Effect of micronutrients on growth and yield of groundnut (Arachis hypogea L.) varieties

ABSTRACT: A field experimental trail on groundnut was conducted during summer season of 2022 at Crop Research Farm (CRF), Department of Agronomy, SHUATS, Prayagraj (U.P.) to evaluate the effect of micronutrients on growth and yield of groundnut (Arachis hypogea L.) varieties. The soil of the experiment plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.7), low in organic carbon (0.44%), available N (171.48 kg/ha), available P (27.00 kg/ha), available K (291.20 kg/ha). The experiment was laid out in Randomized Block Design (RBD) with nine treatments replicated thrice. In the view of this experiment, the treatments consist of combinations of zinc (0.5%), boron (0.2%), zinc+ boron (0.5%+0.2%) as foliar spray and varieties (Kadiri 6, Kadiri 9, Kadiri Amaravati). Application of (0.5% + 0.2%) Zn + B (foliar) with variety Kadiri 6 produced higher Plant height (26.60cm), Nodules/plant (49.14), more Plant dry weight (15.68 g/plant). Maximum No. of pods/plant (27.87), Kernels/pod (2.66), Seed index (40.13 g), Seed yield (2.48 t/ha), Haulm yield (5.67 t/ha) and Harvest index (30.44 %). Thus, with the use of (0.5% + 0.2%) Zn + B (foliar) along with the use of the variety Kadiri 6 could be a promising option for yield enhancement in groundnut.

Keywords: Groundnut, Zinc, Boron, Kadiri 6, Kadiri 9, Kadiri Amaravati, Growth, yield.

INTRODUCTION

Groundnut (*Arachis hypogaea*) is an important oilseed and a grain legume. It belongs to family Leguminaceae and is fourth most important source of edible oil and third most important source of vegetable protein also known as “The King of Oilseeds”. India occupies first place in terms of area and second in terms of production of groundnut. Groundnut crop area in India is at 40.12 lakh per ha in 2018-2019. Similarly, production is estimated at 37.70 lakh tonnes per ha (Vali *et al.*, 2020). It is premier oil seed crop of India popularly known as peanut, monkey nut, manila nut. Globally 50% of groundnut is used for oil extraction, 37% confectionary and 12% seed purpose (Nurezannat *et al.*, 2019). According to Satish *et al.* (2011), groundnut is primarily used for extraction of oil, with an analysis of about 46.70%. It is also consumed directly because of its high food value, which is again due to its higher content of protein (22.0%), carbohydrate (10.0%) and minerals (3.0%).

Zinc is one of the most important nutrient required for plant growth. It plays as an 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. Zinc plays vital role in plant growth and development. Zinc also catalyses the biosynthesis of indole acetic acid, acting as metal activator of the enzyme, there by ultimately increasing crop yield. Some investigators reported that foliar spraying with zinc could correct zinc deficiency, improve growth, yield and seed quality of groundnut. zinc required for chlorophyll production, pollen function, fertilization and germination (Dadhich *et al.*, 2019).

Among nutrient deficiencies, B deficiency has been identified as a serious agricultural issue in more than 100 crops in 80 countries explored that among 73,630 analysed soil samples collected from all around of India, 18.3% of soils were found deficient in B. Hence deficient of boron in India which results in the significant crop losses both in yield and quality of field

crops. In groundnut the B deficiency results in poor pollen viability, reduced peg formation, low pod filling, shrived seeds and hallows heart symptoms are commonly observed causing yield loss in 20-40 percent (Ansari *et al.*, 2014). Boron helps in germination and growth of pollen grains and development of pollen tube thus facilitating fertilization in plant and grain yield. The flowering period was extended in boron deficient plants. Boron element plays major role in the process of physiological of crops, like, regulated metabolism of carbohydrate, contribute in synthesis of protein, and help seed formation. Boron had essential role in saving flowering and fruit regulation in legumes and in peanut crop (Balla *et al.*, 2020).

