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Effect of zinc and boron on growth and yield of green gram at Bhawanipatna, Kalahandi, Odisha

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ABSTRACT

The present study was conducted on Instructional farm of Krishi Vigyan Kendra Kalahandi, Bhawanipatna in Odisha during *rabi* season 2016-17 to study the effect of micronutrients on growth and yield parameters of green gram. The soil texture was sandy loam. Three varieties of green gram viz. Tarm-1, IPM 02-03 and IPM 02-14 were grown by application of micronutrients, i.e. soil application of Zn in form of zinc sulphate @ 25 kg ha^{-1} and of B in form of borax @ 10 kg ha^{-1} along with control keeping other input factors constant. Applications of the said micronutrients resulted in enhancement of plant growth and yield characteristics, viz. plant height, number of branches, pods, seeds and seed weight. The highest seed yield of 7.48 q ha^{-1} was obtained with application of borax @ 10 kg ha^{-1}.

Key words: Boron, green gram, seed yield, yield attributing characters, zinc

INTRODUCTION

Pulses are the major sources of dietary protein in the vegetarian diet in our country. Besides being a rich source of protein, they maintain soil fertility through biological nitrogen fixation in soil and play a vital role in sustainable agriculture. Green gram (*Vigna radiata*) is one of the most important pulse crops. According to Vavilov (1926), green gram is a native of India and Central Asia. It is grown in these areas since pre-historic period. Ascorbic acid (Vitamin C) is synthesized in sprouted seeds of green gram with increment in riboflavin and thiamine. It is also used as green manure crop. Being a short duration crop it also provides an excellent green fodder to the animals. It fits well in various multiple and intercropping systems. After picking of pods, green gram plants may be used as green fodder or can be incorporated as green manure. India grows nearly 23 million ha of pulse with the annual production of 14.18 million tonnes and an average productivity of 617 kg ha^{-1} (GOI, 2009). In spite of being the largest producer in the World, our country has to import pulses to the tune of two million tonnes every year to meet its domestic requirement and the increment in the production being not able to maintain the pace with population growth. Among the grain legumes, green gram [*Vigna radiata* (L.) Wilczek], commonly known as Moong or Mung bean; is an excellent source of high quality protein. It contains about 25% protein of high digestibility. However, the information on integrated nutrient use of organic manures, chemical fertilizers and bio-fertilizers on production of green gram is meagre. The present investigation reports the effect of zinc and boron on growth and productivity of green gram.

MATERIALS AND METHODS

The present investigation was planned to study the impact of micronutrients application with regard to higher seed yield and better growth of green gram. The experimental materials for present investigation comprised of three variety of green gram viz. Tarm-1 (V_1), IPM-02-03 (V_2) and IPM-02-14 (V_3). The seed was obtained from Centre for Pulse Research, Orissa University of Agriculture and Technology, Ratanpur, Berhampur of Ganjam district. The experiment was laid in split plot design with three replications. Appropriate seed production technology (Agrawal, 2003) was adopted to raise the crops. Fertilizer was applied @ 25 kg N, 50 kg P_2O_5 and 30 kg K_2O along with 10 cartloads of FYM per hectare before sowing of seeds. Two hand weeding were done and prophylactic plant protection measures were adopted to protect the crop from weeds, diseases and pests attack. The field was irrigated as and when required.

Table 1. Details of micronutrients application

Sl.	Treatments	Micronutrients	Name of the salt used	Dose of application	Mode of application
1.	T_1	Control	-	-	-
2.	T_2	Zinc (Zn)	Zinc Sulphate	25 kg ha^{-1}	Soil application
3.	T_3	Boron (B)	Borax	10 kg ha^{-1}	-do-

Plant height

Height of the main stem was measured from the base of the plant to the tip of the main axis and average height of the sampled plants was computed and expressed in centimeters.

Number of primary branches

Numbers of branches developed on the main stem were counted as primary (1°) branches and the average number of branches per plant was computed.

Number of secondary branches

Numbers of branches developed on the primary branches were counted and the average number of secondary (2°) branches per plants was computed.

Number of mature pods

Numbers of matured pods per plants were counted by observing pod morphology and colour. Average number of mature pods per plant was computed from the observation data.

Number of immature pods and tender pods

Numbers of immature pods and tender pods per plant were counted and average numbers of immature and tender pods per plant were computed from the observation data.

