

Effect of various organic and inorganic sources of nutrients on growth, yield, and economics of Kharif Greengram [*Vigna radiata*. (L.) Wilczek] in the Bundelkhand Region.

ABSTRACT

The application of organics alone does not result in a dramatic rise in crop yields due to their low nutritional status and large quantity demand, which is also a restriction. As a result of the aforementioned implications, Greengram may now be grown using a combination of organic and inorganic fertilizers, as well as bio-fertilizers. There for a felid experiment was conducted in Effect of various organic and inorganic sources of nutrients on growth, yield, and economics of Kharif Greengram [*Vigna radiata*. (L.) Wilczek] in the Bundelkhand Region. The experiment was laid out in randomized block design with 3 replication having 10 treatments. The application of *Rhizobium* culture @ 25g/kg of seed along with Vermicompost @ 2.5 t ha⁻¹; FYM @ 5 t ha⁻¹ and 100% RDF was found significantly superior in plant height (69.90cm), number of leaves per plant (60.50), leaf area index (1.88) and Number of *Rhizobium* nodules plant⁻¹ (123.37) at 45 DAS, number of branches (8.43), Plant dry matter (362.11 g m⁻²), pods plant⁻¹ (28.60), grain pod⁻¹ (11.20), Length of pods (9.87cm), Seed index (4.50g), grain yield (11.41q ha⁻¹), and straw yield (27.45q ha⁻¹), Gross monetary returns (82330 Rs ha⁻¹) were found higher in same treatment T₁₀, as compared to other combination and control. However, highest benefit: cost ratio (3.44) was recorded with use of *Rhizobium* culture and application of 100% RDF (T₂) as compared to other combination and control

Keywords: Biofertilizer, FYM, INM, Inorganic Fertilizer and Organic.

Introduction

Pulses are vital part of Indian dietary system since of its richness in proteins and other vital nutrients such as Ca & Fe, and vitamins viz., (*carotene, thiamine, riboflavin* and *niacin*) the majority of the Indian population is vegetarian, and pulses are the main source of protein for human growth and development. They are both the poor man's meat and the rich man's vegetables. Each person should consume 80 grams of pulses per day, as the World Health Organization recommends. It's most commonly grown in the kharif season because that's when the rains are. Its possible uses in contingency crop planning are as a vegetable, pulse, feed, and green manure crop. Biological nitrogen fixing maintains soil fertility, essential for long-term agricultural viability (Kannaiyan, 1999). Green gram yielded 0.72 million acres (ha), 40 thousand tons (ton), and 555 kilograms per hectare (kg/ha) in the Uttar Pradesh region in the 2017–18 agricultural year. Greengram is grown mostly in the Bundelkhand region of Uttar Pradesh during the Kharif season when rain is abundant and the soil is most fertile. In 2016–17, Greengram was grown on 2,848 ha, yielded 893.8 tons, and had a productivity of 318 kg/ha in the Banda district of Uttar Pradesh, according to data from www.upkrishi.org. Marginal land sub-marginal fields with low soil fertility and insufficient fertilizer contribute to the low yields of this crop (Saravanan. et al., 2013). The lack of fertilizer use has been linked to a significant decrease in Kharif Greengram yields (Singh and Sekhon, 2008). Improved grain quality, soil health, and sustainability are only two of the many benefits farmers get from adopting INM practices, which boost crop yields by 8-150% compared to conventional methods. Sustainable agriculture on a global scale might learn a lot from the INM approach, which has the

potential to be both cutting-edge and gentle on the planet. (Jat et al., 2015). While chemical fertilizers play a crucial role in ensuring that crops receive the nutrients they require, their excessive and prolonged use can have a negative impact on soil's physical, chemical, and biological characteristics, posing a threat to agricultural production's long-term viability and leading to pollution of the surrounding environment (Virmani, 1994).

