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Effect of micronutrient application on plant growth attribute in blackgram (Var. Prasad)

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Abstract
The field experiment was conducted during *rabi* season of 2013-2014 at the research plot of Department of Seed Science & Technology, Central Research Station, OUAT, Bhubaneswar, Odisha. This field investigation was carried out with the objectives of improving the efficacy of inoculated *Rhizobium* on plant growth attributes in black gram cv. Prasada by application of micronutrients. The experiment was laid out in 3×2 m^2 plots in a randomized complete block design with 3 replications to assess the effect of different micronutrients both as single and in combinations. Shortest days to 50% flowering (32.67 days) was resulted from soil application of mixture of zinc sulphate @ 25 Kg/ha and borax @ 10 Kg/ha followed by soil application of zinc chelate @ 500 gm/ha. Maximum plant height (26.23 cm) was recorded with soil application of zinc sulphate @ 25 Kg/ha which was at par with soil application of mixture of zinc sulphate @ 25 kg/ha and borax @ 10 kg/ha and seed treatment with mixture of ammonium molybdate @ 5gm/Kg seed and cobalt nitrate @ 1 gm/Kg seed.

Keywords: Micronutrient application, plant growth attribute, blackgram (Var. Prasad)

Introduction
Pulses are the second important Indian diet after cereals. Pulses are rich in proteins and found to be main source of protein to vegetarian people of India. They play an important role in crop rotation, mixed and intercropping, as they help in maintaining the soil fertility. In the world, pulses are grown by 171 countries. At triennium ending 2010-11, the total area under pulses was 723 lakh ha. This area provided about 644.08 lakh tones of pulses with a productivity of 890 kg / ha. The highest area was contributed by India (32.24 %). Pulses occupy a strategic position in agricultural economy of India. Pulse crops are grown on an area of 23.84 lakh ha in India accounting for nearly 33 percent of world acreage and consumed by 2.2 percent of world's population. Pulses normally produce a large number of flowers but only a few are retained and developed into pods. Among these pulses, black gram (*Vigna mungo* L.**)** is one of the oldest and popular pulse crops belongs to family Fabaceae and constitute a vital constituent of Indian recipe. Black gram is originated in India, where it has been in cultivation from ancient times and is one of the most highly priced pulses of India and Pakistan. *Vigna mungo*, commonly known as urdbean is having diploid chromosome number 2n = 22. It is known differently in different Indian languages. In Odisha, the total area under black gram in *kharif* and *rabi* includes 253,000 ha and 345,000 ha respectively. The black gram growing regions in Odisha are Nuapada, Ganjam, Kalahandi, Dhenkanal, Anugul, Bolangir, Keonjhar, Bargarh and Sundargarh. Proper management of the seed crop is highly essential in a seed production program to harvest good amount of high quality seeds. Nutritional management is an important factor of seed crop production.

Materials Methods
In all the treatments seeds were first treated with *Rhizobium* culture @ 20gm/kg of seed. Two micronutrients viz. Mo and Co are applied as seed treatment and other two micronutrients viz. Zn and B were applied at the time of sowing on 27th Nov, 2013 as soil application. The vegetative and reproductive growth behaviour of black gram cv. Prasada in response to micronutrients application were recorded in the field, then seed quality attributes were evaluated and recorded in the laboratory experiments after harvest of the crop. The field experiment was taken in a medium land in the research plot, Department of seed science and technology, Orissa University of Agriculture and Technology, Bhubaneswar situated at 20^0 15' N latitude and 85^0 52' E longitudes. Test crop – Black gram (*Vigna mungo* L.)The experiment was done on the variety 'Prasada' of black gram. The seed of the black gram variety 'Prasada' were brought from centre for pulse research, OUAT, Ratanpur, Berhampur of Ganjam district. The seed crop was grown in *rabi*, 2013-2014 using 'Prasada' variety of black gram in a plot

size 3×2 m^2 with spacing 15×10 cm^2 The experiment was laid down in randomized complete block design with 3 replications. All the required agronomic practices were adopted along with appropriate seed production technology. Fertilizer was applied @ 20kg N, 40kg P_2O_5 and 20 kg K_2O along with ten cartload of FYM per hectare before sowing of seeds. Proper plant protection measures were adopted to protect the seed crop against diseases and pest attack. Irrigation was done at regular interval when required. Days to initiation of flowering and 50% flowering was recorded in the standing crop.

Application of micronutrients

Four different micronutrients zinc, boron, molybdenum and cobalt were applied in different concentrations both singly and in combinations of 10 treatments along with a control. The detail procedures of application of micronutrients are provided in the table-1.

