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Response of different nutrient management on the major nutrient N, P and K uptake in black gram

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Abstract
A field experiment entitled "Effect of mycorrhiza, zinc and boron on growth and yield of black gram" 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).
Total uptake of N,P and K content of grain and straw were obtained higher values with the application (T_4). T_2+ Mycorrhiza (AM) @ 10 kg ha^{-1} + Seed Soaking of 1% $ZnSO_4$ (T_6) and followed (T_2) + Seed Soaking of 1% $ZnSO_4$.

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

Introduction
Black gram is one of the important pulse crop in India. It is believed that black gram 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.

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.

Results and Discussion

Nutrient content and uptake

1. Nitrogen uptake (kg ha^{-1})

The data presented in Table 15 revealed that treatment (T6) i.e. T2+ Arbuscular Mycorrhiza Soil Application @ 10 kg ha-1+ Seed Soaking of ZnSO4 @ 1% was recorded significantly highest in grain, straw and total uptake of nitrogen in kg ha-1, (21.75), (25.26) and (47.01) respectively and fallowed by treatment (T7) i.e.T2 + Rhizobium + Arbuscular Mycorrhiza (AM) Soil Application @10 kg ha^{-1} + Seed Soaking of boron @ 0.5% was recorded in grain, straw and total uptake of nitrogen in kg ha^{-1}, (20.08), (24.60) and (44.68) respectively. The minimum nitrogen uptake in (T1) control treatment recorded in grain, straw and total uptake of nitrogen in kg ha^{-1} (10.79), (16.15) and (26.94) respectively.

2. Phosphorus uptake (kg ha^{-1})

The data presented in Table.16 revealed that treatment (T6) i.e. T2+ Arbuscular Mycorrhiza Soil Application @ 10 kg ha^{-1}+ Seed Soaking of ZnSO4 @ 1% was recorded significantly highest in grain, straw and total uptake of phosphorus in kg ha^{-1}, (6.43), (4.68) and (11.11) respectively, and fallowed by treatment (T7) i.e T2 + rhizobium + Arbuscular Mycorrhiza (AM) Soil Application @10 kg ha-1 + Seed Soaking of boron @ 0.5% was recorded in grain, straw and total uptake of nitrogen in kg ha^{-1}, (5.89), (4.33) and (10.21), which was at par with T4 i.e. T2 + Seed soaking 1% ZnSO4.The minimum phosphorus uptake in (T1) control treatment recorded in grain, straw and total uptake of phosphorus in kg ha^{-1} (2.97), (2.63) and (5.60) respectively.

VAM changed the nutritional status of its host plant. P concentrations themselves may affect host water balance, but it is often fixed in soil and not available to plant. Phosphates produced by VAM fungi play an important role in translating fixed or insoluble P into soluble P, which can be used by plant freely. At the same time, hyphae are also important ways of P transported in soil Huixing Song (2004). Similar results were also obtained by Prabhu *et al*. (2013) and Sohrabi *et al*. (2012). Application of zinc significantly increased phosphorus Zaghloul *et al*. (2002) [3], Rahman *et al*. (2015) and Surendra Ram and Katiyar (2013) [5]

3. Potassium uptake (kg ha^{-1})

The data presented in Table 17 and revealed that, the highest values of potassium content with the treatment. (T6) i.e T2 + Arbuscular Mycorrhiza Soil Application @ 10 kg ha-1+ Seed Soaking of ZnSO4 @ 1% was recorded significantly highest in grain, straw and total uptake of potassium in kg ha-1, (23.24), (29.47) and (52.71) respectively, and followed by treatment (T4) i.e T2 + Seed Soaking of ZnSO4 @ 1% and followed by treatment (T7) i.e T2 + Arbuscular Mycorrhiza (AM) Soil Application @10 kg ha^{-1} + Seed Soaking of boron @ 0.5% was recorded in grain, straw and total uptake of potassium in kg ha-1, (13.81), (19.66) and (33.26) respectively. The minimum potassium uptake in (T1) control treatment recorded in grain, straw and total uptake of potassium in kg ha-1 (13.61), (19.66) and (33.26) respectively. Mycorrhiza, zinc and molybdenum combined or singular increase potassium content of seed Zaghloul *et al*. (2002) [3], Meena *et al*. (2015).

Conclusion

Improvement in protein content of grain and also the highest values of nutrients uptake *viz,* N,P and K by crop were obtained by the application of RDF, seed treatment with Rhizobium + PSB and Arbuscular Mycorrhiza soil application @ 10 kg ha^{-1}+ Seed Soaking of ZnSO4 @1%.

