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Response of Different Levels of Zinc and Molybdenum on Yield Attribute and Economics of Blackgram (*Vigna mungo* L.) under Agro-climatic East Uttar Pradesh, India

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A B S T R A C T

A field experiment was conducted during the *Zaid* season 2016 at the Crop Research farm of Agronomy, Naini Agricultural Institute, SHUATS, Allahabad (U.P.) to Field evaluation of blackgram (*Vigna mungo* L.) under Agro-climatic zone of Allahabad. The experiment was conducted to find out the effect of different levels of zinc and molybdenum on growth and yield of blackgram (*Vigna mungo* L.) laid out in RBD with 9 treatment and 3 replications. The treatment consisted of three levels of zinc (0, 5 and 7.5 kg ha^{-1}), three levels of molybdenum (0, 0.5 and 1.0 kg ha^{-1}). results revealed that the maximum number of nodules $plant^{-1}$ (5.87, 16.67, 24.33, 10.93 cm, at 15 DAS, 30 DAS, 45 DAS and 60 DAS respectively), maximum Pods $plant^{-1}$ was recorded as 20.40, maximum Relative growth rate (g $g^{-1}day^{-1}$) (0.09, and 0.17 cm, at 45 DAS and 60 DAS respectively), maximum Grain yield t ha^{-1} was recorded as 1.01, Straw yield t ha^{-1} was recorded as 4.14 and maximum benefit cast ratio was recorded as 4.66. However significantly the highest nodules $plant^{-1}$, Pods $plant^{-1}$, Relative growth rate (g $g^{-1}day^{-1}$), Grain yield t ha^{-1} and Straw yield t ha^{-1} was found in (T_9) R.D.F+ Zinc7.5 kg ha^{-1} + Molybdenum1.0 kg ha^{-1} and highest benefit ratio was found in (T_4) R.D.F + Zinc 5 kg ha^{-1} + Molybdenum 00 kg ha^{-1}.

Introduction

Blackgram crop grown in many parts of India. This crop is grown in the cropping systems as a mixed crop, catch crop, sequential crop besides growing as sole crop under residual moisture conditions after the harvest of other summer crops under semi- irrigated and dry land conditions. Its seeds are highly nutritious with protein (25-26%), carbohydrates (60%), fat (1.5%), minerals, amino acids and vitamins. Seed are used in the preparation of many popular dishes. it is one of the most important components in the preparation of famous south Indian dishes, *e.g.*, dosa, idli, vada *etc*, besides, it adds about 42 kg nitrogen per hectare in soil. (Source: Department of Agriculture, Govt. of Sikkim). In India, Blackgram is very popularly grown in Andhra Pradesh, Bihar, Madhya Pradesh, Maharashtra, Uttar Pradesh and West Bengal, Punjab, Haryana and Karnataka (Singh, 2010).

Zinc is most the daily Zn requirement of humans, the amounts of Zn in the seed need to exceed the optimum level for the crop itself (Grusak and Cakmak, 2005). This implies an urgent need to find new agricultural technologies to obtain sufficient yield of good quality crops, also with respect to globally limited natural resources such as fertilizer and the enormous loss of fertile soils low availability of Zn in soils is one of the widest ranging a biotic stresses in the world agriculture. Black gram and green gram in an important pulse crop grown throughout India where micronutrients play in important role in its production. (Cordell *et al.,* 2009; Adesemoyes *et al.,* 2009).

Molybdenum is one of the most recognized micronutrient element considered to be essential for the growth of plants and improving the crop yield and quality (Tahir *et al.,* 2014). As the constituent of nitrate reductase and nitrogenase enzymes, molybdenum directly influences nitrogen assimilation and its fixation in pulse crop (Biswas *et al.,* 2009). Yield level of major pulses. Also, the perceptions of farmers about their adaptation strategies in the changing climatic regime were ascertained (Dubey *et al.,* 2006).

Materials and Methods

This experiment was conducted in the year 2016 during *Zaid* season at Crop Research Farm (CRF), Naini Agricultural Institute, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad. The geographical co-ordinates of Allahabad are $25^0 57^0$ N latitude and 87^0 19^0 E longitude and an altitude of 98 m above mean sea level. The area is situated on the south of the Allahabad (U.P.) on the side of the Yamuna River at Rewa road at a distance of about 5.0 km away from Allahabad city. All the facilities required for crop cultivation are available.

