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Effect of Sulphur and Foliar Application of Iron (FeSO4) on Growth and Yield of Groundnut

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

The field experiment was carried out on the groundnut crop during the Kharif season of 2022 at the agricultural research farm of the department of agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh. The treatment included a control plot and 3 doses of foliar sprays for iron (0.5, 0.75, and 1%) and sulphur (20, 40, and 60 kg). Ten treatments and three replications were included in the experiment's Randomized Block Design (RBD) design. A significant increase in plant height (53.60 cm) at 80 DAS, dry weight (37.73 g), kernel yield (2.47 t/ha), gross return (157520.00 INR/ha), net return (106768.40 INR/ha), and B:C ratio (2.10) were seen following the application of sulphur at a rate of 60 kg/ha plus 1% FeSO4.

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1. INTRODUCTION

The groundnut, or *Arachis hypogaea* L., is a distinctive and significant legume and oilseed crop grown primarily in India, which accounts for around 27.3% of global production and 33% of the world's groundnut acreage. It is a member of the Leguminoseae family. It is also referred to as goober, peanut, monkey nut, earthnut, and manila nut. It is the fourth-most significant oilseed crop in the world and the world's largest source of edible oil, ranking 13th among food crops. With a production area of 5.95 million hectares and an average yield of 1071 kg/ha during the summer, it is the most important oilseed crop in India (groundnut outlook report, 2020–2021). It is a versatile crop that contains 26% and 45% of high-quality hydrogenated edible oil. [1].

In India, groundnut is a significant oilseed crop that ranks first in terms of acreage and second in terms of production behind soyabean. China produces the most groundnuts, 17.57 million tonnes, followed by India, 6.73 million tonnes, Nigeria, 4.45 lakh tonnes, Sudan, 2.83 million tonnes, and the United States, 2.49 million tonnes. These amounts represent 36.01, 13.79, 9.12, 5.80, and 5.11 percent of the 48.80 million tonnes of groundnuts produced globally in 2019–20, respectively. The estimated groundnut production (kharif and rabi) for 2021–2022, as compared to 10.24 million tonnes in 2020–2021, was 10.08 million tonnes according to the third advance projections (Groundnut Outlook - August 2022).

Sulfur, the fourth key nutrient, is essential for the nutrition of oil-seed crops and contains the amino acids cystine, cysteine, and methionine as a component [2]. It also contributes to the development of glucocides or glucosinolates in oil seed crops, which when hydrolysed increase the oil content. The creation of disulphide bonds between polypeptide chains is one of sulphur's primary roles in proteins or polypeptides. Disulphide bonds play a crucial role in the stabilization and conformation of proteins. Sulphur treatment enhanced groundnut's intake of numerous macro and micronutrients [3].

An important micronutrient called iron actively participates in a plant's metabolic processes. It is a significant component of the nitrogen-fixing bacteria's enzyme nitrogenase. The first stable redox component of the photosynthetic electron transport chain is the ferredoxins, which are Fe-S proteins. It has been discovered that adding iron increases the protein content of groundnut kernels. Successful application of Fe boosts nutrient absorption and pod yield [4].

Keeping all this review “Effect of sulphur and Foliar application of Iron (FeSO4) on growth and yield of groundnut (*Arachis hypogaea* L.)” was carried out at the *Kharif* season of 2022 at the Crop Research Farm, Department of Agronomy, Sam Higgingbottom University of Agriculture Technology and Sciences, Prayagraj, Uttar Pradesh.

2. MATERIALS AND METHODS

The field study took place at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology, & Sciences, Prayagraj, Uttar Pradesh, during the *kharif* season of 2022. Sandal loam with a pH of 7.4, organic carbon of 0.306%, available N of 171.48 kg/ha, available P of 243.5 kg/ha, and available K of 291.2 kg/ha made up the soil in the experimental region. The experiment was set up using a Randomized Block Design with ten treatments that are duplicated three times. There are three levels of foliar applications of iron (0.5, 0.75, and 1.0%), and there are three levels of sulphur application (20, 40, and 60 kg/ha). Treatment combinations include T1: Sulphur 2O kg/ha + FeSO4 0.5%, T2: Sulphur 2O kg/ha + FeSO4 0.75%, T3: Sulphur 2O kg/ha + FeSO4 1.0%, T4: Sulphur 4O kg/ha + FeSO4 0.5%, T5: Sulphur 4O kg/ha + FeSO4 0.75%, T6: Sulphur 4O kg/ha + FeSO4 1.0%, T10: RDF: 20-40-20 NPK kg/ha are employed as the control. In accordance with a seed rate of 90 kg/ha, seeds are sown at a spacing of 30 cm 10 cm. Prior to planting, the basal dose of nitrogen (20 kg/ha), phosphorus (40 kg/ha), and potassium (20 kg/ha) was applied. Sulfur and FeSO4 (foliar spray at 30 DAS) were applied according to the treatments. We used urea, SSP, and MOP as sources of N, P, and K fertilizer, respectively.

