Effect of molybdenum and zinc on Growth and Yield Attributes of Zaid Groundnut (*Arachis hypogaea* L.)

ABSTRACT

The field experiment was conducted during *Zaid* season April-july 2022 at Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P). The aim was to study the effect of soil application of molybdenum and foliar application of zinc on growth and yield of groundnut. The treatments consisted of 3 levels of molybdenum (0.5,1.5,2.0 kg/ha) and zinc(0.25,0.50,0.75% foliar application). The experiment was laid out in randomized block design with ten treatments and were replicated thrice. The soil of experimental plot was sandy loamy in texture, nearly neutral in soil reaction (pH 7.2), low in organic carbon (0.48%) available N (171.48 kg/ha), available P (13.6 kg/ha), available K (215.4 kg/ha), available zinc (0.76ppm) and available Sulphur (12.41ppm). Application of 1.5kg/ha molybdenum with zinc 0.5% treatment-6 recorded Maximum plant height (54.50 cm), highest plant dry weight (54.14g), no. of nodules per plant (47), seed index (42.08 g), no. of pods per plant (23), no. of kernels per pod (2), seed yield (2985 kg/ha), harvest index (43.19%). Minimum parameters were recorded in treatment-10 control plot which is application of recommended dose of fertilizers 20:40:60 kg/ha NPK.

Key words: *Zinc, Molybdenum, G r o w t h , Yield, Groundnut.*

Introduction

"Groundnut (*Arachis hypogaea* L.) is a most important oilseed crop around the world. It is oilseed crop as well as grain legume. Groundnut contains about 20% carbohydrate, 25-30% protein, 50% oil content, and 5% fiber and ash which make groundnut a rich source of nutrition. It is a profitable crop cultivated by millions of small farmers throughout the globe, because of its nutritional and economic value" (**Ramprasad 2020). "**India has been ranking among top three producers of groundnut in the world. Gujarat, Tamil Nadu and Madhya Pradesh being the major producing states in the country. India produces groundnut in an area of 6.09 million/ha and production and productivity of 10.21 million tonnes and 1676 kg/ha" (**Directorate of Economics and Statistics 2022**).

"Molybdenum has a positive effect on yield, quality and nodule formation in legume crops. The functions of molybdenum in leguminous plants include nitrate reduction, nodulation and nitrogen fixation" **(Togay and Dogan 2008)**. " Molybdenum is required for normal plant growth, reduction supply with molybdenum to the growth medium decreased activities of nitrate reductase and glutamine synthetase involved at initial steps of nitrate assimilation" **(Hristozkova *et al.*, 2006). "**Molybdenum is the constituent of nitrate reductase and nitrogenase enzymes. It is involved in reduction of nitrates for protein synthesis in all plants" **(Hazra and Som, 1999)**.

"Zinc plays as activator of several enzymes in plants and is directly involved in the biosynthesis of growth substances such as auxin which produces more plant cells and more dry matter. Some investigators reported that foliar spraying with zinc could correct zinc deficiency, improve growth, yield and seed quality of groundnut" (**Habbasha., 2014)**. "Zinc known to be the constituent of enzyme and also involved in synthesis of pyruvic decarboxylase and indole acetic acid. Zinc is required in various metabolic processes as catalysts.it also increases the content of protein, calorific value, amino acid and fat in oilseed crop. Zinc catalyses the process of oxidation in plant cells and is vital for transformation of carbohydrates, regulates the consumption of sugar, increases source of energy for the production of chlorophyll, aids in the formation of auxin and promotes absorption of water" **(Radhika and Meena 2021)**. Therefore, choice of a variety with suitable dose of zinc is necessary to enhance the productivity of groundnut. Hence, an experiment was planned to study the influence of levels Mo and Zn on growth and yield of summer groundnut.

