

## **Comparative Effects of Organic Nutrient Sources on Green Gram (*Vigna radiata* L.) Quality and Soil Properties**

### **ABSTRACT**

A field experiment entitled “an assessment of different organic sources of nutrients for organic summer green gram cultivation” 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, Gujarat. Different sources of organic manures were tested using randomized block design with four replications. The treatment T<sub>7</sub>(50 % N through FYM followed by Seed treatment of *Rhizobium*) recorded significantly higher available nitrogen content (212 kg/ha) in soil and also same behaviour observed in available phosphorus content in soil. The treatment T<sub>9</sub>(50 % N through castor cake followed by Seed treatment of *Rhizobium*) recorded significantly higher available phosphorus content in soil. Significantly higher value of EC of soil (0.18) was found in treatment T<sub>1</sub>, which was significantly higher EC of soil (0.11) which was recorded with treatment T<sub>9</sub>. Higher organic carbon (0.65%) of soil after harvest of green gram was observed in treatment T<sub>8</sub>. Significantly higher nitrogen content in seed of green gram was obtained with application of treatments T<sub>10</sub>. Treatment T<sub>2</sub>[*Rhizobium* (5.0 mL/kg seed treatment and 1.0 L/ha soil application)] recorded significantly higher *Rhizobium* population in soil at harvest of green gram. Subsequent, treatment T<sub>6</sub>(100 % N through neem cake) recorded significantly higher phosphorus solubilising bacteria (PSB) population in soil as compared to control. The maximum net return 63287 INR/ha was obtained with application of treatment T<sub>10</sub> (50% N through NC + *Rhizobium* seed treatment) followed by treatment T<sub>7</sub> (50% N through FYM + *Rhizobium* seed treatment) with net realization of 54063 INR/ha. With respect to benefit cost ratio, the highest 3.62 BCR was achieved with Treatment T<sub>7</sub>, which closely followed by treatment T<sub>2</sub> (*Rhizobium* seed treatment + 1.0 L/ha soil application) having BCR of 3.52.

**KEY WORDS:** Green gram; Organic; FYM; *Rhizobium*; Neem cake; Soil properties; B:C

### **1. INTRODUCTION**

Green gram (*Vignaradiata* L.) belongs to the family Leguminosae and sub-family Papilionaceae and the earlier name of Green gram was *Phaseolus aureus* that has now been changed to *Vigna radiata*. It falls in the group of Asiatic Species of genus *Phaseolus*. Green gram in India is also known as Mungbean, Sonamung in Bengali, Mung in Hindi, Magum in Assam, Mung in Oria, Pachalopayru in Tamil, Panchapesalu in Telugu, Cerupayarn in Malayalam, Mung in Marathi, Mag in Gujarati. Green gram is grown throughout the southern

Asia including India, Australia, Pakistan, Turkey, Bangladesh, Sri Lanka, Thailand, Cambodia, Vietnam, Indonesia, Malaysia and China, etc. It is also grown in the parts of Africa and USA. The Green gram was domesticated in India, where its wild progenitor (*Vignaradiata* subspecies *sublobata*) occurs wild [1].

India is the World largest producer as well as consumer of Green gram. In the year 2022-23, India produced approximately 3.74 million tonnes of green gram. The total area under green gram cultivation was around 15.57 lakh hectares (38.47 lakh acres). The major states contributing to green gram production were Rajasthan, Karnataka, Madhya Pradesh, Haryana and Gujarat [2].

In Gujarat, the area under green gram cultivation was about 0.13 lakh hectares (0.32 lakh acres), contributing to the overall production. Gujarat's share in the national production was around 4% in 2022 [3].

Green gram is one of the important short season grain legumes in the conventional farming system of tropical and temperate regions. It can be grown on a variety of soil and climatic conditions, as it is tolerant to drought [4].

Green gram is a healthful source of protein, fibres and rich in vitamins and minerals. It is an important legume crop that fixes the atmospheric nitrogen which enhances the fertility of the soil. After chickpea, mung bean is called as poor people diet owing to its protein nature and is meeting the major protein demand of the people [5].

