Plant Archives Vol. 25, Supplement 1, 2025 pp. 3127-3133 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org

DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.supplement-1.427

EFFECT OF SULPHUR LEVELS AND NAPHTHALENE ACETIC ACID ON GROWTH AND YIELD OF GREENGRAM (*VIGNA RADIATA* L.)

Satyam Ranjan[1*], Umesha C.[2], Murari Mohan[1], Ashwani Yadav[1] and Aakash Kumar Saini[3]

[1]Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj-211 007, UttarPradesh, India.

[2] Naini Agricultural Institute, SHUATS, Prayagraj-211 007, Uttar Pradesh, India.

[3]Division of Soil Science and Agricultural Chemistry, Sher-e-Kashmir University of Agricultural Sciences and Technology – Jammu, J&K, India

*Corresponding author E mail:satyamranjan84070@gmail.com

(Date of Receiving : 02-11-2024; Date of Acceptance : 17-01-2025)

ABSTRACT

Also known as green gram, mung bean, or *Vigna radiata* L. The Zaid and Kharif harvests are when this pulse is most abundant in India. This protein-rich staple can fix atmospheric nitrogen and is composed primarily of plants from the Leguminosae family, which accounts for around 25% of its total mass. It is common for soil nutrient supply to fall short of crop needs, especially for crops with a shorter growth season, such as green gram. Thus, foliar nutrition is expected to be an effective tool for addressing crop nutrition requirements and could lead to increased yields, together with soil treatments timed to coincide with weather patterns, especially rainfall. Because it enhances the quality of food crops, especially legumes, Sulphur is a crucial mineral for the pulse industry. This protein-rich staple can fix atmospheric nitrogen and is composed primarily of plants from the Leguminosae family, which accounts for around 25% of its total mass. Particularly for crops with short maturation periods, like green gram, nutrient input to the soil is often inadequate to meet the growing demand for crops. Thus, foliar nutrition is expected to be an effective tool for addressing crop nutrition requirements and could lead to increased yields, together with soil treatments timed to coincide with weather patterns, especially rainfall. Sulfur is a crucial mineral for pulse development because it enhances the nutritional value of legumes and other food crops.

***Keywords* :** Greengram, Sulphur, Naphthalene Acetic Acid, Growth and Economics.

Introduction

Among the significant legume plants belonging to the Fabaceae family, Greengram (*Vigna radiata* L.) stands out. It is used as a crop for green manure and goes by many names, including mungbean, mungo, Oregon pea, or just plain mung. One of the most important pulse crops grown in India during the Zaid season, it is actually a catch crop grown in the interim between the two main harvests. Its seed is more flavorful, nutritious, easy to digest, and gas-free than other pulses grown around the world. According to Sherawat *et al.* (2013), green gram seeds typically have 20-24% protein, 62.5% carbs, 1.4% fat, 4.2% fiber, and other vitamins and minerals. Its high iron and fiber content makes it easy for the digestive system to process. It has a lot of potential uses because to its adaptability, rapid growth rate, high tonnage capacity, and great nutritional qualities for food, feed, and forage. It also works well in intercropping systems with other crops. Pulses are sometimes called "poor man's meat" in the second-generation world due to their lower cost compared to meat (Patel *et al.,* 2020). Green gram is grown in almost every state of India and is hence the world's top producer. Covering an area of 40.38 lakh hectares and producing 31.5 lakh metric tons at a productivity of 783 kg/ha, it accounts for 11% of the total pulse production in 2021–2022. Gujarat, Uttar Pradesh, and Madhya Pradesh are the top three states in India for green gram production, with respective yields of 0.30 lakh/ha, 1.57 lakh/ha, and 20.89 lakh/ha (GOI, 2021).

The soil application of Sulphur and foliar sprays of naphthalene acetic acid during the crop growth period significantly enhances the seed yield and seed quality parameters of greengram. For Greengram to grow and flourish, Sulphur is essential. It is known to improve nodulation activity, which raises atmospheric nitrogen fixation, and is necessary for the synthesis of vitamins and proteins. Since Sulphur is a key source of three amino acids - cysteine and methionine. it is crucial for plants to produce protein. Currently, 42% of Indian soils lack enough Sulphur (Rakesh *et al.,* 2012).

