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Influence of different nutrient management on the growth and yield attributes of black gram

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Abstract
A field experiment entitled "Effect of mycorrhiza, zinc and boron on growth and yield of blackgram" was carried out at Agronomy Unit, Dr. PDKV, Akola during *kharif* season of 2016-17 on clayey soil. The experiment was laid in randomized block design with nine treatments and three replications.
Experimental results revealed that growth parameters were significantly influenced by application of (T_6) *i.e* T_2+ Mycorrhiza (AM) @ 10 kg ha^{-1} + Seed Soaking of 1% $ZnSO_4$ followed by (T_2) + Mycorrhiza (AM) @ 10 kg ha^{-1} + Seed Soaking 0.5% boron (T_7). Similarly Yield attributing characteristics including grain and straw yield were significantly recorded higher values with the application of T_2+ Mycorrhiza (AM) @ 10 kg ha^{-1} + Seed Soaking of 1% $ZnSO_4$ (T_6) followed by RDF + Seed Soaking of 1% $ZnSO_4$ (T_4).
Straw yield and biological yield were significantly more in T_2+ Mycorrhiza (AM) @ 10 kg ha^{-1} + Seed Soaking of 1% $ZnSO_4$ (T_6). The next best treatment was (T_2) + Seed Soaking of 1% $ZnSO_4$ (T_4).

Keywords: zinc, boron, mycorrhiza, straw yield, biological yield, randomized block design

1. Introduction
Blackgram is one of the important pulse crop in India. It is believed that blackgram is a native of India and grown in these regions since prehistoric times. It is widely cultivated throughout the Asia, including India, Pakistan, Bangladesh, Sri Lanka, Thailand, Laos, Cambodia, Vietnam, Indonesia, Malaysia, South China, and Formosa. In Africa and U.S.A., it is probably recent. Blackgram is one of the rich sources of a protein food. It contains about protein – 24 per cent, fat - 1.2 per cent, fiber - 0.8 per cent, minerals - 3.5 per cent, carbohydrates - 59.9 per cent, calcium - 75 mg, phosphorus - 405 mg, iron - 8.5 mg. It supplies major protein requirement of vegetarian population of the country. It is consumed in the form of split pulse as well as whole pulse, which is an essential supplement of cereal based diet.
Blackgram also plays an important role in sustaining soil fertility by improving soil physical properties and also fixing the atmospheric nitrogen. It is a drought resistant crop and suitable for dry land farming and predominantly used as an intercrop with other crops. It is mostly consumed in Southern India. Considering its nutritional value and price, it is necessary to raise its production level and also nutritional quality.

2. Materials and Methods
This field experiment was conducted at Agronomy unit, Dr.PDKV. Akola during *Kharif*2016. Geographically it comes under the sub mountain zone with average annual rainfall of 750 mm being received in about 64 rainy days. The soil of experimental plot was sandy clay loam in texture, low in available phosphorus and moderately high in available nitrogen and potash. It was neutral in reaction. The field experiment was laid out in randomized block design (Panse and Sukhatme, 1967) comprising nine treatments viz., T1: Absolute control, T2: (RDF + Rhizobium + Phosphorus solublising bacteria), T3: T2 + Arbuscular mycorrhiza soil application @ 10 kg/ha, T4: T_2 + Seed soaking @ 1% $ZnSO_4$, T5: T_2 + Seed soaking @ 0.5% boron, T6: T_2 + Arbuscular Mycorrhiza @ 10 kg ha^{-1} + Seed soaking @ 1% $ZnSO_4$, T7: T_2+ Arbuscular Mycorrhizae @10 kg ha^{-1}+ Seed Soaking @ 0.5% boron, T8: T_2 + Arbuscular Mycorrhiza @ 10 kg ha^{-1}+ Foliar Spray @ 1% $ZnSO_4$ (50% at flowering), and T9 :T_2 + Arbuscular Mycorrhiza @ 10 kg ha^{-1}+ Foliar Spray @ 0.5% boron (50% at flowering). The variety PKV Udid-15 black gram was used in this investigation. Seed of blackgram was treated with *Trichoderma* @ 5 g kg^{-1} and was inoculated with *Rhizobium* and PSB culture @ 250 g 10^{-1} kg seed just before sowing. Fertilizer application was done as per the treatments along with recommended dose of fertilizer (RDF) 25:50:00 NPK kg ha^{-1}. Sowing was done with a spacing of 45 X 10 cm. Growth observation viz., plant height (cm), number of root

nodules plant^{-1}, number of branches plant^{-1} and dry matter production plant^{-1} were recorded. The harvesting was done by picking of pods. The post harvest observations viz., no of pod plant^{-1}, pod length, no of grain per pod^{-1} grain yield (kg ha^{-1}), straw yield (kg ha^{-1}), test weight (1000 grain weight) and protein content were also recorded.

