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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(9): 1899-1901

www.thepharmajournal.com
Received: 05-06-2022
Accepted: 20-07-2022

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Response of micronutrients on growth parameters of irrigated blackgram (*Vigna mungo* L.)

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Abstract
A field experiment was carried out in a farmer's field of Vadakadu Village, Alangudi Taluk, Pudukkottai District, Tamil Nadu during June – August of 2021 with VBN 10 blackgram cultivar to study the effect of micronutrients on growth parameters of irrigated blackgram (*Vigna mungo* L.). The experiment was laid out in a Randomized Block Design with three replications. The experiment consists of nine treatments *viz.*, T_1 - Recommended dose of fertilizer, T_2 - RDF + Basal application of zinc chelate @ 500 g ha^{-1}, T_3 - RDF+ Foliar application of zinc chelate @ 0.5% on 30 and 45 DAS, T_4 - RDF + Basal application of Zinc sulphate @ 10 kg ha^{-1}, T_5 - RDF + Foliar application of Zinc sulphate @ 0.2% on 30 and 45 DAS, T_6 - RDF + Basal application of Borax @ 5 kg ha^{-1}, T_7 - RDF + Basal application of Borax @ 10 kg ha^{-1}, T_8 -RDF + Basal application of Borax @ 5 kg ha^{-1} + Foliar application of Zinc chelate @ 0.2% on 30 and 45 DAS and T_9 - RDF + Basal application of Borax @ 10 kg ha^{-1} + Foliar application of Zinc chelate @ 0.5% on 30 and 45 DAS. Among the different soil and foliar application of micronutrients, basal application of borax @ 10 kg ha^{-1} with foliar application of Zinc chelate @ 0.5% on 30 and 45 DAS along with RDF performed higher number of growth attributes such as plant height (49.73 cm), leaf area index (5.12), number of branches plant^{-1} (7.08) and dry matter production (3899 kg ha^{-1}) than control.

Keywords: Blackgram, soil application, zinc chelate, borax, foliar nutrition

Introduction

Pulses are the second most important food crops after cereals. In the world, pulses occupied an area of 85.40 million ha with more area in India, Niger and Myanmar. In India, it is grown over an area of 29.03 million hectare with an average production of 25.72 million tonnes with a productivity of 806 kg ha^{-1} (Indiastat, 2021). The United Nations designated 2016 as a "International year of pulses" to raise public awareness of the nutritional advantage of pulses as part of long term food and nutrient security (Mohanty and Satyasai, 2015) [7]. One of India's most significant pulse crop is Blackgram (*Vigna mungo* L. Hepper) belongs to family Fabaceae. It is well known for its nutritional value, which includes 24% protein, 59.6% carbohydrate, 154 mg calcium, 385 mg phosphorus, 7.57 mg iron, 0.254 mg riboflavin, 0.273 mg thiamin per 100 g of black gram. In India, it is grown over an area of 4.6 million ha area with production and productivity of 24.5 lakh tones and 533 kg ha^{-1} respectively (indiastat, 2020). In Tamil Nadu, black gram is grown in area of 3.70 lakh ha with production of 2.7 lakh tonnes and productivity of 622 kg ha^{-1}. Blackgram area accounts for about 19 per cent of India's total pulse acreage which contribute 23 percent of total pulse production. The productivity of pulse crops including blackgram is not sufficient enough to meet the domestic demand of the population. Because blackgram is mostly cultivated as fallow crop, rainfed crop, bund and border crop with minimum moisture without any nutrition. The yield of blackgram is low due to various reasons includes poor management practices and continues supply of macronutrients that induced the deficiencies of micronutrients. Hence, there is need to enhance blackgram yield by proper balanced nutrition. Balanced fertilization is inevitable to boost the crop productivity. Among the micronutrients zinc and boron improved the yield appreciably the foliar spray and soil application proved to be economical in pulse (Savithri, 2001) [8]. Among the different micronutrients, zinc plays a vital role in plant growth and development. Foliar application of zinc enhance the growth character, yield attributes and yield. Zinc sulphate heptahydrate ($ZnSO_4.7H_2O$) is the most effective, widely accessible, and affordable zinc source for treating zinc deficiency in the majority of crops and diversified soil. (Singh *et al.*, 2011) [9].

