporting sustainable agricultural practices for the sake of their own health and the health of the planet.

## CONCLUSION

Based on a three-year experiment on nutrient management through organic sources in green gram, the applications of nutrient in organic manure for growth and yield of green gram. From results, it could be concluded that different treatments were significantly influenced on seed yield of green gram. Among all the treatments, application of Vermicompost @ 0.5 t/ha + Bio NP (*Rhizobium* and PSB)

recorded maximum yield and net realization as well as benefit cost ratio.

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### Conflict of interest

We have no any conflict of interest for publication of full length research paper with its data.

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