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Effect of organic manure, biofertilizer, phosphorus and nitrogen on growth, seed yield, seed quality attributes of green gram *Vigna radiata* (L.)

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Abstract
An experiment entitled "Effect of organic Manure, Bio fertilizer, Phosphorus and Nitrogen on growth seed yield and seed quality attributes of green gram" was carried out at Nawabganj farm in the Chandhra Shekhar Azad University of Agriculture and Technology, Kanpur Uttar Pradesh during the year 2018-2019. The experiment was laid out in Randomized Complete Block Design with a five factor having Five treatments replicated three times. Organic Manure (FYM and vermicompost), bio fertilizer (PSB), Phosphorus and Nitrogen was subjected to all plots except control. Data were recorded on different parameters such as primary branches, secondary branches, DAS 50% flowering, Number of seeds per plant, Number of pods per plant, Length of pods, seed yield and Test weight of green gram, after a month laboratory observation like germination percentage, root length, shoot length, Tetrazolium test, Brick Gravel test, Electrical Conductivity, Seed Vigour Index –I and Seed Vigour Index –II were reported. The statistical analysis of the data showed that organic Manure (FYM) significantly affected all the studied attributes. The highest number Primary branches, secondary branches and DAS of 50 % flowering Number of seeds per plant, Number of seeds per plant, Number of pods per plant, pod length seed yield and Test weight were recorded highest in treatment T1 (FYM @7.5t/750 m^2) followed T5 (Nitrogen @ 1.5 kg/750 m^2), T4 (Phosphorus @ 3 kg/ 750 m^2), T3 (PSB @ 20 gm Per Kg of seeds), T2 (Vermicompost @ 2.5t/750 m^2). In Laboratory observation the highest germination percentage, root length, shoot length, Tetrazolium test, Brick Gravel test, Electrical Conductivity, Seed Vigour Index –I and Seed Vigour Index –II were recorded in treatment T1 (FYM @7.5t/750 m^2) followed T5 (Nitrogen @ 1.5 kg/750 m^2), T4 (Phosphorus @ 3 kg/ 750 m^2), T3 (PSB @ 20 gm Per Kg of seeds), T2 (Vermicompost @ 2.5t/750 m^2). In general, applications of phosphorus, nitrogen, organic and inorganic in combinations were found effective in enhancing yield in this crop.

Keywords: Organic and Inorganic manure, Biofertilizer, Seed vigour parameters, Statistical analysis, Green Gram *Vigna radiata* L.

Introduction
Pulses occupy a unique position in the Indian diet because of the cheapest source of vegetables protein for the vegetarian population of India. They are said to be poor man's meat because of its richness in proteins and other important nutrients such as Ca, Fe, and vitamins *viz* carotene, thiamine, riboflavin and niacin. Further, pulses are also known to increase soil fertility and consequently the productivity of succeeding crop. It fixes atmospheric nitrogen through symbiotic nitrogen fixation with the help of bacterium called Rhizobia. *Cajanus cajan* (L.) Mill, (Akhtaruzzaman, 1998) [1]. Green gram is locally known as "moong" it is considered as the most wholesome among pulses, free from heaviness and flatulence. It occupies a prominent place and gained popularly by virtue of its photo and thermos insensitiveness. It contains about 25 per cent protein, 1.3 per cent fat, 3.5 per cent minerals, 4.1 per cent fiber and 56.7 per cent carbohydrate. The origin of cultivated green gram is India and central Asia. In India, it occupied an area of 3.44 million hectares having total production of 1.4 million tons of grain with productivity of 407 kg/haha) with an annual yield of 3.65 tonnes and a yield of 898 kg ha^{-1}. In India, major green gram producing states are Orissa, Madhya Pradesh, Rajasthan, Maharashtra, Gujarat and Bihar The protein content of green gram is two to three times more than that of cereals. It is considered as a whole grains a well as dal in variety of way in homes; being easily digestible it is preferred by patients. When moong beans are allowed to sprout, ascorbic acid (Vitamin 'C') is synthesized besides riboflavin and thiamine is also increased. In India, Green gram occupies an area of about 34.3 lakh hectare producing 14 lakh 2 tonnes whereas in Uttar Pradesh it is grown over lakhs hectare.