As rising energy prices make chemical fertilizers unaffordable to farmers, their use will become an increasingly important factor in future agricultural productivity. Therefore, in order to maximize crop yields and quality, it is essential to expand the use of biofertilizers and encourage the use of organic while decreasing the use of chemical fertilizers. However, organics alone do not significantly raise crop yields because of their low nutritional status and high quantity demand. Because of these ramifications, Greengram can now be cultivated with a wide variety of fertilizers, including organic, inorganic, and bio-fertilizers. In addition to increasing crop yields and ensuring their consistency over time, organic manures and inorganic fertilizers have improved the soil's physical qualities (Verma et al., 2012). Integrated Nutrient Management (INM) increases crop yields and ensures the systems' continued sustainability when applied to various cropping systems. Aulakh (2010). Root development, dry matter formation, and nodulation are just a few of the many physiological processes that phosphorus is essential for. In addition, it encourages the growth of both lateral and fibrous roots. Plant growth-promoting chemicals such as n-acetyl-l-alanine (NAA), cytokines (Gibberellins), and gibberellic acid (GA3) are also present in vermicompost together with the nitrogen, phosphate, potassium, copper, zinc, and iron. It has been shown that adding farmyard manure and vermicompost to soil can increase its cations exchange capacity, reduce the release of nutrients, and boost microbial activity, plant growth, and crop output. The biological decomposition of these materials can also provide the plants with nitrogen, phosphorous, potassium, and micronutrients, including Fe, S, Mo, and Zn. When it comes to INM, biofertilizers are a must-have component. They have a lot of potential for fixing atmospheric nitrogen and are cheap and environmentally benign inputs. In addition, they can cut the need for synthetic fertilizers by as much as 25 percent to fifty percent (Pattanayak et al., 2007). Soil nitrogen stores have been depleted due to intensive cropping systems like those used to produce the pulses in such high demand worldwide today. Reduced agricultural yields can be traced back to a lack of essential nutrients in the soil, further depleted by the widespread use of high-analysis fertilizers. An imbalance between domestic consumption and production, rising costs of chemical fertilizers, and a decline in soil health, physiological qualities, and microbial activity all point to a growing need for an Integrated Nutrient Management system. Soil, air, and water pollution result from inorganic fertilizers, which also reduce agricultural production. The INM system and others related to soil health and environmental management solve this problem. It's the lynchpin of long-term agricultural progress (Mahajan & Sharma, 2005).

Materials and methods

The experiment was carried out in Banda, Uttar Pradesh, during the Kharif season of 2019–2020. Green gram growth, yield, and economics as affected by different organic and inorganic nutrient sources and the pursuit of the optimal integrated nutrition management strategy. The experiment consist total 10 treatment replicated thrice in randomised block design and the treatment

includes (T₁) Control, (T₂) Seed Treatment with Rhizobium @ 400 g ha⁻¹, (T₃) T₂ + Recommended Dose of N,P fertilizer@ 25:50 kg ha⁻¹, (T₄) Application of Vermicompost @2.5t/ha, (T₅) Recommended Dose of N,P fertilizer@25:50kg ha⁻¹ + T₄, (T₆) FYM@5t ha⁻¹, (T₇) FYM@5t ha⁻¹ + Recommended Dose of N,P fertilizer@25:50kg ha⁻¹, (T₈) T₂ + T₄ + FYM@5t ha⁻¹, (T₉) T₂ + T₄ + FYM@5t ha⁻¹ + 50% Recommended Dose of N,P Fertilizer@ 12.5:25 kg ha⁻¹, (T₁₀) T₂ + T₄ + FYM@5t ha⁻¹ + 100% Recommended Dose of N,P Fertilizer@ 25:50 kg ha⁻¹. The soil of the experiment field was slightly alkaline black with Electrical conductivity was (0.21 ds/m) bulk density was (1.58), low available nitrogen and phosphors (184 kg ha⁻¹, 10.23 kg ha⁻¹ respectively) and organic carbon(0.47%) and medium available Potassium (197.05 kg ha⁻¹).

