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Effect of Zinc and Molybdenum on Growth, Yield Attributes, Yield and Protein in Grain on Summer Blackgram (*Vigna mungo* L.)

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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}) treatment had significantly the highest plant height (29.29 and 30.51 cm at 45 and 60 DAS), number of branches (7.40 and 7.40 at 45 and 60 DAS), Crop growth rate (0.30, 0.85 and 4.91g $m^{-2}day^{-1}$ at 0-15, 15-30 and 45-60 DAS) except at significantly higher value 1.35 at 30-45 DAS, protein content in grain (24.70 %) and grain yield(1.18 t $ha^{-1)}$. However significantly higher straw yield (4.14 t ha^{-1}) in (T_6) R.D.F + Zinc 5 kg ha^{-1} + Molybdenum 1.0 kg $ha^{-1.}$

Introduction

Pulses have occupied immense significance in recent years as an important component of Indian economy. Pulses are seeds of leguminous plants and belong to the family Fabaceae. Pulses are rich source of protein and thus form an important part of vegetarian diet supplying the major portion of the protein requirements to human nourishment. About 88 per cent of protein consumed in India is of vegetable origin. Pulses are also rich in Vitamin B. Germinate seeds of pulses contain Vitamin C. Pulses have 2 to 6 per cent fats and can meet the essential fatty acids.

Pulse crops are unique in the sense that these possess capacity of fixing atmospheric nitrogen through nitrogen fixing bacteria found in their nodules and thus meet their own nitrogen requirements to a great extent. Pulses are fairly. Drought tolerant due to their deep root system and many of them are short duration crops. These are also ideal for inter-cropping as well as for multiple cropping system (Malik *et al.*, 2015).

Productivity of pulses is low for these crops are mostly grown on marginal and sub-marginal soils with little or no application of fertilizers. Majority of pulse-growing regions of India are low in Zn content, and therefore, application of 1.5-5 kg Zn/ha alone or over and above the recommended doses of NPKS to different pulse crops are necessary. The application of Zn results in the enhancement of grain yield and quality. Genetic variability for response to applied Zn has been noticed among different cultivars of pulses. The Zn requirements of crops are low. Zn application may be performed once in a year, alternate years or after 3-5 years depending on Zn status of the soil. Several methods of Zn application viz., soil, seed coating, spraying, etc. have been found effective in correcting the Zn deficiency of the plants. Among different methods of application, soil application of ZnSO4 is most common and sometimes, it provides more beneficial results than other sources of Zn application. Soil application of Zn depends on nutrient status in soil, soil types, rainfall, organic matter addition and cropping systems. The Zn applied in one crop of the system generally takes care of the Zn requirements of the succeeding crop too. Singh *et al.,* (2011)

Deficiency of Zn in the soil leads to the dietary malnutrition and health problems in human and animals. Presently half of the world population is affected with Zn deficiency (Cakmak, 2008a; Cakmak, 2008b and Takkar *et al.*, 1989), and therefore, it comes second only after iron. In India, about 25% of the population is suffering from Zn-related problems and nearly half of the Indian children under the age of 5 are small due to the Zn deficiency Singh *et al.*, (2009). Zn deficiency is also known to cause several diseases like hypogonadism, anorexia, dwarfism, skin lesion, geophagia, loss of taste, skin lesion, and the like. The Zn related problems are more acute in woman of child bearing age and younger generations including children and livestock. The crops grown in Zn deficient soils are generally having lower zinc content (consequently lower Zn uptake) and intake of produce of such crops or crops as such leads to health related problems in the humans and animals.

Molybdenum is one of the most recognized nutrient elements considered to be essential for the growth of plant. Food insecurity in the 21st century will even increase due to heat and drought stress induced by the climate change, particularly in tropical and subtropical regions. Legumes are good and relatively cheaper source of proteins, carbohydrates and minerals for developing countries including India**.**

Materials and Methods

In order to study the Influence of the experiment of urdbean (*Vigna mungo* L.) in relation to zinc and molybdenum a field experiment was carried out at in year 2016 during *summer* season at Crop Research Farm (CRF), Naini Agricultural Institute, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad. Treatment combinations comprised with three levels of zinc *viz.,* 0 kg, 5 kg, 7.5 kg and 7.5 kg ha^{-1} and three levels of molybdenum *viz.,* 0 kg, 0.5 kg and 1.0 kg ha^{-1} with recommended dose of NPK kg ha^{-1}. Nine treatments combinations were replicated three times in randomized block design.

The soil of the experimental field was sandy loam in texture, slightly alkaline in reaction (pH 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}). Total and available N was analysed by Subbiah and Asija, 1956, Zinc by DTPA extractants Dithizonate method and Mo by using water and ammonium oxalate extractants (Jackson, 1973). 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

Effect of growth parameters on blackgram

The data present indicated that in Table 1 indicates the plant height at 45 DAS significantly the highest in treatment (T_9): R.D.F+ Zinc 7.5 kg ha^{-1} + Molybdenum 1.0 kg ha^{-1} with 29.29 cm and at 60 DAS, significantly the highest value of plant height (30.51 cm) in treatment (T_9) R.D.F+ Zinc 7.5 kg ha^{-1} + Molybdenum 1.0 kg ha^{-1}.