The productivity of IPM^2-3, in Uttar Pradesh is 10 kg per hectare respectively. Seed plays a vital role in sustaining growth of agriculture since it is the basic and primary material for propagation. The important of seed has been recognized from the time immemorial. The old Indian scripture, Manu Smiriti (in sanskriti) says, "Subeejan sukshetre jayate sampadyate" i.e., 'good seed in a good soil yields abundant'. Under seed quality parameters, both viability and vigour of the seed varied from source to source as the local factor influenced the storability of seed (Tank, Damor, *et al.* 1992) [29]. The seed from different sources possess different quality values, physical structure and chemical composition. These factors determine the longevity of seed in the storage. Pulses, the food legume, have been grown by farmer since millennia and these have been contributed in providing nutritionally balanced food to the people of India, while green gram has definitely originated and domesticated in the Indian subcontinent Though substantial progress has been made in evolving techniques to obtain high yields of pulses, their production per hectare has remained the same for the last two centuries. Pulses have been grown since millennia and have been a vital ingredient of the human diet in India. Even "balanced food"- as defined over years ago- consisted of pulses, besides cereals, vegetables, fruits, and milk products. Application of Farm yard manure (FYM) to the crop is an age old practice. The yield and nutritional quality of green gram is greatly influenced by application of FYM plays important role in improving the fertility and productivity of soils through its positive effects on soil physical, chemical and biological properties and balanced plant nutrition (Biswash, Rahman, *et al*. 2014) [6]. Application of well decomposed of FYM not only supplies all nutrients but also 3 improves the physiochemical properties and encourage soil microbial activities. Another important feature of FYM is its residual effect. Bio compost is compost prepared through microorganism and adds more humus to soil (Jain, Tiwari, *et al*., 1995) [12]. Application of bio compost favorably improves the physical properties of soil. This might be due to higher addition of humus through organism Phosphorus is second most critical plant nutrient for pulse, it assumes primary importance, owing to its important role in root proliferation and there by atmospheric nitrogen fixation. Majority of phosphorus gets fixed in the soil due to various factors. The yield and nutritional quality of pulses is greatly influenced by application of phosphorus. It plays a key role in various physiological processes like root growth and dry matter production, nodulation and nitrogen fixation and also in metabolic activities especially in protein synthesis (Barewadia, Kairon, *et al*., 1989) [4]. It also helps in establishing seedling quickly and also hastens maturity as well as improves the quality of crop produce. The most obvious effect of phosphorus is on the root system of plant. It promotes the formation of lateral and fibrous roots system, which facilitates more nodule bacteria and ultimately affects the nitrogen fixation in leguminous crops. Phosphatic fertilizer have more importance than nitrogenous fertilizer because it increases the activity of symbiotic bacteria and brings significant improvement in yield attributing characters. (Bhalu *et al.* 1995) [5] Phosphate Solubilizing Bacteria (PSB) are a group of beneficial bacteria capable of hydrolyzing insoluble compounds of organic and inorganic phosphorus. Many heterotrophic bacteria and fungi efficiently solubilize insoluble phosphate of soil and rock phosphate. Inoculation of phosphate solubilizing microorganism increase crop yield by 5-10 per cent. Since the process of nodulation and nitrogen fixation is inhibited at higher levels of fertilizer nitrogen in the soil but there is a demand of nitrogen of the crop at post flowering period (Channabasavanna, A. S., Yelamali, S.G and *et al*., 2001) [7].

Objective

1. Effect of farm yard manure and vermicompost on growth, seed yield and seed quality attributes seed of green gram.
2. Effect of phosphate solubilizing bacteria (PSB) on growth, seed yield, seed quality attributes seed of green gram.
3. Effect of phosphorus and Nitrogen on growth, seed yield, seed quality attributes on seed of green gram

Material and methods

The field experiment was conducted to study the Effect of Organic Manure, Biofertilizer, Phosphorus, and Nitrogen on growth, seed yield, seed quality attributes of green gram, during summer season 2019 in Nawabganj farm, at Chandra Shekhar Azad University of Agriculture and Technology Kanpur. Laboratory experiment was carried out from august, 2019 to October 2019 in laboratory of Department of Seed Science and Technology Location of the experiment site field experiment was conducted at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh. Kanpur is situated in the central part of Uttar Pradesh at an elevation of 129.0 meters above mean sea level. It lies between 250 26' and 260 58' North latitude and 790 31' and 800 34' East longitude, falls in the sub-tropical zone having semiarid climate (Mahelete, Kushwaha, 2011) [15]. The average annual rainfall is 800 mm, a major portion of which is received during the monsoon season from the last week of June to first week of October. Soil conditions of the experimental site was medium black, with highly medium potassium, the composite soil sample of the experimental site was collected from 0-15 cm depth before the start of the experiment and was analyzed for physical and chemical characteristics by adapting the standard procedure (Appavu, Saravana (1999) [2], The field experiment consisted of 5 treatments and T0 as a control (recommended dose of fertilizer) as given below. T0- control (RDF*)
T1- FYM @ 25t/ha (applied dose @7.5t/750 m^2)
T2- Vermicopost @2.5t/ha m^2 (applied dose @ 0.18/750 m^2)
T3- PSB 20 gm per 1 kg of seed inoculation
T4- Phosphorus @ 40 kg/ha (applied dose @ 3 kg /750 m^2)
T5- Nitrogen @ 20kg/ha (applied dose @ 1.5 kg/750 m^2)
*RDF- Recommended dose of fertilizer

Results and discussions

The present investigation was conducted to find out the Effect of Organic Manure, Biofertilizer, phosphorus and Nitrogen on growth, seed yield, seed quality attributes of green gram variety IPM^2-3.The yield and quality parameters were estimated through laboratory and field observation (Reddy, Maeuthi, and Sreerekha, 2004) [23]. The data recorded on various parameters have been presented in graph 1 to 9.

