

Original Research Article

Response of Foliar spray of Iron and Gibberallic acid on growth and Yield of Green gram

ABSTRACT

A Field experiment was conducted during Kharif 2022 at Crop Research Farm ,Department of Agronomy, Sam Higginbottom University of Agricultural Sciences , Prayagraj, U.P, India . To evaluate the Response of Foliar spray of Iron and Gibberallic acid on Growth and Yield of Green gram. The Treatment consisted of 0.5% , 1.0% and 1.5 % of Iron and 50ppm , 100ppm ,150ppm of GA₃. The experiment was laid out in randomized Block design with ten treatments and replicated thrice. Results revealed that 1.5% FeSO₄ along with 150 ppm GA₃ recorded significantly higher plant height (73.33cm), No. of Nodules /plant (55.33),dry weight (15.67 g/plant), Crop growth rate(14.00g/m²/plant), No. of Pods/Plant(24.5) ,No. of Seeds/Pod(12.00),Test weight (20.50g), Grain yield (1.95 t/ha) ,Stover Yield (3.15 t/ha) and Harvest Index(33.83%)at harvest. Maximum Gross return (INR 129112.50 INR/ha), Net Return (INR 92803.50 INR/ha), highest B:C Ratio (2.56).

Keywords: Green gram , Iron , Gibberellic acid , Dry weight

Introduction

Green gram is botanically recognized as *Vigna radiata* (Lin.) Wilczek and belongs to the family Fabaceae (leguminaceae). Greengram is an important legume crop of Asian origin, and is widely cultivated in the countries of Asia, Australia and Africa continents (Yang et al., 2008). A balanced fertilization of macro and micro nutrients is very important for high yield and high quality products (Sawan et al., 2001). The protein from pulses is easily digestible, relatively cheaper and has higher biological values. The lysine rich protein of pulses are considered to supplement the deficiency of this amino acid in cereal dietaries and because of this pulses are called as “poor man’s protein”. (Ramamurthi et al., 2012) . Pulse crop, greengram , every 100 g of edible portion of mungbean seed contains 75 mg calcium, 4.5 mg phosphorus, 24.5 g protein and 348 K Cal energy (Meena et al. 2013). It has high nutritive value and due to this, has advantage over the other pulses. The seed contains 24.20% protein content, 1.30% fat, and

60.4% carbohydrates, calcium (Ca) 118 mg and phosphorus (P) is 340 mg per 100 g of seed, respectively (Imran *et al.*, 2016). The residue of greengram is also used as feed for animals and enhances the soil fertility (Asaduzzaman. 2008). In year 2016-17 the total pulse grown on 238.56 lakhs hectare and production of India was 18.25 million tonnes with productivity of 765 kg/ha. India is the largest producer and consumer of pulse in world accounting for 25% of globule production and 50% consumption (Saraswati et al. 2004) . Iron (Fe) is one of the essential micronutrient that enhances plant growth and reproduction (Welch. 1995) [23]. Iron was the first nutrient element discovered as essential for plant life. In the plant system, iron plays an important role in a series of metabolic activities involving respiratory enzymes and various photosynthesis reactions. Iron is a vital element in plant life. Iron has a number of important functions in the overall metabolism of the plant and it is essential for the synthesis of chlorophyll, as it is essential for many enzymes, including cytochrome that is involved in electron transport chain, maintain structure of chloroplast and also in enzyme activity. It plays critical role in metabolic processes such as DNA synthesis, respiration and photosynthesis. (Rout and Sahoo, 2015). Greengram occupies 30.53 lakh hectare area and contributes 15.09 lakh tonnes in pulse production in the country (Statistical year book India, 2016). Iron (Fe) is an essential nutrient for plant growth and development and it is involved in chlorophyll and thylakoid synthesis and chloroplast development. Although, total iron content of soils is much higher than requirement of plant but its bioavailability is limited (Guerinot and Yi *et al.*, 1994. Plant growth regulators, use of exogenous gibberellin in breaking dormancy is not well understood but it has been postulated that gibberellins regulate mobilization of food reserves and interact with inhibitors such as abscissic acid. Gibberellic acid (GA₃) has been used to increase the length or height of plants, increase the number of flowers and induce early flowering. To attain such goal, the use of Gibberellic acid may play an important role as this is known to affect many facts of plant life, including, seed germination, leaf expansion, N- fixation, phloem loading, water and mineral uptake, assimilate translocation, harvest index (Gana *et al.*, 2010). Gibberellic acid (GA₃) is known to be concerned in the regulation of plant responses to the external environment (Chakrabarti and Mukherji, 2003). GA₃ was found to influence the spikelet fertility and seed yield significantly (Biswas et al., 2020b). The influence of GA₃ has been found to enhance seed yield plant and all the seed yield attribute characters (Ray and Bordolui, 2020). Among the growth regulators GA₃ occupies a prominent position in mediating a variety of plant