The use of organic manures and biofertilizers instead of synthetic chemical fertilizer are shown to improve plant growth through the supply of plant nutrients and may help to sustain environmental health and soil productivity [6]. The danger of leaching synthetic fertilizers is harmful to soil and groundwater [7]. Thus, it is necessary to supply the plant nutrient requirement through proper on-farm management practices. Organic materials are intrinsic and essential components of all soils and it makes a living dynamic system in the soil that supports all life residing in soil. Organic matter plays a vital role in improving soil health and the quality of soils. Besides this, organic manure improves soil structure by providing binding effect to soil aggregates, increases water holding capacity and improves buffering capacity of soils.

Vermicompost is a sustainable organic input that is regenerated from organic wastes using earthworms. The vermicompost is a rich source of N, P, K and micronutrients and a good proportion of exchangeable Ca, Mg, and Na. 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 by Babhulkaret *al.* (2000) [8].

Neem cake has been also recommended for organic farming since it is readily biodegradable and eco-friendly in usage [9]. Neem cake nourishes the soil and plants by providing all the macro-and micro-nutrients and helps to eliminate bacteria responsible for denitrifying the soil nitrogen. The antifeedant properties of neem cake help to reduce the growth of insects and pests [10].

Phosphorus is the second most important nutrient next to nitrogen. Its deficiency is usually the most important single factor which is responsible for a poor yield of pulses on all soils. It is a major constituent of protein and nucleic acids. Phosphorus plays a key role in the formation of energy-rich bound phosphates (ADP and ATP). It has a beneficial effect on nodulation, stimulation, root development, and growth, hastens the maturity of crops as well as improves quality traits. Indian soils have poor to medium status in available phosphorus [11].

Several bacteria belonging to the genera *Pseudomonas* and *Bacillus* can solubilize inorganic P from insoluble sources. The microorganisms can grow on insoluble forms such as tricalcium phosphate, rock phosphate and bone meal and convert them into soluble forms. The solubilization of phosphorus by these microorganisms is attributed to the secretion of organic acids like citric, glutamic, succinic, lactic, oxalic, glycoxalic, maleic, fumaric, tartaric and alfa ketobutyric acid [12]. Thus, in legumes, it is more important than nitrogen as later is fixed by symbiosis with *Rhizobium* bacteria.

Significant progress has been achieved in the use of biofertilizers during the last few years. Biofertilizer plays an important role in the increasing availability of soil mineral nutrients. They increase the biological fixation of atmospheric nitrogen and also enhance phosphorus availability to the crop by solubilizing fixed phosphorus of soil. Therefore, the application of the efficient strain of *Rhizobium* in the soil may be helpful in nitrogen fixation and consequently production can be boosted through seed inoculation with *Rhizobium* and by usage of phosphorus solubilizing bacteria [13].

## **1. 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 summerseason of the year 2021 at

Certified Organic Farm A-7, College Agronomy Farm, BACA, Anand Agricultural University, Anand (Gujarat).

## 2.2 Experimental Details

### 2.2.1 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 <sub>1</sub>	No manures (Control)
T <sub>2</sub>	<i>Rhizobium</i> (5.0 mL/kg seed treatment and 1.0 L/ha soil application)
T <sub>3</sub>	100 % N through FYM
T <sub>4</sub>	100 % N through vermicompost
T <sub>5</sub>	100 % N through castor cake
T <sub>6</sub>	100 % N through neem cake
T <sub>7</sub>	50 % N through FYM followed by Seed treatment of <i>Rhizobium</i>
T <sub>8</sub>	50 % N through vermicompost followed by Seed treatment of <i>Rhizobium</i>
T <sub>9</sub>	50 % N through castor cake followed by Seed treatment of <i>Rhizobium</i>
T <sub>10</sub>	50 % N through neem cake followed by Seed treatment of <i>Rhizobium</i>

#### 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<sub>1</sub>.

### 2.2.2 Design and Layout

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)

## 2.3 Sample Collection and Processing

### 2.3.1 Soil sampling

Representative soil samples at 0-15 cm depth were collected initially from the entire experimental site and each plot after the harvest of green grams. The soil samples were prepared by mixing the soil collected from four spots randomly. The soil samples were air-dried and ground to pass through a 2 mm sieve. The samples were stored in polythene-lined cotton bags for further analysis.