1. Result of Primary Branches, secondary branches and 50% flowering

It is also evident form graph 1 that treatment T1 (FYM @7.5t/750 m^2) scored the maximum number of primary

branches, followed by treatment T5 (4.53-Nitrogen @1.5 kg/750 m^2), T4 (4.33 Phosphorus @ 3.0 kg/750 m^2) T3 (4.32-@ 20gm PSB per kg of seed) and T2 (4.25-vermicompost @0.18t/750 m^2). The least number of primary branches (4.10), were recorded with control (Nigamananda, Elamathi, Parmar, and Thanki, 2007) [19].

It is also evident form graph 1 that treatment T1 (9.200- FYM @7.5t/750 m^2) scored the maximum number of secondary branches followed by T5 (9.00- Nitrogen @1.5 kg /750 m)2, T3 @(8.603- 20gm PSB per kg of seed),T4 (8.583-phosphorus3.0 kg @ 3kg/750) m^2 while T2 (8460-vermicompost@ 0.18 t /750 m^2).The least number of primary branches (8.15)were recorded with control(8.15)was superior over control and non-significant.

It is also evident form graph 1 that treatment T1 (52.51- FYM @7.5t/750 m^2) scored the maximum number of DAS to 50% flowering, followed by T5 (52.47-Nitrogen@ 1.5 kg /750 m^2), T4 (50.21- Phosphorus @ 3.0 kg /750 m^2), T3 (50.14- @ 20gm PSB per kg of seed) while T2(48.30-vermicompost @ 0.18t /750 m^2) was superior over control and nonsignificant.

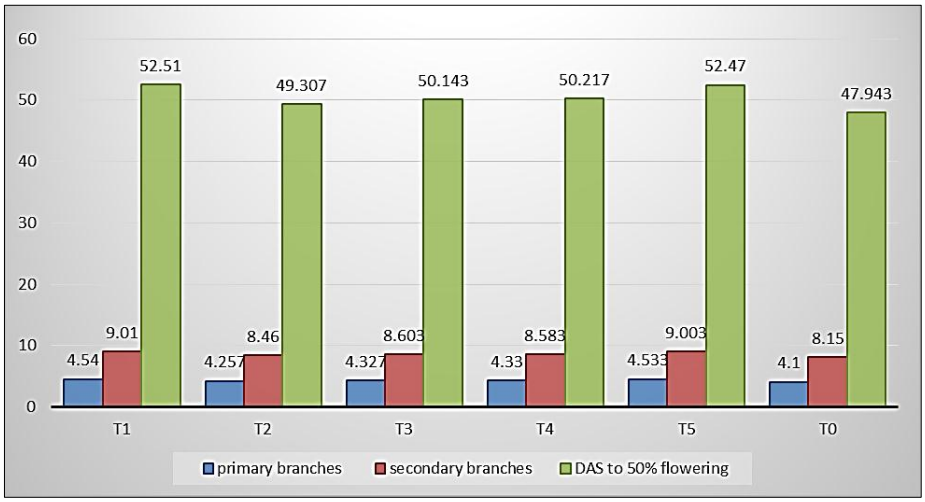

Fig 1: Effect of primary branches, secondary branches and DAS to 50% flowering

2. Results of Effect of seed per pod, No of pods per plant, lenght of pods

It is also evident form graph 2 that treatment T_1 (11.74- FYM @7.5t/750 m^2) scored the maximum number of seeds per pods followed by T_5 (11.72-Nitrogen @1.5 kg /750 m^2), T_3 @ (11.24-20gm PSB per kg of seed), T_4 (11.20-Phosphorus @3.0 kg/750 m^2), while T_2 (11.02-vermicompost @ 0.18t /750 m^2) was superior over control and non–significant (Gupta, A., Sharma, v., Sharma, G, D, *et al.* (2006) [11].

It is also evident form graph 2 that treatment T1 (49.01- FYM @7.5t/750 m^2) scored the maximum number of pod perplant, followed by T5 (48.93-Nitrogen @1.5 kg /750 m^2), T3 @ (46.93-20gm PSB per kg of seed) T4(46.75-Phosphorus @ 3.0 kg/750 m^2), while T2 (46.00vermicompost @ 2.5t /750 m^2) was superior over control and nonsignificant (Vinay Singh, 2006) [32].