Results and Discussion

Effect of INM Treatments on plant growth parameter

Plant height (cm)

The data presented in (Table 1) significantly highest plant height at at 45 DAS was found in treatment T₁₀. However; it was at par with treatments T₉, T₇, T₅, T₃ and T₈. Treatment T₈ was statistically equivalent with T₆ and T₄. Significantly lowest plant height was observed in treatment T₁ (control). Highest plant height at 60 DAS was found in treatment T₁₀; which was found to be at par with T₉, T₇, T₅, T₃, T₈ and T₆. Treatment T₆ was significantly equivalent with T₄. Significantly lowest plant heights were recorded in treatment T₁ (control). The fact that vermicompost includes growth hormones, organic matter, and growth enzymes, which promotes fast cell division and elongation, may be the cause of the rise in plant height. When FYM breaks down, it increases the amount of macro- and micronutrients in the soil and improves its physical, chemical, and biological processes. Its rapid vegetative development may have been caused by this. Rhizobium bacteria have been cited as the primary cause of the increased plant growth since they produce IAA and gibberellin. Additional applications of chemical fertiliser in the form of DAP boost the amount of phosphorus that is readily available in the root zone, which may have accelerated early root development and cell division. It may have increased the plant's ability to get nutrients from the soil's upper layers. The findings of Jat et al. (2012) and Pandey et al. (2019) are consistent with these ones.

Leaf area index

Leaf area index at 45 DAS significantly highest was found in treatment T₁₀; which was found to be at par with T₉, T₇, T₅, T₃ and T₈. Treatment T₈ was at par with T₆, T₄ and T₄. Significantly lowest leaf area index was observed in treatment T₁ (Control). At 60 DAS leaf area index was observed to decline in all the treatments. Highest LAI was found in treatment T₁₀; which was found to be at par with T₉, T₇, T₅, T₃ and T₈. Treatment T₈ was at par with T₆ and T₄. Significantly lowest leaf area index was observed in treatment T₁ (Control).

Number of branches

A perusal of data (1) revealed that significantly treatment T₁₀ had the maximum number of branches at 45 DAS compared to T₉, T₇, T₅, T₃, T₈, T₆, and T₄. The control treatment (T₁) had the fewest reported numbers of branches. Treatment T₁₀ had the maximum number of branches at 60 DAS compared to T₉, T₇, T₅, T₃, and T₈. When compared to T₆ and T₄, Treatment T₈ was statistically

indistinguishable. The control treatment (T₁) had the fewest number of branches. This increase in number of branches might be due to steady supply of essential nutrients to the crop in balance form of organic and inorganic and favorable soil physical environment and also the highest level of primary nutrient which would have promoted the auxiliary buds in to new shoot. Vermicompost presence of growth hormones it responsible for activation of cell division and cell elongation. Sushil et al. (2015) and Singh et al. (2019) have reported consistent results.

Number of Rhizobium nodules plant⁻¹

A perusal of data ((Table 1) indicated that significantly highest number of Rhizobium nodules at 45 DAS significantly highest number of Rhizobium nodules were observed in treatment T₁₀. However; it was at par with T₉, T₃ and T₈. Treatment T₈ was significantly equivalent with T₅ and T₇. T₇ was at par with T₂, which was further at par with T₄. Significantly lowest numbers of Rhizobium were observed in treatment T₁ (control). At 60 DAS no. of Rhizobium nodules were found Significantly decreased in all treatments, significantly highest numbers of Rhizobium nodules were observed in treatment T₁₀. However; it was at par with T₃ and T₉. Treatment T₉ was significantly equivalent with T₈ and T₅. T₅ was at par with T₇, which was further at par with T₂. Significantly lowest numbers of Rhizobium were found in treatment T₁ (control). The highest number of root nodule might be due to increased Nitrogenase activity by Rhizobium which act as growth promoter in legumes and also produce growth hormone, i.e. IAA auxins, gibberellins and vitamins which are conducive to better nodulation. Optimum dose of phosphorus enhances the root nodulation in legume resulted number of root nodules in treated plants are more and maximum at 45 DAS. Likewise, Pandey et al. (2019) reported similar studies.

