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EFFECT OF FOLIAR SPRAY OF MICRONUTRIENTS ON GROWTH AND YIELD OF GREENGRAM (*VIGNA RADIATA* L. WILCZEK)

Satyarth Gupta, Bineeta M. Bara and G.M. Lal

Department of Genetics and Plant Breeding, Naini Agricultural Institute,
Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.), India.

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ABSTRACT

Present investigation was carried out at the Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, Uttar Pradesh during the *Kharif* season 2022-2023 with a to evaluate the effect of micro-nutrients treatments combination on seed yield & its attributing characters of green gram. The experimental material for present investigation comprised of 10 treatments of micronutrients combination applied in green gram variety IPM-205-7. The experimentation was laid out in Randomised Block Design (RBD) with three replications. The treatment comprised of T₀ (RDF + Water spray (Control)); T₁ (RDF + Fe @ 0.5%); T₂ (RDF + Zn @ 0.5%); T₃ (RDF + Mn @ 0.5%); T₄ (RDF + B @ 0.5%); T₅ (RDF + Mo @ 0.5%); T₆ (RDF + Fe @ 0.5% + Zn @ 0.5%); T₇ (RDF + Fe @ 0.5% + Zn @ 0.5% + Mn @ 0.5%); T₈ (RDF + Co @ 0.5%) and T₉ (RDF + Mixture of all micronutrients @ 0.5%). Spraying of micronutrients was done at 30 days after sowing. From the present investigation it is concluded that among 10 treatment combination of foliar spray of nutrients applied in green gram on the basis of mean performance T₉ (RDF+ Mixture of all micronutrients @ 0.5%) performed best in terms of yield parameters like number of pods per plant, number of seeds per pod, seed yield per plant, seed index. It was second highest in harvest index and second most early in flowering and maturing. Therefore, combination used in T₉ *i.e.*, RDF + Mixture of all micronutrients @ 0.5% can be promoted to use to get better yield and overcome low productivity in green gram.

Key words : *Vigna radiata*, Micronutrients, Foliar spray.

Introduction

Grown throughout India, mungbean, also called greengram, is a short-duration pulse crop. It is cultivated as the third most significant pulse crop, behind pigeon pea and chickpea. 12–13% of the entire pulse acreage is made up of it. Green gram is referred to as *Vigna radiata* (L.) Wilczek in botany is a member of the Papilionaceae sub-family of the Leguminosae family. With chromosome number $2n=2x=22$, it is a diploid self-pollinating species (Karpechenko, 1925). According to Vavilov (1935), the Indo-Burma region of central Hindustan is most likely where mungbean originated. It is mostly grown in south-east Asia, including China, India, Burma and other regions. The wild ancestor of mungbean is *Vigna radiata sublobata*. Greengram is grown on 40.38 lakh hectares in India, where 3.15 million tonnes were produced in

2021–2022 (Source: DES, Ministry of Agriculture & Farmers Welfare, Government of India, 2022-23). Rajasthan is ahead of Maharashtra and Karnataka in terms of Greengram production and area in 2021–2022. Greengram is cultivated on 0.58 lakh hectares of land in Uttar Pradesh, with a 0.36 million tonnes production predicted for 2021–2022. Green Gram is considered a high-quality pulse due to its exceptional digestibility and high protein content (25–28%). It is consumed as “dal,” “halwa,” sprouts, boiled dry beans and roasted forms. It has a lot of riboflavin and vitamin C. Applying fertiliser is a key strategy for raising agricultural practices’ productivity. Foliar nutrition is one of the most significant cultural practices for applying fertiliser since it allows micronutrients and fertilisers to be sprayed onto leaves, facilitating quick and easy nutrient uptake through

stomata-mediated penetration and osmotic diffusion. Gaining more yield productivity is prioritised in order to meet the nation's expanding protein needs. It is a warm season crop that provides a good source of seed protein with minimal input requirements. High yielding varieties are therefore needed. The application of fertilisers in a balanced amount using the right techniques and management techniques, such as irrigation and plant production, can increase crop productivity.