It is also evident form graph 2 that treatment T1 (8.49 cm-FYM @7.5t/750 m^2) scored the number of pods length, followed by T5 (8.47cm Nitrogen @ 1.5 kg /750 m^2), T3 @ (8.12cm- 20gm PSB per kg of seed), T4(8.0 cm- phosphorus 3 kg /750 m^2) while T2 (7.96cmvermicompost @ 0.18t /750 $m^2$was superior over control and nonsignificant.

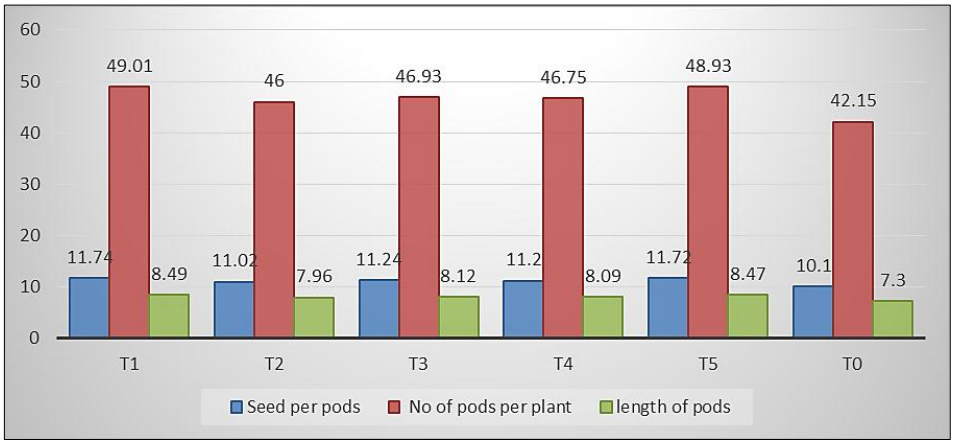

Fig 2: Effect of seed per pod, No of pods per plant, lenght of pods

3. Results of grain yeild and test wieght

It is also evident form graph 3 that treatment T_1 (12.52- FYM @7.5t/750 m^2) scored the highest of number grain yield followed by T_5 (11.80 kg- Nitrogen @1.5kg/750 m^2), T_4 (11.69 kg- Phosphorus @ 3.0 kg/750 m^2),T_3 (11.44-@ 20gm PSB per kg of seed) while T_2 (11.40kg-vermicompost @ 0.18t/750 m^2) was superior over control and non-significant (Devarajan, R. and Palaniappan, S.P., 1995) [9].

It is also evident form graph 3 that treatment T_1 (12.52- FYM @7.5t/750 m^2) scored the highest of maximum Test weight,

followed by T_5 (11.80gm- nitrogen @1.5 kg /750 m^2), T_4 (11.69gm- phosphorus 3.0 kg/750 m^2), T_3 (11.44gm- @20gm PSB per kg of seed) while T_2 (11.40 gm vermicompost @ 0.18 t/750 m^2) was superior over control and non significant.

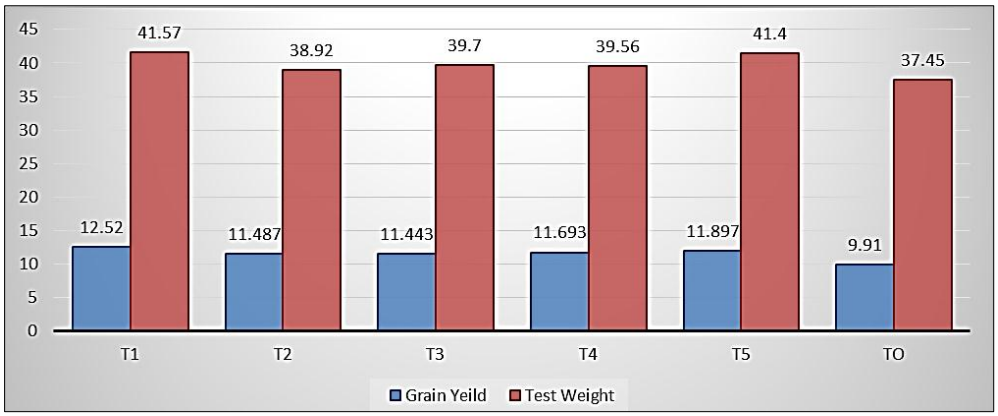

Fig 3: Effect of grain yeild and test wieght

4. Result of tetrazolium test

It is also evident form graph 4 that treatment T_1 (8.84- FYM @7.5t/750 m^2) scored the highest maximum Tetrazolium followed by T_5 (8.83-nitrogen @1.5 kg/750 m^2),T_4 (8.44-phosphorus@3.0 kg/750 m^2), T_3 @ 8.30- @20gm PSB per kg of seed) while T_2 (8.45-vermicompost @0.18t/750 m^2) was superior over control and non- significant (Vikrant, Singh, Malik, 2005) [31].