Material and Methods:

A field experiment was conducted during *Zaid* season April-july 2022 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of agriculture Technology and Sciences, Prayagraj (U.P.) India which is located at 25^0 39‟ 42” N latitude, $81^0$67‟56” E longitude and 98 m altitude above the mean sea level. This area is situated on the right side of the Yamuna River by the side of Prayagraj-Rewa road about 5 km from the city. The soil of experimental plot was sandy loamy in texture, nearly neutral in soil reaction (pH 7.2), low in organic carbon (0.48%) available N (171.48 kg/ha), available P (13.6 kg/ha), available K (215.4 kg/ha), available zinc (0.76ppm) and available Sulphur (12.41ppm). The experiment was laid out in randomized block design comprised of levels of Molybdenum (0.5, 1.5, 2.0 kg/ha) and Zinc (0.25, 0.50, 0.75 % as foliar application) with ten treatments and each were replicated thrice viz. Observations were recorded 15 days interval (20, 40, 60, 80 DAS and at harvest). The observations were recorded for plant height (cm), plant dry weight (g), crop growth rate (g/m2/day), relative growth rate (g/g/day), number of nodules (no.), number of pods/plant (no.), kernels/pod (no.), seed index (g), pod yield (kg/ha), haulm yield (kg/ha), harvest index (%). “The collected data was subjected to statistical analysis by analysis of variance method” **(Gomez and Gomez, 1976).**

The treatments consist of T1- 0.5 kg/ha molybdenum + 0.25% zinc foliar, T2- 0.5 kg/ha molybdenum+ 0.50% zinc foliar, T3- 0.5 kg/ha molybdenum+ 0.75% zinc foliar, T4- 1.5kg/ha molybdenum+ 0.25% zinc foliar, T5- 1.5 kg/ha molybdenum + 0.50% zinc foliar, T6- 1.5kg/ha molybdenum+ 0.75% zinc foliar, T7- 2.0kg/ha molybdenum + 0.25% zinc foliar, T8- 2.0 kg/ha molybdenum + 0.50% zinc foliar, T9- 2.0kg/ha molybdenum + 0.75% zinc foliar, and T10- control plot. The experiment was laid out in Randomized Block Design, with 10 treatments replicated thrice.

Result and Discussion

Pre harvest

Plant height - At 100 DAS, Significantly higher plant height (54.50 cm) was recorded in treatment-6 1.5kg/ha molybdenum along with 0.75% zinc foliar spray. However, treatment -9 2.0 kg/ha molybdenum along with 0.75% zinc foliar (53.30 cm) was found to be statistically par to treatment-6. Minimum plant height were observed in treatment-10 control (47.20 cm). The improvement in these growth characters might be due to the fact that molybdenum is a constituent of enzyme nitrogenase, which is essential for the process of symbiotic N2 fixation. These findings are in close conformity with the results obtained by **Singh *et al.* (2014) & Movalia *et al*. (2018)**. The increase in plant height may be attributed to role of zinc as a catalystor stimulant in most of physiological and metabolic process and it also important in synthesis of trytophane, a component of some protein and a compound needed for production of growth hormones (auxins) like indole acetic acid. Similar results were also reported by **Halepyati (2001)**

Plant dry weight - At 100 DAS, Significantly maximum dry weight (54.14 g) was recorded in treatment-6 1.5kg/ha molybdenum along with 0.75% zinc foliar spray. However, treatment -9 2.0 kg/ha molybdenum along with 0.75% zinc foliar (53.51 g) was found to be statistically par to treatment-6. Minimum dry weight were observed in treatment-10 control (44.13 g). The improvement in these growth characters might be due to the fact that molybdenum is a constituent of enzyme nitrogenase, which is essential for the process of symbiotic N_2 fixation. These findings are in close conformity with the results obtained by **Singh *et al.* (2014).** The increase in dry weight may be attributed to role of zinc as a catalyst or stimulant in most of physiological and metabolic process and it also important in synthesis of trytophane, a component of some protein and a compound needed for production of growth hormones (auxins) like indole acetic acid. Similar results were also reported by **Halepyati (2001).**

