# Response of Foliar spray of Iron and Gibberellic 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 Gibberellic acid on the Growth and Yield of Green gram. The Treatment consisted of 0.5%, 1.0% and 1.5 % of Iron and 50ppm, 100ppm, and 150ppm of $GA_3$. The experiment was laid out in a randomized Block design with ten treatments and replicated thrice. Results revealed that 1.5% $FeSO_4$ along with 150 ppm $GA_3$ recorded significantly higher plant height (73.33cm), No. of Nodules /plant (55.33), dry weight (15.67 g/plant), Crop growth rate(14.00g/$m^2$/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 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 is 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, green gram, 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 an 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) 340 mg per 100 g of seed, respectively (Imran et al., 2016). The residue of green gram is also used as feed for animals and enhances soil fertility” (Asaduzzaman. 2008). “In the 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 the world accounting for 25% of globule production and 50% of consumption" (Saraswati et al. 2004). "Iron (Fe) is one of the essential micronutrients 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 several 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 the electron transport chain, maintaining the structure of chloroplast and also in enzyme activity. It plays a 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 Yearbook 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, the total iron content of soils is much higher than the requirement of plants 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 the mobilization of food reserves and interact with inhibitors such as abscisic acid. Gibberellic acid ($GA_3$) has been used to increase the length or height of plants, increase the number of flowers and induce early flowering. To attain such a 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 ($GA_3$) is known to be concerned with the regulation of plant responses to the external environment" (Chakrabarti and Mukherji, 2003). "$GA_3$ was found to influence spikelet fertility and seed yield significantly" (Biswas et al., 2020b). "The influence of $GA_3$ has been found to enhance the seed yield of plants and all the seed yield attribute characters" (Ray and Bordolui, 2020). "Among the growth regulators $GA_3$ 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 ($GA_3$) is a naturally occurring growth hormone that regulates the growth and

development of plants. Gibberellic acid is 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 Gibberellic 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.$T_1$ -0.5% $FeSO_4$+ 50 ppm $GA_3$ ,$T_2$-0.5% $FeSO_4$ + 100 ppm $GA_3$ ,$T_3$-0.5% $FeSO_4$ + 150 ppm $GA_3$ , $T_4$-1% $FeSO_4$ + 50 ppm $GA_3$ ,$T_5$-1% $FeSO_4$ + 100 ppm $GA_3$ , $T_6$-1% $FeSO_4$ + 150 ppm $GA_3$ ,$T_7$-1.5% $FeSO_4$ + 50 ppm $GA_3$ ,$T_8$-1.5% $FeSO_4$+ 100 ppm $GA_3$ ,$T_9$-1.5% $FeSO_4$ + 150 ppm $GA_3$ ,$T_{10}$-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 Gibberellic 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 Gibberellic acid. Statistical analysis revealed that application of Iron and Gibberellic acid significantly affected Plant Height. significantly higher plant height (73.33 cm) was recorded on application of 1.5% $FeSO_4$ + 150 ppm $GA_3$ . The Foliar spray of Iron and $GA_3$ 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 Gibberellic acid ,significantly. Among various treatments application of 1.5% $FeSO_4$ and 150 ppm $GA_3$ 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 Gibberellic acid is Significantly increased. Statistical analysis of data revealed that Both Iron and Gibberellic acid had significantly affected the Plant dry weight .Treatments that had received 1.5% $FeSO_4$ and 150 ppm $GA_3$ 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 $GA_3$ 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% $FeSO_4$ + 100 ppm $GA_3$) 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% $FeSO_4$ + 150 ppm $GA_3$ and the minimum seeds per pods was control i.e RDF (10.52).

**Test weight (g)**

There was non- significant difference between the treatments and test weight (g) was recorded with the application of 1.5% FeSO4 + 150 ppm $GA_3$ in treatment 9 and the value of the maximum test weight was (20.50), minimum test weight was control (19.25).

**Grain Yield (t/ha)**

Data regarding Grain Yield /hectare by Response of Iron and $GA_3$ 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% $FeSO_4$ along with 150 ppm $GA_3$ ,which is Significantly greater than the other treatments .

**Stover Yield (t/ha)**

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% $FeSO_4$ along with 150 ppm $GA_3$ which found significantly superior over rest of the treatments

**Harvest Index(%)**

Data concerning Harvest Index by responding of Iron and $GA_3$ are presented in table . The data revealed that the application of Iron and its interaction with Gibberellic acid had significant

effect . However highest harvest index 33.83% was recorded from the plots that had received 1.5% Iron and 150 ppm $GA_3$ . 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 Gibberellic acid manipulates the growth of Green gram. Application of 1.5% $FeSO_4$ along with 150 ppm $GA_3$ recorded higher grain Yield and B:C ratio.

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**Table 1. . Effect of different levels of Iron and $GA_3$ 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 $GA_3$ 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 $GA_3$ 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 |