3. RESULTS AND DISCUSSION

3.1 Growth Attributes

3.1.1 Plant height (cm)

The data showed that treatment 9 [Sulphur (60 kg/ha) + FeSO4 (1.0%)] recorded a substantial

and maximum plant height (53.60 cm). However, Table 1 revealed that treatments 7 and 8 were statistically comparable to treatment 9 in terms of effectiveness. The application of sulphur resulted in the highest and most significant plant height, which may be because other macro- and micronutrients are also accessible that are crucial for the growth and development of plants. It appears to have encouraged meristematic processes, leading to increased apical development and photosynthetic surface expansion [5,6]. The plant height, number of branches per plant, dry matter at 45 and 75 DAS, number of nodules per plant, pod weight, 100 kernel weight, shelling percentage, pod and haulm yield all significantly increase after foliar FeSO4 spraying at 40 DAS [7].

3.1.2 Plant dry weight (g)

The data showed that treatment 9 [Sulphur (60 kg/ha) + FeSO4 (1.0%)] recorded a substantial and maximum plant dry weight (37.73 g). In Table 1, it was discovered that Treatments 7 and 8 were statistically comparable to Treatment 9. The application of Sulphur plays a role in plant metabolic activity, which may promote photosynthesis. This was the considerable and greatest dry weight. Similar results were recorded by Sisodiya et al. [8].

3.2 Yield Attributes

3.2.1 Kernel yield (t/ha)

The data showed that treatment 9 [Sulphur (60 kg/ha) + FeSO4 (1.0%)] recorded a considerably greater kernel yield (2.47 t/ha). In Table 2, it was discovered that Treatments 8 and 7 were statistically equivalent to Treatment 9. The amount of sulphur applied at a rate of l5 kg/ha resulted in increases in kernel yield of 106.52% and 73.11% over controls, respectively [9]. In addition to the recommended amount of fertilizers, two foliar sprays of ferrous sulphate 0.5 at 45 and 60 days after planting resulted in an average maximum number of pods/plant (45.0), no. of kernels/pod (1.96), and yield (27.13 q/ha). [10].

Table 1. Effect of sulphur and foliar application of iron on growth and yield of groundnut

S.No.	Treatment combinations	Plant height (cm)	Plant dry weight (g)	Kernel yield (t/ha)	Plant dry weight (g)
1.	Sulphur 20 kg/ha + FeSO4 0.5%	43.97	24.17	1.77	24.17
2.	Sulphur 20 kg/ha + FeSO4 0.75%	46.07	24.93	1.87	24.93
3.	Sulphur 20 kg/ha + FeSO4 1%	45.17	26.33	1.93	26.33
4.	Sulphur 40 kg/ha + FeSO4 0.5%	46.37	27.10	2.06	27.10
5.	Sulphur 40 kg/ha + FeSO4 0.75%	47.67	28.83	1.94	28.83
6.	Sulphur 40 kg/ha + FeSO4 1%	46.83	27.97	2.10	27.97
7.	Sulphur 60 kg/ha + FeSO4 0.5%	49.63	33.93	2.30	33.93
8.	Sulphur 60 kg/ha + FeSO4 0.75%	52.53	33.50	2.35	33.50
9.	Sulphur 60 kg/ha + FeSO4 1%	53.60	35.50	2.47	35.50
10.	Control RDF (20:40:20 kg/ha)	42.07	23.37	1.40	23.37
	F test	S	S	S	S
	SEm(±)	1.36	1.39	0.19	1.39
	CD (p=0.05)	4.03	4.13	0.57	4.13

Table 2. Effect of sulphur and foliar application of iron on economics of groundnut

	Treatment Combination	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	B:C ratio
1.	Sulphur 20 kg/ha + FeSO4 0.5%	46815.60	113470.00	66654.40	1.42
2.	Sulphur 20 kg/ha + FeSO4 0.75%	47583.60	119749.00	72165.40	1.52
3.	Sulphur 20 kg/ha + FeSO4 1%	48315.60	123570.00	75218.40	1.56
4.	Sulphur 40 kg/ha + FeSO4 0.5%	48015.60	132130.00	84114.40	1.75
5.	Sulphur 40 kg/ha + FeSO4 0.75%	48783.60	125408.00	76624.40	1.57
6.	Sulphur 40 kg/ha + FeSO4 1%	49551.60	134330.00	84778.40	1.71
7.	Sulphur 60 kg/ha + FeSO4 0.5%	49215.60	147049.00	97833.40	1.99
8.	Sulphur 60 kg/ha + FeSO4 0.75%	49983.60	150236.00	100252.40	2.01
9.	Sulphur 60 kg/ha + FeSO4 1%	50751.60	157520.00	106768.40	2.10
10.	Control RDF (20:40:20 kg/ha)	43479.60	90280.00	46800.40	1.08

3.3 Economics

The treatment 9 (Sulphur 60 kg/ha + FeSO4 1.0%) in Table 3 had the highest gross return (INR 157520.00/ha), net return (INR 110968.40/ha), and benefit-cost ratio (2.38).

4. CONCLUSION

The results showed that adding sulphur and iron increases the growth characteristics and yield characteristics of groundnut. The application of Sulphur 60 Kg/ha + FeSO4 1% resulted in the highest kernel yield, gross return, net return, and benefit cost ratio.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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