Plant dry matter (g m⁻²)

Treatment T₁₀ had the greatest Plant dry matters at 45 DAS, outperforming T₉, T₇, T₅, T₃, and T₈ by a wide margin. T₈ treatment was statistically similar to T₆ and T₄. Plant dry matter was significantly lower in treatment T₁ (Control). Plant dry matter was considerably higher in the T₁₀ treatment at 60 DAS. However, it was statistically equivalent to T₉, T₇, T₅, T₃, T₈, T₆, and T₄. Treatment T₁ (Control) had the lowest Plant dry matter by a significant margin. The combined application of Rhizobium, Vermicompost, FYM, and chemical fertilization to the treatments increased the availability of nutrients over a longer period, which had a beneficial influence on the growth metrics, resulting in higher plant dry matter. Consistent findings are also found by Dash et al. (2017) and Singh et al. (2018).

Table 1. Effect of Integrated Nutrient Management Treatments on plant growth parameter.

Treatments	Plant height (cm)		Leaf area index		Number of branches		No. of Nodules Plant		Plant Dry Matter (g m ⁻²)	
	45 DAS	60DAS	45 DAS	60DAS	45 DAS	60 DAS	45 DAS	60 DAS	45 DAS	60 DAS
T ₁	35.73	43.13	1.51	1.17	4.93	6.03	55.10	45.90	180.80	266.18
T ₂	38.57	48.93	1.54	1.32	5.20	6.70	91.63	82.43	205.40	299.50
T ₃	54.53	66.53	1.71	1.60	6.03	7.83	116.80	106.67	274.67	342.47
T ₄	52.27	61.93	1.60	1.48	5.63	7.03	80.17	70.40	238.40	315.85
T ₅	54.90	67.50	1.81	1.69	6.03	7.93	106.67	95.60	281.79	345.14
T ₆	52.90	64.53	1.64	1.53	5.87	7.23	70.10	61.43	255.27	323.97
T ₇	57.13	68.23	1.84	1.72	6.07	8.03	102.53	90.07	290.57	352.89
T ₈	53.77	65.30	1.67	1.58	5.97	7.83	111.67	100.00	272.33	332.40
T ₉	58.63	69.09	1.86	1.74	6.27	8.17	120.07	105.50	291.89	355.07
T ₁₀	59.18	69.90	1.88	1.79	6.47	8.43	123.37	113.17	299.65	362.11
SEm±	2.24	2.31	0.06	0.07	0.29	0.34	5.19	3.78	12.31	16.39
CD(P=0.05)	6.66	6.86	0.18	0.21	0.85	1.01	15.41	11.23	36.58	48.70

Effect of INM treatments on Yield attributing parameter

The data (Table 2) shows that the treatment T₁₀ yielded the maximum number of pods overall at harvest. However; it was at par with T₉, T₇, T₅, T₃, T₈ and T₆. T₆ treatment was shown to be statistically comparable to T₄. Treatment T₁ (Control) had the fewest pods by a significant margin. Rhizobium + V.C @2.5t ha⁻¹ + FYM @5t ha⁻¹ + 100% RDF, which supply more nutritional interims, may account for the improved flower-to-pod conversion that led to the higher pod yield per plant. These results corroborate those of Naveen et al. (2012) and Rupa et al. (2014). Resulted in statistically significantly higher numbers of seeds per pod at harvest was observed in treatment T₁₀. It was, however, on par with T₉, which was, in turn, on par with T₇. T₇ treatment was on par with T₅ and T₃, whereas T₃ was on par with T₈ and T₆. The treatment T₁ (Control) yielded fewer seeds per pod than