The soil is experimental plot was sandy loam in texture having pH of 7.60 with low level of organic carbon 00.34 %, available medium level of P (13.5 kg ha^{-1}) and higher level of K (336 kg ha^{-1}). The experiment was laid out randomized block design, comprising of sixteen treatment combinations each replicated thrice.

The treatments consisted of three Zinc levels (0, 5 and 7.5 kg ha^{-1}) and three levels of molybdenum (0, 0.5 and 1.0 kg ha^{-1}) with recommended dose 20:60:20 NPK kg ha^{-1}.

Total nine treatment combinations *viz.,* T_1: R.D.F + Zinc 00 kg ha^{-1} + Molybdenum 00kg ha^{-1}, T_2: R.D.F + Zinc 00 kg ha^{-1} + Molybdenum 0.5kg ha^{-1}, T_3: R.D.F + Zinc 00 kg ha^{-1} + Molybdenum 1.0 kg ha^{-1}, T_4: R.D.F + Zinc 5 kg ha^{-1} + Molybdenum 00 kg ha^{-1}, T_5: R.D.F+ Zinc 5 kg ha-1 + Molybdenum 0.5 kg ha^{-1}, T_6: R.D.F + Zinc 5 kg ha^{-1} + Molybdenum 1.0kg ha^{-1}, T_7: R.D.F+ Zinc 7.5 kg ha^{-1} + Molybdenum 00 kg ha^{-1}, T_8: R.D.F+ Zinc 7.5 kg ha^{-1} + Molybdenum 0.5 kg ha^{-1}, T_9: R.D.F+ Zinc 7.5 kg ha^{-1}+ Molybdenum 1.0 kg ha^{-1}. Five plants were taken from each plot to measure the plant height and yield attributes.

Statistical analysis

The value of table ‘F at 5% level significance, where the treatment difference between were found significant the value of CD and CV % were also worked out to compare the treatment mean (Snedecor and Cochran, 1967). At initial stage select random five plants from net plot area for further recording observations.

Results and Discussion

Results revealed that the maximum number of nodules $plant^{-1}$ (5.87, 16.67, 24.33, 10.93 cm, at 15 DAS, 30 DAS, 45 DAS and 60 DAS

respectively), maximum Pods plant^{-1} was recorded as 20.40, maximum Relative growth rate (g g^{-1}day^{-1}) (0.09, and 0.17 cm, at 45 DAS and 60 DAS respectively), maximum Grain yield t ha^{-1} was recorded as 1.01, Straw yield t ha^{-1} was recorded as 4.14 and maximum benefit cast ratio was recorded as 4.66.

However significantly the highest nodules plant^{-1}, Pods plant^{-1}, Relative growth rate (g g^{-1}day^{-1}), Grain yield t ha^{-1} and Straw yield t ha^{-1} was found in (T_9) R.D.F+ Zinc7.5 kg ha^{-1} + Molybdenum1.0 kg ha^{-1} and highest benefit ratio was found in (T_4) R.D.F + Zinc 5 kg ha^{-1} + Molybdenum 00 kg ha^{-1}.

The probable reason for dry matter accumulation plant^{-1} number of nodules plant^{-1}, pod RGR (g g^{-1}day^{-1}), grain yield t ha^{-1} and straw yield t ha^{-1} may be due to beneficial effect of zinc and molybdenum (Table 1–3).

Table.1 Effect of different levels of zinc and molybdenum on Number of nodules plant-1 and Relative growth rate (g g-1day-1) of blackgram (Vigna mungo L.)