For crops to thrive, especially pulses, Sulphur is a must-have fertilizer. For pulse crops to produce vitamins and proteins, sulfur is a must. Another way that sulfur improves N-fixation is by making legumes more active nodulation activity. During the growth season, sulfur affects green gram plants in various ways, including their height, branching, nodulation, pod number, and seed per pod. Kumar *et al*. (2012) has published on the subject. Biotin and thiamine both include sulfur, and it also plays a role in enzyme and nucleic acid activation. Elemental sulfate and soluble sulfate are the two most common types of Sulphur fertilizers. Elemental Sulphur is completely ineffective for plant use. Soil uptake, yield, and Greengram bacteria convert it to Sulphur, which crops can then consume. Consequently, the rate of Sulphur availability is significantly slower than that of fertilizers containing soluble sulfurate. Upadhyay (2013) and Jat *et al*. (2013) both noted that Sulphur had a positive effect on cowpea and lentil.

A novel family of agricultural compounds known as plant growth regulators (PGRs) has received attention. To enhance flower, pod, and fruit retention, they are known to alter plant architecture, enhance source-sink connections, and boost the transfer of photoassimilates. boost seed quality, yield, and growth. In addition to significantly increasing grain yield and reproductive efficacy, foliar treatments of nutrients and growth regulators during the pre-flowering and blooming stages also reduced flower loss and shed (Ganapathy *et al.,* 2008). Plant growth regulators have the ability to improve a plant's physiological efficiency, including photosynthetic growth, which facilitates the formation of blooms, fruit, and seeds. According to Solamani *et al.* (2011), this raises crop output overall. According to Raoofi *et al.* (2014), cell division, proliferation, vascular tissue differentiation, root initiation, apical dominance, leaf aging, fruit aging, fruit setting, and blooming are all dependent on NAA.

Material and Methods

A field experiment was conducted at Sam Higginbottom University of Agriculture Technology and Sciences' Crop Research Farm in Naini, Prayagraj (U.P.), India, during the *Zaid* Season of 2023. The purpose of the study is to examine the relationship between Sulphur and Naphthalene Acetic Acid on growth and yield of summer Greengram (*Vigna radiata L.*). The current study used a randomized block design (RBD) with three replications for each of the ten treatments.

The Crop Research Farm of the Department of Agronomy, SHUATS, Prayagraj, U.P., was the site of a 2023 field experiment in alluvial soil. A randomized block design was employed, with ten treatment combinations being replicated three times each. Soil reaction was almost neutral (pH 6.8), organic carbon was medium (0.562%), available nitrogen was low (220 kg/ha), potassium was medium (240.7 kg/ha), and accessible phosphorus was extremely high (28.2 kg/ha) in the sandy loam soil that was used for the experiment. The electrical conductivity was 0.409 ds/m as well. On April 20, 2023, 30 cm by 10 cm spacing was used to sow Greengram seeds (Virat IPM 205-7). The treatment combinations were composed of the amounts of sulfur and naphthalene acetic acid. included two components, namely, sulfur and naphthene acetic acid concentrations. The method of hand hoeing was used to dig furrows that were 4-5 cm deep along the seed rows. At 25 and 35 DAS, NAA was sprayed foliar to apply the sulfur as a broadcasting approach. Thinning was done by removing surplus plants to maintain the necessary spacing, while gap filling was done 10 DAS. At 15 and 30 DAS, intercultural operations were repeated twice to decrease weed competition and crop density. Starting from seed germination to harvest, root nodules, plant height in cm, and dry weight in g/plant were measured at regular intervals of 15 days. Conversely, analysis of variance (ANOVA) for randomized block design was used to statistically assess a number of yield parameters that were measured during harvest. Pods per plant, seeds per pod, test weight, seed yield, stover yield, and harvest index were some of the parameters that were measured (Gomez and Gomez., 1984; Kavya *et al*., 2021).