the other treatments. An increased number of seed pods per unit area may have occurred from adequate photosynthetic results and nutrition availability via organic, inorganic, and biofertilizer. The number of seed pods per plant was increased using Rhizobium, Vermicompost, FYM, and inorganic fertilizers. Kokani et al. (2014) and Singh et al. (2019) discover consistent results. Treatment T₁₀ had the longest pods, followed closely by treatments T₉ and T₇. It was determined that T₇, T₅, T₃, T₈, T₆, and T₄ are all statistically similar treatments. Pod lengths were significantly shorter in T₁ (Control) than in any other treatment. The increased number of long pods may result from adequate photosynthetic results and nutrition supply via organic, inorganic, and biofertilizer. Pod length was enhanced by applying Rhizobium+Vermicompost+FYM and inorganic fertilizers across the board. Kokani et al. (2014) and Verma et al. (2017) both provide results that are consistent with these findings. Significantly highest seed index was observed in treatment T₁₀. However; it was at par with T₉, T₇, T₅, T₃ and T₈. Treatment T₈ was significantly equivalent with T₆ and T₄. Significantly lowest seed index was observed in treatment T₁ (Control). Data indicated that Rhizobium+ Vermicompost+ FYM and inorganic fertilizers with all levels of fertility registered boldness and sound health of seeds which ultimately resulted in higher seed weight, and these also improved the size of grain by improving the availability of soil nutrients and translocation of manufactured food from source to sink in plant and ultimately increased the yield. A similar result has been reported by Singh *et al.* (2011) and Rupa *et al.*(2014).

Effect of INM Treatments on Production

The data (Table 2) shows that treatment T₁₀ had the maximum grain yield, followed by treatments T₉ and T₇. Treatment T₅ had the lowest grain yield. It was determined that T₅, T₃, T₈, T₆, and T₄ are all statistically similar treatments. Treatment T₁ (Control) had the lowest grain yield by a statistically significant margin. It may have been caused by the improved growth and subsequent higher photosynthesis from an appropriate supply of nutrients provided by Vermicompost, FYM, Rhizobium, and inorganic fertilizers. It aided in the accumulation of photosynthesis and subsequent translocations towards the sink, boosting yield. Significantly highest Straw yield was observed in treatment T₁₀ (Rhizobium + V.C @2.5t ha⁻¹ + FYM@5t ha⁻¹ + 100% RDF). However; it was at par with T₉, T₇, T₅ and T₃. Treatments T₃, T₈, T₆ and T₄ were found to be statistically equivalent. Significantly lowest Straw yield was found in treatment T₁ (Control). Treatment T₁₀ had the best

biological yield, as the data shows. But it held its own against T₉, T₇, and T₅. T₅, T₃, T₈, and T₆ were all statistically indistinguishable. Treatment T₁ (Control) produced the lowest biological yield by a significant margin. exhibit harvest index data; however, neither table nor figure shows a statistically significant difference. Treatment 10 had the greatest harvest index, followed by T₉ (Rhizobium + V.C @2.5t ha⁻¹ + FYM @5t ha⁻¹ + 50% RDF), T₇ (FYM @5t ha⁻¹ +RDF @25: 50kg ha⁻¹), Treatments 5, 3, 4, 8, 6, and 4. TreatmentT₁ (Control) yielded the lowest harvest index. Singh et al. (2018), and Singh et al. (2019) all found similar things.

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Table 2. Effect of INM treatments on Yield attributing parameter, production and economics of green gram.

Treatments	No. of pods plant ⁻¹	No. of grain pod ⁻¹	Length of pods ⁻¹ (cm)	Seed index	Grain (q ha ⁻¹)	Stover (q ha ⁻¹)	Biomass yield (q ha ⁻¹)	Harvest index(%)	Gross returns (Rs ha ⁻¹)	Net returns (Rs ha ⁻¹)	B:C ratio
T ₁	19.80	8.77	7.00	3.03	6.48	19.72	26.20	24.77	47169.67	28325.67	2.50
T ₂	20.07	9.40	7.30	3.30	7.23	20.15	27.38	26.48	52443.92	33543.92	2.77
T ₃	26.07	10.13	7.83	4.03	9.73	24.40	34.31	28.36	69538.75	49070.75	3.40
T ₄	22.23	9.60	7.40	3.63	8.68	22.65	31.34	27.87	62831.58	39787.58	2.73
T ₅	26.40	10.30	7.90	4.17	10.16	25.58	35.57	28.54	73429.58	48817.58	2.98
T ₆	24.30	9.77	7.60	3.67	8.85	23.40	32.25	27.39	63396.42	41752.42	2.93
T ₇	26.87	10.50	8.57	4.20	10.57	25.99	36.56	28.95	76324.42	53112.42	3.29
T ₈	25.43	9.93	7.80	3.93	9.32	24.11	33.43	27.80	66755.33	40855.33	2.58
T ₉	27.50	10.90	9.13	4.23	11.03	26.80	37.83	29.18	79591.00	52907.00	2.98
T ₁₀	28.60	11.20	9.87	4.50	11.41	27.45	38.86	29.36	82330.08	54862.08	3.00
SEm±	1.07	0.14	0.44	0.20	0.54	1.04	1.30	1.32	3849.74	3849.74	0.17
CD(P=0.05)	3.19	0.43	1.31	0.60	1.60	3.10	3.86	NS	11438.06	11438.06	0.51