The increase in plant height under zinc treatment may be due to its effect in the metabolism of growing plants, which may effectively explain the observed response of zinc application. Favourable response of zinc application on plant height has also been reported by Shanti, *et al.*, 2008.

The increase in growth attributes due to molybdenum might be due to that molybdenum is a structural component of nitrogenase and the enzyme actively involved in nitrogen fixation by root nodule bacteria of leguminous crops. Similar findings were also reported by Kumar and Sharma (2005) and Khan and Prakash (2013)

Crop growth rate significantly the highest at (0-15, 15-30, 45-60 DAS) was observed value (0.30, 0.85 and 4.91 g $m^{-2}day^{-1}$ in treatment (T_9) R.D.F+ Zinc 7.5 kg ha^{-1}+ Molybdenum 1.0 kg ha^{-1} respectively. While significantly higher as same treatment crop growth rate value was observed (1.35 g $m^{-2}day^{-1}$ at 30-45 DAS).

With the respect significantly the highest number of branches both intervals at 45 and 60 DAS was observed value same as (7.40 $plant^{-1}$) in treatment (T_9) R.D.F + Zinc 7.5 kg ha^{-1} + Molybdenum 1.0 kg ha^{-1} respectively.

Yields attributes and yield of blackgram

The data pertaining to effect of different levels of zinc and molybdenum on grain yield. Significantly the highest grain yield (1.18 t ha^{-1}), was observed under treatment (T_9) R.D.F + Zinc 7.5 kg ha^{-1} + Molybdenum 1.0 kg ha^{-1}, whereas, significantly the lowest grain yield (1.18 t ha^{-1}), was observed under treatment T_1 R.D.F + Zinc 00 kg ha^{-1} + Molybdenum 00kg ha^{-1} and T_4 R.D.F + Zinc 5 kg ha^{-1} + Molybdenum 00 kg ha^{-1}, respectively.

The data presented in Table 2 on grains per pod (5) was observed non significantly effect in treatment (T_9) R.D.F + Zinc 7.5 kg ha^{-1}+ Molybdenum 1.0 kg ha^{-1}, T_3 R.D.F + Zinc 00 kg ha^{-1} + Molybdenum 1.0 kg ha^{-1} and T_8 R.D.F+ Zinc 7.5 kg ha^{-1} + Molybdenum 0.5 kg ha^{-1}, respectively.

The increased in yield might be due to positive effect of zinc on yield attributes as it plays an important role in metabolic process (Shanti *et al.,* 2008 and Ahmed *et al.,* 2013).

The increase in seed and haulm yield of blackgram due to zinc might be attributed to the reason that, zinc shows beneficial effects on chlorophyll content and so it indirectly influences the photosynthesis and reproduction.

The channelization of photosynthates during reproductive stage might have been influenced by zinc, by way of its involvement in electron transport (Baker *et al.,* 1982).

Sudharsan and Ramaswami (1993) found that residual effect of $ZnSO_4$ gave good seed and haulm yield in blackgram crop in a groundnut-blackgram cropping system Shanti *et al.,* (2008).

Table.1 Response of different levels of zinc and molybdenum on growth attributes of blackgram (*Vigna mungo* L.)

Treatment combinations	Plant height (cm)		Crop growth rate (g $m^{-2}day^{-1}$)				Number of branches plant $^{-1}$	
	45 DAS	60 DAS	0-15 DAS	15-30 DAS	30-45 DAS	45-60 DAS	45 DAS	60 DAS
T_1 : R.D.F + Zinc 00 kg ha^{-1} + Molybdenum 00kg ha^{-1}	26.19	26.64	0.27	0.34	**0.93**	4.45	4.53	4.53
T_2 : R.D.F + Zinc 00 kg ha^{-1} + Molybdenum 0.5kg ha^{-1}	26.89	27.29	0.27	0.41	**1.21**	4.32	5.73	5.73
T_3 : R.D.F + Zinc 00 kg ha^{-1} + Molybdenum 1.0 kg ha^{-1}	27.65	28.23	0.27	0.69	**1.13**	4.72	6.80	6.80
T_4 : R.D.F + Zinc 5 kg ha^{-1} + Molybdenum 00 kg ha^{-1}	27.44	28.15	0.27	0.61	**0.98**	4.32	5.47	5.47
T_5 : R.D.F+ Zinc 5 kg ha^{-1} + Molybdenum 0.5 kg ha^{-1}	28.03	28.59	0.28	0.70	**1.05**	4.36	6.60	6.60
T_6 : R.D.F + Zinc 5 kg ha^{-1} + Molybdenum 1.0kg ha^{-1}	28.51	29.22	0.28	0.78	**1.20**	4.78	7.00	7.00
T_7 : R.D.F+ Zinc 7.5 kg ha^{-1} + Molybdenum 00 kg ha^{-1}	28.45	29.39	0.28	0.78	**0.98**	4.30	6.20	6.20
T_8 : R.D.F+ Zinc 7.5 kg ha^{-1} + Molybdenum 0.5 kg ha^{-1}	28.94	29.87	0.28	0.79	**1.02**	4.82	6.80	6.80
T_9 : R.D.F+ Zinc7.5 kg ha^{-1}+ Molybdenum 1.0 kg ha^{-1}	**29.29**	**30.51**	**0.30**	**0.85**	**1.35**	**4.91**	**7.40**	**7.40**
F test	S	S	S	S	S	S	S	S
SEd(_+)	0.03	0.13	0.001	0.01	0.01	0.04	0.09	0.09
CD (P=0.05)	0.07	0.27	0.01	0.03	0.45	0.08	0.19	0.19