physiological processes including seed germination, leaf expansion, flower and fruit set, dry matter production, photosynthesis, translocation of food material and synthesis of mRNA coding for hydrolytic enzymes (Tiwari *et al.*, 2011). Gibberellic acid (GA₃) is a naturally occurring growth hormone which regulates the growth and development of plant. The Gibberellic acid are associated with various plant growth and development processes such as seed germination, hypocotyls elongation, leaf expansion, floral initiation, uniform flowering, floral organ development, reduced time to flowering, increased flower number and size and induction of some hydraulic enzymes in aleuronic of cereal grain . Hence, the present investigation was conducted to study the Response of Iron and Gibberallic acid on growth and Yield of Greengram.

Materials and Methods

The experiment was conducted during *Kharif* seasons of 2022 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 25.57 N latitude, 87.19 E longitude and at an longitude and at an altitude of 98m above mean sea level. The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction(ph 7.0),low in organic carbon (0.40%),available N(161.48kg/ha),available 151.2kg/ha)and available K(232.5kg/ha). The experiment was laid down in Randomized Block Design and comprised of levels of Iron (0.5% , 1.0% and 1.5 %) and Gibberallic acid (50ppm , 100ppm ,150ppm). with ten treatments and each were replicated thrice viz.T₁ -0.5% FeSO₄+ 50 ppm GA₃ ,T₂-0.5% FeSO₄ + 100 ppm GA₃ ,T₃-0.5% FeSO₄ + 150 ppm GA₃ , T₄-1% FeSO₄ + 50 ppm GA₃ ,T₅-1% FeSO₄ + 100 ppm GA₃ , T₆-1% FeSO₄ + 150 ppm GA₃ ,T₇-1.5% FeSO₄+ 50 ppm GA₃ ,T₈-1.5% FeSO₄+ 100 ppm GA₃ ,T₉-1.5% FeSO₄ + 150 ppm GA₃ ,T₁₀-Control (RDF 20:40:20) . Green gram variety 'PDM-139' was used for the experiment . Sowing was carried out on 5 August . Row to Row distance 30 cm and plant to plant distance 10 cm were maintained in all plots and furrows were opened at 3 to 4 cm. The Foliar application of Iron was done at 15,30 DAS and foliar spray of Gibberallic acid was done at 20,40 DAS. The annual rainfall observed in cropping period was (98.68mm).The observation was recorded for Plant height (cm), Number of Nodules/Plant , Plant Dry weight (g/plant), Number of pods/plant , No. of Seeds/pod, Test weight , Grain yield (t/ha) , Stover Yield (t/ha) Harvest index (%).

Result and Discussion

Plant height (cm)

Plant height as affected by combination of Iron and Gibberallic acid. Statistical analysis revealed that application of Iron and Gibberallic acid significantly affected Plant Height. significantly higher plant height (73.33 cm) was recorded on application of 1.5% FeSO₄ + 150 ppm GA₃. The Foliar spray of Iron and GA₃ has a synergistic effect which leading higher availability of nutrients and thereby results higher crop growth rate. Similar result is observed by Meena *et al.*, 2013; Niyigaba *et al.*, 2019.