Foliar feeding is the most effective and economic way to improve plant nutrient efficiency (Dixit and Elamathi, 2007). Application of nutrient through foliar spray at appropriate stages of crop growth becomes important for their utilization and better performance of the crop (Anandhkrishnaveni *et al.*, 2004). Foliar application is credited with the advantage of quick and efficient utilization of nutrients elimination of losses through leaching and fixation and regulating the uptake of nutrients by plants (Manonami and Srimathi, 2009). Iron (Fe) is one of the essential micronutrients that enhance plant growth and reproduction (Welch, 1995). 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 photosynthetic reactions. Iron also plays an important role in legumes including green gram for nodule formation and nitrogen fixation. It is not only essential element that is required by both, the host legume, and the rhizobium. Bera and Ghosh (2015) reported that foliar sprays of Fe significantly reduced iron-deficiency chlorosis and increased seed yield in soybean. Therefore, balanced fertilization of macro and micronutrients particularly in combination is very important for proper growth, development and high yield production of crop plants including green gram. Several ways are being initiated to boost the productivity of greengram. One among them is foliar application of organic and inorganic sources of nutrients for exploiting the genetic potential of the crop. The soil applied nutrients bear many changes and losses that occur through leaching and volatilization. Therefore, foliar application of nutrients is imperative in order to avoid or minimise the severity of such conditions and found to be inexpensive way to meet nutrient needs of greengram especially at critical stages. The extent of flower drop determines the yield attributing characteristics and yield of greengram. Retention of flowers by the plant gives a higher yield than expected. Hence, present investigation was carried out with objective to evaluate the effect of micro-nutrients treatments combination on seed yield and its attributing characters of green gram.

Materials and Methods

The investigation was done at Central Research Farm (CRF), Department of Genetics and Plant Breeding, Naini Agricultural Institute, SHUATS, Prayagraj, during the *Kharif* season of 2023. The experimental material for present investigation comprised of 10 treatments of micronutrients combination applied in green gram variety IPM-205-7. The experimentation was laid out in Randomised Block Design (RBD) with three replications. The treatment comprised of T₀ (RDF + Water spray (Control)); T₁ (RDF + Fe @ 0.5%); T₂ (RDF + Zn @ 0.5%); T₃ (RDF + Mn @ 0.5%); T₄ (RDF + B @ 0.5%); T₅ (RDF + Mo @ 0.5%); T₆ (RDF + Fe @ 0.5% + Zn @ 0.5%); T₇ (RDF + Fe @ 0.5% + Zn @ 0.5% + Mn @ 0.5%); T₈ (RDF + Co @ 0.5%) and T₉ (RDF + Mixture of all micronutrients @ 0.5%). Spraying of micronutrients was done at 30 days after sowing. In each replication and in each plot randomly five plants were selected and tagged excluding border plants to minimize the border effects. The data were recorded from randomly selected five plants for each treatment for each replication except for days to field emergence, days to 50% flowering, pod setting and days to maturity data were recorded on randomly per plot. The fifteen characters studied were days to field emergence, days to 50% flowering, days to 50% pod setting, days to maturity, plant height (cm), number of primary branches, number of secondary branches, number of pods per plant, length of pod (cm), number of seeds per pod, 1000-seed weight (g), biological yield (g), harvest index(%), seed yield per plant (g/plant) and seed yield per hectare (kg/ha). All the weights were recorded in grams, with the help of physical balance. Following observations were recorded from five randomly selected plants of each treatment for all replication for the statistical analysis. Plant height was measured from ground level to the top of the plant of five randomly selected plants at the time of maturity. Weight of one thousand random seeds from total seed yield of tagged plants were recorded in grams after threshing and sun drying, and mean was worked out. Harvest index was computed by using following formula as suggested by Singh and Stoskoff (1971). The harvest index was worked out by using following formula:

$$\text{Harvest index (\%)} = \frac{\text{Seed yield per plant (g)}}{\text{Biological yield per plant (g)}} \times 100$$

The data collected were subjected to analysis using method suggested by Fisher and Yates (1963).