Table 1: Details of micronutrients application

Sl No	Treatment symbol	micronutrients	Name of the salt	Dose of application	Mode of application
1	T1	Control	_	_	_
2	T2	Zinc(Zn)	Zinc sulphate	10 kg/ha	Soil
3	T3	Zinc(Zn)	Zinc sulphate	25 kg/ha	Soil
4	T4	Boron(B)	Borax	5 kg/ha	Soil
5	T5	Boron(B)	Borax	10 kg/ha	Soil
6	T6	Molybdenum (Mo)	Ammonium molybdate	5 gm/kg seed	Seed
7	T7	Cobalt(Co)	Cobalt nitrate	1 gm/kg seed	Seed
8	T8	Mixture (Mo + Co)	Ammonium Molybdate + Cobalt nitrate	5 g/kg + 1 gm/kg seed	Seed
9	T9	Zinc(Zn)	Zinc chelate	500 g/ha	Soil
10	T10	Mixture (Zn + B)	Zinc sulphate + Borax	25 kg/ha + 10 kg/ha	Soil

Recording of observation

10 plants were randomly selected and tagged in each treatment and replication to record the following observations. Days to initiation of flowering in each plot occupied by black gram was recorded end expressed in days after sowing.Days to completion of 50% flowering in each plot occupied by black gram was recorded and expressed in days after sowing. The 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 10 sampled plants was compared and expressed in centimetres. Numbers of branches developed on the main stem of the 10 sampled plants were counted as primary branches and average number of branches per plant was computed. Numbers of branches developed on the primary branches of the 10 sampled plants were counted and the average number of secondary branches per plants was computed. Observation data recorded in various field and laboratory experiments were subjected to statistical analysis following the principle and procedure out lined by Rangaswami.

Discussion

Days to initiation of flowering: The analysed data relating to the days to initiation of flowering in black gram have been presented in the Tab. 2. It was revealed from the data that there was significant difference among various micronutrient treatments. The days to flower initiation among various treatments ranged from 19.67 to 27.67 days after sowing with an overall mean value of 21.87 days. Early flowering (19.67 days) was recorded in soil application of mixture of zinc sulphate @ 25 Kg/ha and borax @ 10 Kg/ha followed by soil application of zinc chelate @ 500 gm/ha and seed treatment of mixture with ammonium molybdate @ 5 gm/Kg and cobalt nitrate @ 1 gm/Kg seed and late flowering (27.67 days) was recorded in control. There was a decrease of 28.91%, 27.72% and 26.52% in days to initiation of flowering through soil application of mixture of Zn and B, soil application of zinc chelate and mixture seed treatment respectively as compared to control. Positive response on flowering was also observed by combined effect of Zn and B through soil application. This may be due to application of zinc which is closely involved in N-metabolism in plants and also boron as it has positive role on initiation of reproductive growth. This corroborates the findings of Smiranova *et al.,* (1989) [5] in tomato.

Table 2: Effect of micronutrients application on flowering characteristics in black gram cv. Prasada

SL. No.	Treatment code	Treatment details	Days to initiation of flowering	Days to 50% flowering
1	T_1	Control	27.67	41.67
2	T_2	$ZnSO_4$ @ 10 kg/ha (soil application)	22.67	36.33
3	T_3	$ZnSO_4$ @ 25 kg/ha (soil application)	21.00	35.33
4	T_4	Borax @ 5 kg/ha (soil application)	22.67	37.00
5	T_5	Borax @ 10 kg/ha (soil application)	20.33	34.67
6	T_6	Ammonium molybdate @ 5 gm/kg seed (seed treatment)	20.67	34.00
7	T_7	Cobalt nitrate @ 1gm/kg seed (Seed treatment)	23.67	36.67
8	T_8	Ammonium molybdate @ 5gm/kg seed + Cobalt nitrate @ 1gm/kg seed (seed treatment)	20.33	33.00
9	T_9	Zinc chelate @ 500 gm/ha (soil application)	20.00	33.00
10	T_{10}	Zinc sulphate @ 25 kg/ha+ Borax @ 10kg/ha (soil application)	19.67	32.67
	MEAN		21.87	35.43
	CD(0.05)		3.52	3.09
	CV (%)		9.44	5.09

Days to 50 percent flowering: Data from the Tab.2 on the days to 50 percent flowering indicated variation in days from 32.67 to 41 67 after sowing as influenced by various treatments with an overall mean value of 35.43. Significant

difference was observed among the treatments. Shortest days to 50% flowering (32.67 days) was resulted from soil application of mixture of zinc sulphate @ 25 Kg/ha and borax @ 10 Kg/ha followed by soil application of zinc chelate @ 500 gm/ha and seed treatment of mixture of ammonium molybdate @ 5gm/Kg and cobalt nitrate @ 1 gm/Kg seed. Late flowering (41.67 days) was observed with the control.