Other inorganic sources of zinc include chelated zinc, which is particularly efficient due to the ease with which roots can absorb it and also which it can travel through soil like other amino acids and reach the proximity of roots due to its negatively charged ion. Tariq and Mott (2007) [11] reported that boron nutrition lead to better pollination, pod setting which finally contributed to higher grain yield.

Material and Methods

The field experiment was conducted in farmer's field during late June - August 2021 in the Vadakadu Village, Alangudi Taluk of Pudukkottai District. The experimental farm is situated at 10° 34' N latitude and 79° 06' E longitude and at an Altitude of +79 m above MSL. The experimental site is situated in hot and humid region. The experimental site's soil texture was sandy loam, with a pH of 6.88 and an electric conductivity of 0.10 d Sm^{-1}. Nitrogen, phosphorus, and potassium availability were 137.8, 9.7 and 182.34 kg ha^{-1} respectively, at the experimental site. The mean annual rainfall of 208 mm received in 22 rainy days during the crop season, with average maximum temperatures ranged from 29.90 °C to 37.60 °C and minimum temperatures are ranged from 23.30 °C to 26.70 °C. The experiment was laid out in a Randomized Block Design with three replications. The experiment consists of nine treatments *viz.*, T_1 - Recommended dose of fertilizer, T_2 - RDF + Basal application of zinc chelate @ 500 g ha^{-1}, T_3 - RDF+ Foliar application of zinc chelate @ 0.5% on 30 and 45 DAS, T_4 - RDF + Basal application of Zinc sulphate @ 10 kg ha^{-1}, T_5 - RDF + Foliar application of Zinc sulphate @ 0.2% on 30 and 45 DAS, T_6 - RDF + Basal application of Borax @ 5 kg ha^{-1}, T_7 - RDF + Basal application of Borax @ 10 kg ha^{-1}, T_8 -RDF + Basal application of Borax @ 5 kg ha^{-1} + Foliar application of Zinc chelate @ 0.2% on 30 and 45 DAS and T_9 - RDF + Basal application of Borax @ 10 kg ha^{-1} + Foliar application of Zinc chelate @ 0.5% on 30 and 45 DAS. For this experiment, the blackgram variety VBN 10 was chosen and sowed at a spacing of 30 x 10 cm. The seeds were treated with rhizobium (600 g ha^{-1}) for 4-5 hours before sowing and the recommended dose of fertilizer 25:50:25 kg of N, P_2O_5 and K_2O ha^{-1} was applied in the basal dose before sowing of crop in the form of urea, single super phosphate and muriate of potash respectively. The various biometric observation, analytical data of soil and plant samples and the computed data were subjected to statistical scrutiny as per the procedure given by Gomez and Gomez (1984) [5]. The treatment difference was found to be significant using the F test, the crucial difference was calculated at a 5% probability level.

Result and discussion

Effect of growth parameters

Among the various treatments tested, the application of recommended dose of fertilizer along with basal application of Borax @ 10 kg ha^{-1} + foliar application of Zinc chelate @ 0.5% (T_9) recorded higher plant height at harvest of 49.73 cm (Table 1). This was followed by T_8 -RDF + basal application of Borax @ 5 kg ha^{-1} + foliar application of Zinc chelate @ 0.2% with (46.81 cm) at harvesting stage. The lower plant height of 31.11 cm at harvesting stage were recorded under the treatment T_1- RDF (control). It might be due to the application of zinc by EDTA would have double benefited by the greater utilisation efficiency of the added zinc through their ability to sequester. Involvement of micronutrients in several physiological processes, such as enzyme activation, electron transport, chlorophyll synthesis, stomatal regulation, etc., may be the cause of the increase in plant height. With the increase in levels of zinc and change in methods of application of boron from soil application to foliar application, the plant height gradually increased, which might be attributable to greater photosynthetic activity and chlorophyll synthesis due to zinc and boron fertilization resulting into better vegetative growth. Similar findings were reported by Banoth Murali Krishna *et al*. (2022) [3] and Dinesh Kumar Yadav *et al*. (2020) [4]. Data regarding number of branches per plant was recorded at all growth intervals and at harvest (Table 1) treatment T_9 with 7.08 (Table 1) recorded significantly higher with application of RDF + basal application of Borax @ 10 kg ha^{-1} + foliar application of Zinc chelate @ 0.5% which was found to be followed by T_8 (6.71), while the lowest was observed in the control (T_1). This was due to the positive effect of zinc application on improved branching in pulses, which is mostly linked to auxins' encouragement of bud and branch growth. Zn application also accelerated the transfer of photo assimilates and boosted the availability of other nutrients. The movement of photosynthates from source to sink and plant metabolism are both significantly influenced by boron. Similar findings were reported earlier by Movalia Janaki *et al*. (2018) [6] and Abdul Quddus *et al.* (2020) [2] determined the reason for increase in branches. Data regarding leaf area index with 5.12 at 45 DAS was recorded higher with the treatment T_9- RDF + basal application of Borax @ 10 kg ha^{-1} + foliar application of Zinc chelate @ 0.5%. It is then followed by T_8- RDF + basal application of Borax @ 5 kg ha^{-1} + foliar application of Zinc chelate @ 0.2% with 4.77 at 45 DAS. The lower LAI of 2.87 at 45 DAS were recorded under the treatment T_1- RDF (control). The data on dry matter production 3899 kg ha^{-1} at harvest stage was recorded higher with the treatment T_9- RDF + basal application of Borax @ 10 kg ha^{-1} + foliar application of Zinc chelate @ 0.5%, the application of zinc and boron in terms of leaf area index and dry matter can be interpreted the metabolic function of micronutrients in the plants. The conducive physical environment along with a regular supply of extra nutrients may be to responsible for the increase in DMP based on by the addition of zinc as zinc chelate. In order to maintain cell wall plasticity and elongation, plasma membrane integrity, and other physiological and metabolic activities that result in a higher leaf area index and the accumulation of dry matter, plants need to have an optimal level of zinc and boron from the very beginning of their life cycle. These results were in agreement with the findings of Abu sayem *et al.* (2018) [1] and Saakshi *et al.* (2020) [10].

