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

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%), 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. 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.***

INTRODUCTION

The important grain legume groundnut

(Arachis hypogaea) is also a major oil seed crop. 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. Currently, groundnut is grown in about 90 nations in a variety of agroclimatic zones between latitudes 40^{o}S and 40^{o}N. Groundnut has been cultivated in India for around 250 years. It is the most common oil seed grown there and a significant cash crop. After China, India is the second-largest producer of groundnuts. With 17.39 million tonnes produced, China tops the list, followed by India with 6.10 million tonnes. 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**. 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.

"Zinc was one of the first micronutrients, essential for plant growth. Zinc also plays a role in nucleic acid and protein synthesis and helps in the utilization of phosphorus and nitrogen, as well as in seed formation" **Swaroop and Debbarma (2022).** 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),** sulphur has a major impact on the grain quality of sunflower crops as well as on how effectively nitrogen and phosphorus are used.

The formation of roots and nodules, which facilitates nitrogen fixing in plant tissue, depends on boron for proper seed setting, seed quality, and nitrogen absorption by groundnut. Groundnut yields are low and of poor quality due to the "hallow-heart" effect of boron deficiency in the kernels. Boron participates in the transformation of sugar and starch, cell growth and elongation, and the creation of proteins and amino acids **(Naiknaware et al., 2015).** Boron also plays a vital role in preserving blooming and regulating fruit development in legumes and the peanut crop. **Singh *et al.* (2020).**

MATERIALS AND METHODS

"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". (Ramya et. Al., 2022) In order to study the effect of two micronutrients with foliar spray, Zinc and Boron, basal application of Sulphur. 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 10 Days After Sowing (DAS) plants were thinned to appropriate density. Weeds were controlled manually at 25 DAS to maintain a uniform plant population. Growth characteristics namely plant height (cm) and dry weight (g) 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/plant, number of kernels/pod, kernel yield (t/ha), pod yield (t/ha) and haulm yield (t/ha) 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

Growth parameters

At 100 DAS, [Table 1], higher plant height (57.42 cm) was recorded significantly in the 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] (55.97 cm) was found to be statistically at par with treatment 9. Maximum plant dry weight (30.93 g) was recorded significantly in the 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] (30.60 g) was found to be statistically at par with treatment 9.

Yield attributes and yield

At 100 DAS, [Table 2] the data recorded higher kernels/pod (2.27) 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] (2.20) was statistically at par with treatment 9. Higher pods/plant (43.33) 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] (42.73) was statistically at par with treatment 9. Higher kernel yield (2.58 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] (2.49 t/ha) was statistically at par with treatment 9. Higher pod yield (2.54 t/ha) in treatment 9 [40 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc] and treatment 8 [30 Kg/ha Sulphur + 0.2 % Boron + 0.5 % Zinc] (2.48 t/ha) was statistically at par with treatment 9. 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] (5.99 t/ha) was statistically at par with treatment 9.

DISCUSSIONS

Sulphur and related nutrients aid in quick cell division and higher chlorophyll levels, which speed up photosynthesis and increase the amount of nutrients available to plants, increasing their growth in terms of a larger canopy and plant height at various growth stages. The results conform with **Yadav et al. (2019).** Sulphur might have helped in the release of available nutrients from soil and thus higher uptake by the crop was noticed, higher nutrients uptake increased vegetative growth of the plant that is ultimately increased photosynthesis and yield of the plant. The results obtained correspond with the finding of **Chopra and Kanwar (1976).** "Higher yield and oil content with increased application of sulphur also attributed protein and enzyme synthesis as it is a constituent of sulphur containing amino acids namely methonine, cysteine and cystine" **Sisodiya *et al.*, 2016.** "Application of sulphur significantly increased photosynthesis rate thereby increased the haulm yield and its also increased the pod yield" **(Wali and shivaraj 1994).** "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).** "Boron increased nitrogen fixation which affects plant growth rate and metabolism which results in higher haulm yields" **Bhagiya *et al.* (2005).** "Boron increased availability and uptake of macro and micronutrients and improving soil conditions for water and nutrient supply required for better plant growth and dry matter accumulation" **Abhigna *et al.*, (2021). "**Boron helps in the formation of chlorophyll, photosynthetic process & activation of enzymes as well as grain formation. They are also involved in carbohydrates metabolism which increases the uptake of nutrients & ultimately resulted in increasing the yield of groundnut". **Naiknaware *et al.*, (2015).** 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). "**Zinc helps in many physiological process of plant such as chlorophyll formation, stomatal regulation, starch utilization and biomass accumulation" **Swaroop and Debbarma (2022). "**Zinc plays as an activator of several enzymes in plants, and it is directly involved in the biosynthesis of growth substances such as auxin which produces more plant cells and more dry matter that in turn will be stored in seeds as a sink" **Atluri *et al.*, (2022).** The significant improvement in growth parameters brought about by the use of zinc fertiliser may have enhanced the yield and yield characteristics, activation of several enzymes and the plant's basic metabolic rate, which increased the availability of nutrients and photosynthetic materials and, as a result, increased pod output. **Christopher et al. (2019).**

CONCLUSION

From the observations, it is concluded that with the combination of 0.2 % Boron along wih 0.5 % Zinc and 40 Kg/ha Sulphur in treatment 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-test	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-test	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