Soil analysis of the experiment field
(A) Physical Characteristics

Soil Characteristics	›sition
Soiltextureclass	Sandyloam
Sand	55.50
Silt	28.10
Clay	16.40

(B) Chemical Analysis of the soil

Soil Characteristics	Composition
pH	6.8
$EC_e(dSm^{-1})$	0.409
Organic matter (%)	0.562
Available N (kg)	220.00
Available Phosphorus P_2O_5 (kg)	28.2
Available Potassium K_2O	240.7

Results and Discussions

The results showed that at 60 DAS, applying 35 kg Sulphur/ha with 20ppm of Naphthalene Acetic Acid produced the best growth characteristics, including a plant height of 42.12 cm, a dry matter accumulation of 18.09 g/m^2, and a crop growth rate of 20.20 g/m^2/day. At 45 DAS, applying 35 kg Sulphur/ha with 20ppm of NAA produced the highest number of nodules per plant (32.83). On the other hand, resulted in higher yield and production parameters. There were 19.31 pods per plant, 9.41 grains per pod, 37.12 g per thousand grains, 1,484 kg/ha of seed yield, 2,675.00 kg/ha of stover yield, and 35.67 percent harvest index. The same holds true for 35 kg/ha of Sulphur and 20 ppm of Naphthene Acetic Acid at 60DAS produced greater net returns (INR 86,313.35/ha) and benefit-cost ratios (2:25) than the control.

Effect of Sulphur and foliar applied Naphthalene Acetic Acid on plant height of Greengram

Plant height during research was recorded at 15, 30, 45 and 60 DAS which was significantly influenced by Sulphur and foliar applied Naphthalene Acetic Acid (Table 1). Foliar applications of 35 kg/ha of Sulphur and 20 ppm of NAA resulted in a maximum plant height of 42.12 cm at 60 DAS, 16.5% more than the control plant height of 32.35 cm; however, at 60 DAS, all other treatments (6,7,8) were statistically equivalent to Sulphur and 20 ppm of NAA.This could be because Sulphur is involved in the production of chlorophyll, photosynthetic activities, and stimulation of cell division (Arunraj *et al.,* 2018). Additionally, the foliar spray application of NAA stimulated the plant's development by making the cell wall more flexible, which in turn allowed starch to be hydrolysed into sugars, and by lowering the cell's water potential, which allowed water to enter the cell and cause elongation. These outcomes were consistent with (Aucharmal *et al.,* 2017).

Effect of Sulphur and foliar applied Naphthalene Acetic Acid on number of nodules/plants

Conversely, the increase in root nodules persisted until 45 DAS, at which point they started to decrease. Given that the nitrogen accumulated in the nodules through symbiotic fixation is utilized for the growth of generative components, this may be the result of the root nodules dying, which happens after flowering. There was a significant difference in the number of nodules at 15, 30, 45, and 60 days after applying 35 kg/ha of Sulphur and 20 ppm of NAA foliar spray at 45 DAS. Except for T7 (27.49) and T8 (29.09) at 45 DAS, which are shown in Table 1, the largest number of nodules was obtained with Sulphur at 35 kg/ha together with 20 ppm foliar spray of NAA at 45 DAS (32.83). An increase in leg haemoglobin pigment production in nodules may be the cause of the nodule count increase (Parry *et al.*, 2018). Moreover, supplemental nutrients sprayed foliarly are essential for promoting faster root growth and improved nutrient absorptionfrom the soil. The present findings are within the proximity of (Sridhar *et al.,* 2021).

Effect of Sulphur and foliar applied Naphthalene Acetic Acid on Dry matter accumulation of Greengram

The amount of dry matter accumulated rose with crop age up to 60 DAS, when maximum amounts were reached. Based on data spanning 60 DAS, it was found that both the foliar spray of naphthalene acetic acid and the basal dose of Sulphur had a substantial impact on dry weight. Maximum dry weight of 35 kg/ha of Sulphur and 20 ppm of naphthalene acetic acid applied foliarly (18.09 g) was reached at 60 DAS, which was substantially higher than the control (18.56 g). It could be because the administration of NAA facilitates the translocation of stored photo assimilates toward the growth of reproductive organs, with the amount of total dry matter serving as a barometer of overall resource use efficiency and improved light interception. These outcomes were consistentwith those of (Rajesh *et al.,* 2014).

Effect of Sulphur and foliar applied Naphthalene Acetic Acid ongrowth rate of Greengram

The pace of crop growth was greatly affected by applying a basal dose of sulfur and foliar applications of naphthene acetic acid. Table 1 shows that a basal dose of 35 kg/ha of Sulphur and a foliar spray of 20ppm of NAA at 60 DAS (20.20 g/m^2/day) significantly increased the crop growth rate between 45 and 60 DAS.It may be because growth parameter increases might be the consequence of cell division, enlargement, and elongation, which would improve plant organs generally and speed up and uniformize the crop's vegetative growth when Sulphur is applied. These findings concur with the conclusion of (Yadav *et al.,* 2022).

