TITLE

EFFECT OF PLANT SPACING AND ORGANIC NUTRIENT MANAGEMENT ON GROWTH AND YIELD ATTRIBUTES OF GREEN GRAM (*Vigna radiata* L.)

Article type: *Original Research Article*

Abstract

The field experiment was conducted during Zaid season of 2021 at the CRF, Department of Agronomy, SHUATS, Prayagraj (U.P.). The soil of the experiment plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.2), low in organic carbon (0.72%), available N (278.48 kg/ha), available P (27.80 kg/ha) and available K (233.24 kg/ha). The treatments included three spacing's (20 cm × 10 cm, 30 cm × 10 cm and 40 cm × 10 cm), as well as three organic nutrient managements (4 t/ha Vermicompost + 10% Vermiwash + 10% Jeevamruth at 20 DAS, 5 t/ha Vermicompost + 12% Vermiwash + 5 kg/ha FYM + 12% Jeevamruth at 40 DAS and 6 t/ha Vermicompost + 14% Vermiwash + 6 kg/ha FYM), respectively. The experiment was laid out in a randomized block design with nine treatments combinations and the treatment combinations were replicated thrice. The results obtained showed that growth parameters such as plant height (63.41 cm), number of branches (6.60/plant) and plant dry weight (13.38 g/plant) were significantly higher with the application of 30 cm × 10 cm spacing along with + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS. While yield parameters such as pods (25.52/plant) were the highest in 40 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS. Whereas, seed yield (1,869.82 kg/ha), haulm yield (3,888.33 kg/ha), harvest index (33.84%), gross returns (INR 2, 28,266.33/ha), net returns (INR 1, 64,206.33/ha) and benefit: cost ratio (2.89) were recorded maximum in the treatment combination of 20 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS.

***Keywords*:** Economics, Farmyard Manure, Green gram, Jeevamruth, Seed yield, Vermicompost, Vermiwash

INTRODUCTION

Green gram regionally referred to as as mung or mug (*Vigna radiata L.Wilczek*) belongs to the family leguminaceae. Pulses are essential now no longer best for his or her fee as human food, however additionally due to excessive protein content material for livestock. It has been essential factor of agriculture permit withinside the land repair fertility through solving atmospheric nitrogen, as a way to produce affordable yields of succeeding plants and to fulfill out the call for of nutritional requirement concerning proteins, carbohydrates and different nutrient sources. On an average, Pulses include 22-24% protein as towards 8-10% in cereals. A precise quantity of lysine is present pulses. Green gram is rich protein content contains 24%, 1.74% fat, 3.5% fiber and 67% carbohydrates and also rich source of calcium and iron. It assessments the soil erosion. It additionally bureaucracy correct silage and green manure . It has capacity to restore approximately 22.10 kg of atmospheric nitrogen per hectare via its root nodules. In 2018-19, inexperienced gram became cultivated in India in a place of approximately 9.44 million hectares, with a production of 10.13 million hectares and productiveness of 1073 kilograms per hectare. As usual, Madhya Pradesh has contributed a significant 36.37% of the overall gram area and 45.54% of total gram production in the country, thereby ranking first each in area and production. Uttar Pradesh contributes approximately 6.06% in area stands 5th in position and 7.18% in production stands 4th in role throughout India. More than 90 per cent production of the country throughout the duration under report has been found out by 10 states of Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Karnataka, Chhattisgarh, Andhra Pradesh, Gujarat and Jharkhand (Directorate of Economics and Statistics, DAC&FW).

The crop is in particular cultivated as rainfed crop under marginal and submarginal situations without any nutrient management .Generally the farmers aren't adopting any nutrient and bio fertilizer applications that is major cause for poor yield on this area. One of the major constraints of poor yield and spread of green gram, is the non-availability of appropriate excessive yielding variety to update the conventional varieties. The Crop is grown in neglected lands under residual soil moisture with poor management practices, the crop faces water strain situation generally main to lower in productiveness and profitability. Plant spacing and organic nutrient management on growth and yield attributes of green gram is play a vital role for improve the soil physiochemical and biological properties and increase production, productivity and profitability in green gram. On the point view of sustainability these practices is helpful for the maintaining soil fertility, soil physical properties ,ecological balance and providing the stability to the production without polluting soil, water and air. Spacing performs an vital position in deliver to the excessive yield due to the fact thick plant populace will not get proper light for photosynthesis and excessive infestation of diseases. On the alternative hand very low plant populace can even lessen the output. Due to purpose ordinary populace can even lessen the the output. The advantage of optimum spacing under irrigated condition is due to reduce competition for light because when the moisture is lacking, light is no longer limiting factors and the advantage of uniform spacing is lost (Ihsanullah at al., 2002)

Farmyard manure is known to play an important role in improving the fertility and capacity of soils through its positive effects on soil physical, volatile and biological properties as well as the level of plant nutrition. Significant information generated by long-term studies related to the ability of bulky organic manures to neutralize the rapid yield fall with the continuous use of chemical fertilizers.

