Original Research Article

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

ABSTRACT

The experiment was conducted in CRF department of agronomy during summer season of 2022 on groundnut crop. The aim was to study the effect of soil application of molybdenum and foliar application of zinc and 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) . application of 1.5kg/ha molybdenum with zinc 0.5% recorded Maximum plant height (54.50 cm), highest plant dry weight (54.14g), no.of

nodules per plant (47.37), seed index (42.08 g), no.of pods per plant (22.85) ,no.of kernels per pod (2.09), seed yield(2985 kg/ha), harvest index (43.19%) and recorded higher net return (1,31,578.00₹/ha), gross return (1,94,045.00₹/ha) and benefit: cost ratio (2.11).

***Key words*: economics, growth, groundnut, molybdenum, yield ,zinc**

Introduction:

Groundnut (*Arachis hypogaea* L.) is a most important oilseed crop around the world. It is oilseed crop as well as grain legume. Peanut 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 of 2021-22 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of agriculture Technology and Sciences, Prayagraj (U.P.) India. The soil of experimental plot was sandy loamy in texture, nearly neutral in soil reaction (pH 7.8), low in organic carbon (0.35%), The treatments consist of 0.5 kg/ha molybdenum + 0.25% zinc foliar, 0.5 kg/ha molybdenum+ 0.50% zinc foliar, 0.5 kg/ha molybdenum+ 0.75% zinc foliar, 1.5kg/ha molybdenum+ 0.25% zinc foliar, 1.5 kg/ha molybdenum + 0.50% zinc foliar, 1.5kg/ha molybdenum+ 0.75% zinc foliar, 2.0 kg/ha molybdenum + 0.25% zinc foliar, 2.0 kg/ha molybdenum + 0.50% zinc foliar, 2.0kg/ha molybdenum + 0.75% zinc foliar, and control plot. The experiment was laid out in Randomized Block Design, with 10 treatments replicated thrice. The observations were recorded for plant

height, plant dry weight, Crop growth rate (g/m2/day), Relative growth rate, Number of nodules, Number of pods/plant, Kernels/pod, seed index, seed yield, Haulm yield, Harvest index. The collected data was subjected to statistical analysis by analysis of variance method **(Gomez and Gomez, 1976).**

Result and Discussion

Pre harvest

Plant height - At 100 DAS, Significantly higher plant height (54.14 cm) was recorded in treatment-6(1.5kg/ha molybdenum +0.75% zinc foliar). However, treatment -9(2.0kg/ha molybdenum + 0.75% zinc foliar)) the significantly higher plant height might be due to with the application ofmolybdenum levels and zinc. 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) & 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 higher plant dry weight (54.14g/plant) was recorded in treatment-6(1.5kg/ha molybdenum +0.75% zinc foliar). However, treatment -7 (2.0kg/ha molybdenum + 0.25% zinc foliar)) the significantly higher plant dry weight might be due to with the application ofmolybdenum levels and zinc. 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 symbioticN_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 higher number of nodules/plants (47.37) was recorded in treatment-6(1.5kg/ha molybdenum +0.75% zinc foliar). However, treatment -5 (1.5 kg/ha molybdenum +0.50% zinc foliar) the significantly higher number of nodules might be due to with the application ofmolybdenum levels and zinc. molybdenum supplied in optimum quantity seems to 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 areclose conformity with results obtained by **Halepyati (2001)**

Post harvest

Number of pods/plant

Significantly higher number of pods/ plant (22.85) however , 2kg/ha molybdenum +0.75% zinc were found to be statistically on par with 1.5 kg molybdenum + 0.75% zinc 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 kernels/pod (2.09)) however , 2kg/ha molybdenum +0.75% zinc were found to be statistically on par with 1.5 kg molybdenum + 0.75% zinc The beneficial effect of organic manuring might be due to improvement in the physical condition of soil as well as increased availability of plant nutrients, which results increasing kernels/pod

.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 seed index was found to be significant highest seed index (42.08g) was recorded with treatment 1.5kg molybdenum +0.75% zinc. however, 2kg molybdenum +0.75% zinc were found to be statistically on par with 1.5 kg molybdenum + 0.75% zinc Seed index was influenced by the application of molybdenum and zinc which might be due to charactershighly influenced by its genetic makeup.

Seed 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 1.5kg molybdenum + 0.75 % zinc (2985 kg/ha).Treatment with 2kg molybdenum + 0.75 % zinc were found to be statistically on par with 1.5kg molybdenum + 0.75 % zinc.

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 2kg molybdenum + 0.75 % zinc. Treatment with 1.5kg molybdenum + 0.75 % zinc was found to be statistically on par with 2kg molybdenum + 0.75 %zinc.

Application of poultry manure and vermicompost to groundnut which result to slowly releasing available nutrients were had favourable effect on growth and biomass production similar results were reported by **Chauhan *et al.* (2013) & Movalia *et al*. (2018)**

Harvest index (%)

The data showed significant difference in 1.5kg molybdenum + 0.75 % zinc (43.19) harvest index. however, treatment with 2kg molybdenum + 0.75 % zinc were found to be statistically on par with 1.5kg molybdenum + 0.75 % zinc.

Gross Returns (₹/ha)

Data pertaining to the gross returns as influenced by various treatments are presented in Table 3 Gross returns (1,94,045.00₹ /ha) was found to be highest in treatment with application 1.5kg molybdenum + 0.75 % zinc and the minimum gross (1,48,222₹/ha) was found to in treatment with application of 0.5kg molybdenum + 0.25 % zinc as compared to other treatments.