Number of Nodules/ Plant

The result has demonstrated that number of Nodules per Plant was influenced by application of Iron and Gibberallic acid, significantly. Among various treatments application of 1.5% FeSO₄ and 150 ppm GA₃ has indicated maximum no. nodules per plant (55.33). Iron activates the no. of certain enzymes that helps the plant to attain a more vigorous in formation of nodules. Thus, increase the no. of nodules per plant and the same result was reported by Sahu *et al.*, 2008.

Plant Dry weight (g/plant)

Data regarding Plant Dry Weight By Response of Iron and Gibberallic acid is Significantly increased. Statistical analysis of data revealed that Both Iron and Gibberallic acid had significantly affected the Plant dry weight. Treatments that had received 1.5% FeSO₄ and 150 ppm GA₃ produced maximum (15.67) plant dry weight, while minimum (6.87) plant dry weight was observed in the plots that received in the control. This increase in Plant Dry weight with application iron and GA₃ have resulted in more pronounced growth of plant which in turn had increased Plant dry weight. Increasing the ability of iron also help in absorption of nutrient which is expected to have a efficient photosynthetic mechanism better equipt for translocation of photosynthetic material in a plant and increase the weight of plant. Similar result was reported by Bera *et al.*, 2015.

Number of pods/plant

There was non-significant difference between the treatments and number of pods/plant . (24.60) was observed during the applications of (1% FeSO₄ + 100 ppm GA₃) in treatment 5, whereas the minimum number of pods/plant (23.40) was observed in control .

Number of Seeds/pod

There was non-significant difference between the treatments and number of seeds/pod. (12.00) was recorded in Treatment 9 with application of 1.5% FeSO₄ + 150 ppm GA₃ and the minimum seeds per pods was control i.e RDF (10.52).

Test weight

There was non- significant difference between the treatments and test weight (g) was recorded with the application of 1.5% FeSO₄ + 150 ppm GA₃ in treatment 9 and the value of the maximum test weight was (20.50), minimum test weight was control (19.25).

Grain Yield

Data regarding Grain Yield /hectare by Response of Iron and GA₃ are presented in table .Our result showed that on average ,the maximum grain Yield of (1.95 t/ha) was obtained with the application of 1.5% FeSO₄ along with 150 ppm GA₃ ,which is Significantly greater than the other treatments .

Stover Yield

The data on Stover yield presented in Table. The mean data revealed a significant increase due to various treatments. The data on Stover Yield was recorded highest (3.15 t/ha) with foliar sprayed of 1.5% FeSO₄ along with 150 ppm GA₃ which found significantly superior over rest of the treatments

Harvest Index

Data concerning Harvest Index by responding of Iron and GA₃ are presented in table . The data revealed that the application of Iron and its interaction with Gibberallic acid had significant effect . However highest harvest index 33.83% was recorded from the plots that had received 1.5% Iron and 150 ppm GA₃ . Iron also improves photosynthesis and assimilates transportation to sink finally increase the seed and stover yield .similar effect if spray of iron was absorbed in Cowpea in Sandy loamy Soil by (Anitha *et al.*, 2005)

Economic analysis

The gross return was recorded highest in treatment 9 as Rs 129112.50/ha followed by treatment 8 recorded as Rs.123583.30 .The lowest gross return was in treatment 10 as Rs.71991.67/ha. The net return was recorded highest in treatment 9 as Rs. 92803.50/ha followed by treatment 8 was recorded as Rs.88174.33/ha and was lowest in treatment 10 (control) as Rs.39366.67. Similar trend was observed for B:C ratio . This gave value as 2.56, 2.49 , 1.21 in treatment 9 ,8 and 10 respectively.

Conclusion

It is clear from the present study that combination of Iron and Gibberallic acid manipulates the growth of Green gram. Application of 1.5% FeSO₄ along with 150 ppm GA₃ recorded higher grain Yield and B:C ratio.