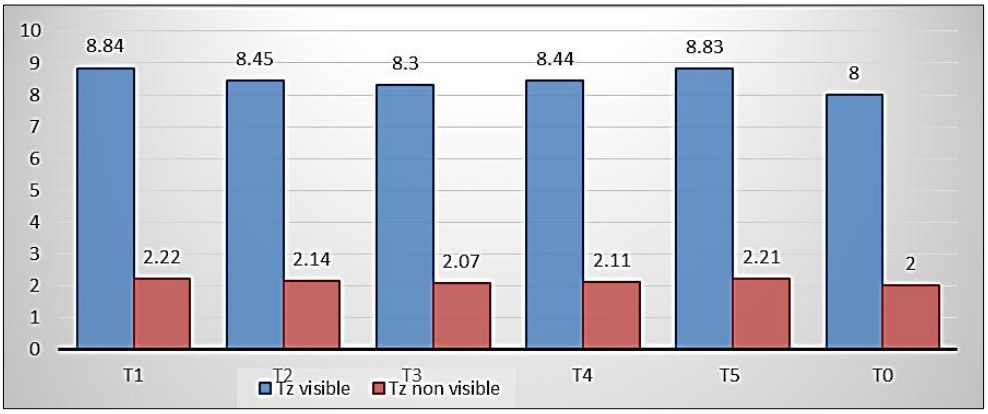

Fig 4: Effect of tetrazolium test

5. Result of Electrical conductivity

It is also evident form graph 5 that treatment T_1(0.210 ds/m^2 -FYM @7.5t/750 m^2) scored the minimum electrical conductivity followed by T_5 (0.200 ds/m^2 -nitrogen @ 1.5 kg /750 m^2), T_3 (0.201 ds/m^2 -@20gm PSB per kg of seed), T_4 (0.201ds/m^2- Phosphorus @ 3.0 kg/750 m^2) while T_2 0.197 ds/m^2 -vermicompost @ 0.18 t/750 m^2) was superior over control and non significant.

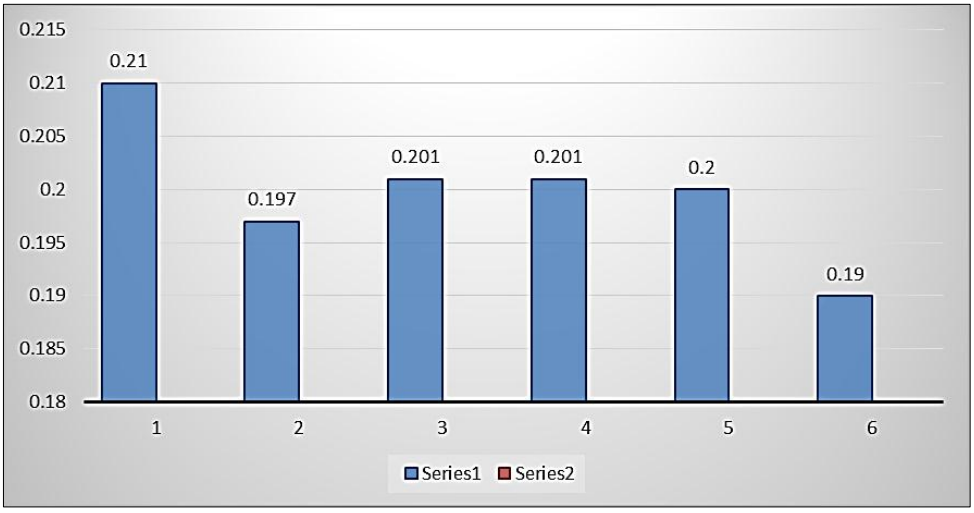

Fig 5: Effect of Electrical Conductivity

6. Result of Brick Gravel Test

It is also evident form graph 6 that treatment T_1 (7.847 - FYM @7.5t/750 m^2) scored highest Brick Gravel test, followed by T_5 (7.838-nitrogen @ 1.5 kg/750 m^2), T_4 (7.507- phosphorus @3.0 kg /750 m^2), T_3 (7.493- @20gm PSB per kg of seed), while T_2 (7.370-vermicompost @ 0.18 t/750 m^2) was superior over control and non significant.

