Effect of Sulphur and Foliar Spray of Micronutrients on Growth and Yield of Zaid Groundnut (Arachis hypogaea)

ABSTRACT

The field experiment was conducted during *Zaid* season 2022 at experimental field of Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj, Uttar Pradesh, India. The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.2), (EC 0.26 Ds/m), low in organic carbon (0.48% or 0,36%), available nitrogen (;~~230 kg/ha~~ or171,48Kg/ha), available phosphorus (13.60- or 15,2 kg/ha) and available potassium (215.4 kg/ha or 232,5 Kg/ha). The treatments consist of Sulphur (20, 30, 40 kg/h), Boron (0.2%) and Zinc (0.5%) along with control. The experiment was layout in Randomized Block Design with ten treatments each replicated thrice. Significantly and higher plant height (57.42 cm), dry weight (30.93 g), and the yield attributes namely kernels/pod (2.27), pods/plant (43.33), kernel yield (2.58 t/ha), pod yield (2.54 t/ha) and haulm yield (6.29 t/ha), were obtained highest in the treatment 9 [40 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc].

Keywords: Sulphur, Zinc, Boron, Yield and yield attributes, Zaid Groundnut.

INTRODUCTION

The groundnut, or peanut (*Arachis hypogaea* L.), is a significant grain legume and an oil seed crop. As the third most significant source of vegetable protein and a valuable source of all the nutrients, groundnut, a member of the Leguminaceae family, is also known as "The King of Oilseeds" and is the fourth most significant source of edible oil. The groundnut is also known as the miracle nut and the poor man's cashew. Currently, groundnut is grown in about 90 nations in a variety of agroclimatic zones between latitudes 40^{o}S and 40^{o}N (ref). Groundnut has been cultivated in India for around 250 years (ref). It is the most common oil seed grown there and a significant cash crop. After China, India is the second-largest producer of groundnuts (ref). With 17.39 million tonnes produced, China tops the list, followed by India with 6.10 million tonnes (ref) . In terms of overall production of oilseeds, Gujarat is the top-producing state. According to **Anonymous (2020–21),** India's groundnut cultivation area for the 2020–2021 growing season was around 41.23 lakh hectares, and during that time, 638.59 MT of groundnuts worth 5,381 crores ? were exported. Being a legume, it made a contribution to sustainable agriculture and is grown by farmers in both *kharif* and *zaid* seasons. Groundnut is typically utilised for oil extraction, with an analysis of roughly 46.70%, according to **Satish *et al.*, 2011 (not in the referenes)**. Because of its high food value, which is again a result of its higher amount of protein (22.0%), carbohydrates (10.0%), and minerals (3.0%), it is also consumed directly (ref).

Zinc is one of the nutrients that is most important for plant growth (ref). More plant cells and dry matter are produced as a result of the production of growth hormones like auxin . The development and growth of plants depend on zinc. Zinc also acts as a metal activator for enzymes and catalyses the manufacture of indole acetic acid, which ultimately increases crop yield. Some researches asserted that by addressing zinc deficiency, foliar zinc spraying could improve groundnut growth, production, and seed quality. Chlorophyll synthesis, pollen functioning, fertilisation, and sprouting all require zinc. **Yadav *et al.* (2019).**

Sulphur is a crucial plant nutrient for the growth of crops. Sulphur is essential for the growth of oil seeds and for enhancing quality. After nitrogen, phosphorus, and potassium, sulphur is rapidly becoming seen as the fourth major plant nutrient. According to **Najer *et al.* (2011),(not in the references)** sulphur has a major impact on the grain quality of sunflower crops as well as on how effectively nitrogen and phosphorus are used (ref).

Boron helps pollen grains and tubes germinate, grow, and develop, enabling fertilization of plants and increasing grain output. In boron-deficient plants, the blooming period was extended (ref). The physiological activities that take place in plants, such as the regulation of glucose metabolism, the generation of protein, and seed formation, all depend on the element boron. Boron played a vital role in preserving blooming and regulating fruit development in legumes and the peanut crop. **Singh *et al.* (2020).**

MATERIALS AND METHODS

~~The materials and methodology and techniques adopted in the present experiment entitled, Effect of sulphur and foliar spray of micronutrients on growth and yield of zaid groundnut (*Arachis hypogaea* L.) with a brief description regarding site of experiment, soil properties, sampling techniques, climatic conditions during crop growing period, cropping history, calendar operations and statistical analysis are presented in this chapter with following headings~~.