References

- Aninda Chakraborty and Sanjoy Kumar Bordolui. 2021. Impact of Seed Priming with AgNanoparticle and GA₃ on Germination and Vigour in Green gram. *Int.J.Curr.Microbiol.App.Sci.* **10**(03): 941-950.
- Anitha S, Sreenivan E, Purushothaman SM. 2005 Response of cowpea (*Vigna unguiculata* L. Walp) to foliar nutrition of zinc and iron in the oxisols of Kerala. *Legume Research*, **28**(4):294-296

- Asaduzzaman. 2008 Response of mung bean to nitrogen and irrigation management. *American Eurasian Journal of Agricultural and Environment Sciences.*;3:40, 43.
- Bera, A. K.; Maity, U. And Mazumdar, D. 2008. Effect of foliar application of brassinolide and salicylic acid on NPK content in leaf and nutritive values of seed in green gram (*Vigna radiata* L. Wilczek). *Legume Rese*,**31** (3):169-173.
- Bera, Manisankar, Ghosh, Goutam Kumar 2015. Efficacy of sulphur sources on greengram (*Vigna radiata* L.) in red and lateritic soil of west Bengal. *International Journal of Plant, Animal and Environmental Sciences.* **5**(2)
- Biswas, S., Bordolui, S.K. and Chattopadhyay, P. 2020. Influence of GA3 on hybrid rice seed production in West Bengal. *J. of Crop and Weed.* **16**(3): 136-142.
- Chakrabarti, N. and Mukherji, S. 2003. Effect of Phytohormone pretreatment on nitrogen metabolism in *Vigna radiata* under salt stress. *Biol. Planta.* **46**: 63- 66.
- Guerinot ML, Yi Y. Iron. 1994nutritions, noxious and not readily available. *Plant Physiology.***104**:815-820.
- Imran; Khan, A. A.; Inam, I. and Ahmad, F. 2016. Yield and yield attributes of mungbean (*Vigna radiata* L.) cultivars as affected by phosphorus levels under different tillage system. *Soil and crop Science Res.*, **2**: 1151.
- Meena KK, Meena RS. 2013 Effect of sulphur and iron on yield attribute, yield and net return of greengram. *Indian J. Ecol.*,**40**(1):165-166.
- Niyigaba E, Twizerimana A, Mugenzi I, Ngnadong WA, Ye YP, Wu BM, et al. 2019Winter wheat grain quality, zinc and iron concentration affected by a combined foliar spray of zinc and iron fertilizers. *Agronomy.*; **9**:250

- Ramamurthi K, Geetha Lakshmi R, 2012 Sowmay Sahadevan. Institute of management and technology Coimbatore, **23-25**.
- Raut, G.R. and S. Sahoo, 2015. Role of iron in plant growth and metabolism *Reviews in Agri. Sci.* **3**:1-24.
- Ray, J. and Bordolui S.K. (2020). Effect of GA₃ on Marigold Seed Production in Gangetic Alluvial Zone. *J. of Crop and Weed.* **16**(1): 120-126.
- Saraswati R, Krishnamurti R, Singgaram P. 2004 Nutrient management for rainfed greengram. *Madras Agric. Journal.*; **91**:230-233.
- Sawan ZM, Hafez SA, Basyony AE. 2001 Effect of phosphorus fertilization and foliar application of chelated zinc and calcium on seed, protein and oil properties of cotton. *Journal of Agriculture sciences.*; **136**:191-198.
- Sahu S, Lidder RS, Singh PK 2008. Effect of micronutrients and bio fertilizers on growth, yield and nutrients uptake by Chickpea (*Cicer arietinum* L.) in vertisol of Madhya Pradesh. *Adv. Pl. Sci.*; **21**(3):501-503.
- Statistical year book. ,2016. India Ministry of Statistics & Programme Implementation, Government of India
- Welch RM. 1995 Micronutrient nutrition of plants. *CRC Crit Rev Plant Sci.*; **14**:49-82.
- Yang JK, Yuan TY, Zang WT, Zhou JC, Li YG. Polyphasic characterization of mung bean (*Vigna radiata* L.) rhizobia from different geographical regions of China. *Soil. Biol. Biochem.* 2008; **40**(7):1681-1688.

Table 1. . Effect of different levels of Iron and GA₃ foliar spray on growth parameter of green gram..