Variety is the most important factor in groundnut production. Use of high yielding varieties has been increased remarkably in recent years and the country has reached almost a level of sufficiency in groundnut. The varieties which may be suited to early kharif is quite different from rest of the seasons with respect to growth habit. Optimum plant population with unit area per hectare for a given variety at specific situation not only reduce the cost of cultivation but also augment to the full yield potential of the cultivar (Dileep *et al.*, 2021). Variety Kadiri 6 is released from the Agriculture Research Station, Kadiri Andhra Pradesh. Its parentage is JL24 x AH 316. It was released in the year 2002. The Crop duration 100-105 (kharif) 110-115 (rabi). Its average Yield in quintal /ha is 20-25 (kharif) and 40-45 (rabi). The Oil percentage is 48% and shelling is 74%. 100 Kernel weight (g) is 35-40g. The salient features are it is early variety, high yielding, spanish bunch, attractive kernel, and synchronous maturity.

MATERIALS AND METHODS

A field trial was conducted during summer season of 2022 at Crop Research Farm (CRF), Department of Agronomy, SHUATS, Prayagraj (U.P.), India which is located at 25.40˚ N latitude, 81.85 ˚ E longitude, and 98 m altitude above the mean sea level (MSL). The soil of the experiment plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.7), low in organic carbon (0.44%), available N (171.48 kg/ha), available P (27.00 kg/ha), available K (291.20 kg/ha). Nutrient sources were Urea, Single Super Phosphate and Murate of Potash to fulfill the requirement of Nitrogen, Phosphorus and Potassium respectively. The experiment was laid out in Randomized Block Design (RBD) with nine treatments replicated thrice. RDF of 20:40:40 NPK kg/ha was used in all treatments as basal dose, also the foliar application of the nutrients Zinc and Boron was done according to the treatments. Seeds were dibbled manually at the seed rate of 100 kg/ha at a depth of 4-5 cm at a spacing of 30 cm X 10 cm. The growth parameters of the plants were recorded at frequent intervals from germination up until harvest and finally, the yield parameters were recorded after harvest. These parameters were statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design.

RESULTS AND DISCUSSION

Plant height (cm)

The significantly taller plant height (26.60 cm) at 60 DAS was recoded in treatment 7 with (0.5% + 0.2%) Zn + B (foliar) with variety Kadiri 6. However, treatments with 0.5 % Zinc (foliar) + Kadiri 6 (26.10 cm) and (0.5 % + 0.2 %) Zn+ B (foliar) + Kadiri 9 (26.31 cm) were found to be statistically at par with (0.5 % + 0.2 %) Zn+ B (foliar) + Kadiri 6.

With the application of boron and zinc the plant height gradually increased, which might be attributable to greater photosynthetic activity and chlorophyll synthesis, formation of new plant cells, elevated level of IAA, development of meristematic tissues, cell elongation and tissue differentiation and sugar transportation resulting into better vegetative growth. Kadiri 6 variety outperformed other varieties and achieved higher plant height over Kadiri 9 and Kadiri Amaravati. The results were found to be in accordance with Suhathiya and Ravichandran (2018) and Mani *et al.* (2021).

Number of nodules per plant

The significantly higher number of nodules/plant (49.14) at 60 DAS were recorded with the treatment 7 with (0.5% + 0.2 %) Zn+ B (foliar) + Kadiri 6. However, treatment with 0.5 % Zinc (foliar) + Kadiri 6 (48.66) and (0.5 % + 0.2 %) Zn+ B (foliar) + Kadiri 9 (48.89) which were found to be statistically at par with (0.5 % + 0.2 %) Zn+ B (foliar) + Kadiri 6.

The variety Kadiri 6 recorded higher nodules compared to the Kadiri 9 and Kadiri Amaravati varieties. The probable reason for this might be the genetical potential of the variety that has helped in producing higher number of nodules and the results were similar to Jiotode *et al.* (2017).