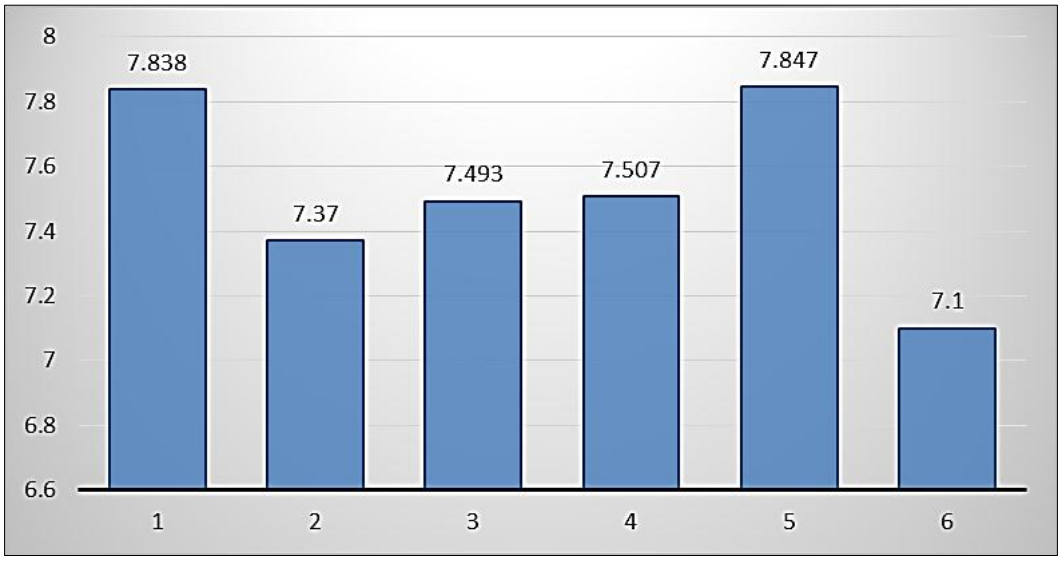

Fig 6: Effect of Brick Gravel Test

7. Result of Germination %

It is also evident form graph 7 that treatment T_1(83.66 - FYM @7.5t/750 m^2) scored highest germination %, followed by T_5 (82.33-nitrogen @ 1.5 kg/750 m^2),T3(80.00-@ 20gm PSB per kg of seed) T_4 79.00-phosphorus 3.0 kg/750 m^2), while T_2(78.00-vermicompost @ 0.18 t/750 m^2) was superior over control and non significant (Meena, Singh, 2006) [17].

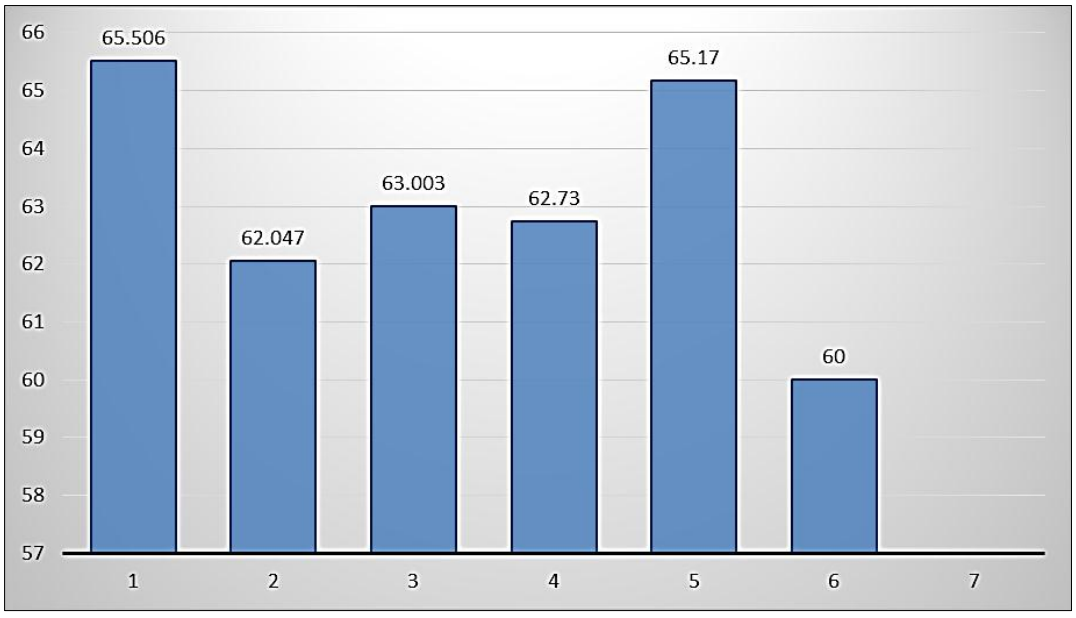

Fig 7: Effect of Germination %

8. Result of Root and shoot lenght

It is also evident form graph 8 that treatment T_1(8.693cm - FYM @7.5t/750 m^2)maximum root length, followed by T_5 (8.680 cm- Nitrogen @ 1.5 kg /750 m^2),T_3(8.323 cm - @ 20gm PSB per kg of seed), T_4 (8.293 cm- phosphorus@ 3.0 kg /750 m^2), while (T_2 8.160cm-vermicompost @ 0.18 t/750 m^2) was superior over control and non-significant.