Economics:

Gross monetary returns and Benefit: cost ratio

The data showed in (Table 2) revealed that significantly highest gross monetary returns (Rs 82330) per hectare were observed in treatment T₁₀ (Rhizobium + V.C @2.5t ha⁻¹ + FYM@5t ha⁻¹ + 100% RDF); which was found to be at par with treatment T₉, T₇ and T₅. Treatment T₅ was significantly equivalent with T₃, T₈, T₅ and T₄. This was further at par with T₂. Significantly Lowest Gross monetary returns of (Rs 47170) per hectare were found in treatment T₁ (Control). The data presented in (Table 4.14 and Fig. 4.14) significantly highest benefit: cost ratio (3.40) was observed in treatment T₃ (T₂ + Recommended Dose of N, P fertilizer@ 25:50 kg ha⁻¹); which was found to be at par with treatment T₇, T₁₀, T₉, T₅ and T₆. Treatment T₆ was significantly equivalent with T₂, T₄, and T₂. Significantly Lowest benefit: cost ratio (2.50) was observed in treatment T₁ (Control). The observations related to monetary return are directly related to grain and straw yields which resulted in terms of output after sale in the market. Findings are in accordance with those of Meena *et al.* (2015), Kumari *et al.* (2018) and Singh *et al.* (2018).

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Conclusion

On the basis of *Kharif* field experiment in Greengram it is concluded that integrated nutrient management practice of Rhizobium seed treatment @ 20g/kg of seed along with combined application of Vermicompost @ 2.5t ha⁻¹, FYM @ 5 t ha⁻¹ and 100% recommended dose of fertilizer (25: 50 N & P) per hectare has been found best option for productivity and economic return. This combination has also helped to improved organic carbon, bulk density and nutrient status of the soil.

REFERENCES:

- Aulakh, M. S. 2010. Integrated nutrient management for sustainable crop production, improving crop quality and soil health, and minimizing environmental pollution. In *19th world congress of soil science, soil solutions for a Changing world* (pp. 1-6).
- Dash, A. C., Saren, B. K. & Roul, P. K. 2017. Residual Effect of Nutrient Management Practices in Hybrid Rice under Sri on Growth and Yield of Greengram (*Vignaradiata* L.) in Rice-Greengram Cropping System. *International Journal of Bio-resource and Stress Management*, 8(6): 749-752.
- Jat, L. K., Singh, Y. V., Meena, S. K., Meena, S. K., Parihar, M., Jatav, H. S. & Meena, V. S. 2015. Does integrated nutrient management enhance agricultural productivity? *Journal Pure Applied Microbiol*, 9(2): 1211-1221.
- Jat, S. L., Prasad, K. & Parihar, C. M. 2012. Effect of organic manuring on productivity and economics of summer Greengram (*Vignaradiata* var. radiata). *Annals of Agricultural Research*, 33(1&2).
- Kannaiyan, S. 1999. Bio-resource technology for sustainable agriculture. Associated publishing company New Delhi, p 422.
- Kokani, J. M., Shah, K. A., Tandel, B. M. & Nayaka, P. 2014. Growth, yield attributes, and yields of summer black gram (*Vigna mungo* L.) As influenced by FYM, phosphorus, and sulfur. *The Bioscan*, 6(3): 429-433.
- Kumari, A., Singh, O. N. & Kumar, R. 2018. Effect of integrated nutrient management on growth, seed yield and economics of field pea (*Pisumsativum* L.) and soil fertility changes. *Journal of Food Legumes*, 25(2): 121-124.
- Mahajan, A., Sharma, R. 2005. INM system Concept, needs, and future strategy. *Agro bios new letter*, 4(3):29-32.
- Meena, R. S., Dhakal, Y., Bohra, J. S., Singh, S. P., Singh, M. K., Sanodiya, P. & Meena, H. 2015. Influence of bioinorganic combinations on yield, quality, and economics of mung bean. *International Journal of Experimental Agriculture*, 159-166.
- Naveen, K.H. and Mevada, K.D. 2012. Performance of different composts and biofertilizer on yield and quality of Greengram (*Vignaradiata*L.), *Advances Research Journal of Crop Improvement*, 3(1):17-20.

