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Effect of gypsum and zinc on growth and yield of Groundnut (*Arachis hypogaea* L.)

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Abstract

The field experiment titled “Effect of Gypsum and Zinc on growth and yield of Groundnut (*Arachis hypogaea* L.)” was conducted during *Kharif* season 2025 at Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh. The present one season field experiments were carried out at Crop Research Farm (25.40° N latitude, 81.85° E longitude, and 112.05 m above mean sea level). The experimental field soil was sandy loam in texture, moderately basic in reaction (pH 6.9), available medium organic Carbon (0.562%) low in available nitrogen (278.93 kg/ha), and very high accessible phosphorus (10.8 kg/ha) and available potassium (260.4 kg/ha). The experiment was laid out in a randomized block design with ten treatments replicated thrice. The result revealed that Treatment 6 (Gypsum soil application 200 kg/ha, Gypsum 200 kg/ha at flowering + Zinc 400 ppm) recorded significantly higher Plant height (57.28 cm), Number of nodules per plant (44.34), Plant dry weight (47.93 g/plant), and also significantly higher number of pods/plant (24.9), Kernels/pod (2.06), Kernel yield (2.13 t/ha), Haulm yield (7.5 t/ha), was found Treatment - 6 with application of (Gypsum soil application 200 kg/ha, Gypsum 200 kg/ha at flowering + Zinc 400 ppm.)

Keywords: Groundnut, gypsum, zinc, growth, yield

Introduction

Groundnut (*Arachis hypogaea* L.) is an important oil seed crop and a grain legume. It is also called peanut, monkey nut, Pinda, Mungfali. Groundnut belonging to family *Leguminaceae* is the fourth most important source of edible oil also known as “The King of Oilseeds” and third most important source of vegetable protein. Groundnut is the largely produced oil seed in India, it is also an important cash crop. It contributed to sustainable agriculture being a legume and is cultivated in both *kharif* and *zaid* by farmers. Groundnut seed contains about 45% oil and 26% protein. Being a leguminous crop groundnut helps in maintenance of soil properties and soil fertility by adding about 100 to 120kg of nitrogen per hectare per season. Peanuts are a good source of niacin, folate, fibre, magnesium, vitamin E, manganese and phosphorus Indian Council of Agricultural Research (2023) ^[1].

India is the second largest producer of groundnut after China accounting for 38% of the total area (7.7 million ha) and 31% production (6.7 million t) of the world. The average productivity in India is 977 kg ha. Groundnut oil cake is used as animal and poultry feed as well as organic fertilizer. It also avoids soil erosion by acting as a cover crop. Groundnut is primarily used for extraction of oil, with an analysis of about 46.70%. It is also consumed directly because of its high food value, which is again due to its higher content of protein (22.0%), carbohydrate (10.0%) and minerals (3.0%). The role of zinc in increasing the crop yield has been well established (Patil *et al.*, 2017) ^[18]. Zinc plays significant role in various enzymatic and physiological activities of the plant.

Zinc catalysis the process of oxidation in plant cells and is vital for transformation of carbohydrates, regulates the consumption of sugar, increases source of energy for the production of chlorophyll, aids in the formation of auxins which produce more plant cells and more dry matter, that in turn, will be stored in seed as a sink and promotes absorption of water. Several experiments conducted at farmer’s fields under AICRP on groundnut revealed tremendous

response of the crop to Zn application in different soils located in different parts of the country. Therefore, choice of a variety with suitable dose of zinc is necessary to enhance the productivity of groundnut. Hence, an experiment was planned to study the influence of levels Zinc and Boron on growth and yield of summer groundnut.

Gypsum was initially introduced as heavily subsidized ameliorant for treating alkaline soils in India. Over a period of time, gypsum being a cheap source of calcium and Sulphur, farmers began to use it as a fertilizer in oilseeds production. Moderate solubility of gypsum helps in the ready availability of both the nutrients (calcium and Sulphur) syncing with the critical growth stages of the plant. Many research trials proved that in groundnut, application of gypsum during the flowering stage enhances pod filling eventually increasing the pod yield along with improved seed quality. The application of right dose of gypsum at the right time not only improves the productivity but also minimizes environmental pollution. This study provides an overview of gypsum's role in the improvement of pod yield, its advantages and absorption of gypsum by roots and pods from the soil in groundnut crop Kadirimangalam *et al.* (2024) ^[15].