Vermicompost is a wealthy supply of N, P, K and micronutrients. Besides containing a very good share of exchangeable Ca, Mg, Na, etc. it provides natural carbon to the soil and allows to release the vitamins slowly. In vermicompost, a number of the secretions of worms and the related microbes act as growth promoters. It improves physical, chemical and biological properties of soil. Vermiwash is one examples of organic liquid fertilizer that is produced with the help of earthworms. Vermiwash contains micro and macro nutrients and hormones that promote plant growth and yield (Sharma *et al*., 2005), increases soil fertility (Leifeld and Fuhrer, 2010), reduces agricultural greenhouse gas emissions (Gomiero *et al*., 2008) and reduces nitrogen losses from the system (Drinkwater *et al*., 1998). Furthermore, it is less e×pensive compared with chemical fertilizer and ease to produce. Vermiwash is an eco-friendly organic liquid fertilizer that could be used as a foliar spray on many different crops (Jandaik *et al*., 2015).

Use of liquid organic manures such as Jeevamruth, microbial consortia and decomposer results in accelerated increase and yield of plants and enhance the soil physicochemical and biological properties. They comprise micro and macro nutrients, many vitamins, essential amino acids, useful microorganisms and increase selling materials like IAA and GA (Devakumar et al., 2014 and Tharmaraj et al., 2011). Jeevamruth is an eco-friendly organic preparation crafted from cow products. The products of cow have the capacity to convey the float of cosmic energy which in flip can revitalize the increase process. So, there is a need to know the proper spacing to maximize the moog production with efficient organic nutrient management for eastern Utter Pradesh condition. In light of the above, a field experiment was carried out to find out the effect of plant spacing and organic nutrient management on the growth and yield attributes of green gram.

MATERIALS AND METHODS

The present experiment entitled, “Effect of plant spacing and organic nutrient management on growth and yield attributes of green gram (*Vigna radiata* L.)”, was conducted during *zaid* season of 2021 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). The Crop Research Farm is situated at 25.570 N latitude, 87.190 E longitude and at an altitude of 98 m above mean sea level. This area is situated on the right side of the river *Yamuna* and by the opposite side of Prayagraj city. The crop received mean monthly rainfall

of 3.42 mm in May and 3.43 mm in June and zero rainy days were occurred in April month, respectively. The soil of experimental field was sandy loam having a pH of 7.2, with 0.72 (%) Organic carbon. The experiment was laid out in Randomized Block Design comprised of plant spacing and organic nutrient management with nine treatments each replicated thrice. The variety Samrat was sown on April 12th, 2021 by line sowing.The treatment combinations are T_1- 20 cm × 10 cm + 4 t/ha Vermicompost + 10% Vermiwash + 10% Jeevamruth at 20 DAS , T_2 - 30 cm × 10 cm + 4 t/ha Vermicompost + 10% Vermiwash + 10% Jeevamruth at 20 DAS , T_3 - 40 cm × 10 cm + 4 t/ha Vermicompost + 10% Vermiwash + 10% Jeevamruth at 20 DAS , T_4 - 20 cm × 10 cm + 5 t/ha Vermicompost + 12% Vermiwash + 5 kg/ha FYM + 12% Jeevamruth at 40 DAS , T_5 - 30 cm × 10 cm + 5 t/ha Vermicompost + 12% Vermiwash + 5 kg/ha FYM + 12% Jeevamruth at 40 DAS , T_6 - 40 cm × 10 cm + 5 t/ha Vermicompost + 12% Vermiwash + 5 kg/ha FYM + 12% Jeevamruth at 40 DAS , T_7 - 20 cm × 10 cm + 6 t/ha Vermicompost + 14% Vermiwash + 6 kg/ha FYM , T_8 - 30 cm × 10 cm + 6 t/ha Vermicompost + 14% Vermiwash + 6 kg/ha FYM , T_9 - 40 cm × 10 cm + 6 t/ha Vermicompost + 14% Vermiwash + 6 kg/ha FYM. . The observations were recorded on different parameters at harvest *viz.* plant height (cm), branches/plant, nodules/plant ,plant dry weight, pods/ plant, seeds/ pod, test weight (g), seed yield(kg/ha), Haulm yield (kg/ha), Harvest index (%) were statistically analyzed and critical difference were concluded