### 2.3.2 Plant sampling for chemical analysis

After the harvest of the crop green gram grain and straw samples were taken for analysis. The samples were dried in paper bags at 70°C till constant weight in a hot air oven and preserved

for further analysis. These samples were ground in a stainless-steel grinder to avoid contamination of micronutrients. The processed samples were preserved in airtight polyethylene bags for further analysis.

## 2.4 Quality parameter

### 2.4.1 Protein content in seeds (%)

The protein content in seeds was calculated by multiplying the nitrogen content of seeds (%) with the conversion factor of 6.25 as reported by Gupta *et al.* (1972) [14].

## 2.5 Methods of analysis

### 2.5.1 Soil analysis

The processed soil samples were analyzed for important soil properties *viz.* pH, EC (1:2.5; soil: water ratio), organic carbon (O.C. %) and available nutrients *viz.*, N, P<sub>2</sub>O<sub>5</sub> were determined as per the standard methods (Table 2).

**Table 2: Methods used for soil and plant analysis**

Sr. No.	Parameters	Extraction method	References
<b>A. Soil analysis</b>			
1.	pH(1:2.5 soil: water)	Potentiometric	Jackson (1973) [15]
2.	EC(1:2.5 soil: water)	Conductometric	Jackson (1973) [15]
3.	Organic carbon(OC)	Walkley Black's wet digestion method	Jackson (1973) [15]
4.	Available N	Alkaline KMnO <sub>4</sub> (0.32%) method	Subbaiah (1956) [16]
5.	Available P <sub>2</sub> O <sub>5</sub>	0.5 M NaHCO <sub>3</sub> , pH 8.5, Spectrophotometry	Olsen (1954) [17]
<b>B. Plant analysis</b>			
1.	Nitrogen	Kjeldahl's Method	Jackson (1973) [15]
2.	Phosphorus	Vanadomolybdo phosphoric acid yellow color method	Jackson (1973) [15]
3	Potassium	Flame photometry	Jackson (1973) [15]

### 2.5.2 Plant analysis

Dried plant samples (straw and grain) were ground in a stainless-steel grinder and digested in the di-acid mixture (HNO<sub>3</sub>: HClO<sub>4</sub> - 4:1) and the volume was made with double distilled water [18]. The extract was filtered through Whattman filter paper No. 42. The filtrate of plant samples was used for the analysis of nutrients on the Atomic Absorption Spectrophotometer (AAS Model: PE 3110).

## 2.6 Statistical analysis

The statistical analysis of the data of various characters studied in the investigation was carried out through the procedure appropriate to the design of the experiment as described by Panse&Sukhatme (1967) [19].

## 2.7 Economics

The cost of cultivation was worked out by taking into consideration all the expenses incurred. Gross return was worked out by multiplying the seed yield of the crop with their prevailing market prices. Calculations were made as per normal rates prevalent at the Agricultural Research Farm, AAU, Anand. The cost of manure, biofertilizers and seed, etc. was taken as per prevailing market prices. Net return (INR/ha) and the benefit-cost ratio was calculated with the help of the following formula:

$$\text{Net return (INR/ha)} = \text{Gross return (INR/ha)} - \text{Cost of cultivation (INR/ha)}$$

$$\text{B : C Ratio} = \frac{\text{Gross realisation (₹/ha)}}{\text{Total cost of cultivation (₹/ha)}}$$

## 3. RESULTS AND DISSCUSION

### 3.1 Effect on Quality Parameters

#### Protein content of seed (%)

The results presented in Table 3 showed that different organic sources remained at par with protein (%) content and they had no significant influence on protein (%) content.