Number of Nodules- At 100 DAS, Significantly more no. of nodules per plant (47 n/plant) was recorded in treatment-6 1.5 kg/ha molybdenum along with 0.75% zinc foliar spray. However, treatment-9 2.0 kg/ha molybdenum along with 0.75% zinc foliar (46 n/plant) was found to be statistically par to treatment-6. Minimum dry weight were observed in treatment-10 control (41 n/plant). Molybdenum have favoured plant vegetative growth, these findings are close conformity with results obtained by **Movalia et al. (2018).** Zinc might have stimulated the activities of microorganisms that made the plant nutrients readily available to the crops which augmented higher nodule growth resulted in higher photosynthesis and consequently the higher growth rate might have resulted in favorable effect on growth attributes viz., dry matter accumulation and root nodulation, these findings are close conformity with results obtained by **Halepyati (2001).**

Post-harvest

Number of pods/plant- Significantly higher number of pods/ plant (22.85 pods/plant) was recorded in treatment-6 1.5 kg/ha molybdenum along with zinc 0.75% foliar spray. However, treatment-9 2kg/ha molybdenum along with zinc 0.75% foliar spray (22.50 pods/plant) were found to be statistically at par with treatment-6. Minimum no. of pods/plant were observed in treatment-10 control (16 pods/plant). The improvement in photosynthesis and carbohydrate metabolism resulting into greater formation of photosynthetic and metabolites in source and later on translocated in the newly formed sinks which ultimately increased number of pods/plant These results are in agreement with the findings of **Movalia *et al.* (2018) & Singh *et al*. (2014).**

Kernels/pod- Significantly higher number of pods/ plant (2 kernels/pods) was recorded in treatment-6 1.5 kg/ha molybdenum along with zinc 0.75% foliar spray. Minimum no. of kernels/pods were observed in treatment-10 control (1 kernels/pods). The availability and optimum regular supply of plant nutrients might have favorably influenced the flowering and kernel formation which ultimately increased pods/plant. Those results are in conformity with those of **Movalia *et al.* (2018).**

Seed index (g)- The statistical analysis on test weight was found to be significant. Highest seed index (42.08 g) was recorded with treatment-6 1.5kg molybdenum along with 0.75 % zinc. However, treatment-9 2 kg molybdenum along with 0.75% zinc were found to be statistically on par with treatment-6. Minimum no. of seed index were observed in treatment-10 control (34.68 g).

Pod yield (t/ha)- The seed yield showed increasing trend with the application of molybdenum and zinc in groundnut. The highest seed yield was obtained with the treatment- 6 1.5kg molybdenum along with 0.75 % zinc (2985 kg/ha). However, treatment- 9 with 2 kg molybdenum along with 0.75 % zinc (2899 kg/ha) were found to be statistically on par with treatment-6. Minimum no. of seed yield (2149 kg/ha) were observed in treatment-10 control. Yield increases with increase in Mo application might be due to increased growth characters and yield attributes because of its unique role in enhancing N-fixation, thereby increasing N availability to plants for efficient growth and development which might have enhanced photosynthesis and synthesis other metabolites for plant use. Similar finding were reported by **Halepyati (2001) & Movalia *et al.* (2018).**

Haulm yield (t/ha)- The haulm yield of groundnut was also influenced by the application of molybdenum and zinc. Highest haulm yield (3947 kg/ha) was recorded highest in treatment-6 1.5 kg/ha molybdenum along with 0.75 % zinc. However, treatment-9 with 2 kg/ha molybdenum along with 0.75 % zinc (3893) was found to be statistically on par with treatment-6. Minimum no. of seed yield (2284 kg/ha) were observed in treatment-10 control. This result also in conformity with those of **Bhagiya *et al.* (2005) and Bhuiyan *et al.* (2008).**

Harvest index (%)- The data showed significant difference in treatment-6 1.5kg molybdenum along with 0.75 % zinc (43.19 %) harvest index. However, treatment- 9 with 2kg molybdenum along with 0.75 % zinc (42.91 %) were found to be statistically at par with treatment- 6.