Number of seeds per pod

One hundred matured pods were sampled after drying from each treatment and replication. After threshing, total number of seeds was counted and average number of seeds per pod was computed.

1000-seed weight

The seeds obtained from the sampled plants of each plot and replication were counted and their weight recorded by an analytical balance. From these data, 1000 seed weight was computed and expressed in gram.

Seed yield

Seed yield per hectare of each treatment was computed from recorded yield for plot data and expressed in kg ha^{-1}.

RESULTS AND DISCUSSION

Plant height

As revealed from the results (Table 2), 28.37 cm (T_3) with an overall mean value of 27.68 cm plant height indicates positive effects on applications of micronutrients in influencing

height of plant in green gram. However, among the varieties, significantly higher effects were observed in IPM 02-14 (V_3) and followed by Tarm-1 (V_1) and IPM 02-03 (V_2) with respect to the same treatment combination. The analysis of variance in respect of this trait showed the significant differences among the treatments and varieties.

Applications of zinc and boron have been reported to increase the plant height of tomato (Bhatt et al., 2004; Tamil Selvi, 2005) and soyabean (Basu et al., 2008). Increase in plant height may be attributed to the role of zinc and boron in auxin synthesis (Basabarajeswari et al., 2008).

Primary branches

The average number of primary branches per plant among the treatments ranged from 4.70 (T_1) to 4.89 (T_3) with an overall mean value of 4.78 (Table 2) which indicates positive effects on application of both micronutrients in influencing this characters in green gram. However, among the Varieties, significantly higher effects were observed in variety IPM 02-14 (V_3) and followed by IPM 02-03 (V_2) and Tarm-1 (V_1) with respect to the same treatment combination. The analysis of variance for this character showed significant differences among the treatments and varieties used in this investigation.

Secondary branches

The average number of secondary branches per plant ranged from 6.26 (T_2) to 6.51 (T_3) with an overall mean value of 6.38 (Table 2). Both micronutrients were found to have enhancing effect on this character. However, the maximum effect was found with application of borax closely followed by Application of zinc sulphate and control. However, among the varieties, significantly higher effects were observed in IPM 02-14 (6.48) and followed by IPM 02-03 (6.32) and Tarm-1 (6.18) with respect to the same treatment combination. The analysis of variance for this character showed significant variations among the treatments and varieties studied in the investigation.

Significant increase in number of branches per plant has been reported by application of boron (Basabarajeswari et al., 2008), zinc (Mohanty et al., 2013) in different crops.

Mature pods

The analysis of variance showed presence of significant differences among the treatments in respect of this character. The average number of mature pods per plant among the treatments ranged from 12.92 (T_1) to 13.16 (T_3) with an overall mean value of 13.05 (Table 2). Applications of both micronutrients were found to have enhancing effect on this trait. However, significantly higher effects were observed with application of boron and followed by zinc and control. Among the Varieties, significantly higher effects were observed in IPM 02-14 (V_3) and followed by IPM 02-03 (V_2) and Tarm-1 (V_1) with respect to the same treatment combination.

Immature pods

The average number of immature pods per plant ranged from 3.83 (T_1) to 4.21 (T_3) with an overall mean value of 4.07 (Table 2). Application of both micronutrients also resulted in higher number of immature pods per plant as compared to control. Among the Varieties, significantly higher effects were observed with the application of IPM 02-14 (V_3) and followed by IPM 02-03 (V_2) and Tarm-1 (V_1) with respect to the same treatment combination. The analysis of variance indicated presence of significant differences among the treatments and varieties in respect of this character in green gram.

Number of seeds per pod

The average number of seeds per pod ranged from 8.73 (T_1) to 8.94 (T_3) with an overall mean value of 8.86 (Table 2). However, Application of both the micronutrients was also found effective on this trait. Among the varieties, significantly higher effects were observed in IPM 02-14 (V_3) and followed by IPM 02-03 (V_2) and Tarm-1 (V_1) with respect to the same treatment combination. The analysis of variance for this trait indicated presence of significant differences among the treatments and varieties.