**Table 3:Protein content (%) of green gram as influenced by different organic sources of nutrients**

Treatment	Protein content (%)
T <sub>1</sub>	21.67±0.28
T <sub>2</sub>	21.45±0.03
T <sub>3</sub>	21.47±0.08
T <sub>4</sub>	21.70±0.31
T <sub>5</sub>	21.55±0.06
T <sub>6</sub>	21.55±0.11
T <sub>7</sub>	21.75±0.20
T <sub>8</sub>	21.78±0.27
T <sub>9</sub>	21.81±0.09
T <sub>10</sub>	21.83±0.30
SEm ±	0.10
CD (P=0.05)	NS
CV (%)	0.96

## **3.2 Effect of Organic manure and Bio fertilizer on soil chemical and biological properties of soil after Harvest green gram**

### **3.2.1 EC, pH, OC (%), available N and P<sub>2</sub>O<sub>5</sub>**

Data presented in Table 4 showed that the significantly higher value of EC (0.18 dS/m) was found in treatment T<sub>1</sub> [No manure (Control)], whereas the lowest value (0.09 dS/m) of EC was found in treatment T<sub>4</sub>, which was remained at par (0.11) with treatment T<sub>9</sub>. The close examination of data given in Table 6 indicated that the effect of various treatments of organic sources did not show any statistical differences concerning the pH of soil. Though the higher pH (7.58) of soil after harvest of green gram was observed in treatments T<sub>4</sub> (100% N through VC) and T<sub>6</sub> (100% N through NC).

The effect of various treatments of organic sources significantly showed statistical differences concerning organic carbon of soil after harvest of green gram crop as the experiment was conducted in a certified organic plot. Higher organic carbon (0.65%) of soil after harvest of green gram was observed in treatment T<sub>8</sub> (50% N through VC + *Rhizobium* seed treatment). but it was statistically at par (0.60) with treatment T<sub>9</sub>. While lower (0.51%) with treatment T<sub>1</sub>, which was at par (0.53%) with treatment T<sub>2</sub>.

The availability of nitrogen, phosphorus, potassium, and organic carbon status of the soil improved with the organic manure which enhanced the use of organic sources for higher production and stable soil health. Organic manure released nutrients more slowly than mineral nutrients and contributed to the residual pool of organic nitrogen, phosphorus and potassium in the soil, and reduces nutrient loss from the soil by improving soil organic matter and increasing organic carbon content in the soil. Similar results were also noticed by Sharma & Dayal (2005) [20] and Chaudhary *et al.* (2015) [21] in green gram and groundnut, respectively.

The treatment T<sub>7</sub> (50% N through FYM + *Rhizobium* seed treatment) recorded significantly higher available nitrogen content in soil (212 kg/ha) after harvest of a green gram but it was at par statistically (210.25 kg/ha, 208.75 kg/ha, 207.25 kg/ha and 204.75 kg/ha, respectively) with treatments T<sub>10</sub>, T<sub>8</sub>, T<sub>9</sub> and T<sub>5</sub>. While significantly lower nitrogen content (194 kg/ha) was recorded with treatment T<sub>1</sub> (Control) after harvest of the green gram crop.

The treatment T<sub>9</sub> (50% N through CC + *Rhizobium* seed treatment) recorded significantly higher available phosphorus content in soil (36.41 kg/ha) after harvest of green gram, however, it remained at par (35.83 kg/ha, 35.50 kg/ha, 35.44 kg/ha, 35.38 kg/ha, 34.97 kg/ha

and 34.66 kg/ha, respectively) with treatment T<sub>10</sub>, T<sub>3</sub>, T<sub>7</sub>, T<sub>5</sub> and T<sub>6</sub>, respectively, while significantly lower phosphorus content (30.21 kg/ha) was recorded with treatment T<sub>1</sub> (No manure control) at the harvest of green gram crop.

