Original Research Article

Effect of Zinc and Gypsum on Growth, Yield and Economics of Groundnut

(*Arachis hypogaea* L.)

ABSTRACT

The experiment entitled was "Effect of zinc and gypsum on growth and yield of Groundnut (*Arachis hypogaea* L.)" conducted during *kharif*, (2021) at crop research farm, Department of Agronomy, SHUATS, Prayagraj (U.P) on sandy loam soil. the experiment was laid out in Randomized Block Design consisting of 9 Treatment and 3 Replication comprising three level of zinc and gypsum the significantly highest result showed in (Treatment 9) 0.75% ZnO foliar spray + 500 kg/ha Gypsum) growth and yield attributing character viz., plant height (58.33 cm), nodules/plant (106.88), dry weight (39.3 g), pod/plant (19.3), kernel/pod (2.6), seed index (41.00), seed yield (2917.00 kg/ha), haulm yield (4453.3 kg/ha). The crop growth rate (19.06 g/m^2/day) were found to be non-significant. The gross returns (1,25,431.00 INR/ha) net returns (83355.60 INR/ha) and B:C ratio (1.98) are also recorded numerically highest in treatment 9 application of 0.25% ZnO foliar spray + 500 kg/ha gypsum.

Keywords: Growth, Yield, Gypsum, and Zinc.

Introduction

Groundnut (*Arachis hypogaea* L.*)* is an important oilseed crop of india, popularly known as peanut, earthnut, monkey-nut and locally called as "Mongphali" .it is world's largest source of edible oil, ranks 13th among the food crops as well as 4th most important oilseed crops of the world (Ramnathan, 2001). Groundnut seeds contain high quality edible oil (48%), easily digestible protein (26 %) and carbohydrate (20 %). Groundnut occupies premier position with regards to both area and production in India. It accounts about 22 percent (5.95 m/ha) and 24 percent of production (7.54 mt) with the productivity of 1268 kg/ha (Anonymous, 2001). In Rajasthan, groundnut is cultivated mainly in north-east region covering the districts of Bikaner, Jaipur, Nagpur and sikar. Total area of groundnut in Rajasthan is 3.46 lakh/ha. With total

production of 6.81 lakhs for oil extraction, 37% confectionary and 12% for seed purpose (Nurezennat et al. 2019).

Nowadays zinc deficiency is virtually an all india problem and in west Bengal 49- 68% of soil are Zn deficiency. It is well established that zinc is one of the most important nutrient required for plant growth as it plays as an activator of several enzymes in plant and is directly involved in the biosynthesis of growth substance such as auxin which produces more plant cells and more dry matter. It was evident that application of zinc enhanced the seed and oil yield/ha and protein percentage in groundnut. Additionally, foliar spray enables plant to absorb the applied nutrients from the soluation throughout their leaf surface and thus may result in the economic use of fertilizer. So, the proper micronutrient fertilizer management of groundnut crop with reference to amount, method and time of application has significant effect on yield and quality. Zinc deficiency in soil is one of constraint in india and to improve quality of oil in groundnut zinc and proper amount of NPK is important. Balanced nutrition is considered as one of the basic needs "to achieve the potential yield" **(Yadav *et al.,* 2017)**. The adequate availability of zinc to young and developing plants might be a certain promise for sufficient growth and development. The positive response of Zinc application to groundnut has been reported by **Christopher *et al.,* 2019**. Zinc known to be the constituent of enzyme and also involved in synthesis of pyruvic decarboxylase and indole acetic acid. Zinc is required in various metabolic processes as catalyst. Zinc also increases the content of protein, calorific value, amino acid, and fat in oilseed crop. Zinc catalysis the process of oxidation in plant cells and is vital for transformation of carbohydrate, regulates the consumption of sugar, increases source of energy for the production of chlorophyll, aids in the formation of auxin and promotes absorption of water.