3. Results and Discussion

A. Growth studies

1. Plant height

Among the various treatments significantly maximum plant height throughout the growth period were recorded with treatment T6 i.e application of T2 + Rhizobium + Phosphorus solublising bacteria + Arbuscular Mycorrhiza (AM) soil application @ 10 kg ha-1 + seed soaking in 1% ZnSO4 as compared to other treatments and lowest plant height was recorded in treatment T1 i.e absolute control. The findings of Dixit and Elamathi (2007) [1] reported the similar observation where they found significant variation in plant height of black gram.

2. Total dry matter plant^{-1}:

Application of T_2 + Arbuscular Mycorrhiza (AM) soil application @ 10 kg ha^{-1} + seed soaking 1% $ZnSO_4$ (T_6) recorded significantly higher total dry weight closely followed by T_2 + AM soil application @ 10 kg ha^{-1} + seed soaking of 0.5% boron () and T_2+ AM + seed soaking 1% Zinc Sulphate and lowest dry weight observed in absolute control (T1) treatment. however, the soil application of mycorrhiza did not contribute significantly for increase in dry matter accumulation of blackgram as AM fungi did not get enough time for establishment of fungal mycelia on root.

The increase in dry weight of blackgram under zinc treatment may be due to its role of zinc in biosynthesis of indole acetic acid Surendra Ram and Katiyar (2013) [5]. Similar results were also obtained by Venkatesh *et al.* (2014) [2].

3. Number of root nodules plant^{-1}

The results showed that the higher number of nodules plant^{-1} were recorded with treatment T_6 i.e application of T_2 + Arbuscular Mycorrhiza (AM) soil application @ 10 kg ha^{-1} + seed soaking 1% $ZnSO_4$ and minimum recorded in treatment (T_1) absolute control. The increase in nodulation might be due to the enhanced and established good rooting system with the application of zinc (Khalil and Ved Prakash, 2014) [4]. Similar results were also obtained by Zaghloul *et al.* (2002) [3] and Surendra and Katiyar (2013) [5].

B. Yield studies

C. Yield

1. Grain yield

Highest grain yield (1236 kg ha^{-1}) was observed in treatment T_6 *i.e.* application of T_2 + Arbuscular mycorrhiza soil application @ 10 kg ha^{-1}+ seed soaking in 1% $ZnSO_4$. While treatment T_1 *i.e.* absolute control recorded lowest grain yield. Similarly the grain yield recorded in treatment T_7 *i.e.* application of T_2+ seed soaking in 0.5% boron with or without mycorrhiza (T_5) was remained at par closely followed by their foliar spray. Similar results were noted by Surendra and Katiyar (2013) [5] and Khalil and Prakash (2014) [4].

2. Straw yield

The highest straw yield (2339 kg ha^{-1}) was observed with the treatment (T_6) *i.e.* T_2+ AM soil application @ 10 kg ha^{-1} + seed soaking of $ZnSO_4$ @ 1% was found significantly superior over rest of the treatment. Similar results were noted by Surendra and Katiyar (2013) [5] and Khalil and Prakash (2014) [4].

4. Conclusion

- Application of RDF 25:50:00 NPK kg ha^{-1} with Rhizobium + PSB along with soil application of Arbuscular Mycorrhiza @ 10 kg ha-1 with Seed Soaking in 1% ZnSO4 improved growth parameters like plant height, dry matter accumulation, number of root nodules and recorded the highest grain and straw yield of blackgram.

Table 1: Effect of different treatment on Growth attributes and yield attributes

Tr. No	Treatments	No. of branches plant^{-1}	Total dry matter	No. of root nodules plant^{-1}	Grain Yield (kg ha^{-1})	Straw Yield (kg ha^{-1})
T_1	Absolute control	6.66	11.68	24.12	782	1755
T_2	RDF + Rhizobium + Phosphorus solublising bacteria	7.21	12.23	26.24	1059	1983
T_3	T2 + Arbuscular mycorrhiza soil application @ 10 kg/ha	7.32	12.70	26.88	1080	2154
T_4	T_2 + Seed soaking @ 1% $ZnSO_4$	7.72	14.24	28.34	1154	2290
T_5	T_2 + Seed soaking @ 0.5% boron	7.58	13.97	30.16	1100	2258
T_6	T_2 + Arbuscular Mycorrhiza @ 10 kg ha^{-1} + Seed soaking @ 1% $ZnSO_4$	8.46	15.91	32.24	1236	2339
T_7	T_2+ Arbuscular Mycorrhizae @10 kg ha^{-1}+ Seed Soaking @ 0.5% boron	7.88	14.45	29.06	1151	2278
T_8	T_2 + Arbuscular Mycorrhiza @ 10 kg ha^{-1}+ Foliar Spray @ 1% $ZnSO_4$ (50% at flowering)	7.41	14.00	27.62	1110	2210
T_9	T_2 + Arbuscular Mycorrhiza @ 10 kg ha^{-1}+ Foliar Spray @ 0.5% boron (50% at flowering)	7.38	13.95	28.26	1106	2202
	SE (m) ±	0.18	0.70	0.39	14.10	15.72
	CD at 5 %	0.53	2.10	1.16	42.27	47.18
	General Mean	7.51	123.1	27.99	1086	2163

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