Materials and Methods

An experiment was conducted during the *Kharif* season of 2025. It was conducted in alluvial soil at the Department of Agronomy's Crop Research Farm, SHUATS, Prayagraj, U.P. It is situated 98 meters above mean sea level at latitude 25° 24' 42" N, longitude 81° 50' 56" E. About five kilometres from Prayagraj city, this location lies on the right bank of the Yamuna River beside Prayagraj Rewa Road. At a depth of 0–30 cm, a composite soil sample was taken. It underwent crushing, air drying, and physical and chemical testing. The experimental field soil was sandy loam in texture, moderately basic in reaction (pH 6.9), available medium organic Carbon (0.562%) low in available nitrogen (278.93 kg/ha), and very high accessible phosphorus (10.8 kg/ha) and available potassium (260.4 kg/ha). On 19th July 2025, Groundnut seeds (GG-20) were planted with a 40 cm x 10 cm spacing. Experiments were carried out in a Randomized block design. There were nine treatment combinations with different levels of Gypsum in soil application (Gypsum soil application 400 kg/ha, Gypsum soil application 200 kg/ha and 200 kg/ha at flowering) and foliar application of Zinc (150 ppm, 200 ppm and 400 ppm) and along with RDF 30:60:70 kg NPK/ha. The treatment combination are as follows i.e., T₁- Gypsum soil application 400 kg/ha + Zinc 150 ppm, T₂- Gypsum soil application 400 kg/ha + Zinc 200 ppm, T₃- Gypsum soil application 400 kg/ha + Zinc 400 ppm, T₄- Gypsum soil application 200 kg/ha + 200 kg/ha at flowering + Zinc 150 ppm, T₅- Gypsum soil application 200 kg/ha and 200 kg/ha at flowering + Zinc 200 ppm, T₆- Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 400 ppm, T₇- Zinc 150 ppm, T₈- Zinc 200 ppm, T₉- Zinc 400 ppm. To apply nutrients as a spreading method, 4-5 cm deep furrows were dug along the seed rows using a hand hoeing. Ten days after sowing, the gaps were filled by transplanting once germination took place. In order to reduce crop density, weed competition, intercultural operations were carried out between 25- and 45-days intervals. On 12th October 2024, harvesting of the crop was done. At regular intervals from germination to harvest, plant growth parameters such as plant height (cm), dry weight (g/plant), number of Nodules, CGR and RGR were assessed. At harvest, yield metrics such as No. of pods/plant, number of Kernels, seed index, Kernels yield (t/ha), haulm yield (t/ha) and harvest index (%) were measured at 20, 40, 60 and 60 DAS. Analysis of variance (ANOVA), as it relates to randomized block design,

was used to statistically examine the observed data of ten treatments (Gomez and Gomez, 1984 and Mohan *et al.* 2024) ^[8].

Results and Discussion

Growth parameter

The data of growth parameter are presented in Table 1. The observation on Plant height (cm) of Groundnut were statistically analyzed and significantly highest plant height (57.28 cm) was observed in treatment -6 (Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 400 ppm). However, treatments -5 with application of Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 200 ppm was observed (55.7 cm) were statistically at par with the highest. The increase in plant height may be attributed to role of zinc as a catalyst or stimulant in most of physiological and metabolic process and it also important in synthesis of tryptophane, a component of some protein and a compound needed for production of growth hormones (auxins) like indole acetic acid. The significant and higher plant height was with application might be due to involvement of gypsum in stimulation of cell division, photosynthetic process as well as formation of chlorophyll was similar to Yadav *et al.* (2017) ^[24]. Whereas, treatment -6 with application of Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 400 ppm was observed (44.34) number of nodules which was significantly higher as compare to other treatment. Maximum number of nodules/plant might be due to the application of gypsum (300 kg/ha) root and shoot growth, flower fertility and essential nutrient for nodule forming bacteria. Similar results were reported by Das *et al.* (2015) ^[3]. The significant and maximum number of nodules/plant was with application of gypsum might be due to the supply the calcium and formation in nodules Reddy *et al.* (2023). The application of Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 400 ppm was recorded significantly highest dry weight (47.93g) in treatment - 6 which was statistically at par with treatments other treatment. The significant and higher plant dry weight was with the application of gypsum at 300 kg/ha increased the availability of nutrients like Ca and S. Increased physiological processes such cell division, elongation and meristematic tissue creation resulted from the availability of more nutrients, which enhanced growth characteristics and dry matter production. Similar results have also been reported by Chaudhary *et al.* (2005) ^[2]. The increase in dry weight may be attributed to role of zinc as a catalyst or stimulant in most of physiological and metabolic process and it also important in synthesis of tryptophane, a component of some protein and a compound needed for production of growth hormones (auxins) like indole acetic acid. The increase in dry weight may be attributed to role of Zinc as a catalyst or stimulant in most of the physiological and metabolic processes and metal activator or enzymes resulting in increased growth and development of plant. The probable reason for this result was attributed to higher plant height recorded in this treatment. Zinc encourages the growth and development of roots, which improve nutrient uptake and shoot development Raju *et al.* (2022).

