

Original Research Article
**Influence of Sulphur and Zinc on Growth, Yield and Economics of Groundnut
(*Arachis hypogaea* L.)**

Abstract

A field experiment was conducted during *Zaid* (summer) season of 2023 at Crop Research Farm Department of Agronomy. The treatments consisted of 3 levels of Sulphur (15, 30 and 45 kg/ha) and 3 levels of zinc (20kg/ha, 0.50% and 0.25% foliar application) along with recommended doses of nitrogen, phosphorus and potash and a control (20-60-40 kg N-P-K/ha). The experiment was laid out in a Randomized Block Design with 10 treatments and replication thrice. Application of Sulphur (45 kg/ha) + Zinc (10kg/ha + 0.25% foliar application) (treatment 9) recorded highest plant height (46.00 cm), number of branches (7.93) maximum plant dry weight (23.95 g), and yield attributes namely more number of pods/plants (26.53), kernels/pod (2.33), highest seed yield (2.65 t/ha) and haulm yield (6.37 t/ha). The treatment also recorded Maximum gross return (INR 186876/ha), net return (INR 135076/ha) and B:C ratio (2.61).

Keywords: Groundnut, Sulphur, Zinc, Growth, Yield and Economic

Introduction

Groundnut (*Arachis hypogaea* L.) is one of the self-pollinating edible oil seed crops, cultivated throughout the world. It belongs to family Leguminaceae. It is of South American origin. It is known as the king of oilseeds crops (**Hammons and Branch, 1982**). It is one of the major vegetable oil crops in the world and ranked 13th among the principle economic crops of the world. It plays a vital role in sustainable agriculture because of its nitrogen fixing ability. It is a very exhaustive crop as compared to other legume crops because very little part of the crop will be left in the soil after harvest. In India, groundnut crop is being cultivated in an area of 4.73 mha and accounts for 6.72 mt of production with an average productivity of 1422 kg/ha (**India Stat, 2020-21**). In Telangana, it is occupying an area of 0.126 mha with a production of 0.313 mt and average productivity of 2491 kg/ha. Groundnut is a crop of global importance and is classified both as a grain legume and an oilseed crop, because of its high oil content. It is unpredictable, heavy feeder legume. Groundnut requires only about 400-500

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mm (500-700 mm evapotranspiration) of water. Its cultivation has been extended on almost all soil types in tropical countries.

Zinc may be present in the soil, but not available to plants. A high soil pH or a calcareous soil means availability of zinc is less. Crops under these soil conditions may suffer from zinc deficiency. Zinc is an essential component of a variety of dehydrogenases, proteinases and peptidases. All these enzymes show sensitivity to Zn deficiency. Zn is now being regarded as the third most limiting nutrient element in crop production after N and P. Critical level of zinc in groundnut leaves is 23 ppm (Sarangi *et al.*, 2016).

Sulphur is a now recognized, as the fourth major plant nutrient, along with Nitrogen, Phosphorous and Potassium, therefore sulphur is now very much a part of balanced fertilization and nutrition for oilseed crops in general and for groundnut crop in particular. It is one of the important pre-requisites for enhance productivity and quality of groundnut. Sulphur as plant nutrients is becoming increasingly important in dry land agriculture as it is master nutrient of all oilseed crops. Among the field crops, oilseeds and pulses are more responsive to sulphur. The sulphur is one of the essential nutrient elements plays an important role in carbohydrate metabolism and formation of chlorophyll, glycosides, oils and many other compounds that are involved in N-fixation and photosynthesis of plants. Its nutrition to crops is vital both from quality and quantity point of view. It lowers HCN content of certain crops, promotes nodulation in legumes and produces heavier grains of oilseeds (Tandon, 1991).

MATERIALS AND METHODS

The experiment was conducted during the *Zaid* season 2023, at the Crop Research Farm (CRF), Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.) which is located at 25° 39' 42"N latitude, 81° 67' 56" E longitude, and 98 m altitude above the mean sea level (MSL). This area is situated on the right side of the river Yamuna by the side of Prayagraj Rewa Road about 5 km away from Prayagraj (U.P) city. The experiment was laid out in Randomized Block Design Which consisting of ten treatments with T₁ – Sulphur 15 kg/ha + Zinc 20 kg/ha, T₂ – Sulphur 15 kg/ha + Zinc 0.50% foliar application, T₃ – Sulphur 15 kg/ha + Zinc 10 kg/ha + Zinc 0.25% foliar application, T₄ - Sulphur 30 kg/ha + Zinc 20 kg/ha, T₅ - Sulphur 30 kg/ha + Zinc 0.50% foliar application, T₆ - Sulphur 30 kg/ha + Zinc 10 kg/ha + Zinc 0.25% foliar application, T₇ - Sulphur 45 kg/ha + Zinc 20 kg/ha, T₈ - Sulphur 45 kg/ha + Zinc 0.50% foliar application, T₉ Sulphur 45 kg/ha + Zinc 10 kg/ha + Zinc 0.25%

foliar application, T₁₀ - Control (RDF 20-60-40). The soil in the experimental area was sandy loam with pH (8.0), Organic Carbon (0.62%), Available N (225.00 kg/ha), Available P (38.20 kg/ha), and Available K (240.70 kg/ha). Seeds are sown at a spacing of 30×10 cm² to a seed rate of 100 kg/ha. The recommended dose of nitrogen (20 kg/ha), phosphorus (60 kg/ha) and potassium (40 kg/ha) and Sulphur and Zinc were applied as per the treatments. Data recorded on different aspects of crop, viz., growth, yield attributes were subjected to statistically analysis by analysis of variance method. (Gomez and Gomez, 1976) and economic data analysis mathematical method.