Pandey, O. P., S.K., Shahi, A. N., Dubey and Maurya, S. K 2019. Effect of integrated nutrient management of growth and yield attributes of Greengram (*Vignaradiata*L.).*Journal of Pharmacognosy and Phytochemistry*8(3): 2347-2352.

Pandey, O. P., S.K., Shahi, A. N., Dubey and Maurya, S. K 2019. Effect of integrated nutrient management of growth and yield attributes of Greengram (*Vignaradiata*L.).*Journal of Pharmacognosy and Phytochemistry*8(3): 2347-2352.

Pattanayak, S. K. Rao, D. L. N., and Mishra, K. N. (2007).Effect of biofertilizers on yield, nutrient uptake and nitrogen economy of the rice-peanut cropping sequence. *Journal of the Indian Society of Soil Science*, 55(2), 184-189.

Rupa, W. S., Miah, M. S., Shiam, I. H., Mehraj, H and Jamal Uddin, A. F. M. 2014. Organic and inorganic fertilizers on growth, yield, and nutrient content of Greengram (BARIMung5). *International Journal of Business, Social and Scientific Research*, 1(2): 107-111.

Saravanan, P.S., Singh, K. and Lgnesh, A. 2013. Effect of organic manures and chemical fertilizers on the yield and macronutrient concentration of Greengram. *International Journal of Pharmaceutical Science Invention*, 2(1): 18-20.

Singh, G. and Sekhon, H. S. 2008. Effect of various growth and yield of summer Greengram (*Vignaradiata*L.).*Indian Journal of Agricultural Sciences*, 78(1): 87-89.

Pattanayak, S. K. Rao, D. L. N., and Mishra, K. N. (2007).

Singh, I. D. and stoskopf, N. C. 2011. Harvest index in cereals. *Agronomy journal* of 4: 176-181.

Singh, P. K., Anees, M., Kumar, M., Yadav, K. G., Kumar, A., Sharma, R.& Kumar, S. 2019. Effect of integrated nutrient management on growth, yield, and quality of mungbean (*Vigna radiate* L.).*Journal of Pharmacognosy and Phytochemistry*, 1003-1006.

Singh, R., Singh, P., Singh, P. and Yadav, R. A. 2018. Effect of phosphorus and PSB on yield attributes, quality, and economics of summer Greengram(*Vigna radiate* L.). *Journal of Pharmacognosy and Phyto-chemistry*, 7(2): 404-408.

Singh, R., Singh, P., Singh, P. and Yadav, R. A. 2018. Effect of phosphorus and PSB on yield attributes, quality, and economics of summer greengram (*Vigna radiata* L.). *Journal of Pharmacognosy and Phyto-chemistry*, 7(2): 404-408.

Sushil, V., E. P. Rao. 2015. Integrated Nutrient Management on seed yield and quality of green gram. *International Journal of Recent Research in Life Sciences*, 2(2): 42-45.

Verma, S., Saxena, R. and Singh, H. V. 2012. Integrated nutrient management in sesame (*Sesamum indicum* L.). *Bioinfolet-a Quarterly Journal of Life Sciences*, 9(4): 576-579.

Virmani, S. M.1994. The twenty-first- Dr. R. V. Tamhane Memorial Lecture: UNCEED Agenda 21: The new challenge for protein research. *Journal of Indian Society of Soil Science* 42: 516-523.