It is also evident form graph 8 that treatment T_1(18.437cm - FYM @7.5t/750 m^2)maximum showed maximum shoot length, followed by T_5 (18.410 cm-nitrogen @ 1.5 kg /750 m^2),T_4 (17.600 cm-phosphorus 3.0 kg/750 m^2), T_3 (17.450 cm -@ 20gm PSB per kg of seed) while T_2(17.307 cm-vermicompost @ 0.18 t/750 m^2) was superior over control and non significant.

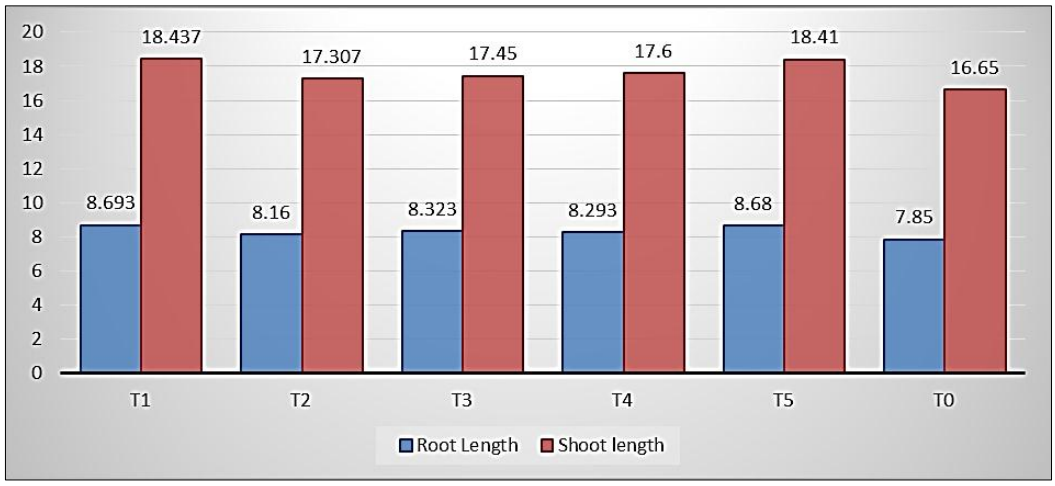

Fig 8: Effect of Root lenght and Shot lenght

9. Result of seed vigour index I and II

It is also evident form graph 9 that treatment T_1 (2244.190 - FYM @7.5t/750 m^2) showed maximum SVI followed by T_5 (2231.500 -nitrogen @1.5 kg Nitrogen/750 m^2),T_3 (2062.387- @ 20gm PSB per kg of seed) T_4 (2043.973-phosphorus @ 3.0 kg/750 m^2), while T_2 (1993.617-vermicompost @ 0.18 t/750 m^2) was superior over control and non-significant (Singh, Singh, V.K., 2008b) [25].

It is also evident form graph 10 that treatment T_1(15.587 - FYM @7.5t/750 m^2) showed maximum SVII, followed by T_5 (15.313-Nitrogen @ 1.5 kg /750 m^2), T_4 (14.737phosphorus @3.0 kg/750 m^2), T_3(14.507-@ 20gm PSB per kg of seed) while T_2 (14.230-vermicompost @ 0.18 t/750 m^2) was superior over control and non-significant (Srinivas, Shaik, Mohammad, 2002) [27].