In order to study the effect of two micronutrients with foliar spray, z Zinc and b Boron with and basal application of s Sulphur were taken. The, an experiment was conducted at during z Zaid 2022, at Crop Research Farm, Naini Agricultural Institute, SHUATS, Prayagraj. The experimental site of the study is geographically located at 25.28^{o}N latitude, 81.54^{o}E longitude and 98 m altitude above the mean sea level (MSL). The soil of the experimental field constituting a part of central Gangetic alluvium is neutral and deep. Pre- sowing soil samples were taken from a depth of 15 cm with the help of an auger. The composite samples were used for the chemical and mechanical analysis. The soil was sandy loam in texture, low in organic carbon (0.36%) and medium in available nitrogen (171.48 kg/ha), phosphorous (15.2 kg/ha) and low in potassium (232.5 kg/ha). The treatments consist of foliar spray of two micronutrients zinc and boron (0.5%, 0.2% and 0.5+0.2%) and basal application of sulphur at (20, 30 and 40Kg/ha) respectively. The experiment was laid out in randomized block design with ten treatments each replicated thrice and control i.e., recommended N, P and K (20:40:40 kg/ha). The plots were prepared with dimension of 3m × 3m and seeds were sown with a spacing of 30cm × 10cm. At 10DAS plants were thinned to appropriate density. Weeds were controlled manually at 25DAS to maintain a uniform plant population. Growth characteristics namely plant height (cm), dry weight (g), number of nodules, crop growth rate (g/m^2/day) and relative growth rate (g/g/day) were recorded. Irrigations were given uniformly and regularly to all plots as per requirement so as to prevent the crop from water stress at any stage. The crop was completely harvested at physiological maturity stage and their post-harvest observations such as number of pods per plant, number of kernels per pod, test weight (g), kernel yield (t/ha), pod yield (t/ha), haulm yield (t/ha) and harvest index (%) were recorded. The data recorded for different characteristics were subjected to statistical analysis by adopting the method of analysis of variance (ANOVA) as described by **Gomez (1984).**

RESULTS AND DISCUSSION

Growth parameters

Plant height (cm)

At 100 DAS, [Table 1], higher plant height (57.42 cm) was recorded significantly in the treatment no.9 [40 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc]. However, treatment no.8 [30 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc] (55.97 cm) was found to be statistically at far with treatment no. 9.

The increase in plant height might be due to the increased supply of sulphur and associated nutrients might have helped in rapid cell multiplication and higher chlorophyll content, thereby accelerating photosynthesis rate and activity and eventually more supply of assimilates to plants that in turn increased the growth in terms of a greater canopy, plant height at the successive growth stages. The results conform with **Yadav et al. (2018).not in the references**

Dry weight (g)

At 100 DAS, [Table 1] maximum plant dry weight (30.93 g) was recorded significantly in the treatment no.9 [40 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc]. However, treatment no.8 [30 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc] (30.60 g) was found to be statistically at far with treatment no. 9.

Application of micro-nutrients in combination increased the supply of micronutrients necessary for growth and development, which resulted in an increase of dry matter accumulation in the reproductive parts and the formation of higher sink capacity with the application of micronutrients. These results conform with the findings of **Elayaraja and Singaravel (2012) not in the references.**

Yield attributes and yield

Kernels/pod

At 100 DAS, [Table 2] the data recorded more kernels/pod (2.27) in treatment no.9 [40 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc]. However, treatment no.8 [30 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc] (2.20) was statistically at par with treatment no.9.

Supply of Sulphur in adequate amount also helps in the development of floral primordial i.e., reproductive parts, which results in the development of kernels in plants. **(Mannem 2021).**

Pods/plant

At 100 DAS, [Table 2] the data recorded more pods/plant (43.33) in treatment no.9 [40 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc]. However, treatment no.8 [30 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc] (42.73) was statistically at par with treatment no.9.