RESULT AND DISCUSSION

Growth parameters

Plant height

The data pertaining on plant height of green gram recorded at 60 DAS as influenced by plant spacing and organic nutrient management were presented in Table 1. At 60 DAS, maximum plant height (63.41 cm) is recorded in 30 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS and at par values were noticed in the treatment combination of 40 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS and 30 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM (58.82 and 55.48 cm), respectively. The spacing practices had significant effects on plant height. However, an increasing trend with adequate geometry level could be noticed. This may be due to the competition between the inter and intra plants for sun light, water, nutrients and space at closer spacing which encouraged self-thinning of branches and enhanced vertical growth rather than horizontal growth (Thavaprakaash, 2017). Vermiwash promotes healthier shoot and root growth and improves the nutrient assimilation and uptake by the plant, which results in better growth and development. FYM provides a favourable soil environment and supplies more nutrients which results in better plant growth and also forms physico-chemical and biological properties of the soil (Mishra *et al.*, 2016). The higher plant height may also be due to the positive effect of application of Jeevamruth along with organic manures on the vegetative growth and accumulation of metabolic material. Similar results have been reported by Palve *et al.* (2011) and Tharmaraj *et al.* (2011).

Number of branches per plant

The data on number of branches per plant were significantly higher in 30 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS (6.60/plant). However, 30 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM (6.33/plant) recorded at par values. Number of branches/plant was found to be significantly higher under wider spacing; this may be attributed to more horizontal growth and plant canopy area under wider spacing due to less plant density and competition compared to those in closer spacing (Bahadur and Singh, 2005). **Number of nodules**

The data on number of nodules per plant at 60 DAS, influenced by different treatment in green gram presented in Table 2. The highest number of nodules (10.03/plant) were observed in 30 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS and lowest number of nodules (8.87/plant) was observed in 20 cm × 10 cm + 4 t/ha VC + 10% VW + 10% J at 20 DAS. The development of nodules populace is can be because of the symbiotic affiliation of rhizobium microorganism and the utility of organic manures would

possibly have more suitable the populace of favored microbes with inside the root region throughout the early level of contamination via way of means of improving the physical, chemical and biological of properties of soil. Higher population of the desired organisms will always have greater possibilities of infection and consequently formation of more healthy and effective root nodules having higher amount of leghaemoglobin and thus increases the nodule population (Khan *et al*., 2015).

Dry weight

The data on dry weight at 60 DAS, was significantly higher in 30 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS (13.38 g/plant). However, treatments with 40 cm × 10 cm + 5 t/ha VC +12% VW + 5 kg/ha FYM + 12% J at 40 DAS, 30 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM and 40 cm v 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM (13.23, 11.95 and 11.64 g/plant) were statistically at par to the treatment of 30 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS, respectively. Higher dry matter production is observed in 30 cm × 10 cm spacing due to better photosynthetic activity due to greater exposure to light and increased availability of nutrients to plants have also resulted in higher root dry weight on the plants results reported by Salman khan (2017).

Fig 1.Mi×ing of vermicompost

Fig 2. 20 cm×10 cm line Sowing

3.irrigation 35DAS at flowering

Yield parameters

The data pertaining to yield parameters have been presented in Table 2. The important yield parameters Pods/ plant, Seeds/ pod, Test weight (g), Seed yield (kg/ha), Haulm yield (kg/ha) and Harvest index (%), were influenced significantly by various treatment.

Pods per plant

Pods per plant had a significant difference among treatment combinations. significantly higher pods/plant (25.52) was recorded in 40 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS which was followed by the treatment combinations of 40 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM, 30 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM and 40 cm × 10 cm + 4 t/ha VC + 10% VW + 10% J at 20 DAS (24.20, 24.02 and 23.22/plant), respectively

Seed per pod

Seed per pod was noticed maximum (6.97/pod) in 40 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS treatment combination. However, least number of seeds (5.87/pod) was noticed in 20 cm × 10 cm + 4 t/ha VC + 10% VW + 10% J at 20 DAS treatment combination, respectively.