Gypsum is widely used as a source of Calcium and Sulphur for groundnut worldwide. The dissolution of gypsum is fairly rapid and therefore readily adds Ca and S to the podding zone. Survey data form the small holder farming sector has shown that the majority of the farmers apply gypsum to get good yield of groundnut **(Sreelatha *et al.,* 2004)**. Application of gypsum split doses facilitate the calcium and Sulphur requirement for better shell development and oil content in critical pod development period of plant growth. The primary nutrients calcium and sulfur also plays an important role in enhancing production and

productivity of groundnut. Sulfur is very crucial for the formation of sulfur containing amino acids and oil synthesis and it is also improving both yield and quality of crops. Calcium nutrition is also considered a yield limiting factor for groundnut production. Calcium absorbed by the roots is not translocated to the developing pod whereas calcium required for pod formation is absorbed directly from soil solution.

Materials and method

The experiment was conducted during *kharif* season (2021) at crop research farm SHUATS, department of agronomy, Naini Agriculture institute, Sam Higgin bottom university of Agriculture, Technology and Science, Prayagraj, Uttar Pradesh. The crop research farm is situated at 25.75^0 N latitude, 87.19^0 E longitude and at altitude of 98 m above mean sea level. The area is situated on the right side of the Yamuna river. the soil of the experimental field consists of alluvial soil. the experiment was laid out in Randomized Block Design consist of 3 level of zinc and 3 level of gypsum. The treatment combination is T_1 (0.25% ZnO foliar spray + 300 kg/ha Gypsum), T_2 (0.25% ZnO foliar spray + 400 kg/ha gypsum), T_3 (0.25% ZnO foliar spray + 500 kg/ha gypsum) T_4 (0.5% ZnO foliar spray + 300 kg/ha gypsum) T_5 (0.5% ZnO foliar spray + 400 kg/ha gypsum) T_6 (0.5% ZnO foliar spray + 500 kg/ha gypsum) T_7 (0.75% ZnO foliar spray + 300 kg/ha gypsum), T_8 (0.75% ZnO foliar spray + 400 kg/ha gypsum), T_9 (0.75% ZnO foliar spray + 500 kg/ha gypsum).the experiment was laid out in Randomized Block Design there are 9 treatments and replicated thrice to fulfill the nutrient sources nutrients used in this experiment are urea, DAP and MOP recommended dosage of fertilizer (RDF) 20 kg N, 40 kg P, 60 kg K. the growth and yield parameter and economics were recorded in equal interval of crop duration like plant height (cm), number of root nodules (No.), plant dry weight (g), crop growth rate (g/g/day), number of pods/plant, number of kernel/pod, seed index (g), seed yield (kg), haulm yield (kg/ha), harvest index(%) and economics. The data was analyzed statistically by using ANOVA and it is applicable for Randomized Block Design.

Results and Discussion

Effect on growth attributes

It is noticed from Table 1. The plant height was increased with the crop duration stage in different treatment combination. At 60 DAS significantly higher plant height (47.20 cm) was observed with the application of 0.25% ZnO foliar spray + 500 kg/ha gypsum as compared to the

other treatment and statistically at par (46.00 cm) with the application of 0.75% ZnO foliar spray + 400 kg/ha gypsum. The plant height was significantly influenced by the application of Sulphur along with recommended dosage of fertilizer at all stages of crop. **(Yadav 2005) and Srivastava et al. (2006)**

Root nodules

It is observed from Table 1. The number of nodule per plant was increased at 60 DAS the data shown significantly higher root nodules per plant (106.88) was obtained with the application of 0.75% ZnO foliar spray + 500 kg/ha gypsum as compare to the other treatment and statistically at par (105.88) with the application of 0.75% ZnO foliar spray + 400 kg/ha gypsum. The Sulphur availability result in better formation of nodule and nitrogenase enzyme **Niraj and Prakash (2015)**

Plant Dry weight

The data on plant dry weight obtained from Table 1. At 60 DAS the higher plant dry weight (18.87 g) was observed with the application of 0.75% ZnO foliar spray + 500 kg/ha gypsum as compare to the other treatment, which was statistically at par (17.20 g) with the 0.75% ZnO foliar spray + 400 kg/ha gypsum. The accumulation of dry matter at the successive growth stages further lead to increase the crop growth rate and relative growth rate in all stages of plants were the findings by **Sarkar and banik (2002)**