Supply of Sulphur in adequate amount also helps in the development of floral primordial i.e., reproductive parts, which results in the development of pods in plants **(Mannem, 2021).** Boron is involved in nitrogen fixation during nodule production and also helps in translocation of sugars and protein from leaves to the pods which results in a higher number of pods per plant and the seed index also increased **(Pasala *et al.* 2022)** **not in the reference**

Kernel yield (t/ha)

At 100, [Table 2] the data recorded higher kernel yield (2.58 t/ha) in treatment no.9 [40 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc]. However, treatment no.8 [30 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc] (2.49 t/ha) was statistically at par with treatment no.9.

The application of boron aids in the synthesis of chlorophyll, photosynthetic process, enzyme activation and grain formation, as well as carbohydrate metabolism, which leads to nutrient uptake and finally results in an increase in groundnut yield **(Naiknaware *et al.* 2015).**

Pod yield (t/ha)

At 100 DAS, [Table 2] the data recorded higher pod yield (2.54 t/ha) in treatment no.9 [40 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc] and treatment no.8 [30 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc] (2.48 t/ha) was statistically at par with treatment no.9.

Application of sulphur significantly increased photosynthesis rate thereby increased the haulm yield and its also increased the pod yield **(Wali and shivaraj 1994).**

Haulm yield (t/ha)

At 100 DAS, [Table 2] the data recorded higher haulm yield (6.29 t/ha) in treatment no.9 [40 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc]. However, treatment no.8 [30 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc] (5.99 t/ha) was statistically at par with treatment no.9.

The increase in haulm yield might be due to the synergistic effect of sulphur and calcium due to utilization of large quantities of nutrients through their well-developed root system and nodules which might have resulted in both plant development and ultimate straw yield at maturity the results conform with **Ramjeet Yadav *et al.* (2015)not in the references.**

Boron increased nitrogen fixation which affects plant growth rate and metabolism which results in higher haulm yields **Bhagiya *et al.* (2005)** **not in the references.**

~~DISCUSSIONS~~

Application of 30 kg sulphur/ha recorded better yield attributes *viz.*, branches per plant, pods per plant, seeds per pod and 100 seed weight and higher yield than the other treatments. Similarly, the application of boron 1.0 kg per ha recorded better yield attributes and a higher yield of grain and straw. **(Vaiyapuri *et al* 2010)**

Micronutrient application in groundnut not only changed the quality of kernel by enhancing zinc content but also contributed for substantial increase in pod yield under certain conditions. **(Arunachalam *et al.* 2013)**

Three levels of Zn, two levels of B and three levels of S in integrated manner which showed positive interaction as yield increased with the uptake of nutrients in groundnut. Oil content in the nut ranged from 45.3% to 54.4%, while Iodine value ranged from 97.8% to 90.5%. Application of S and Zn significantly increased oil content while it significantly decreased iodine value in groundnut. So, application of micronutrients with zinc and boron as well as sulphur fertilisation could be a useful strategy not only to increase the yield but also the quality of groundnut. **(Saha *et al.* 2015)**

Effect of foliar application of potash and micronutrients on growth and yield of groundnut and expressed that maximum production from summer groundnut can be secured by combined foliar spraying of K 0.5%, Fe 0.5%, Zn 0.5% and B 0.2% at 40 DAS beside RDF. **(Der *et al.* 2015)**

Application of boron in the foliar form of flowering and pod formation stage can have a positive effect on groundnut crop yields under subtropical and semi-arid climatic conditions of north eastern parts of Uttar Pradesh. **(Ravichandran *et al.* 2015)**

Uptake by plants of micronutrients as nano-size particulate materials, relative to conventional uptake of ionic nutrients. Reports show that micro nutrients enhance crop nutritional quality, yield, biomass production and resiliency to drought, pest and diseases and these positive effects range from 10 to 70% dependent on micronutrient and can occur with or without NPK fertilisation. **(Christian and Bindraban ~~*et al.*~~ 2016)**

Importance of secondary and micronutrient fertilisation for enhancing the productivity of groundnut crop. Combined foliar application of secondary and micro nutrients along with RDF recorded increase in pod yield and haulm yield. **(Rajitha *et al.* (2018)**

Necessity of micronutrients supplement along NPK in improving the soil physico chemical and enzymatic activities along with enhanced yield and nutrient uptake of groundnut. **(Elayaraja and Sen….~~*et al*~~*.* 2019)**