Plant dry weight (g)

The significantly maximum dry weight (6.56 g) was recorded with treatment 7 with (0.5 % + 0.2 %) Zn+ B (foliar) + Kadiri 6. However, treatment with (0.5 % + 0.2 %) Zn+ B (foliar) + Kadiri 9 (6.44) which was found to be statistically at par with (0.5 % + 0.2 %) Zn + B (foliar) + Kadiri 6.

Dry weight was increased significantly with levels of zinc and boron generally influences cell division and nitrogen absorption from the soil might enhanced plant growth which reflects in terms of plant dry weight and Kadiri 6 variety showed highest dry weight due to the higher growth and biomass accumulation compared to other varieties. These findings are in harmony with those obtained by Subasinghe *et al.* (2003) and Shendage *et al.* (2018)

Crop growth rate (g/m^2/day) and Relative growth rate (g/g/day)

Between 60-80 DAS Crop Growth Rate and Relative Growth Rate showed significant difference among the treatments.

Yield attributes

The significantly higher number of pods/plant (27.87), number of kernels per pod (2.66) and seed index (40.13 g) were found with treatment 7 (0.5% + 0.2%) Zn + B (foliar) with variety Kadiri 6. However, the treatments 0.5 % Zinc (foliar) + Kadiri 6 (27.26) and (0.5 % + 0.2%) Zn+ B (foliar) + Kadiri 9 (27.51) which were found to be statistically at par with (0.5 % + 0.2 %) Zn+ B (foliar) + Kadiri 6.

The positive effect of boron may be due to key role in plant metabolism and in the synthesis of nucleic acid and Zinc plays a very important role in the metabolism of the plant process by influencing the activity of growth enzymes as well as it is involved in carbohydrate metabolism, maintenance of the integrity of cellular membranes, protein synthesis, and regulation of auxin synthesis and pollen formation. Similar findings were under the conformity of Tekale *et al.* (2009). The enhancement effect on Kernels/pod and pods/plant attributed to the favorable influence of the Zn and Boron application to crops on nutrient metabolism, biological activity, and growth parameters and hence, applied zinc resulted in

taller and higher enzyme activity which in turn encourage more kernels/pod and pods/plant. Similar findings have been reported earlier by El-Habbasha *et al.* (2013). Increase in this attribute by foliar spray might be due to the involvement of the sprayed zinc and boron in enzyme activation, membrane integrity, chlorophyll formation, stomatal balance and starch utilization at early stages which enhanced accumulation of assimilate in the grains resulting in heavier grains. The results were found similar to Jaiswal *et al.* (2015).

Yield

Significantly higher seed yield (2.48 t/ha), haulm yield (5.67 t/ha) and harvest index (30.44%) were found in treatment 7 with (0.5% + 0.2%) Zn + B (foliar) with variety Kadiri 6. However, the treatments 0.5 % Zinc (foliar) + Kadiri 6 (2.26 t/ha) and (0.5 % + 0.2 %) Zn+ B (foliar) + Kadiri 9 (2.38 t/ha) which were found to be statistically at par with (0.5 % + 0.2 %) Zn+ B (foliar) + Kadiri 6.

Boron takes place in many physiological processes of plant such as chlorophyll formation, stomatal regulation, starch utilization which enhances seed yield. Boron is a required for many physiological processes and plant growth, also adequate nutrition is a critical for increase yields and quality of crops. Zinc also converts ammonia to nitrate in crops which contribute to yield. These results are in confirmatory with the work of Gowthami and Ananda (2017). The performance of Kadiri 6 variety as regard of pods/plant and kernels/pod was found to be superior. The probable reason for this may be the genetic make-up of the variety that has helped in improving the photosynthetic activity due to increased source capacity and efficient translocation of photosynthesis to the sink. The results were in accordance to Dileep *et al.* (2020). The performance of ground nut varieties in respect of seed yield was very encouraging
and followed a similar trend that of yield attributes. The variety Kadiri 6 recorded higher stover yield over other varieties might be due to the higher production efficiency and higher bio mass accumulation that has been reflected through improvement in different yield attributing characters. Similar findings were reported by Rajpal Bochliya *et al*. (2020).