Crop growth rate

The data obtained from Table 1. At 45-60 DAS, significantly higher in crop growth rate (22.22 $g/m^2/day$) was observed with the application of 0.5% ZnO foliar spray + 500 kg/ha gypsum as compare to the other treatment and statistically at par (20.69 $g/m^2/day$) with the application of 0.5% ZnO foliar spray + 400 kg/ha gypsum.

Effect on yield and yield attributes

Number of pods per plant

The data presented in Table 2. The Number of pods per plant (19.30) was recorded significantly superior with the application of 0.75% ZnO + 500 kg/ha gypsum which was statistically at par with (18.93) the application of 0.75% ZnO foliar spray + 400 kg/ha gypsum. The increased in seed per pod might due to more availability of zinc nutrient to plant at all the growth stages in finding of **deb Roy et al. (2013)**

Number of kernel per pod

The data observed from table 2. The Number of kernel per pod (2.60) was recorded significantly higher with the application of 0.75% ZnO + 500 kg/ha gypsum which was statistically at par with (2.40) the application of 0.75% ZnO foliar spray + 400 kg/ha gypsum. This might be due to activation of enzyme by application of Sulphur **(Mitra et al. 2006)**

Seed index (g)

The higher seed index (41.10) was recorded with the application of 0.75% ZnO foiar spray + 500 kg/ha gypsum and statistically at par with (39.42) the 0.75% ZnO foliar spray + 400 kg/ha gypsum.

Shelling percentage

The maximum shelling percentage (72.22) was recorded significantly higher in the application of 0.5% ZnO foliar spray + 500 kg/ha gypsum and there is no statistically at par value.

Seed yield

The higher seed yield (2917.00kg/ha) was recorded significantly superior with application of 0.75% ZnO foliar spray + 500 kg/ha gypsum and at statistically at par (2846.70kg/ha) with the 0.75% ZnO foliar spray + 400 kg/ha gypsum.

Haulm yield

The maximum haulm yield (4453.30 kg/ha) was recorded significantly with the application of 0.75% ZnO folar spray + 500 kg/ha gypsum which was statistically at par (4380.00 kg/ha) with the 0.75% + 400 kg/ha gypsum. The magnitude of pod and haulm yield due to treatment gypsum. The better performance of this treatment might due to higher solubility of nutrient and nutrient uptake similar findings were reported earlier **(Ruksar Banu 2017)**

Harvest index

The highest harvesting (39.77%) was recorded with the application of 0.5% foliar spray + 400 kg/ha gypsum which was statistically on par (39.42%) with 0.75% ZnO foliar spray + 300 kg/ha gypsum.

Effect on Economics

The data on economics of different treatment obtained from the Table 3. The cultivation of groundnut crop recorded numerically highest in gross returns (1,25,431.00 INR/ha) net returns (83355.60 INR/ha) and B : C ratio (1.98) With the application of 0.25% ZnO foliar spray + 500 kg/ha gypsum among all the treatments.

Conclusion

On the bases of one season of experiment, It is conclude that application of 0.75% ZnO foliar spray + 500 kg/ha gypsum were found to more productive and economically viable.

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Table 1. Effect of Zinc and Gypsum on Growth attributes.