Effect of Sulphurand foliar applied Naphthalene Acetic Acid on yield attributes of Greengram

Table 2. displays data regarding the characters that contribute to yield. Treatment 9 (35 kg/ha of Sulphur and 20 ppm of naphthalene acetic acid applied foliarly) produced the most pods per plant (19.31), which was statistically equivalent to treatments 5, 6, 7, and 8 (17.34, 18.17, 18.90, 19.19, respectively). Sulphur applied at a rate of 35 kg/ha in conjunction with 20 ppm NAA resulted in a noticeably increased number of seeds per pod (9.41). Statistically, T9 was surpassed by T6(8.55), T7(8.72), and T8 (8.89). However, out of all the treatments, T9 had the greatest test weight (37.12 g). Greengram growth and yield, including test weight, number of seeds per pod, and number of pods per plant, were significantly affected by foliar NAA application and a basal dose of Sulphur. The results demonstrated that T9 resulted in the best plant growth and yield characteristics. Sulphur may enhance plant metabolism and photosynthetic activity, leading to improved yield quality. In a similar vein, Jat *et al.* (2013) have also observed results. According to Mahesh *et al.* (2022), who found similar results, using can improve growth characteristics, which boosts photosynthetic rate and metabolite translocation to reproductive pods, perhaps leading to an even higher seed yield.

Effect of Sulphur and foliar applied Naphthalene Acetic Acid onyield of Greengram

Applying Sulphur as a basal dose and naphthalene acetic acid topically had a substantial impact on seed and stover yields. Treatments including 35 kg/ha of Sulphur as a basal dosage and 20ppm of foliar spray of NAA at 60 DAS resulted in the highest seed yield (1484.15 kg/ha) (Table 2.) Outperforming all other treatments except for 35 kg/ha of Sulphur and 15ppm of Naphthalene Acetic Acid at 60 DAS (1358.92 kg/ha). Similarly, a basal dose of 35 kg/ha of Sulphur and a foliar spray of 20ppm of NAA at 60 DAS resulted in a maximum stover production of 2675 kg/ha, a 49.03% improvement over the control treatment of 1393 kg/ha. Applying sulfur in combination with naphthalene acetic acid may have resulted in the highest and most abundant stover yield (Arunraj *et al.,* 2018) since amino acids contribute to chlorophyll production, photosynthetic process, enzyme activation, and grain development.

Effect of Sulphur and foliarly applied Naphthalene Acetic Acid on Economicsof Greengram.