CONCLUSION

Based on my research trail, the treatment combination of (0.5% + 0.2%) Zn + B (foliar) with variety Kadiri 6 was found to be more productive. Although the findings are based on one season further research is needed to confirm the findings and their recommendation.

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Table 1. Effect of Micronutrients on growth and growth attributes of groundnut varieties.

S No.	Treatment Combinations	60 DAS			60 DAS- 80 DAS	
		Plant Height (cm)	Number of Nodules/plant	Dry weight (g)	Crop Growth Rate ($g/m^2/day$)	Relative Growth Rate (g/g/day)
1.	0.5 % Zinc (foliar) + Kadiri 6	26.10	48.66	6.32	14.56	0.0486
2.	0.5 % Zinc (foliar) + Kadiri 9	25.64	47.72	6.04	14.48	0.0466
3.	0.5 % Zinc (foliar) + Kadiri Amaravati	24.34	46.83	5.61	14.72	0.0463
4.	0.2 % Boron (foliar) + Kadiri 6	25.80	48.10	6.23	14.82	0.0453
5.	0.2 % Boron (foliar) + Kadiri 9	24.66	47.08	5.78	15.18	0.0443
6.	0.2 % Boron (foliar) + Kadiri Amaravati	23.90	46.36	5.35	15.19	0.0440
7.	(0.5 % + 0.2 %) Zn+ B (foliar) + Kadiri 6	26.60	49.14	6.56	14.69	0.0456
8.	(0.5 % + 0.2 %) Zn+ B (foliar) + Kadiri 9	26.31	48.89	6.44	14.97	0.0446
9.	(0.5 % + 0.2 %) Zn+ B (foliar) + Kadiri Amaravati	25.18	47.54	5.93	15.19	0.0446
	F-test	S	S	S	NS	NS
	SEm (±)	0.17	0.16	0.05	0.38	0.00
	CD (p=0.05)	0.52	0.48	0.14	-	-

Table 2. Effect of Micronutrients on yield and yield attributes of groundnut varieties.

S No.	Treatment Combinations	At Harvest					
		No. of pods/plant	No. of kernels/Pod	Seed Index (g)	Seed yield (t/ha)	Stover yield (t/ha)	Harvest Index (%)
1.	0.5 % Zinc (foliar) + Kadiri 6	27.26	2.29	39.63	2.26	5.40	29.52
2.	0.5 % Zinc (foliar) + Kadiri 9	26.53	1.97	38.13	1.99	5.00	28.50
3.	0.5 % Zinc (foliar) + Kadiri Amaravati	25.54	1.84	37.38	1.70	4.14	29.08
4.	0.2 % Boron (foliar) + Kadiri 6	26.85	2.05	38.25	2.16	5.15	29.54
5.	0.2 % Boron (foliar) + Kadiri 9	25.72	1.87	37.50	1.74	4.51	27.85
6.	0.2 % Boron (foliar) + Kadiri Amaravati	25.28	1.76	37.30	1.45	3.93	26.99
7.	(0.5 % + 0.2 %) Zn+ B (foliar) + Kadiri 6	27.87	2.66	40.13	2.48	5.67	30.44
8.	(0.5 % + 0.2 %) Zn+ B (foliar) + Kadiri 9	27.51	2.49	39.94	2.38	5.54	30.01
9.	(0.5 % + 0.2 %) Zn+ B (foliar) + Kadiri Amaravati	26.19	1.91	37.89	1.87	4.84	27.90
	F-test	**S**	**S**	**S**	**S**	**S**	**S**
	SEm (±)	0.25	0.13	0.33	0.08	0.09	0.39
	CD (p=0.05)	0.75	0.38	0.98	0.23	0.27	1.16