Test weight

Test weight recorded at harvest, is presented in Table 2. The data showed a non- significant effect among the treatments. The highest test weight (32.06 g) was recorded in 40 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS.

Seed yield

Seed yield recorded a significant difference among treatment combinations. However, Seed yield (1869.82 kg/ha) recorded significantly higher in 20 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS. Whereas, 20 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM and 20 cm × 10 cm + 4 t/ha VC + 10% VW + 10% J at 20 DAS were noticed at par values (1861.42 and 1634.34 kg/ha), respectively.

Haulm yield

Significantly higher haulm yield was recorded in 20 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS (3888.33 kg/ha) which was followed by 20 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM, 20 cm × 10 cm + 4 t/ha VC + 10% VW + 10% J at 20 DAS and 30 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS(3630.14, 3423.34 and 3179.59 kg/ha) which were presented in Table 2.

Harvest index

Harvest index recorded at 60 DAS. However, significantly higher harvest index (33.84%) was noticed in 20 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS which was followed by 20 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM (32.35%), respectively. This could be due to the fact that organic manures supplied the crop with a balanced nutrition, better translocation of nutrients, better soil conditions, manures are sustaining other growth factors, apparently linked to organic matter and trace elements resulted increased growth and development leading to greater yield attributes and yield. Application of organic manures, vermiwash and Jeevamruth could have led to increased energy transfers. These manure contains NPK and many other micronutrients, which are components of many enzymes and their remobilization to reproductive parts of plants. As a result, the increased number of leaves, flowering, fruiting and seed formation could be attributed to increased yield (Yadav *et al.*, 2007).

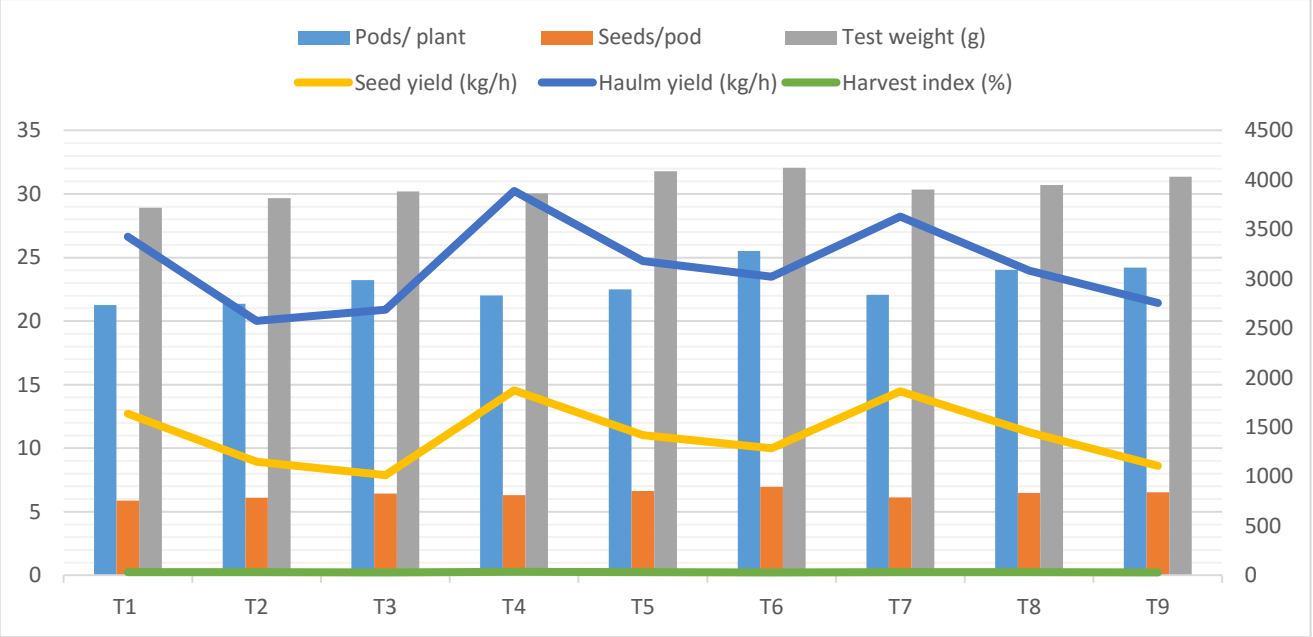

Figure 1.Showing yield attributes of green gram

Table 1. Effect of plant spacing and organic nutrient management on growth attributes of green gram