RESULT AND DISCUSSION:

Growth parameters

Plant height (cm)

The data revealed that a significantly higher plant height (46.00 cm) was recorded in treatment 9 [Sulphur 45 kg/ha + Zinc 10 kg/ha + Zinc 0.25% foliar application]. However, the treatment 6 [Sulphur 30 kg/ha + Zinc 10 kg/ha + Zinc 0.25% foliar application] (43.89 cm), treatment 3 [Sulphur 15 kg/ha + Zinc 10 kg/ha + Zinc 0.25% foliar application] (43.67 cm), were found to be statistically at par with treatment 9.

The results of the present investigation revealed that, the groundnut treatments differed significantly with respect to the plant height. Plant height increased with the application of zinc sulphate both at flowering and pegging stage. Micronutrients are known for their specific ability to enhance plant height by increased internodal length, Plant height was significantly increased with the combined application of 0.2% ZnSO₄ when compared to control (Sale and Nazirkar 2013). The plant height exhibited increasing trend with corresponding increase in level of sulphur at all the growth stages. Application of sulphur at 60 kg/ha produced the tallest plants and proved superior to all other doses of applied sulphur at all growth stages. Sulphur has also been reported to help in lowering the soil pH which is the main reason for greater availability and mobility of nutrients especially P, Fe, Mn and Zn. The present investigation is in cognizance with the findings Gowthami *et al.*, (2017) and Kamera *et al.*, (2011).

Yield and Yield attributes

Number of pods/plant:

The data revealed that Treatment 9 [Sulphur 45 kg/ha + Zinc 10 kg/ha + Zinc 0.25% foliar application] was recorded significant and maximum number of pods/plant (26.53) which was superior over all other treatments. However, the treatment 6 [Sulphur 30 kg/ha +

Comment [U3]: It was not specified in the material and methods that Zn is administered in the form of sulfate

Comment [U4]: Gowthami VS, Ananada N. (2017)

Zinc 10 kg/ha + Zinc 0.25% foliar application] (25.87), treatment 3 [Sulphur 15 kg/ha + Zinc 10 kg/ha + Zinc 0.25% foliar application] (25.60) was found to be statistically at par with the treatment 9.

Application of Sulphur along with Zinc increased the number of pods per plant might be due to the enhanced early vegetative growth in terms of higher leaf area, dry matter accumulation and vigorous root system resulted in more branches which consequently increased the number of pods bearing branches significantly **Singh (2010)**.

Seed yield (t/ha):

The data revealed that Treatment 9 [Sulphur 45 kg/ha + Zinc 10 kg/ha + Zinc 0.25% foliar application] was recorded significant and maximum seed yield (2.65 t/ha) which was superior over all other treatments. However, the treatment 6 [Sulphur 30 kg/ha + Zinc 10 kg/ha + Zinc 0.25% foliar application] (2.45 t/ha), treatment 3 [Sulphur 15 kg/ha + Zinc 10 kg/ha + Zinc 0.25% foliar application] (2.37 t/ha) was found to be statistically at par with the treatment 9.

The higher seed yield may be attributed to higher total dry matter accumulation due to better total nitrogen as well as Zn and Fe uptake and their translocation to the reproductive parts and improvement in yield attributing characters like number of pods/plant, pod weight, 100 kernel weight and shelling percentage. (**Yadav et al., 2018**)

Haulm yield (t/ha):

The data revealed that Treatment 9 [Sulphur 45 kg/ha + Zinc 10 kg/ha + Zinc 0.25% foliar application] was recorded significant and maximum haulm yield (6.37 t/ha) which was superior over all other treatments. However, the treatment 6 [Sulphur 30 kg/ha + Zinc 10 kg/ha + Zinc 0.25% foliar application] (5.94 t/ha), treatment 3 [Sulphur 15 kg/ha + Zinc 10 kg/ha + Zinc 0.25% foliar application] (5.71 t/ha) was found to be statistically at par with the treatment 9.

The data on haulm yield also differed significantly due to micronutrient application. Soil application of ZnSO₄ at 25 kg/ha + foliar application of ZnSO₄ at 0.5% recorded significantly higher haulm yield (3080 kg/ha) (**Gowthami et al., 2017**). Similar results were also observed by **Meena et al., (2007)**. The marked improvements in pods, kernel and haulm yields due to applying sulphur could be ascribed to overall improvement in vigour and crop growth, as reflected in plant height, dry matter accumulation and number of nodules/plant.