Table 2. Effect of zinc and boron on growth and yield characters of green gram

	Plant height (cm)	No. of 1° branches	No. of 2° branches	No. of mature pods	No. of immature pods	No. of seeds/ pod	1000 seed weight (g)	Yield (q)
				Treatments				
T_1	27.23	4.70	6.26	12.92	3.83	8.73	25.33	7.14
T_2	27.44	4.77	6.40	13.08	4.18	8.91	27.88	7.34
T_3	28.37	4.89	6.51	13.16	4.21	8.94	26.29	7.48
Mean	27.68	4.78	6.38	13.05	4.07	8.86	26.50	7.32
				Varieties				
V_1	26.93	4.48	6.18	12.76	3.78	8.68	24.83	7.10
V_2	26.44	4.67	6.32	12.98	4.14	8.89	25. 97	7.32
V_3	27.28	4.79	6.48	13.06	4.21	8.94	26.86	7.46
Mean	26.88	4.64	6.32	12.93	4.04	8.83	25.88	7.29

		SE(m)+	C.D.	CV%			SE(m)+	C.D.	CV%			SE(m)+	C.D.	CV%
Plant height	V	0.083	0.325	0.9	No. of Mature Pods	V	0.023	0.091	0.53	1000 seed weight	V	0.057	0.223	0.64
	T	0.076	0.234	0.82		T	0.016	0.050	0.37		T	0.038	0.118	0.43
	VxT	0.135	0.460			VxT	0.033	0.0114			VxT	0.078	0.276	
	TxV	0.131	0.405			TxV	0.028	0.086			TxV	0.066	0.204	
No. of primary branches	V	0.018	0.069	1.10	No. of Immature Pods	V	0.020	0.078	1.46	yield	V	0.011	0.045	0.47
	T	0.043	0.132	2.68		T	0.031	0.096	2.29		T	0.008	0.025	0.33
	VxT	0.063	0.198			VxT	0.048	0.156			VxT	0.016	0.057	
	TxV	0.074	0.228			TxV	0.054	0.166			TxV	0.014	0.043	
No. of secondary branches	V	0.019	0.073	0.87	No. of seeds/pod	V	0.032	0.125	1.08					
	T	0.028	0.087	1.33		T	0.025	0.077	0.85					
	VxT	0.044	0.143			VxT	0.048	0.164						
	TxV	0.049	0.151			TxV	0.043	0.134						

Positive effect of application of micronutrients viz. boron and zinc in increasing the number of seeds per pod has been reported in green gram (Begum, 2014). The micronutrients might have enhancing role in seed setting that resulted in improvement in number of seeds per pod.

1000-seed weight

Seed weight is an important quality attribute. Although this character is genetically controlled, the growing condition exerts considerable influence on its expression. The mean value of 1000-seed weight among the treatments ranged from 25.33 g (T_1) to 27.88 g (T_3) with grand mean value of 26.50 g (Table 2). Among various treatments which significantly enhanced seed weight in green gram were application of zinc (T_2) followed by boron (T_2) as compared to the control (T_1). Among the varieties, significantly higher effects were observed in IPM 02-14 (V_3) and followed by IPM 02-03 (V_2) and Tarm-1 (V_1) with respect to the same treatment combination. In the present investigation, significant variations were observed for 1000-seed weight among the treatments and varieties. Greater

mobilisation of photosynthates to the developing seeds by application of micronutrients might be the reason for increase in seed weight. Similar to our findings, previous reports also showed similar effects in green gram (Begum, 2014).

Seed yield

Seed yield is an important consideration in any study relating to commercial cultivation as well as seed production of a crop. The average yield ranged from 7.14 q (T_1) to 7.48 q (T_3) with an overall mean value of 7.32 q (Table 2). However, application of both the micronutrients was also found effective on this trait. Among the varieties, significantly higher effects were observed in IPM 02-14 (V_3) and IPM 02-03 (V_2) followed by Tarm-1 (V_1) with respect to the same treatment combination. The analysis of variance in respect of both the traits indicated presence of significant variations among the treatments and varieties. Yield potential of IPM 2-14 in the present investigation has been assess in terms of both plant and plot basis. The results of the present investigation are in agreement with the findings of a number of workers in a number of crops (Dordas et al., 2007; Ramu et al., 2007; Shil et al., 2007).

CONCLUSION

In the present investigation, it was apparent that application of micronutrients enhanced plant height, number of branches and other characters. Among the treatments, Zn and B had produced significant enhancing effect on yield attributes including seed yield. In general, Applications of boron was found beneficial in green gram seed production by not only enhancing seed yield but in every trait. Yield potential of IPM 02-14 in the present investigation has been assessed in terms of both plant and plot basis.

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