Treatment combinations	Number of nodules plant^{-1}				Relative growth rate (g g^{-1}day^{-1})	
	15 DAS	30 DAS	45 DAS	60 DAS	45 DAS	60 DAS
T_1: R.D.F + Zinc 00 kg ha^{-1} + Molybdenum 00kg ha^{-1}	4.07	9.73	20.93	9.13	0.06	0.17
T_2: R.D.F + Zinc 00 kg ha^{-1} + Molybdenum 0.5kg ha^{-1}	5.07	10.53	21.87	9.50	0.08	0.16
T_3: R.D.F + Zinc 00 kg ha^{-1} + Molybdenum 1.0 kg ha^{-1}	4.80	11.87	23.53	10.13	0.07	0.17
T_4: R.D.F + Zinc 5 kg ha^{-1} + Molybdenum 00 kg ha^{-1}	5.27	12.40	21.07	9.53	0.06	0.16
T_5: R.D.F+ Zinc 5 kg ha^{-1} + Molybdenum 0.5 kg ha^{-1}	5.33	13.53	22.53	9.33	0.07	0.16
T_6: R.D.F + Zinc 5 kg ha^{-1} + Molybdenum 1.0kg ha^{-1}	5.47	14.20	24.13	10.13	0.08	0.17
T_7: R.D.F+ Zinc 7.5 kg ha^{-1} + Molybdenum 00 kg ha^{-1}	5.13	14.93	21.47	9.60	0.06	0.16
T_8: R.D.F+ Zinc 7.5 kg ha^{-1} + Molybdenum 0.5 kg ha^{-1}	5.53	15.73	23.07	10.07	0.07	0.17
T_9: R.D.F+ Zinc7.5 kg ha^{-1}+ Molybdenum 1.0 kg ha^{-1}	5.87	16.67	24.33	10.93	0.09	0.17
F test	S	S	S	S	S	S
SEd(_+)	0.11	0.13	0.10	0.15	0.001	0.001
CD (P=0.05)	0.24	0.28	0.20	0.32	0.001	0.001

Table.2 Effect of different levels of zinc and molybdenum on yield attributes (Pods plant-1, Grain yield t ha-, Straw yield t ha-1) of blackgram (*Vigna mungo* L.)

Treatment combinations	Pods plant^{-1}	Grain yield t ha^{-1}	Straw yield t ha^{-1}
T_1: R.D.F + Zinc 00 kg ha^{-1} + Molybdenum 00kg ha^{-1}	17.00	1.01	3.71
T_2: R.D.F + Zinc 00 kg ha^{-1} + Molybdenum 0.5kg ha^{-1}	17.27	1.10	3.80
T_3: R.D.F + Zinc 00 kg ha^{-1} + Molybdenum 1.0 kg ha^{-1}	17.93	1.15	3.81
T_4: R.D.F + Zinc 5 kg ha^{-1} + Molybdenum 00 kg ha^{-1}	17.73	1.08	3.71
T_5: R.D.F+ Zinc 5 kg ha^{-1} + Molybdenum 0.5 kg ha^{-1}	18.33	1.11	3.96
T_6: R.D.F + Zinc 5 kg ha^{-1} + Molybdenum 1.0kg ha^{-1}	19.33	1.17	**4.14**
T_7: R.D.F+ Zinc 7.5 kg ha^{-1} + Molybdenum 00 kg ha^{-1}	18.60	1.09	3.87
T_8: R.D.F+ Zinc 7.5 kg ha^{-1} + Molybdenum 0.5 kg ha^{-1}	19.13	1.13	3.84
T_9: R.D.F+ Zinc7.5 kg ha^{-1}+ Molybdenum 1.0 kg ha^{-1}	20.40	1.18	3.84
F test	**S**	S	S
SEd(_+)	**0.09**	0.003	0.01
CD (P=0.05)	**0.21**	0.010	0.03

Table.3 Evaluation of different Benefit cost Ratio (C:B) of different Treatment Combination of Blackgram (Vigna mungo L.)

Treatment	Grain yield (t.ha^{-1})	Straw yield (t.ha^{-1})	Gross return (Rs.)	Total Cost of cultivation (Rs.)	Net return (Rs.)	BCR
T_1	1.01	3.71	101515.00	22674.00	78841.00	4.48
T_2	1.10	3.80	110200.00	31074.00	79126.00	3.54
T_3	1.14	3.81	114015.00	39474.00	74541.00	2.89
T_4	1.08	3.71	108165.00	23174.00	84991.00	4.66
T_5	1.11	3.96	111390.00	31574.00	79816.00	3.53
T_6	1.17	4.14	117360.00	39974.00	77386.00	2.93
T_7	1.09	3.87	109355.00	23424.00	85931.00	4.67
T_8	1.14	3.84	114060.00	31824.00	82236.00	3.58
T_9	1.18	3.84	117860.00	40224.00	77636.00	2.93

However the essential role of zinc has been established as a component of several enzymes concerned with carbohydrate and nitrogen metabolism, in addition to its involvement directly or indirectly in regulating the various physiological processes of plants. Similar results were reported by Sharma *et al.,* (2010) significant difference in dry matter per plant was recorded with 15 kg Zn/ha (Ullah *et al.,* 2007).

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