### **3.2.2 Soil microbial count after harvest**

The data in Table 5 revealed that microbial count after harvest of the crop was significantly influenced due to the application of different organic sources of nutrients in green gram. The treatment T<sub>2</sub> (*Rhizobium* seed treatment + 1.0 L/ha soil application) recorded a significantly higher *Rhizobium* population in soil ( $2.9 \times 10^7$  CFU/g) after harvest of green gram. However, it remained at par ( $8.7 \times 10^6$  CFU/g,  $7.62 \times 10^6$  CFU/g,  $3.9 \times 10^6$  CFU/g and  $2.19 \times 10^6$  CFU/g, respectively) with treatment T<sub>8</sub>, T<sub>7</sub> and T<sub>10</sub>. While significantly the lowest *Rhizobium* population ( $4.4 \times 10^3$  CFU/g) was recorded with treatment T<sub>1</sub> (No manure control). Further,

**Table 4: Initial and at harvest soil status of EC, pH, OC (%), available N, and P<sub>2</sub>O<sub>5</sub> as influenced by different organic sources of nutrients**

<b>Treatment</b>	<b>EC (dS/m)*</b>	<b>pH</b>	<b>OC (%)</b>	<b>Available N (kg/ha)</b>	<b>Available P<sub>2</sub>O<sub>5</sub> (kg/ha)</b>
<b>Initial</b>	<b>0.26</b>	<b>7.5</b>	<b>0.51</b>	<b>192</b>	<b>33.19</b>
<b>T<sub>1</sub></b>	0.18±0.03	7.43±0.17	0.51±0.00	194.75±4.86	30.21±0.04
<b>T<sub>2</sub></b>	0.14±0.02	7.60±0.08	0.53±0.01	196.25±3.10	32.45±2.00
<b>T<sub>3</sub></b>	0.14±0.05	7.55±0.06	0.58±0.03	196.50±2.38	35.50±0.40
<b>T<sub>4</sub></b>	0.09±0.01	7.58±0.05	0.56±0.03	197.00±2.83	34.97±1.67
<b>T<sub>5</sub></b>	0.12±0.02	7.53±0.10	0.58±0.04	204.75±0.96	34.66±1.77
<b>T<sub>6</sub></b>	0.13±0.02	7.58±0.15	0.56±0.03	202.50±12.23	35.44±1.85
<b>T<sub>7</sub></b>	0.13±0.01	7.55±0.10	0.58±0.02	212.00±4.97	35.38±1.23
<b>T<sub>8</sub></b>	0.13±0.01	7.55±0.06	0.65±0.03	208.75±10.34	33.69±3.06
<b>T<sub>9</sub></b>	0.11±0.01	7.55±0.13	0.60±0.08	207.25±9.60	36.41±3.55
<b>T<sub>10</sub></b>	0.13±0.03	7.50±0.08	0.61±0.07	210.25±10.87	35.83±1.83
<b>SEm ±</b>	<b>0.01</b>	<b>0.05</b>	<b>0.02</b>	<b>3.10</b>	<b>0.64</b>
<b>CD (P=0.05)</b>	<b>0.02</b>	<b>NS</b>	<b>0.058</b>	<b>9.02</b>	<b>1.86</b>
<b>CV (%)</b>	<b>15.58</b>	<b>1.57</b>	<b>7.03</b>	<b>3.06</b>	<b>3.72</b>

\*Decisiemens per meter

**Table 5:Initial and at harvest soil microbial count (CFU/g of soil) of green gram as influenced by different organic sources of nutrients**