Results and Discussion

Pre-harvest parameters

T₉ (RDF+ Mixture of all micronutrients @ 0.5%) took minimum days to field emergence (3.78 days) followed by T₇ (RDF + Fe @ 0.5% + Zn @ 0.5% + Mn @ 0.5%) having 4.05 days, whereas the maximum days for field emergence was observed in treatment T₀ (Control) with 7.74 days. T₉ (RDF+ Mixture of all micronutrients @ 0.5%) recorded maximum height of plant (82.07 cm) followed by T₂ (RDF + Zn @ 0.5%) having 75.60 cm whereas the minimum plant height was observed in treatment T₀ (Control) with 57.27 days. Highest number of primary and secondary branches per plant was observed in T₉ (RDF + Mixture of all micronutrients @ 0.5%) having (10.26, 5.69 branches) followed by T₇ (RDF + Fe @ 0.5% + Zn @ 0.5% + Mn @ 0.5%) having 9.20, 5.63 branches, respectively whereas the minimum primary and secondary branches was observed in treatment T₀ (Control) with 5.89, 2.89 branches. Minimum days to 50% flowering was observed in T₂ (RDF + Zn @ 0.5%) with 31.81 days followed by T₉ (RDF + Mixture of all micronutrients @ 0.5%) having 33.82 days, whereas the maximum days to 50% flowering was observed in treatment T₀ (Control) with 40.26 days.

Minimum days to 50% pod setting was observed in T₂ (RDF + Zn @ 0.5%) with 37.73 days followed by T₉ (RDF + Mixture of all micronutrients @ 0.5%) having 42.81 days, whereas the maximum days to 50% pod setting was observed in treatment T₀ (Control) with 51.69 days. Minimum days to physiological maturity was observed in T₂ (RDF + Zn @ 0.5%) with 64.69 days followed by T₉ (RDF+ Mixture of all micronutrients @ 0.5%) having 65.55 days whereas the maximum days to physiological maturity was observed in treatment T₀ (Control) with 76.95 days.

The superior performance of green gram treated with a micronutrient combination of recommended dose of fertilizer (RDF) along with a mixture of all micronutrients at 0.5% concentration can be attributed to synergistic effects and balanced nutrition. This combination ensures that the plant receives essential macronutrients from RDF for overall growth while micronutrients support specific physiological functions crucial for plant development. The balanced supply of micronutrients aids in optimal photosynthesis, nutrient uptake, and enzyme activation, leading to enhanced plant height, increased number of primary and branches per plant, earlier flowering, improved pod setting and maturity, and faster emergence. Unlike individual micronutrient applications which may

Table 1 : Effect of different foliar spray of micronutrient on green gram for various pre-harvest parameters.

Notation	Treatment details	Days to field emergence	Plant height (cm)	No of primary branches	No of secondary branches	Days to 50% flowering
T ₀	RDF + Water spray (Control)	7.74	57.27	5.89	2.80	40.26
T ₁	RDF + Fe @ 0.5%	4.41	64.09	8.25	4.58	37.82
T ₂	RDF + Zn @ 0.5%	4.65	75.60	8.22	5.03	31.81
T ₃	RDF + Mn @ 0.5%	5.18	64.64	8.38	5.42	35.15
T ₄	RDF + B @ 0.5%	4.84	67.91	8.11	5.35	38.49
T ₅	RDF + Mo @ 0.5%	6.91	61.36	6.38	5.19	38.82
T ₆	RDF + Fe @ 0.5% + Zn @ 0.5%	7.00	72.30	7.84	5.14	37.48
T ₇	RDF + Fe @ 0.5% + Zn @ 0.5% + Mn @ 0.5%	4.05	74.51	9.20	5.63	35.00
T ₈	RDF + Co @ 0.5%	5.83	68.17	8.51	4.25	37.82
T ₉	RDF+ Mixture of all micronutrients @ 0.5%	3.78	82.07	10.26	5.69	33.82
'F' test		S	S	S	S	S
SEm (±)		0.14	1.08	0.41	0.21	1.69
CD_{5%}		0.40	3.16	1.21	0.63	4.95
CV. (%)		4.74	2.98	9.67	8.29	8.73

Table 2 : Effect of different foliar spray of micronutrient on green gram for various pre-harvest and post-harvest parameters.