Comment [U5]: Gowthami VS, Ananada N. (2017)

The improved growth due to S fertilization coupled with increased photosynthesis on one hand and greater mobilization of photosynthates towards reproductive structures, on the other, might have been responsible for significant increase in yields of groundnut. (Yadav *et al.*, 2018).

Economics

Net return (INR/ha)

Net return (135076) was found to be highest in treatment 9 [Sulphur 45 kg/ha + Zinc 10 kg/ha + Zinc 0.25% foliar application] as compared to other treatment.

B: C Ratio

Benefit Cost Ratio (2.61) was found to be highest in treatment 9 [Sulphur 45 kg/ha + Zinc 10 kg/ha + Zinc 0.25% foliar application] as compared to other treatment.

The increased gross returns, net returns and benefit: cost ratio was due to increased seed and stover yield under foliar application of Sulphur 4% with zinc at 1.5%. The findings are in close conformity with those of Durugude *et al.*, 2014

Comment [U6]: Durgude AG, Kadam SR, Pharande AL. (2014)

CONCLUSION:

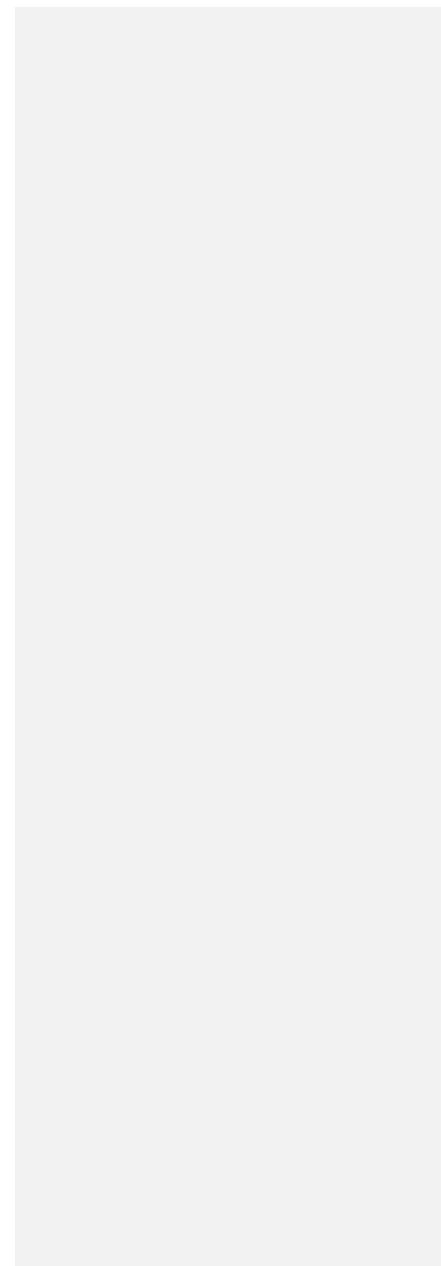
It is concluded that the application of Sulphur 45 kg/ha along with Zinc 10 kg/ha along with Zinc 0.25% foliar application (treatment-9) was recorded highest plant height, no. of branches, dry weight, no. of pods/plant, no. of kernels/pod, seed yield, Haulm yield and benefit cost ratio in groundnut crop.

Table 1: Effect of Sulphur and Zinc on Growth, Yield and Economics of Groundnut.

S.No.	Treatment combinations	Plant height (cm) (80 DAS)	Number of pods/plant	Seed Yield (t/ha)	Haulm Yield (t/ha)	Net return (INR/ha)	B:C
1	Sulphur 15 kg/ha + Zinc 20 kg/ha	39.29	23.04	1.70	4.50	72309	1.46
2	Sulphur 15 kg/ha + Zinc 0.50% foliar application	40.16	23.71	1.68	4.47	72512	1.50
3	Sulphur 15 kg/ha + Zinc 10 kg/ha + Zinc 0.25% foliar application	43.67	25.60	2.37	5.71	118688	2.43
4	Sulphur 30 kg/ha + Zinc 20 kg/ha	41.25	23.38	1.66	4.86	70491	1.38
5	Sulphur 30 kg/ha + Zinc 0.50% foliar application	40.84	23.98	1.82	5.00	81646	1.64
6	Sulphur 30 kg/ha + Zinc 10 kg/ha + Zinc 0.25% foliar application	44.30	25.87	2.45	5.94	122683	2.44
7	Sulphur 45 kg/ha + Zinc 20 kg/ha	43.89	22.92	1.61	4.86	66231	1.26
8	Sulphur 45 kg/ha + Zinc 0.50% foliar application	42.31	24.00	2.01	4.71	90171	1.76
9	Sulphur 45 kg/ha + Zinc 10 kg/ha + Zinc 0.25% foliar application	46.00	26.53	2.65	6.37	135076	2.61
10	Control (RDF)	39.12	22.74	1.50	4.12	63089	1.39
F-test		S	S	S	S	-	-

SEm(±)	1.24	0.68	0.16	0.22	-	-
CD (p=0.05)	3.67	2.03	0.47	0.68	-	-

UNDER PEER REVIEW



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