<b>Treatment</b>	<b><i>Rhizobium</i> population at harvest (CFU/g of soil)</b>	<b>PSBpopulation at harvest (CFU/g of soil)</b>
<b>Initial</b>	<b>3.18 (1.4 × 10<sup>3</sup>)</b>	<b>4.17 (2.4 × 10<sup>4</sup>)</b>
<b>T<sub>1</sub></b>	3.61 (4.4 × 10 <sup>3</sup> )	4.41 (3.4 × 10 <sup>4</sup> )
<b>T<sub>2</sub></b>	7.48 (2.9 × 10 <sup>7</sup> )	7.65 (4.4 × 10 <sup>7</sup> )
<b>T<sub>3</sub></b>	5.61 (4.5 × 10 <sup>5</sup> )	7.69 (5.2 × 10 <sup>7</sup> )
<b>T<sub>4</sub></b>	5.99 (8.2 × 10 <sup>5</sup> )	7.67 (5.6 × 10 <sup>7</sup> )
<b>T<sub>5</sub></b>	5.96 (5.9 × 10 <sup>5</sup> )	7.17 (5.0 × 10 <sup>7</sup> )
<b>T<sub>6</sub></b>	5.24 (2.2 × 10 <sup>5</sup> )	7.92 (5.9 × 10 <sup>7</sup> )
<b>T<sub>7</sub></b>	6.92 (3.9 × 10 <sup>6</sup> )	7.13 (4.9 × 10 <sup>7</sup> )
<b>T<sub>8</sub></b>	6.97 (7.62 × 10 <sup>6</sup> )	7.82 (6.09 × 10 <sup>7</sup> )
<b>T<sub>9</sub></b>	6.98 (8.7 × 10 <sup>6</sup> )	7.88 (6.9 × 10 <sup>7</sup> )
<b>T<sub>10</sub></b>	6.82 (2.19 × 10 <sup>6</sup> )	7.73 (4.90 × 10 <sup>7</sup> )
<b>SEm ±</b>	<b>0.25</b>	<b>0.34</b>
<b>CD (P=0.05)</b>	<b>0.62</b>	<b>0.69</b>

CFU:colony forming unit

treatment T<sub>6</sub> (100% N through NC) recorded a significantly higher PSB population in soil ( $6.9 \times 10^7$  CFU/g) after harvest of green gram as compared to control.

The higher microbial count might be due to the availability of abundant organic matter and effective microbial activities because of a sufficient supply of feeding material for the microorganism in the form of humus. The results are in close proximity to the tune reported by Ghosh *et al.* (2013) [22].

### 3.3 Effect on Nutrient Content in Plant

#### Nitrogen content in green gram seed and haulm

The data tabulated in Table 6 indicated that significantly higher nitrogen content in seed (3.49%) of green gram was obtained with the application of treatments T<sub>10</sub> (50% N through NC + *Rhizobium* seed treatment), T<sub>9</sub> (50% N through CC + *Rhizobium* seed treatment) and T<sub>8</sub> (50% N through VC + *Rhizobium* seed treatment) and it was remained at par (3.48, 3.47 and 3.45) with treatments T<sub>1</sub>, T<sub>4</sub>, T<sub>5</sub> and T<sub>6</sub>. These results are in close agreement with the findings of Sardar *et al.* (2016) [23], in green gram and Kant *et al.* (2017) [24] in black gram.

It was observed from Table 6 data that Nitrogen (%) content in haulm did not exert any significant differences among varied treatments of effects of different organic sources of nutrients. However, the numerically highest response (1.03) was collected from treatments T<sub>2</sub> (*Rhizobium* seed treatment + 1.0 L/ha soil application), T<sub>3</sub> (100% N through FYM), and T<sub>5</sub> (100% N through CC).

**Table 6: Effect of Organic manure and Bio fertilizer on nitrogen (%) content in seed and haulm of green gram**

Treatment	Nitrogen (%) of seed	Nitrogen (%) of haulm
T <sub>1</sub> : No manure (Control)	3.47±0.05	1.04±0.02
T <sub>2</sub> : <i>Rhizobium</i> seed treatment + 1.0 L/ha soil application	3.43±0.00	1.03±0.02
T <sub>3</sub> : 100% N through FYM	3.44±0.01	1.03±0.02
T <sub>4</sub> : 100% N through vermicompost (VC)	3.47±0.05	1.04±0.02
T <sub>5</sub> : 100% N through castor cake (CC)	3.45±0.01	1.03±0.01
T <sub>6</sub> : 100% N through neem cake (NC)	3.45±0.02	1.05±0.02
T <sub>7</sub> : 50% N through FYM + <i>Rhizobium</i> seed treatment	3.48±0.03	1.04±0.02
T <sub>8</sub> : 50% N through VC + <i>Rhizobium</i> seed treatment	3.49±0.04	1.05±0.02
T <sub>9</sub> : 50% N through CC + <i>Rhizobium</i> seed treatment	3.49±0.01	1.04±0.02
T <sub>10</sub> : 50% N through NC + <i>Rhizobium</i> seed treatment	3.49±0.05	1.04±0.02
<b>SEm ±</b>	<b>0.01</b>	<b>0.01</b>