Notation	Treatment details	Days to 50% pod setting	Days to maturity	No of pods per plant	No of seeds per pod	Length of pod (cm)
T ₀	RDF + Water spray (Control)	51.69	76.95	11.00	6.83	5.19
T ₁	RDF + Fe @ 0.5%	46.81	71.35	12.13	7.74	7.05
T ₂	RDF + Zn @ 0.5%	37.73	64.69	13.19	8.11	7.22
T ₃	RDF + Mn @ 0.5%	45.48	71.02	13.26	8.84	7.28
T ₄	RDF + B @ 0.5%	47.48	71.02	11.99	8.48	6.04
T ₅	RDF + Mo @ 0.5%	47.48	72.35	10.79	7.14	6.63
T ₆	RDF + Fe @ 0.5% + Zn @ 0.5%	46.14	69.35	12.99	8.08	6.38
T ₇	RDF + Fe @ 0.5% + Zn @ 0.5% + Mn @ 0.5%	46.14	65.69	14.90	9.38	7.93
T ₈	RDF + Co @ 0.5%	47.48	72.02	12.53	8.24	7.27
T ₉	RDF+ Mixture of all micronutrients @ 0.5%	42.81	65.55	15.19	9.67	8.87
'F' test		S	S	S	S	S
SEm (±)		0.72	0.87	0.38	0.30	0.26
CD_{5%}		2.13	2.56	1.10	0.88	0.77
CV. (%)		3.00	2.37	5.57	6.90	7.09

result in imbalances or deficiencies, the combination approach provides a comprehensive nutrient profile, promoting robust growth and development throughout the plant's lifecycle, ultimately translating to superior performance in terms of yield and quality. The findings were in accordance with earlier findings of Gahlot *et al.* (2020), Yeshwanth and Thind (2022), Arutkumaran *et al.* (2023).

Post-harvest parameters

Highest number of pods per plant was observed in T₉ (RDF+ Mixture of all micronutrients @ 0.5%) having (15.19 pods) followed by T₇ (RDF + Fe @ 0.5% + Zn @ 0.5% + Mn @ 0.5%) having 14.90 pods whereas the lowest number of pods per plant was observed in treatment T₅ (RDF + Mo @ 0.5%) with 10.79 pods. Highest number of seeds per pod was observed in T₉ (RDF + Mixture of all micronutrients @ 0.5%) having (9.67 seeds) followed by T₇ (RDF + Fe @ 0.5% + Zn @ 0.5% + Mn @ 0.5%) having 9.38 seeds whereas the lowest number of seeds per pod was observed in treatment T₀ (Control) with 6.83 seeds. Length of pod was recorded maximum in T₉ (RDF + Mixture of all micronutrients @ 0.5%) having (8.87 cm) followed by T₇ (RDF + Fe @ 0.5% + Zn @ 0.5% + Mn @ 0.5%) having 7.93 cm pod length whereas the lowest length of

pod was observed in treatment T₀ (Control) with 5.19 cm. Maximum biological yield was recorded in T₉ (RDF+ Mixture of all micronutrients @ 0.5%) having (32.61 grams) followed by T₇ (RDF + Fe @ 0.5% + Zn @ 0.5% + Mn @ 0.5%) having 31.16 grams whereas the minimum biological yield was observed in treatment T₀ (Control) with 20.61 grams. Maximum 1000-seed weight was recorded in T₉ (RDF + Mixture of all micronutrients @ 0.5%) having (45.89 grams) followed by T₈ (RDF + Fe @ 0.5% + Zn @ 0.5% + Mn @ 0.5%) having 43.23 grams whereas the minimum 1000-seed weight was observed in treatment T₀ (Control) with 26.86 grams. Highest harvest index percentage was recorded in T₇ (RDF + Co @ 0.5%) having (40.82%) followed by T₉ (RDF+ Mixture of all micronutrients @ 0.5%) having 40.52%, whereas the minimum biological yield was observed in treatment T₀ (Control) with 20.67%. Maximum seed yield per plant was recorded in T₉ (RDF+ Mixture of all micronutrients @ 0.5%) having (10.30 g/plant) followed by T₇ (RDF + Fe @ 0.5% + Zn @ 0.5% + Mn @ 0.5%) having 9.98 g/plant whereas the minimum seed yield per plant was observed in treatment T₀ (Control) with 7.26 g/plant. Maximum seed yield per hectare was recorded in T₉ (RDF+ Mixture of all micronutrients @ 0.5%) having (739.59 kg/ha) followed by T₇ (RDF + Fe @ 0.5% + Zn @ 0.5% + Mn @ 0.5%)