Table.2 Response of different levels of zinc and molybdenum on yield attributes, yield and protein content in grain of blackgram (*Vigna mungo* L.)

Treatment combinations	Grains per pod (No.)	Grain yield t ha^{-1}	Straw yield t ha^{-1}	Biological yield t ha^{-1}	Protein Content in grain (%)
T_1 : R.D.F + Zinc 00 kg ha^{-1} + Molybdenum 00kg ha^{-1}	4.60	1.01	3.71	4.73	23.80
T_2 : R.D.F + Zinc 00 kg ha^{-1} + Molybdenum 0.5kg ha^{-1}	4.80	1.10	3.80	4.90	23.90
T_3 : R.D.F + Zinc 00 kg ha^{-1} + Molybdenum 1.0 kg ha^{-1}	**5.00**	1.15	3.81	4.96	23.80
T_4 : R.D.F + Zinc 5 kg ha^{-1} + Molybdenum 00 kg ha^{-1}	4.80	1.08	3.71	4.80	24.40
T_5 : R.D.F+ Zinc 5 kg ha^{-1} + Molybdenum 0.5 kg ha^{-1}	4.80	1.11	3.96	**5.08**	24.40
T_6 : R.D.F + Zinc 5 kg ha^{-1} + Molybdenum 1.0kg ha^{-1}	5.00	**1.17**	**4.14**	**5.31**	24.30
T_7 : R.D.F+ Zinc 7.5 kg ha^{-1} + Molybdenum 00 kg ha^{-1}	4.80	1.09	3.87	4.97	**24.70**
T_8 : R.D.F+ Zinc 7.5 kg ha^{-1} + Molybdenum 0.5 kg ha^{-1}	**5.00**	1.13	3.84	4.96	**24.60**
T_9 : R.D.F+ Zinc7.5 kg ha^{-1}+ Molybdenum 1.0 kg ha^{-1}	**5.00**	**1.18**	3.84	**5.02**	**24.70**
F test	NS	S	S	S	S
SEd(_+)	0.18	0.003	0.01	0.02	0.10
CD (P=0.05)	0.39	0.010	0.03	0.04	0.21

This increase was due to the reason that blackgram being a legume crop, fixes the atmospheric nitrogen in the soil. These results corroborate the findings of the Tomar *et al.*, (1996) in groundnut. Almost similar trend was observed in case of no zinc control. In absolute control there was slight decrease of N at harvest of blackgram (Shanti *et al.*, 2008).

This might be due to the fact that molybdenum is helpful in formation of nodules. Similar results were also reported by Singh *et al.*, (2006) and Bhuiyan *et al.*, (2008) and Khan and Prakash (2013)

The increase in yield may be due to increase in the availability of this nutrient with the application of this content (Sharma and Abraham 2010).

Quality parameters of blackgram

Effect of different levels of zinc and molybdenum on protein content in grain (%), revealed significant effect on oil content (%). Significantly the highest protein content (24.70%) was recorded under treatment T_9) R.D.F + Zinc 7.5 kg ha^{-1}+ Molybdenum 1.0 kg ha^{-1} and T_7 R.D.F+ Zinc 7.5 kg ha^{-1} + Molybdenum 00 kg ha^{-1} respectively.

The minimum seed protein content of urdbean was recorded in without zinc application. The increase in seed protein content in grain of urd bean with the application of zinc have also been reported by Krishna (1995) and Singh and Yadav (1997).

The minimum protein contet in grain was recorded in without molybdenum applied plots. The role of molybdenum is well established in improving the quality by nitrogenase enzyme which is helpful in protein synthesis. These results are in agreement with the findings of Jat and Rathore, 1994. It is concluded that T_9 (R.D.F + Zinc7.5 kg ha^{-1} + Molybdenum1.0 kg ha^{-1}.) was best for obtaining maximum growth attributes, yield attributes, yield and protein content in grain of Blackgram. **S**ince the findings were based on the research done in one season it may be repeated for further confirmation.

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