Yield attributes

The data pertaining to yield-attributing characters are presented in Table 2. The maximum number of pods/plant (19.14 g) was found to be significantly higher with application of Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 400 ppm in treatment - 6 which was found to be statistically at par to all treatment. Significantly higher number of Seed/tiller (2.06) was found to be significantly higher with application of Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 400 ppm in

treatment – 6 were statistically at par with the highest. The present nutrient management practice involving gypsum application @ 200 kg/ha as basal + 200 kg/ha at flowering along with foliar spray of zinc (400 ppm) plays a crucial role in enhancing growth, yield, and quality of groundnut. It is a unique leguminous crop in which pods develop underground, and therefore calcium availability in the pegging zone becomes a limiting factor for proper pod development was reported by Hirpara *et al.* (2017) [9]. The application of gypsum, a rich source of calcium and sulphur, ensures an adequate supply of these nutrients. Basal application supports early vegetative growth, while application at flowering coincides with the critical pegging and pod formation stage, thereby directly influencing pod filling. Adequate calcium reduces the incidence of unfilled pods and improves kernel development was similar to Dhumgond *et al.* (2013) [5]. The data showed that the treatment – 6 with application of Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 400 ppm was found to be highest in Seed Index (44.03 g). Whereas, the treatment - 2 (Gypsum soil application 400 kg/ha + Zinc 200 ppm) (36.93 g) was found to be lowest. There was no significant difference among the treatments. The seed index in groundnut is significantly influenced by nutrient availability, particularly calcium, sulphur, and micronutrients like zinc. The application of gypsum 200 kg/ha as basal and 200 kg/ha at flowering ensures adequate calcium supply during the pegging and pod development stages. Calcium plays a crucial role in cell division and seed formation, leading to better kernel development and increased seed weight. Adequate calcium availability reduces the formation of shriveled or ill-filled seeds, thereby improving seed index.

Kernel yield (t/ha)

The statistical data in Table 2 showed that significantly highest kernel yield (2.13 t/ha) was found to be significantly higher with application of Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 400 ppm in treatment -6. Whereas, application of Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 200 ppm in treatment – 5 was recorded (1.96 t/ha) were statistically at par with the highest. The present treatment involving gypsum 200 kg/ha as basal + 200 kg/ha at flowering along with foliar application of zinc (400 ppm) showed a significant improvement in kernel yield of groundnut. This enhancement can be explained through the combined physiological and nutritional effects of calcium, sulphur, and zinc. Gypsum serves as a major source of calcium and sulphur, both of which are essential for pod and kernel development. Calcium plays a direct role in peg penetration, pod formation, and kernel filling, as it is absorbed by developing pods from the soil was reported by Kadirimangalam *et al.* (2024) [15]. Gypsum application significantly increased pod yield and kernel quality

in groundnut. Similarly, Gour *et al.* (2024) [7] observed improved yield attributes and test weight with higher gypsum levels. Zinc is an essential micronutrient involved in enzyme activation, auxin synthesis, and photosynthesis. Its foliar application at 400 ppm enhances physiological efficiency during reproductive stages. Ravi Kumar *et al.* (2023) [16] observed that gypsum + zinc treatment produced higher kernel yield compared to individual applications.