Plant height: The analysed data relating to plant height in black gram have been presented in the Tab. 3.The height of the plants as recorded in the field revealed that application of different doses of micronutrients had significant variations among the treatments. Lowest plant height (20.83 cm) was recorded with the control gradually increased by zinc sulphate @ 10 Kg/ha (21.57 cm) and borax @ 10 Kg/ha (23.12 cm). Maximum plant height (26.23 cm) was recorded with soil application of zinc sulphate @ 25 Kg/ha which was at par with soil application of mixture of zinc sulphate @ 25 kg/ha and borax @ 10 kg/ha and seed treatment with mixture of ammonium molybdate @ 5gm/Kg seed and cobalt nitrate @ 1 gm/Kg seed. All other micronutrient treatments had influencing effect on plant height of black gram plant compared to the control. As it is known that zinc helps in auxin biosynthesis therefore increase in plant height may be attributed to auxin synthesis which ultimately help in root and shoot growth of plants. Similar result was obtained by Skoog, 1940.

Besides Patel and Singh (2010) [3] reported that increased plant height was mainly due to the effect of Zn and B in increasing early vigour, crop growth and dry matter production. Further it was concluded by Briat *et al.* (2007) [2] that the increase in plant height may be due to catalytic effect of zinc in electron transport process of photosynthesis and respiration.

Number of primary branches/plant: In the present study number of primary branches per plant varied from3.87 in control to 4.93 in soil application of zinc chelate (Tab. 3). Significant difference was found among the treatments in producing number of primary branches/plant. Highest number of primary branches (4.93) was recorded in the soil application of zinc chelate @ 500gm/ha which was at par with soil application of zinc sulphate @ 10 Kg/ha and seed treatment with cobalt nitrate @ 1gm/Kg seeds. Other treatments resulted more number of primary branches/plant than the control.

Number of secondary branches/plant: The analysis of variance for the data on number of secondary branches/plant in black gram has been presented in the Tab. 3. Data recorded on number of secondary branches/plant revealed that significant difference was observed among various treatments. Highest number of secondary branches /plant (4.47) was recorded from soil application of zinc chelate @ 500 gm/ha which was at par with the soil application of mixture of zinc sulphate @ 25 Kg/ha and borax @ 10 Kg/ha, soil application of zinc sulphate @ 25 Kg/ha alone and seed treatment of cobalt nitrate @ 1 gm/Kg seed alone. Lowest number of secondary branches/plant (2.23) was obtained from control plot followed by seed treatment with mixture of ammonium molybdate @ 5 gm/Kg. Higher number of secondary branches/plant was recorded in other treatments compared to control. Singh *et al.*, (1989) in his work on micronutrients has also reported that there was increase in plant growth characters by application of micronutrients along with RDNPK. This may be due to their involvement in chlorophyll formation, cell division, cell expansion, formation of new cell wall and meristematic activity in apical tissue. Further, Bean (1942) opined that application of zinc enhances the rate of protein synthesis resulting into an acceleration of vegetative growth. These findings were further confirmed by Naga Sivauah *et.al.* (2013) and Basavarajeswari *et.al.* (2008) [1] in different crops.

Table 3: Effect of micronutrients application on plant growth characteristics in black gram cv. Prasada

SL. No.	Treatment code	Treatment details	Plant height (cm)	No. of primary branches /plant	No. of secondary branches/plant
1	T_1	Control	20.83	3.87	2.23
2	T_2	$ZnSO_4$ @ 10 kg/ha (soil application)	21.57	4.67	3.00
3	T_3	$ZnSO_4$ @ 25 kg/ha (soil application)	26.23	4.07	3.40
4	T_4	Borax @ 5 kg/ha (soil application)	23.37	4.00	3.07
5	T_5	Borax @ 10 kg/ha (soil application)	23.12	3.93	3.13
6	T_6	Ammonium molybdate @ 5gm/kg seed (seed treatment)	23.67	4.20	3.03
7	T_7	Cobalt nitrate @ 1gm/kg seed (Seed treatment)	23.16	4.57	3.33
8	T_8	Ammonium molybdate @ 5gm/kg seed + Cobalt nitrate @ 1gm/kg seed (seed treatment)	24.71	4.07	2.63
9	T_9	ZInc chelate @ 500 gm/ha (soil application)	23.21	4.93	4.47
10	T_{10}	Zinc sulphate @ 25 kg/ha+ Borax @ 10 kg/ha (soil application)	24.93	4.13	4.23
	MEAN		23.48	4.24	3.25
	CD(0.05)		2.35	0.64	1.22
	CV (%)		5.83	8.85	21.98

Conclusion

It was concluded that shortest days to flowering was recorded with the soil application of mixture of zinc sulphate @ 25 Kg/ha and borax @ 10 Kg/ha.However application of all the treatments either singly or in combination resulted in increase in plant height. Maximum effect was observed with the soil application of zinc sulphate @ 25 Kg/ha alone followed by soil application of mixture of zinc sulphate @ 25 Kg/ha and borax @ 10 Kg/ha. Though all the treatments showed positive effect in increasing number of primary and secondary branches/plant, the maximum effect was observed with soil application of zinc chelate @ 500 gm/ha.

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