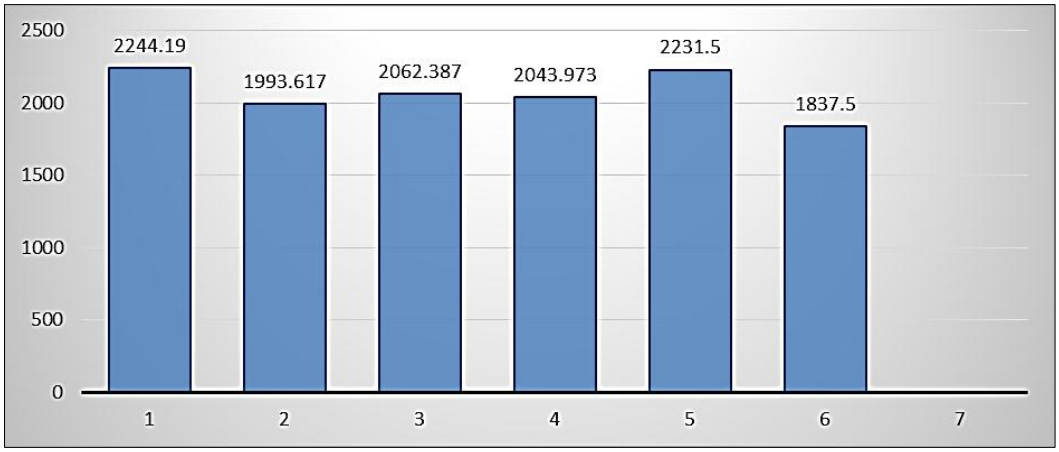

Fig 9: Effect of seed vigour Index -I

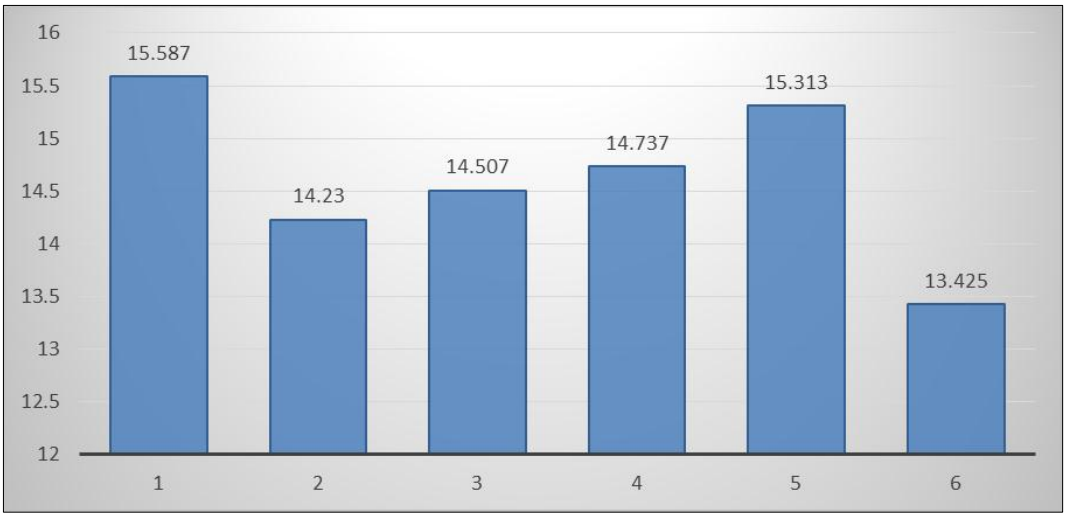

Fig 10: Effect of seed vigour index - II

Conclusion

The objectives of (i)Effect of farm yard manure and vermicompost on growth, seed yield and seed quality attributes seed of green gram.(ii) Effect of phosphate solubilizing bacteria (PSB) on growth, seed yield, seed quality attributes seed of green gram.(iii) Effect of phosphorus and Nitrogen on growth, seed yield, seed quality attributes on seed of green gram. The green gram crop av. IPM 2-3 was sown on march 03, 2019 and harvested on June 08, 2019. The crop was fertilized according to the treatment and followed recommended practices to raise the crop The weather conditions were favourable for normal growth during crop season

The field experiments were conducted in Randomized Block Design. The field observation were recorded for primary branches, secondary branches, DAS to 50% flowering, number of seed per pod, number of pods per plant, pod length and laboratory experiment, Electrical conductivity, Brick Gravel Test, Tetrazolium test, germination %, Root length, shoot length and Seed Vigour Index I and Seed Vigour Index II.

Practical utility of research

1. Effect of organic manure, biofertilizer, Phosphorus and Nitrogen on growth, seed yield and seed quality attributes of green gram.

Effect of FYM@7.5t per 750 m^2, vermicompost @ 0.18t per 750 m^2, biofertilizer (PSB) @ 20 gm per kg of seeds, Phosphorus @ 3kg per 750 m^2,Nitrogen @ 1.5kg 2.5t per 750 m^2 were recorded in primary branches, secondary branches, DAS to 50% flowering, number of seed per pod, number of pods per plant, pod length and laboratory experiment, Electrical conductivity, Brick Gravel Test, Tetrazolium test, germination %, Root length, shoot length and Seed Vigour Index I and Seed Vigour Index II. In which the Treatment T_1 is best among all the treatment in case of FYM, followed by treatment T_5, T_4,T_3 and T_2 (Yakadri, M., Thatikunta, R. *et al* 2002) [33].

Conclusion

Future line of work

1. Studies with organic organic only may be initiated with respect to different source and dose.
2. Application of phosphorus and nitrogen is used for IPM^2-3 variety is useful in limited dose.
3. There is need of study of seed treatment with PSB (Rizhobium).

Thus possible agriculture uses of integrated nutrient management are more useful and diverse than individual seed treatment in improvement of number of branches, number of pods per plant, number of seeds per plant, seed yield per plot, test weight of harvested seed, various seed quality attributes *viz*. germination percentage, seedling length, seedling dry weight, seedling vigour index-I and seedling vigour index-II etc.

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