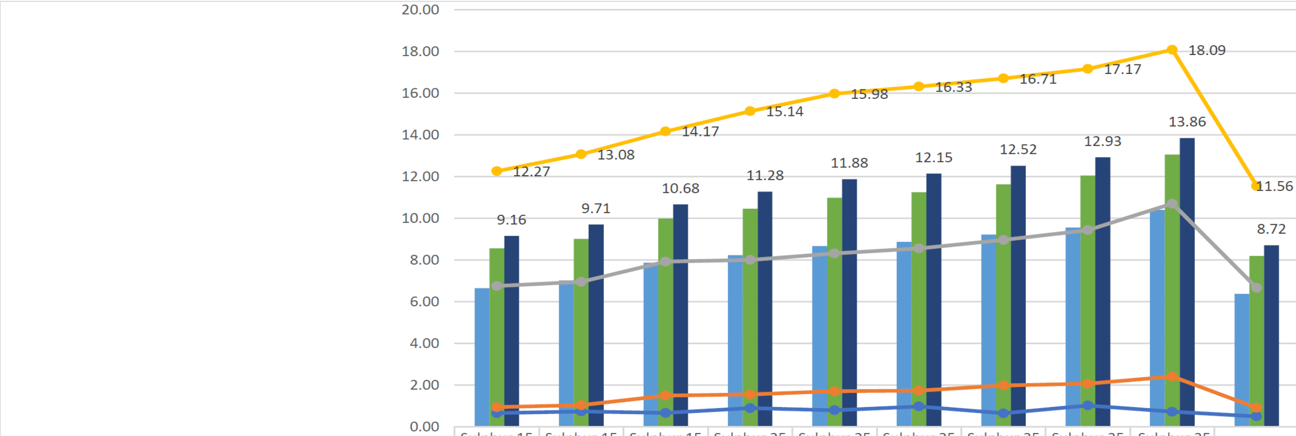
Experimental results revealed that application of Sulphur and NAA was significantly influenced the economics of Greengram. Higher gross return was obtained with applying of 35 kg/ha of Table 2. Shows that the basal dose of Sulphur and the 20ppm foliar spray of NAA at 60 DAS (1,24,677.30 INR/ha) were considerably better than the other treatments, except for 35 kg/ha of Sulphur and the 15ppm foliar spray of Naphthalene Acetic Acid at 60 DAS (1,14,639.00 INR/ha). The basal dose of 35 kg of Sulphur and the foliar application of 20 ppm of NAA at 60 DAS (86,275.00 INR/ha) yielded a better net return than the other treatments, except for 35 kg of Sulphur and the 15ppm foliar spray of Naphthalene Acetic Acid at 60 DAS (76,323.00 INR/ha). Applying 20 ppm NAA via foliar spray at 60 DAS (2.25) and 35 kg/ha of Sulphur as a basal dose resulted in a higher benefit-cost ratio that was noticeably better than the other treatments except 35 kg/ha Sulphur along with 15ppm foliar spray of Naphthalene Acetic Acid at 60 DAS (1.99) Kavya *et al*. (2021).

The Future Scope

Research has demonstrated that applying micronutrients effectively targets plants exhibiting symptoms of vitamin deficiencies. A crop can be improved by applying micronutrients before there are obvious symptoms of a deficit, either by encouraging faster regrowth or by optimizing the stage of growth when yield potential is at its highest. Applying micronutrients can increase a plant's ability to withstand environmental stressors and increase its potential output. With these considerations in mind, a field test was carried out to see how foliar nutrition affected Greengram productivity. Regarding these factors, there is a wealth of material available on kharif greengram; nevertheless, there is a dearth of information regarding summer greengram in Uttar Pradesh. The study was conducted to determine the optimal dose of sulfur as a basal soil application and the foliar application of naphthalene acetic acid in summer greengram under the agro-ecological conditions of Uttar Pradesh in order to generate location-specific information on these two nutrients.

Conclusion

We must apply enough sulphur fertilizer and NAA to increase the productivity of Greengram. Foliar spraying is particularly beneficial as it can effectively eliminate losses from leaching and fixation while also controlling plant uptake of nutrients. Based on the current study, it is evident from the results that applying 35 kg/ha of sulphur in combination with a foliar spray of 20 ppm Naphthalene Acetic Acid worked better to increase the production and financial gains of Greengram.



	Sulphur 15 kg/ha + NAA 10 ppm/ha 1	Sulphur 15 kg/ha + NAA 15 ppm/ha 2	Sulphur 15 kg/ha + NAA 20 ppm/ha 3	Sulphur 25 kg/ha + NAA 10 ppm/ha 4	Sulphur 25 kg/ha + NAA 15 ppm/ha 5	Sulphur 25 kg/ha + NAA 20 ppm/ha 6	Sulphur 35 kg/ha + NAA 10 ppm/ha 7	Sulphur 35 kg/ha + NAA 15 ppm/ha 8	Sulphur 35 kg/ha + NAA 20 ppm/ha 9	Control (25-50-25 kg NPK/ha) 10
Crop Gwoth Rate(g/g/day)	6.66	7.03	7.87	8.24	8.67	8.88	9.22	9.56	10.41	6.38
Crop Gwoth Rate(g/g/day)	8.56	9.02	9.99	10.46	10.99	11.26	11.63	12.06	13.07	8.20
Crop Gwoth Rate(g/g/day)	9.16	9.71	10.68	11.28	11.88	12.15	12.52	12.93	13.86	8.72
Plant Dry Weight (g)	0.67	0.74	0.67	0.91	0.80	0.98	0.66	1.03	0.73	0.51
Plant Dry Weight (g)	0.95	1.05	1.51	1.56	1.71	1.75	1.99	2.07	2.42	0.92
Plant Dry Weight (g)	6.76	6.96	7.93	8.01	8.32	8.56	8.97	9.44	10.71	6.67
Plant Dry Weight (g)	12.27	13.08	14.17	15.14	15.98	16.33	16.71	17.17	18.09	11.56

Fig. 1 : Influence of Sulphur level and Naphthalene Acetic Acid on Growth attributes of Greengram on Clustered Column Chat.