Table 1: Effect of micronutrients on growth parameters of irrigated blackgram (*Vigna mungo* L.)

Treatments	Plant height (cm)			Number of branches per plant	Leaf area index		Dry mater production (kg ha^{-1})		
	30 DAS	45 DAS	At harvest		30 DAS	45 DAS	30 DAS	45 DAS	At harvest
T_1	15.51	24.28	31.11	4.62	1.36	2.87	1632	2027	2644
T_2	17.94	31.71	42.49	6.23	2.35	4.38	2004	2483	3492
T_3	15.87	32.45	44.28	6.35	1.52	4.41	1668	2597	3498
T_4	16.56	25.68	33.61	5.01	1.74	3.22	1770	2166	2852
T_5	15.62	27.00	35.70	5.25	1.43	3.43	1652	2173	2958
T_6	17.19	29.38	38.05	5.64	2.00	3.78	1884	2312	3175
T_7	17.28	29.56	39.87	5.86	2.07	4.03	1896	2324	3237
T_8	17.25	34.87	46.81	6.71	2.03	4.77	1890	2775	3698
T_9	17.32	36.38	49.73	7.08	2.13	5.12	1899	2981	3899
S.Em±	0.16	0.45	0.70	0.11	0.05	0.10	33.33	45.65	66.23
CD (P=0.05)	0.50	1.35	2.11	0.34	0.16	0.32	100.12	135.2	198.12

T_1 - Recommended dose of fertilizer, T_2 - RDF + Basal application of zinc chelate @ 500 g ha^{-1}, T_3 - RDF+ Foliar application of zinc chelate @ 0.5% on 30 and 45 DAS, T_4 - RDF + Basal application of Zinc sulphate @ 10 kg ha^{-1}, T_5 - RDF + Foliar application of Zinc sulphate @ 0.2% on 30 and 45 DAS, T_6 - RDF + Basal application of Borax @ 5 kg ha^{-1}, T_7 - RDF + Basal application of Borax @ 10 kg ha^{-1}, T_8 -RDF + Basal application of Borax @ 5 kg ha^{-1} + Foliar application of Zinc chelate @ 0.2% on 30 and 45 DAS and T_9 - RDF + Basal application of Borax @ 10 kg ha^{-1} + Foliar application of Zinc chelate @ 0.5% on 30 and 45 DAS.

Conclusion

Result indicated that the combined application of soil and foliar nutrition of boron and zinc chelate fertilizer regarding to various morphological characters of blackgram were significantly influenced by RDF + basal application of Borax @ 10 kg ha^{-1} + foliar application of Zinc chelate @ 0.5% were more effective for obtaining the greater results comparatively than other application. So, it could be concluded that the combined application of boron and zinc chelate would be optimum level for maximizing the growth characters of blackgram.

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