Table 3 : Effect of different foliar spray of micronutrient on green gram for various post-harvest parameters.

Notation	Treatment details	Biological yield (g)	1000-seed weight (g)	Harvest index (%)	Seed yield per plant (g/plant)	Seed yield per hectare (Kg/ha)
T ₀	RDF + Water spray (Control)	20.61	26.86	20.67	7.26	513.31
T ₁	RDF + Fe @ 0.5%	29.68	36.63	28.20	8.11	594.67
T ₂	RDF + Zn @ 0.5%	21.07	40.89	36.34	8.58	546.43
T ₃	RDF + Mn @ 0.5%	27.94	39.23	31.91	9.33	665.16
T ₄	RDF + B @ 0.5%	25.01	28.23	30.68	9.50	643.56
T ₅	RDF + Mo @ 0.5%	23.34	35.39	22.55	8.31	586.22
T ₆	RDF + Fe @ 0.5% + Zn @ 0.5%	27.41	36.23	22.45	8.71	686.84
T ₇	RDF + Fe @ 0.5% + Zn @ 0.5% + Mn @ 0.5%	31.16	41.79	40.89	9.98	705.41
T ₈	RDF + Co @ 0.5%	26.87	43.23	38.29	9.64	663.80
T ₉	RDF+ Mixture of all micronutrients @ 0.5%	32.61	45.89	40.52	10.30	739.59
'F' test		S	S	S	S	S
SEm (±)		0.56	2.15	0.74	0.34	0.91
CD_{5%}		1.64	6.30	2.18	1.00	2.68
CV. (%)		4.01	10.87	4.53	7.22	0.27

having 705.41 kg/ha whereas the minimum seed yield per hectare was observed in treatment T₀ (Control) with 513.31 kg/ha.

The enhanced performance of green gram treated with a micronutrient combination of recommended dose of fertilizer (RDF) along with a mixture of all micronutrients at 0.5% concentration can be attributed to the holistic approach towards plant nutrition. This combination ensures that the plant receives a balanced array of essential nutrients required for optimal growth and development. Unlike treatments with individual micronutrients, which may lead to imbalances or deficiencies, the combined application provides a comprehensive solution, addressing the diverse nutritional needs of the plant throughout its lifecycle. The synergistic effects of the micronutrient combination promote increased number of pods per plant, longer pod length, higher number of seeds per pod, greater 1000-seed weight and improved biological yield. Additionally, the balanced nutrient uptake facilitated by the combination contributes to a higher harvest index, indicating better partitioning of assimilates towards seed production. Consequently, green gram treated with the RDF + Mixture of micronutrients exhibits superior seed yield per plant and per hectare compared to those treated with individual micronutrients,

as it ensures optimal plant growth, development, and reproductive success, resulting in enhanced overall productivity and quality. Similar conclusions were also accorded by Kavaya *et al.* (2021), Boradkar *et al.* (2023).

Conclusion

From the present investigation, it is concluded that among 10 treatment combination of foliar spray of nutrients applied in green gram on the basis of mean performance T₉ (RDF + Mixture of all micronutrients @ 0.5%) performed best in terms of yield parameters like number of pods per plant, number of seeds per pod, seed yield per plant, seed index. It was second highest in harvest index and second most early in flowering and maturing. Therefore, combination used in T₉, *i.e.*, RDF + Mixture of all micronutrients @ 0.5% can be promoted to use to get better yield and overcome low productivity in green gram.

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