Table 1 : Influence of Sulphur level and Naphthalene Acetic Acid on growth attributes of Greengram.

S. No.	Treatments	Plant height 60 DAS	Dry weight(g) 60 DAS	No of Nodules 45 DAS	CGR(g/g/day) 45-60DAS	RGR(g/g/day) 45-60DAS
1	Sulphur 15 kg/ha+ NAA 10 ppm/ha	33.92	12.27	20.45	12.51	0.04
2	Sulphur 15 kg/ha+ NAA 15 ppm/ha	35.95	13.08	21.88	13.76	0.04
3	Sulphur 15 kg/ha+ NAA 20 ppm/ha	36.88	14.17	23.55	13.87	0.04
4	Sulphur 25 kg/ha+ NAA 10 ppm/ha	37.95	15.14	24.33	15.85	0.04
5	Sulphur 25 kg/ha+ NAA 15 ppm/ha	38.11	15.98	25.40	17.03	0.04
6	Sulphur 25 kg/ha+ NAA 20 ppm/ha	38.64	16.33	26.22	17.25	0.04
7	Sulphur 35 kg/ha+ NAA 10 ppm/ha	39.16	16.71	27.49	17.21	0.04
8	Sulphur 35 kg/ha+ NAA 15 ppm/ha	39.77	17.17	29.09	17.32	0.04
9	Sulphur 35 kg/ha+ NAA 20 ppm/ha	42.12	18.09	32.83	20.20	0.04
10	Control (25-50-25kg NPK/ha)	32.35	11.56	23.73	11.10	0.04
SEm(+)		1.29	0.57	1.95	1.06	NS
CD (P= 0.05)		3.84	1.70	5.80	3.17	-

Table 2 : Influence of Sulphur level and Naphthalene Acetic Acid on yield attributes and yield of Greengram.

S.No.	Treatments	No. of Pods /plant	No. of Seeds /pod	Test weight (g)	Grain yield (kg/ha)	Stover yield (kg/ha)	Total Gross return (INR/ha)	Net returns (Rs/ha)	Benefit cost ratio (B:C)
1	Sulphur 15 kg/ha+ NAA 10 ppm/ha	16.78	7.75	31.20	880.77	1663.33	74171.33	37,879.33	1.04
2	Sulphur 15 kg/ha+ NAA 15 ppm/ha	16.95	7.82	32.16	923.43	1706.67	77618.67	41,302.67	1.14
3	Sulphur 15 kg/ha+ NAA 20 ppm/ha	17.13	7.91	32.56	948.31	1884.67	80104.17	43,740.17	1.20
4	Sulphur 25 kg/ha+ NAA 10 ppm/ha	17.6	8.16	32.80	1007.87	2031.67	85215.17	47,923.17	1.29
5	Sulphur 25 kg/ha+ NAA 15 ppm/ha	17.23	8.38	33.12	1059.00	2200.33	89717.83	52,401.83	1.40
6	Sulphur 25 kg/ha+ NAA 20 ppm/ha	18.38	8.55	34.02	1162.06	2342.00	98207.50	60,843.50	1.63
7	Sulphur 35 kg/ha+ NAA 10 ppm/ha	18.66	8.72	35.64	1291.88	2430.00	107013.50	68,721.50	1.79
8	Sulphur 35 kg/ha+ NAA 15 ppm/ha	19.15	8.89	36.21	1358.92	2650.00	114639.00	76,323.00	1.99
9	Sulphur 35 kg/ha+ NAA 20 ppm/ha	19.31	9.41	37.12	1484.15	2675.00	124639.00	86,275.00	2.25
10	Control (25-50-25kg NPK/ha)	16.34	7.69	30.54	837.45	1393.00	70050.50	35,306.50	1.02
SEm(+)		0.67	0.29	1.17	52.30	72.32	4308.26	4308.26	0.11
CD (P= 0.05)		2.01	0.88	3.48	155.41	214.89	12800.52	12800.52	0.34