CONCLUSION

From the results, it was concluded that with the application of molybdenum 1.5 kg/ha along with zinc 0.75 % foliar spray (treatment-6), has performs positively and improves better growth and yield parameters. Maximum pod yield (kg/ha) was highest in molybdenum 1.5 kg/ha along with zinc 0.75 % foliar spray (treatment-6) since it is economically more profitable and hence, can be recommended to the farmers. Minimum parameters were recorded in treatment-10 control plot which is application of recommended dose of fertilizers 20:60:40 kg/ha NPK.

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Table 1. Effect of Molybdenum and Zinc on growth attributes of Groundnut.

S No.	Treatment combination	100 DAS			80-100 DAS	
		Plant height (cm)	Dry weight (g)	No. of nodules / plant (No.)	CGR ($g/m^2/day$)	RGR (g/g/day)
1.	0.5kg/ha molybdenum + 0.25% zinc foliar spray	47.90	46.02	41.90	6.67	0.0020
2.	0.5kg/ha molybdenum + 0.50% zinc foliar spray	48.10	47.95	42.10	6.05	0.0017
3.	0.5kg/ha molybdenum + 0.75% zinc foliar spray	49.07	49.06	43.07	7.28	0.0020
4.	1.5kg/ha molybdenum + 0.25% zinc foliar spray	49.40	48.69	43.40	7.78	0.0022
5.	1.5kg/ha molybdenum + 0.50% zinc foliar spray	49.67	50.51	46.33	6.78	0.0018
6.	1.5kg/ha molybdenum + 0.75% zinc foliar spray	54.50	54.14	47.37	2.64	0.0007
7.	2.0kg/ha molybdenum + 0.25% zinc foliar spray	50.10	50.03	44.10	6.72	0.0018
8.	2.0kg/ha molybdenum + 0.50% zinc foliar spray	51.00	49.30	45.00	7.94	0.0022
9.	2.0kg/ha molybdenum + 0.75% zinc foliar spray	53.30	53.51	46.97	6.17	0.0016
10.	Control	47.20	44.13	41.20	5.11	0.0016
	F-test	S	S	S	NS	NS
	SEm±	0.30	0.74	0.20	1.17	0.0003
	CD (p=0.05)	0.90	2.21	0.60	-	-

Table 2. Effect of Molybdenum and Zinc on yield and yield attributes of Groundnut.

S. No.	Treatment combinations	No.of pods/plant(cm)	No. of kernels/ pod	Seed index (g)	Pod yield (kg/ha)	Haulm yield (kg/ha)	Harvest index (%)
1.	0.5kg/ha molybdenum + 0.25% zinc foliar spray	17.36	1.53	35.39	2280	3434	39.87
2.	0.5kg/ha molybdenum + 0.50% zinc foliar spray	18.24	1.56	35.63	2346	3507	40.08
3.	0.5kg/ha molybdenum + 0.75% zinc foliar spray	18.65	1.60	36.02	2419	3518	40.74
4.	1.5kg/ha molybdenum + 0.25% zinc foliar spray	19.12	1.65	36.22	2548	3583	41.55
5.	1.5kg/ha molybdenum + 0.50% zinc foliar spray	19.57	1.67	37.07	2553	3591	41.55
6.	1.5kg/ha molybdenum + 0.75% zinc foliar spray	22.85	2.09	42.08	2985	3947	43.19
7.	2.0kg/ha molybdenum + 0.25% zinc foliar spray	20.54	1.71	38.24	2679	3698	42.01
8.	2.0kg/ha molybdenum + 0.50% zinc foliar spray	20.95	1.78	39.35	2791	3770	42.54
9.	2.0kg/ha molybdenum + 0.75% zinc foliar spray	22.50	2.00	41.65	2899	3893	42.91
10.	Control	21.53	1.87	40.34	2149	2284	41.62
	F-test	S	S	S	S	S	S
	SEm±	0.23	0.03	0.19	46.97	32.92	0.45
	CD (p=0.05)	0.69	0.10	0.58	139.54	92.82	1.35