<b>CD (P=0.05)</b>	<b>0.04</b>	<b>NS</b>
<b>CV (%)</b>	<b>0.82</b>	<b>1.32</b>

### 3.4 Economics

Data presented in Table 7 revealed that a maximum net realization of ₹63287/ha was recorded under the application of treatment T<sub>10</sub> (50% N through NC + *Rhizobium* seed treatment) which was followed by treatment T<sub>7</sub> with the net realization of ₹54063/ha. The lowest net returns of ₹26222/ha was obtained under treatment T<sub>4</sub> (100% N through VC).

In the case of benefit-cost ratio, the highest benefit-cost ratio of 3.62 was recorded under the application of 50% N through FYM + *Rhizobium* seed treatment (T<sub>7</sub>) which was closely followed by treatment T<sub>2</sub> (3.52). Application of 100% N through NC (T<sub>6</sub>) registered the lowest benefit-cost ratio of 1.94.

**Table 7: Economics as influenced by the application of different organic sources of nutrients in green gram**

<b>Treatment</b>	<b>Seed yield (kg/ha)</b>	<b>Gross realization (INR/ha)</b>	<b>Cost of cultivation (INR/ha)</b>	<b>Net realization (INR/ha)</b>	<b>BCR</b>
<b>T<sub>1</sub></b>	<b>868</b>	47740	18609	29131	2.57
<b>T<sub>2</sub></b>	<b>1248</b>	68640	19473	49167	3.52
<b>T<sub>3</sub></b>	<b>906</b>	49830	21871	27959	2.28
<b>T<sub>4</sub></b>	<b>972</b>	53460	27238	26222	1.96
<b>T<sub>5</sub></b>	<b>1096</b>	60280	24657	35623	2.44
<b>T<sub>6</sub></b>	<b>1115</b>	61325	31692	29633	1.94
<b>T<sub>7</sub></b>	<b>1358</b>	74690	20627	54063	3.62
<b>T<sub>8</sub></b>	<b>1208</b>	66440	23311	43129	2.85
<b>T<sub>9</sub></b>	<b>1351</b>	74305	22021	52284	3.37
<b>T<sub>10</sub></b>	<b>1615</b>	88825	25538	63287	3.48

Haulm to be incorporated into the field. The selling price of green gram has been computed as ₹55.

### 4. CONCLUSION

It can be concluded that treatments T<sub>10</sub> (50% N through NC + *Rhizobium* seed treatment), T<sub>9</sub> (50% N through CC + *Rhizobium* seed treatment), T<sub>8</sub> (50% N through VC + *Rhizobium* seed treatment), T<sub>7</sub> (50% N through FYM + *Rhizobium* seed treatment) and T<sub>2</sub> (*Rhizobium* seed treatment + 1.0 L/ha soil application) are superior among the other treatments in case of net realization, higher available phosphorus content in soil, higher organic carbon, higher available nitrogen content in soil and higher *Rhizobium* population in soil, respectively.