Note: Price of grain yield – Rs. 7950/q (MSP) and price of stover yield – Rs. 250/q and Rs. 79.50/kg grain yield and stover yield – Rs.2.5/kg

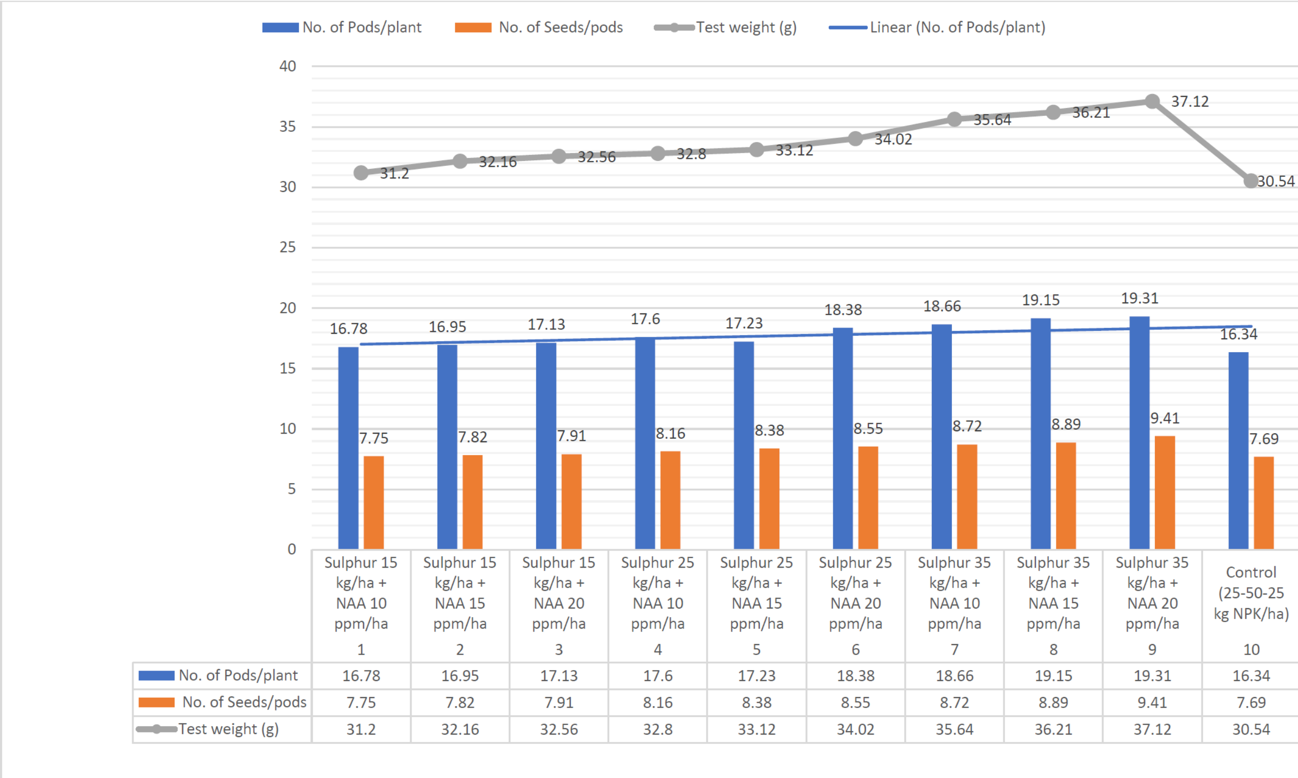


Fig. 2 : Influence of Sulphur level and Naphthalene Acetic Acid on yield attributes of Greengram on Combo graph.

Acknowledgement

For providing the facilities needed to carry out the research, the authors are grateful to the Department of Agronomy at the Naini Agricultural Institute, Prayagraj, Sam Higginbottom University of Agriculture Technology and Sciences, (U.P.) India.

References

Arunraj, M., Vasanthi, D., Mansingh, M. D. I. (2018). Effect of Sulphur on growth and yield of greengram [*Vigna radiata*]. *International Journal of Science, Environment and Technology*. **7(5)**, 1861 – 1867.