Net Returns (₹/ha)

Data pertaining to the net returns as influenced by various treatments are presented in Table 3. Net returns (1,31,578.00₹/ha) was found to be highest in treatment with application of 1.5kg molybdenum + 0.75 % zinc and the minimum gross (88,014.00₹/ha) was found to be in treatment with application of 0.5kg molybdenum + 0.25 % zinc as compared to other treatments

Benefit Cost Ratio (₹/ha)

Data pertaining to the B:C ratio as influenced by various treatments are presented in Table 3.Benefit cost ratio (2.11) was found to be highest in treatment with application of 1.5kg molybdenum + 0.75 % zinc and the minimum Benefit cost ratio (1.46) was foundto be in treatment with application of 0.5kg molybdenum + 0.25 % zinc as compared to other treatments.

CONCLUSION

It was concluded that with the application of molybdenum 1.5 kg/ha along with the Zinc 0.75% foliar application (Treatment-6), recorded higher yield attributes & yield and also maximum benefit cost ratio

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Table 1. Effect of plant height of Groundnut as influenced by Calcium and Boron.

S No	Treatments	100 DAS			During 60-80 DAS	
		plant height (cm)	Number of nodules/plant	Plant dry weight (g/plant)	Crop Growth Rate ($g/m^2/day$)	Relative growth rate (g/g/day)
1.	0.5kg/ha molybdenum+ 0.25% zinc foliar	47.90	41.90	46.02	34.16	0.0221
2.	0.5kg/ha molybdenum+ 0.50% zinc foliar	48.10	42.10	47.95	37.24	0.0229
3.	0.5kg/ha molybdenum + 0.75% zinc foliar	49.07	43.07	49.06	37.18	0.0224
4.	1.5kg/ha molybdenum + 0.25% zinc foliar	49.40	43.40	48.69	35.57	0.0214
5.	1.5kg/ha molybdenum + 0.50% zinc foliar	49.67	46.33	50.51	38.19	0.0215
6.	1.5kg/ha molybdenum + 0.75% zinc foliar	54.50	47.37	54.14	45.49	0.0222
7.	2.0kg/ha molybdenum + 0.25% zinc foliar	50.10	44.10	50.03	38.03	0.0218
8.	2.0kg/ha molybdenum+ 0.50 % zinc foliar	51.00	45.00	49.30	36.36	0.0217
9.	2.0kg/ha molybdenum+ 0.75 % zinc foliar	53.30	46.97	53.51	35.34	0.0212
10.	Control	53.20	46.20	54.13	43.15	0.0225
	F-test	S	s	S	NS	NS
	Sem±	0.26	0.20	0.66	2.80	0.0010
	CD at 5%	0.79	0.600	1.96	_	

Table 2. Effect of yield and yield attributes of Groundnut as influenced by Molybdenum and Zinc foliar .

S No	Treatments	No. of pods/ plant	No. of kernels/ pod (g)	Seed index (g)	Seed yield (kg/ha)	Haulm yield (kg/ha)	Harvest index (%)
1.	0.5kg/ha molybdenum + 0.25% zinc foliar	17.36	1.53	35.39	2280	3434	39.87
2.	0.5kg/ha molybdenum + 0.50% zinc foliar	18.24	1.56	35.63	2346	3507	40.08
3.	0.5kg/ha molybdenum + 0.75% zinc foliar	18.65	1.60	36.02	2419	3518	40.74
4.	1.5kg/ha molybdenum + 0.25% zinc foliar	19.12	1.65	36.22	2548	3583	41.55
5.	1.5kg/ha molybdenum + 0.50% zinc foliar	19.57	1.67	37.07	2553	3591	41.55
6.	1.5kg/ha molybdenum + 0.75% zinc foliar	22.85	2.09	42.08	2985	3927	43.19
7.	2.0kg/ha molybdenum + 0.25% zinc foliar	20.54	1.71	38.24	2679	3698	42.01
8.	2.0kg/ha molybdenum + 0.50% zinc foliar	20.95	1.78	39.35	2791	3770	42.54
9.	2.0kg/ha molybdenum + 0.75% zinc foliar	22.50	2.00	41.65	2966	3947	42.91
10.	N : P : K - 20: 40 : 60 (control)	21.53	1.87	40.34	2769	3884	41.62
	F-test	S	S	S	S	S	NS
	Sem±	0.23	0.03	0.19	42.29	25.76	0.45
	CD at 5%	0.69	0.10	0.58	125.64	76.53	1.35

Table 3. Effect of molybdenum and zinc on economics of production of groundnut

Treatment No.	Treatment combinations	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	Benefit: Cost ratio
1.	0.5kg/ha molybdenum + 0.25% zinc foliar	60,208.00	1,48,222.00	88,014.00	1.46
2.	0.5kg/ha molybdenum + 0.50% zinc foliar	60,396.00	1,52,495.00	92,099.00	1.52
3.	0.5kg/ha molybdenum + 0.75% zinc foliar	60,583.00	1,57214.00	96,631.00	1.60
4.	1.5kg/ha molybdenum + 0.25% zinc foliar	62,092.00	1,65,616.00	1,03,524.00	1.67
5.	1.5kg/ha molybdenum + 0.50% zinc foliar	62,280.00	1,65,976.00	1,03,696.00	1.66
6.	1.5kg/ha molybdenum + 0.75% zinc foliar	62,467.00	1,94,045.00	1,31,578.00	2.11
7.	2.0kg/ha molybdenum + 0.25% zinc foliar	63,054.00	1,74,139.00	1,11,085.00	1.76
8.	2.0kg/ha molybdenum + 0.50% zinc foliar	63,242.00	1,81,438.00	1,18,196.00	1.87
9.	2.0kg/ha molybdenum + 0.75% zinc foliar	63,429.00	1,92,781.00	1,29,352.00	2.04
10.	N : P : K - 20: 40 : 60 (control)	58,021.00	179,990.00	1,21,969.00	2.10