## REFERENCES

1. Swamy, KRM. Origin, Domestication, Taxonomy, Botanical Description, Genetics and Cytogenetics, Genetic Diversity and Breeding of Mung bean (*Vigna radiata* L.) R. Wilczek". International Journal of Current Research.2023;15(07): 25351-25375.
2. Anonymous. Production data of green gram. Directorate of Economics and Statistics, Ministry of Agriculture & Farmers Welfare, Government of India, 2022a.
3. Anonymous. Production data of green gram. Professor Jayashankar Telangana State Agricultural University, 2022b.
4. Malik AM, Waheed A, Qadir GH, Asghar R. Interactive effects of irrigation and phosphorus on green gram (*Vigna radiata* L.). Pakistan Journal of Botany. 2006;38(4):1119.
5. Pataczek L, Zahir ZA, Ahmad M, Rani S, Nair R, Schafleitner R, Cadisch G, Hilger T. Beans with benefits—the role of Mungbean (*Vigna radiata*) in a changing environment. American Journal of Plant Sciences. 2018;9(07):1577.
6. O'connell PF. Sustainable agriculture-a valid alternative. Outlook on Agriculture. 1992;21(1):5-12.
7. Naeem M, Iqbal JA, Bakhsh MA. Comparative study of inorganic fertilizers and organic manures on yield and yield components of mungbean (*Vigna radiata* L.). J. Agric. Soc. Sci. 2006;2(4):227-9.
8. Babhulkar PS, Wandile RM, Badole WP, Balpande SS. Residual effect of long-term application of FYM and fertilizers on soil properties (Vertisols) and yield of soybean. Journal of the Indian society of soil science. 2000;48(1):89-92.
9. Nicoletti M, Mariani S, Maccioni O, Coccioletti T, Murugan K. Neem cake: chemical composition and larvicidal activity on Asian tiger mosquito. Parasitology research. 2012;111:205-13.
10. Lokanadhan S, Muthukrishnan P, Jeyaraman S. Neem products and their agricultural applications. Journal of Biopesticides. 2012;5:72.
11. Syers JK, Johnston AE, Curtin D. Efficiency of soil and fertilizer phosphorus use. FAO Fertilizer and plant nutrition bulletin. 2008;18(108):5-0.

12. Raju RA, Rao AS, Rupa TR. Strategies for integrated phosphorus management for sustainable crop production. *Indian Journal of Fertilizers*. 2005;1(8), 25–28.
13. Dhakal Y, Meena RS, Kumar S. Effect of INM on nodulation, yield, quality and available nutrient status in soil after harvest of greengram. *Legume Research-An International Journal*. 2016;39(4):590-4.
14. Jackson ML. Soil chemical analysis, pentice hall of India Pvt. Ltd., New Delhi, India. 1973;498:151-4.
15. Subbaiah BV. A rapid procedure for estimation of available nitrogen in soil. *Curr. Sci.* 1956;25:259-60.
16. Olsen SR. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. US Department of Agriculture; 1954.
17. Gupta BR, Pathak RK, Bhan S, Singh A. Effect of NPK on yield, nutrient uptake and quality of toria (*Brassica campestris* var. toria T. 9). 1972; pp. 88-91.
18. Lindsay WL, Norvell W. Development of a DTPA soil test for zinc, iron, manganese, and copper. *Soil science society of America journal*. 1978;42(3):421-8.
19. Panse VG, Sukhatme PV. Statistical methods of agricultural workers. 2<sup>nd</sup> Endorsement. ICAR Publication, New Delhi, India. 1967;381.
20. Sharma VK, Dayal B. Response of linseed to organic and inorganic sources of nitrogen. *Indian Journal of Agricultural Research*. 2005;39(4):269-74.
21. Chaudhary VJ, Patel BJ, Patel KM. Response of summer groundnut (*Arachishypogaea* L.) to irrigation scheduling and sources of nitrogen under North Gujarat conditions. *Trends in Biosciences*. 2015;8(5):1310-3.
22. Ghosh AK, Duary B, Ghosh DC. Nutrient management in summer sesame (*Sesamum indicum* L.) and its residual effect on black gram (*Vigna mungo* L.). *International journal of Bio-resource and Stress Management*. 2013;4(4):541-6.
23. Sardar SS, Yogesh Kumar YK, Shahi UP, Ashok Kumar AK, Dhyani BP, Yadav AK, Singh SP. Effect of integrated use of bio-fertilizers and vermi compost on nutrient availability, uptake and performance of urd bean (*Vigna mungo*) in sandy loam soil. 2016. pp. 18-22.

24. Kant S, Kumar A, Kumar S, Kumar V, Gurjar OP. Effect of biofertilizers and P-levels on yield, nutrient content, uptake and physico-chemical properties of soil under blackgram (*Vigna mungo* L.). International journal of current microbiology and applied sciences. 2017;6(3):1243-51.