Table 1: Effect of different treatments on N uptake (kg ha^{-1}) and Total N (kg ha^{-1})

Tr.no	Treatments	N uptake (kg ha^{-1})		Total N (kg ha^{-1})
		Seed	Straw	
T_1	T_1 - Absolute control	10.79 (1.38)	16.15 (0.92)	26.94
T_2	RDF + Rhizobium + Phosphorus solubilizing bacteria	15.04 (1.42)	19.04 (0.96)	34.07
T_3	T2 + Arbuscular mycorrhiza soil application @ 10 kg/ha	16.63 (1.54)	20.68 (0.96)	37.31
T_4	T_2 + Seed soaking 1% $ZnSO_4$	18.88 (1.64)	23.36 (1.02)	42.23
T_5	T_2 + Seed soaking 0.5% boron	18.26 (1.66)	23.48 (1.04)	41.74
T_6	T_2 + Arbuscular Mycorrhiza @ 10 kg ha^{-1} + Seed soaking 1% $ZnSO_4$	21.25 (1.76)	25.26 (1.08)	47.01
T_7	T_2+ Arbuscular Myorrhizae @10 kg ha^{-1}+ Seed Soaking 0.5% boron	20.0 (1.74)	24.60 (1.08)	44.68
T_8	T_2 + Arbuscular Mycorrhiza @ 10 kg ha^{-1}+ Foliar Spray 1% $ZnSO_4$	18.32 (1.65)	21.66 (0.98)	39.97
T_9	T_2 + Arbuscular Mycorrhiza @ 10 kg ha^{-1}+ Foliar Spray 0.5% boron	18.47 (1.67)	22.02 (1.00)	40.49
	SE (m) ±	1.08	0.21	1.28
	CD at 5 %	3.21	0.62	3.82
	General Mean	39.31	21.80	61.11

Table 2: Effect of different treatments on P uptake (kg ha^{-1}) and Total P (kg ha^{-1})

Tr.no	Treatments	P uptake (kg ha^{-1})		Total P (kg ha^{-1})
		Seed	Straw	
T_1	Absolute control	2.97 (0.38)	2.63 (0.15)	5.60
T_2	RDF + Rhizobium + Phosphorus solublising bacteria	4.87 (0.46)	2.97 (0.15)	7.85
T_3	T2 + Arbuscular mycorrhiza soil application @ 10 kg/ha	5.29 (0.49)	3.45 (0.16)	8.74
T_4	T_2 + Seed soaking 1% $ZnSO_4$	5.76 (0.50)	4.12 (0.18)	9.88
T_5	T_2 + Seed soaking 0.5% boron	5.28 (0.48)	3.84 (0.17)	9.12
T_6	T_2 + Arbuscular Mycorrhiza @ 10 kg ha^{-1} + Seed soaking 1% $ZnSO_4$	6.43 (0.52)	4.68 (0.20)	11.11
T_7	T_2+ Arbuscular Myorrhizae @10 kg ha^{-1}+ Seed Soaking 0.5% boron	5.89 (0.51)	4.33 (0.19)	10.21
T_8	T_2 + Arbuscular Mycorrhiza @ 10 kg ha^{-1}+ Foliar Spray 1% $ZnSO_4$	5.66 (0.51)	3.98 (0.18)	9.64
T_9	T_2 + Arbuscular Mycorrhiza @ 10 kg ha^{-1}+ Foliar Spray 0.5% boron	5.53 (0.50)	3.74 (0.17)	9.27
	SE (m) ±	0.16	0.11	0.31

	CD at 5 %	0.51	0.32	0.90
	General Mean	5.30	3.75	9.05

Table 3: Effect of different treatments on K uptake (kg ha^{-1}) and Total K (kg ha^{-1})

Tr.no	Treatments	K uptake (kg ha^{-1})		Total K (kg ha^{-1})
		Seed	Straw	
T_1	Absolute control	13.61 (1.74)	19.66 (1.12)	33.26
T_2	RDF + Rhizobium + Phosphorus solublising bacteria	18.64 (1.76)	22.61 (1.14)	41.24
T_3	T2 + Arbuscular mycorrhiza soil application @ 10 kg/ha	19.33 (1.79)	25.42 (1.18)	44.75
T_4	T_2 + Seed soaking 1% $ZnSO_4$	20.95 (1.82)	27.48 (1.20)	48.43
T_5	T_2 + Seed soaking 0.5% boron	19.58 (1.78)	26.64 (1.18)	46.22
T_6	T_2 + Arbuscular Mycorrhiza @ 10 kg ha^{-1} + Seed soaking 1% $ZnSO_4$	23.24 (1.88)	29.47 (1.26)	52.71
T_7	T_2+ Arbuscular Myorrhizae @10 kg ha^{-1}+ Seed Soaking 0.5% boron	21.23 (1.84)	28.02 (1.23)	49.25
T_8	T_2 + Arbuscular Mycorrhiza @ 10 kg ha^{-1}+ Foliar Spray 1% $ZnSO_4$	20.09 (1.81)	26.74 (1.21)	46.83
T_9	T_2 + Arbuscular Mycorrhiza @ 10 kg ha^{-1}+ Foliar Spray 0.5% boron	19.91 (1.80)	26.42 (1.20)	46.33
	SE (m) ±	0.65	0.45	1.14
	CD at 5 %	2.00	1.41	3.42
	General Mean	19.62	25.83	45.45

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