S.No.	Treatments	Plant height in (cm)	Number of nodules/plant	Plant dry weight(g/m ²)
1.	0.5% FeSO ₄ + 50 ppm GA ₃	57.04	48.33	7.41
2.	0.5% FeSO ₄ + 100 ppm GA ₃	61.73	48.33	7.41
3.	0.5% FeSO ₄ + 150 ppm GA ₃	62.56	50.33	8.33
4.	1% FeSO ₄ + 50 ppm GA ₃	62.25	51.00	7.88
5.	1% FeSO ₄ + 100 ppm GA ₃	68.29	50.00	10.47
6.	1% FeSO ₄ + 150 ppm GA ₃	66.8	49.33	11.52
7.	1.5% FeSO ₄ + 50 ppm GA ₃	65.17	47.00	13.00
8.	1.5% FeSO ₄ 100 ppm GA ₃	57.8	48.67	13.00
9.	1.5% FeSO ₄ + 150 ppm GA ₃	73.33	55.33	15.67
10.	Control (RDF)	55.17	43.67	6.87
	F-Fest	S	S	S
	SEm (±)	3.53	1.72	1.73
	C D at 0.5%	10.50	5.10	5.14

Table 2. Effect of different levels of Iron and GA₃ foliar spray on yield attributes and yield of Green Gram

S. No.	Treatments	No. of pod/ plant	No of Seeds/Pod	Test weight (g)	Grain yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
1	0.5% FeSO ₄ + 50 ppm GA ₃	23.68	10.60	19.30	1.31	2.15	29.52
2	0.5% FeSO ₄ + 100 ppm GA ₃	23.78	10.75	19.35	1.29	2.20	32.22
3	0.5% FeSO ₄ + 150 ppm GA ₃	23.85	10.84	19.56	1.47	2.35	30.50
4	1% FeSO ₄ + 50 ppm GA ₃	23.95	10.96	19.67	1.58	2.56	31.97
5	1% FeSO ₄ + 100 ppm GA ₃	24.6	11.00	19.80	1.62	2.65	31.13
6	1% FeSO ₄ + 150 ppm GA ₃	24.12	11.21	19.95	1.70	2.78	33.69
7	1.5% FeSO ₄ + 50 ppm GA ₃	24.21	11.11	20.20	1.72	2.89	33.71
8	1.5% FeSO ₄ 100 ppm GA ₃	24.3	11.56	20.35	1.87	3.00	32.97
9	1.5% FeSO ₄ + 150 ppm GA ₃	24.5	12.00	20.50	1.95	3.15	33.83
10	Control (RDF)	23.4	10.52	19.25	1.08	2.10	23.83
	F-Fest	NS	NS	NS	S	S	NS
	SEm (±)	0.89	0.94	1.79	1.16	1.65	1.89
	C D at 0.5%	-	-	-	0.25	0.50	-

Table 3. Effect of different levels of Iron and GA₃ foliar spray on Economics

S. No.	Treatments	Gross return (INR/ha)	Net return (INR/ha)	Benefit cost ratio (B:C)
1.	0.5% FeSO ₄ + 50 ppm GA ₃	86589.17	52736.17	1.56
2.	0.5% FeSO ₄ + 100 ppm GA ₃	85500.00	51347.00	1.50
3.	0.5% FeSO ₄ + 150 ppm GA ₃	97095.83	62042.83	1.77
4.	1% FeSO ₄ + 50 ppm GA ₃	104403.30	69922.33	2.03
5.	1% FeSO ₄ + 100 ppm GA ₃	107093.30	72312.33	2.08
6.	1% FeSO ₄ + 150 ppm GA ₃	112585.00	76904.00	2.16
7.	1.5% FeSO ₄ + 50 ppm GA ₃	107250.80	72141.83	2.05
8.	1.5% FeSO ₄ 100 ppm GA ₃	123583.30	88174.33	2.49
9.	1.5% FeSO ₄ + 150 ppm GA ₃	129112.50	92803.50	2.56
10.	Control (RDF)	71991.67	39366.67	1.21