Effect of Sulphur and Foliar Spray of Micronutrients on Yield and Economics 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 Sciences, Prayagraj and Uttar Pradesh, India. The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH7.3), (EC 0.26 Ds/m), low in organic carbon (0.48%), available nitrogen (230 kg/ha), available phosphorus (13.60 kg/ha) and available potassium (215.4 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. 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), Maximum gross return (140970.00 INR/ha), net return (89974.00 INR/ha) and B C ratio (1.76) were also obtained highest in the treatment 9 [40 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc].

Keywords: ***Sulphur, Zinc, Boron, Yield, Economics.***

INTRODUCTION

Groundnut, a member of the Leguminaceae family, is commonly referred to as "The King of Oilseeds" and is the fourth most important source of edible oil. It is also the third most major source of vegetable protein and a valuable supplier of all nutrients. The groundnut is sometimes referred to as the poor man's cashew and the miracle nut. Between latitudes 40oS and 40oN, groundnut is currently farmed in about 90 different countries across a variety of agroclimatic zones. India has been growing groundnuts for almost 250 years. It is a substantial cash crop and the most popular oil seed there. India is the second-largest producer of groundnuts after China. 17.39 million tonnes were produced. 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*. Groundnut is typically utilised for oil extraction, with an

analysis of roughly 46.70%, according to **Satish *et al.*, 2011**. 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.

One of the nutrients that is crucial for plant growth is zinc. The creation of growth hormones like auxin results in the synthesis of more plant cells and dry matter. Zinc is essential for plant growth and development. Additionally, zinc serves as an enzyme metal activator and catalyses the production of indole acetic acid, both of which boost crop yield. Foliar zinc spraying, according to certain studies, could enhance groundnut growth, productivity, and seed quality by treating zinc deficiency. Zinc is needed for the production of chlorophyll, pollen, fertilisation, and sprouting. **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),** sulphur has a major impact on the grain quality of sunflower crops as well as on how effectively nitrogen and phosphorus are used.

In order to fertilise plants and increase grain production, boron aids in the germination, growth, and development of pollen grains and tubes. The length of the blooming period was increased in boron-deficient plants. The production of protein, the control of glucose metabolism, and seed development are only a few of the physiological processes that depend on the element boron in plants. In legumes and the peanut crop, boron was crucial in sustaining flowering and controlling fruit development. **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 two micronutrients with foliar spray, zinc and boron and basal application of sulphur were taken. The experiment was conducted at during 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

Yield attributes and yield

At 100 DAS, [Table 1] the data recorded more kernels/pod (2.27), pods/plant (43.33), kernel yield (2.58 t/ha), higher pod yield (2.54 t/ha), higher haulm yield (6.29 t/ha), in treatment 9 [40 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc]. However, treatment 8 [30 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc] was statistically at par with treatment 9.

Economics

Maximum gross returns (140970.00 INR/ha), net returns (89974.00 INR/ha), B: C ratio (1.76) were recorded with the application of 0.2 % Boron + 0.5 % Zinc + 40 Kg/ha Sulphur

in treatment no. 9. [Table 2].

DISCUSSIONS

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).**

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)**

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).**

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

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 **Yadav *et al.* (2015).**

Boron increased nitrogen fixation which affects plant growth rate and metabolism which results in higher haulm yields **Bhagiya *et al.* (2005)**

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 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 lodine 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 *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 *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 *et al.* 2021).**

CONCLUSION

From the observations, it was concluded that with the combination of 0.2 % Boron + 0.5 % Zinc + 40 Kg/ha Sulphur in treatment no. 9 significantly recorded higher in all the growth and yield attributes namely, plant height, dry weight, number of nodules per plant, pods per plant, kernels per pod, test weight, kernel yield, pod yield and haulm yield.

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

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

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

No.	Treatment combination	Cost of Cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B C ratio (%)
1.	0.5 % Zinc + 20 Kg/ha Sulphur	49126.00	123210.00	74084.00	1.50
2.	0.5 % Zinc + 30 Kg/ha Sulphur	50026.00	124875.00	74849.00	1.49
3.	0.5 % Zinc + 40 Kg/ha Sulphur	50926.00	128760.00	77834.00	1.52
4.	0.2 % Boron + 20 Kg/ha Sulphur	49086.00	129315.00	80229.00	1.63
5.	0.2 % Boron + 30 Kg/ha Sulphur	49986.00	130980.00	80994.00	1.62
6.	0.2 % Boron + 40 Kg/ha Sulphur	50886.00	131535.00	80649.00	1.58
7.	0.2 % Boron + 0.5 % Zinc + 20 Kg/ha Sulphur	49196.00	134310.00	85114.00	1.73
8.	0.2 % Boron + 0.5 % Zinc + 30 Kg/ha Sulphur	50096.00	137640.00	87544.00	1.74
9.	0.2 % Boron + 0.5 % Zinc + 40 Kg/ha Sulphur	50996.00	140970.00	89974.00	1.76
10.	Control (RDF 20:40:40 NPK kg/ha)	47216.00	117105.00	69889.00	1.48