Sulphur fertilisation at 20 to 60 kg/ha was found most suitable for obtaining higher productivity and profitability of groundnut. Gypsum was observed as the most effective source of sulphur for enhancing growth, nutrient use efficiencies, yield attributes, quality parameters, yield and profitability of groundnut with a positive residual effect on succeeding crops. **(Solaimalai *et al.* 2020)**

Application of sulphur enhanced the leaf chlorophyll content and photosynthetic activity which may boost the crop yields. **(Jawahar *et al.* 2020)**

Foliar spray of Zn and Bo jointly increased the leaf area to the tune of 55% and 29% at flowering and pod formation stages respectively. They also increased leaf chlorophyll content in groundnut along with yield. (**Ramprasad *et al.* 2020)**

Plant height exhibited an increasing trend with corresponding increase in level of sulphur and all the growth stages. The number of nodules and crop dry matter also increased. **(Dileep *et al.* 2021)**

Effect of zine on growth, yield, nutrient uptake and quality of groundnut and expressed that fertilizer application of zinc significantly increased all the mentioned parameters. **(Radhika and Meena ~~*et al*~~*.* 2021)**

CONCLUSION

From the observations, it was concluded that with the combination of 0.2 % Boron along with 0.5 % Zinc and 40 Kg/ha Sulphur in treatment no. 9 significantly recorded higher in all the growth and yield attributes.

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Table 1: Effect of sulphur and foliar spray of micronutrients on growth attributes of *zaid* groundnut.

S. No.	Treatment combination	Plant height (cm)	Dry weight (g)
1.	0.5 % Zinc + 20 Kg/ha Sulphur	52.57	25.38
2.	0.5 % Zinc + 30 Kg/ha Sulphur	53.14	26.58
3.	0.5 % Zinc + 40 Kg/ha Sulphur	53.45	27.22
4.	0.2 % Boron + 20 Kg/ha Sulphur	53.84	28.39
5.	0.2 % Boron + 30 Kg/ha Sulphur	54.20	28.47
6.	0.2 % Boron + 40 Kg/ha Sulphur	54.37	29.29
7.	0.2 % Boron + 0.5 % Zinc + 20 Kg/ha Sulphur	55.59	30.48
8.	0.2 % Boron + 0.5 % Zinc + 30 Kg/ha Sulphur	55.97	30.60
9.	0.2 % Boron + 0.5 % Zinc + 40 Kg/ha Sulphur	57.42	30.93
10.	Control (RDF 20:40:40 NPK kg/ha)	51.31	24.61
	F Tab (5%)	S	S
	SEm (±)	0.28	0.14
	CD (p=0.05%)	0.84	0.42

Table 2: Effect of sulphur and foliar spray of micronutrients on yield attributes of *zaid* groundnut.

S. No.	Treatment combination	Pods/plant	Kernels/pod	Kernel yield (t/ha)	Pod yield (t/ha)	Haulm yield (t/ha)
1.	0.5 % Zinc + 20 Kg/ha Sulphur	36.00	1.73	2.05	2.22	5.19
2.	0.5 % Zinc + 30 Kg/ha Sulphur	38.93	1.80	2.09	2.25	5.22
3.	0.5 % Zinc + 40 Kg/ha Sulphur	39.13	1.87	2.11	2.32	5.27
4.	0.2 % Boron + 20 Kg/ha Sulphur	40.00	1.93	2.16	2.33	5.39
5.	0.2 % Boron + 30 Kg/ha Sulphur	40.93	2.00	2.23	2.36	5.54
6.	0.2 % Boron + 40 Kg/ha Sulphur	42.47	2.07	2.30	2.37	5.75
7.	0.2 % Boron + 0.5 % Zinc + 20 Kg/ha Sulphur	42.53	2.07	2.38	2.42	5.91
8.	0.2 % Boron + 0.5 % Zinc + 30 Kg/ha Sulphur	42.73	2.20	2.49	2.48	5.99
9.	0.2 % Boron + 0.5 % Zinc + 40 Kg/ha Sulphur	43.33	2.27	2.58	2.54	6.29
10.	Control (RDF 20:40:40 NPK kg/ha)	35.53	1.67	1.98	2.11	4.93
	F Tab (5%)	S	S	S	S	S
	SEm (±)	0.22	0.06	0.08	0.07	0.12
	CD (p=0.05%)	0.65	0.17	0.24	0.21	0.35