Haulm Yield (t/ha)

The data in Table 2 showed that a significantly maximum haulm yield (7.5 t/ha) was found to be significantly higher with application of Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 400 ppm in treatment – 6. Whereas, Treatment – 5 was recorded with application of Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 200 ppm were statistically at par with the highest. The present study demonstrated that the application of gypsum 200 kg/ha as basal + 200 kg/ha at flowering along with foliar spray of zinc (400 ppm) significantly improved growth, yield attributes, seed index, and overall productivity of groundnut. The observed improvements can be attributed to the synergistic effects of calcium, sulphur, and zinc on physiological, biochemical, and reproductive processes of the crop. This resulted in improved peg penetration, enhanced pod formation, and reduced incidence of unfilled pods (pops). Similar findings were reported by Kadirimangalam *et al.* (2024) [15], who observed that gypsum application at flowering significantly improved pod yield and quality in groundnut.

Harvest index

The data showed that the treatment – 6 with application of Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 400 ppm was found to be highest in Harvest Index (22.14). Whereas, the treatment - 8 (Gypsum soil application 400 kg/ha + Zinc 150 ppm) (17.54) was found to be lowest. There was no significant difference among the treatments. Higher number of pods per plant, Kernels/pod might be due to application of Gypsum increases the fertility of flowers and increase in leaf area and duration and resulted into increase in supplying assimilates for the sink (Chaitanya *et al.*, 2017). The favorable effect of basal dose of Zn may be due to better absorption and efficient utilization of Zinc by plant and its direct influence on the quantity of auxin produced which in turn enable the plant to grow taller and produce more dry matter. Remarkable effect of Zinc may also be appeared on account of balanced nutritional environment inside the plant. Bhoya *et al.*, (2013) was reported positive interaction between Gypsum and Zinc fertilization at lower levels.

Table 1: Effect of Gypsum and zinc on yield and yield attribute of Groundnut

S. No.	Treatments	Plant height (cm)	Number of Nodules	Dry weight (g)
		80 DAS	60 DAS	80 DAS
1	Gypsum soil application 400 kg/ha + Zinc 150 ppm	49.65	39.57	43.12
2	Gypsum soil application 400 kg/ha + Zinc 200 ppm	51.26	41.01	44.08
3	Gypsum soil application 400 kg/ha + Zinc 400 ppm	53.23	42.33	44.95
4	Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 150 ppm	54.51	44.29	45.93
5	Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 200 ppm	55.7	45.75	46.62
6	Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 400 ppm	57.28	48.27	47.93
7	Zinc 150 ppm	46.68	34.51	39.98
8	Zinc 200 ppm	49.05	36.05	41.09
9	Zinc 400 ppm	47.22	36.92	42.01
	F-test	S	S	S
	SEm(±)	0.44	1.91	0.19
	CD (P= 0.05)	1.30	5.751	0.57

Table 2: Effect of Gypsum and zinc on yield and yield attribute of Groundnut

S. No.	Treatment Combination	Yield attribute and yield					
		Pods /Plant	Kernels/ pod	Seed Index	Kernel Yield	Haulm Yield	Harvest Index
1.	Gypsum soil application 400 kg/ha + Zinc 150 ppm	21.4	1.6	40.43	1.50	7.0	17.54
2.	Gypsum soil application 400 kg/ha + Zinc 200 ppm	21.9	1.66	36.93	1.72	7.1	19.38
3.	Gypsum soil application 400 kg/ha + Zinc 400 ppm	22.2	1.7	39.96	1.9	7.2	20.92
4.	Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 150 ppm	23	1.73	40.33	1.91	7.3	20.71
5.	Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 200 ppm	23.2	1.86	42.6	1.96	7.4	20.91
6.	Gypsum soil application 200 kg/ha, 200 kg/ha at flowering + Zinc 400 ppm	24.9	2.06	44.03	2.13	7.5	22.14
7.	Zinc 150 ppm	17.3	1.66	43.26	1.38	5.9	18.75
8.	Zinc 200 ppm	19.4	1.55	40.46	1.44	6.6	17.81
9.	Zinc 400 ppm	21.4	1.59	41.7	1.49	6.7	17.94
	F-test	S	S	NS	S	S	NS
	Sem ($\pm$)	0.88	0.05	2.26	0.12	0.29	1.48
	CD (p=0.05)	2.65	0.17	-	0.38	0.89	-

Conclusion

From the results, it is concluded that application of Gypsum soil application 200 kg/ha, 200 kg/ha at flowering along with Zinc 400 ppm Treatment 6 in Groundnut has been recorded highest Kernal yield.

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