	At 60 DAS				
Treatment combinations	**Plant height (cm)**	**Nodules/ plant**	**Dry weight/plant**	**CGR ($g/m^{2/}day$)**	**RGR (g/g/day)**
0.25% ZnO foliar spray + 300 kg/ha Gypsum	43.0	95.77	13.1	15.6	0.047
0.25% ZnO foliar spray + 400 kg/ha Gypsum	43.5	100.77	13.9	16.5	0.047
0.25% ZnO foliar spray + 500 kg/ha Gypsum	44.1	102.22	15.6	19.0	0.049
0.5% ZnO foliar spray + 300 kg/ha Gypsum	43.7	101.55	14.6	17.6	0.048
0.5% ZnO foliar spray + 400 kg/ha Gypsum	44.9	102.66	16.3	19.6	0.048
0.5% ZnO foliar spray + 500 kg/ha Gypsum	45.7	104.77	15.7	18.4	0.045
0.75% ZnO foliar spray + 300 kg/ha Gypsum	44.6	103.88	16.0	19.4	0.049
0.75% ZnO foliar spray + 400 kg/ha Gypsum	46.0	105.88	17.2	20.7	0.048
0.75% ZnO foliar spray + 500 kg/ha Gypsum	47.2	106.88	18.9	22.2	0.046
F – test	S	S	S	S	NS
SEm±	0.40	0.64	0.58	0.92	0.92
CD (P=0.05)	1.21	1.93	1.76	2.77	2.77

Table 2. Effect of Zinc and Gypsum on Yield attributes.

Treatment combinations	No. of pods/ plant	No. of kernels/ pod	Seed index (g)	Shelling (%)	Seed yield (kg/ha)	Haulm yield (kg/ha)	Harvest index (%)
0.25% ZnO foliar spray + 300 kg/ha Gypsum	16.2	1.7	31.50	65.6	2380.70	4153.30	36.3
0.25% ZnO foliar spray + 400 kg/ha Gypsum	16.7	1.9	32.23	66.2	2427.00	3633.30	39.6
0.25% ZnO foliar spray + 500 kg/ha Gypsum	17.5	2.1	34.97	69.1	2614.70	3743.30	40.6
0.5% ZnO foliar spray + 300 kg/ha Gypsum	17.2	2.0	33.43	69.4	2508.70	3753.30	39.6
0.5% ZnO foliar spray + 400 kg/ha Gypsum	18.2	2.2	37.10	69.4	2702.70	3746.70	42.3
0.5% ZnO foliar spray + 500 kg/ha Gypsum	18.4	2.3	38.67	72.2	2749.00	4330.00	38.1
0.75% ZnO foliar spray + 300 kg/ha Gypsum	17.9	2.1	36.30	67.1	2653.70	3576.70	42.2
0.75% ZnO foliar spray + 400 kg/ha Gypsum	18.9	2.4	39.42	69.6	2846.70	4380.00	39.4
0.75% ZnO foliar spray + 500 kg/ha Gypsum	19.3	2.6	41.10	70.8	2917.00	4453.30	39.8
F – test	S	S	S	NS	S	S	S
SEm±	0.15	0.09	0.55	4.46	28.61	102.55	0.68
CD (P=0.05)	0.45	0.27	1.66	-	85.78	307.44	2.05

Table 3. Effect of Zinc and Gypsum on Economics of Groundnut

Treatment combinations	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net Return (INR/ha)	B:C ratio
0.25% ZnO foliar spray + 300 kg/ha Gypsum	41,300.40	1,02,370.10	61,069.70	1.47
0.25% ZnO foliar spray + 400 kg/ha Gypsum	41,500.40	1,04,361.00	62,860.60	1.51
0.25% ZnO foliar spray + 500 kg/ha Gypsum	41,700.40	1,12,432.10	70,731.70	1.69
0.5% ZnO foliar spray + 300 kg/ha Gypsum	41,425.40	1,07,874.10	66,448.70	1.60
0.5% ZnO foliar spray + 400 kg/ha Gypsum	41,625.40	1,16,216.10	74,590.70	1.79
0.5% ZnO foliar spray + 500 kg/ha Gypsum	41,825.40	1,18,207.00	76,381.60	1.82
0.75% ZnO foliar spray + 300 kg/ha Gypsum	41,675.40	1,14,109.10	72,433.70	1.73
0.75% ZnO foliar spray + 400 kg/ha Gypsum	41,875.40	1,22,408.10	80,532.70	1.92
0.75% ZnO foliar spray + 500 kg/ha Gypsum	42,075.40	1,25,431.00	83355.60	1.98