Treatments	Plant height(cm)	Branches/plant	Nodules/plant	Dry weight (gm per plant)
20 cm × 10 cm + 4 t/ha VC + 10% VW + 10% J at 20 DAS	39.02	4.03	8.87	9.81
30 cm × 10 cm + 4 t/ha VC + 10% VW + 10% J at 20 DAS	45.32	4.17	9.17	10.59
40 cm × 10 cm + 4 t/ha VC + 10% VW + 10% J at 20 DAS	40.96	4.60	8.93	10.02
20 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS	45.50	5.03	30.06	11.03
30 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS	63.41	6.60	31.78	13.38
40 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS	55.48	5.40	32.06	13.23
20 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM	41.31	4.77	30.36	10.14
30 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM	58.82	6.33	30.70	11.95
40 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM	45.96	5.17	31.37	11.64
F-Test	S	S	NS	S
SE (+)	3.96	0.39	1.79	0.67
CD (P=0.05)	11.89	1.17		2.00

Table 2 Effect of plant spacing and organic nutrient management on yield attributes and yield of green gram

Treatments	Pods/ plant	Seeds /pod	Test weight (g)	Seed yield (kg/ha)	Haulm yield (kg/ha)	Harvet index (%)
20 cm × 10 cm + 4 t/ha VC + 10% VW + 10% J at 20 DAS	21.27	5.87	28.92	1634.34	3423.34	32.20
30 cm × 10 cm + 4 t/ha VC + 10% VW + 10% J at 20 DAS	21.36	6.10	29.67	1147.93	2574.62	30.87
40 cm × 10 cm + 4 t/ha VC + 10% VW + 10% J at 20 DAS	23.22	6.43	30.21	1013.60	2686.55	27.45
20 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS	22.02	6.30	30.06	1869.82	3888.33	33.84
30 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS	22.50	6.63	31.78	1419.16	3179.59	32.08
40 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS	25.52	6.97	32.06	1285.91	3020.50	28.85
20 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM	22.07	6.13	30.36	1861.42	3630.14	32.35
30 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM	24.02	6.47	30.70	1448.47	3080.96	31.84
40 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM	24.20	6.53	31.37	1106.46	2755.15	28.64
F-Test	S	NS	NS	S	S	S
SE (+)	0.82	0.45	1.79	135.67	259.13	0.50
CD (P=0.05)	2.46	-	-	406.75	776.88	1.50

Economics

Data with respect to different treatments on economic point of view like cost of cultivation, gross returns, net returns and benefit: cost ratio were calculated and has been presented in Table 3.

Data showed that maximum cost of cultivation (INR 73,300/ha) was observed similar in 20 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM, 30 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM and 40 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM, respectively.

The data clearly revealed that grass monetary return per unit area was maximum (INR 2,28,266.33/ha) was noticed in with the application of 20 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS, also recorded highest net returns per unit area (INR 1,64,206.33/ha) respectively. The treatment combination of 20 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS which obtained highest B: C ratio (2.56) because of least cost of cultivation .The above results might be due to the more yield of green pods and resulted higher gross returns and net returns, while high benefit: cost ratio may be due to maximum economic yield of the crop and favorable effect of the treatments applied in the crop. The results are in line with the findings of Saket *et al.* (2014); Qureshi *et al.* (2016) and Choudhary *et al.* (2018).