Aucharmal SM, Bhosale SG, Pawar HD, Karanjkar PN. (2007). Growth and yield of black gram (*Vigna mungo*) as influenced by growth regulators. *Journal of Soil Crops*. **17(1)**, 82-85.

Ganapathy M, Baradhan G, Ramesh N. (2008). Effect of foliar nutrition on reproductive efficiency and grain yield of rice fallow pulses. *Legume Research*, **31(2)**,142- 144.

GOI, (2021). Agricultural Statistics at a Glance, Agricultural Statistics Division, Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi. https://eands.dacnet.nic.in.

Gomez, K. A., and Gomez, A. A. (1984). *Statistical Procedures for Agricultural Research*. John Wiley and Sons.

Jat, S. R., Patel, B. J., Shivran, A. C., Kuri, B. R. and Jat, G. (2013). Effect of phosphorus and Sulphur levels on growth and yield of cowpea under rainfed conditions. *Annals of Plant and Soil Research*, **15(2)**, 114-117.

Kavya, P., Singh, S., Hinduja, N., Tiwari, D. and Sruthi, S. (2021). Effect of Foliar Application of Micronutrients on Growth and Yield of Greengram (*Vigna radiata* L.). *Legume Research- An International Journal*, **44 (12)**, 1460-1464

Kumar, R., Singh, Y. V., Singh, S., Latare, A. M., Mishra, P. K. and Supriya, P. (2012). Effect of phosphorus and Sulphur nutrition on yield attributes and yield of mung bean. *Journal of Chemical and Pharmaceutical Research*, **4(5)**, 2571- 2573.

Mahesh Sangeeta IM, Shakuntala NM, Doddagoudar SR, Ravi MV. (2022) Effect of nutrients and growth regulators on growth yield and economics of black gram in paddy fallow (*Vigna mungo* L.). *The Pharma Innovation*. **11(2)**, 3025-3029.

Patel, R., Babady, E., Theel, E.S., Storch, G.A., Pinsky, B.A., St. George, K., (2020). Report from the *American Society for Microbiology* COVID-19 *International Summit*, value of diagnostic testing for SARS– CoV-2/COVID-19. *M Bio*. **11(2)**, 10-128.

Rajesh, K., Reddy, S.N., Reddy, A.P.K., Singh, B.G. (2014). A comparative study of plant growth regulators on morphological seed yield and quality parameters of greengram. *International Journal of Applied Biology and Pharmaceutical Technology*. **5(3)**, 103-109.

Rakesh, K., Singh, Y.V., Surendra, S., Latare, A.M. and Mishra, P.K. (2012). Effect of phosphorus and sulphur nutrition on yield attributes, yield of mungbean [*Vigna radiata* (L.) Wilczek]. *Journal of Chemical and Pharmaceutical Research*. **4(5)**, 2571-2573.

Raoofi, M.M., Dehghan, S., Keighobadi, M., Poodineh, O. (2014). Effect of naphthalene acetic acid in agriculture and the role of increase yield. *International Journal of Agricultural Crop Science*, **7(14)**,1378-1380.

Sehrawat, N., Jaiswal, P.K., Yadav, M., Bhat, K.V. and Sairam, R.K. (2013). Salinity stress restraining mung bean (*Vigna radiata* L.) production: Gateway for genetic improvement. *International Journal of Agricultural Crop Sciences*, **6(9)**, 505-509

Solamani, A., Sivakumar, C., Anubumani, S., Suresh, T., Arumugam, K. (2011). Role of plant growth regulators on rice production. *Agricultural Review*. **23**, 33-40.

Sridhar, A., Singh, V., Tiwari, D., Uday Kiran V. (2021). Effect of plant growth regulators and micronutrients on growth and yield of varieties of greengram (*Vigna radiata* L.). *The Bioscan*. **16(1)**, 195- 198.

Upadhyay, A.K. (2013). Effect of Sulphur and zinc nutrition on yield, uptake of nutrients and quality of lentil in alluvial soils. *Annals of Plant and Soil Research,* **15(2)**, 160-163.

Singh, Y.D., Kumar, P.C. and Kumar, R. (2022). Effect of phosphorus and Sulphur on growth and yield of black gram (*Vigna mungo* L.). *The Pharma Innovation Journal,* **11(9)**, 2674-2676.