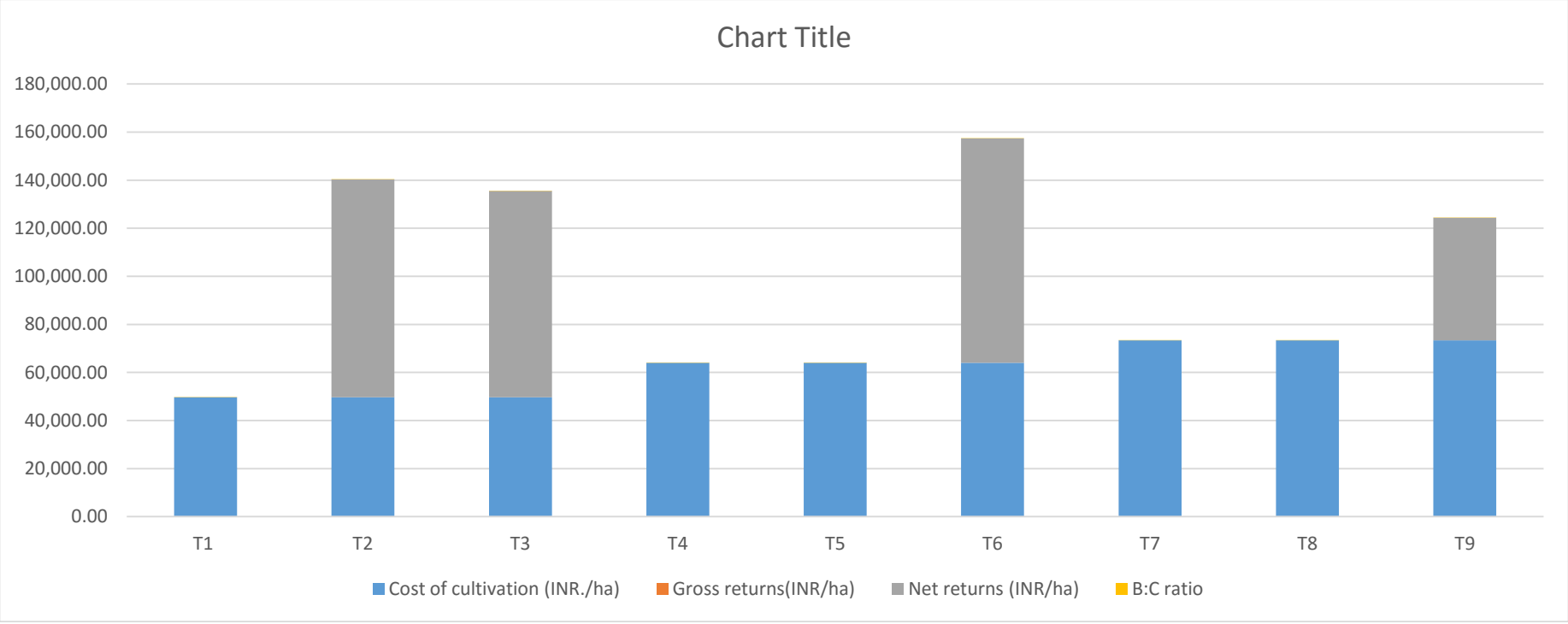

Figure 2. Showing economics of green gram

Table 3. Effect of plant spacing and organic nutrient management on economics of green gram

S. No.	Treatments	Cost of cultivation(INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	B:C ratio
1.	20 cm × 10 cm + 4 t/ha VC + 10% VW + 10% J at 20 DAS	49,700.00	1,99,544.14	1,49,844.14	2.33
2.	30 cm × 10 cm + 4 t/ha VC + 10% VW + 10% J at 20 DAS	49,700.00	1,40,326.22	90,626.22	1.41
3.	40 cm × 10 cm + 4 t/ha VC + 10% VW + 10% J at 20 DAS	49,700.00	1,35,530.35	85,830.35	1.33
4.	20 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS	64,060.00	2,28,266.33	1,64,206.33	2.56
5.	30 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS	64,060.00	1,73,478.79	1,09,418.79	1.70
6.	40 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS	64,060.00	1,57,330.10	93,270.10	1.46
7.	20 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM	73,300.00	2,27,000.94	1,53,700.94	2.10
8.	30 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM	73,300.00	1,76,896.96	1,03,596.96	1.41
9.	40 cm × 10 cm + 6 t/ha VC + 14% VW + 6 kg/ha FYM	73,300.00	1,24,318.15	51,018.15	0.69

CONCLUSION

From the present investigation, The results obtained showed that seed yield (1,869.82 kg/ha), haulm yield (3,888.33 kg/ha), harvest index (33.84%), gross returns (INR 2, 28,266.33/ha), net returns (INR 1, 64,206.33/ha) and benefit: cost ratio (2.89) were recorded maximum in the treatment combination of 20 cm × 10 cm + 5 t/ha VC + 12% VW + 5 kg/ha FYM + 12% J at 40 DAS. It is concluded that spacing of 20 cm × 10 cm along with 5 t/ha Vermicompost, 12% Vermiwash, 5 kg/ha FYM and 12% Jeevamruth at 40 DAS is highly remunerative practice registering higher productivity and thereby realizing a higher monetary advantage.

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