International Journal of Plant & Soil Science

34(15): 79-83, 2022; Article no.IJPSS.86351
ISSN: 2320-7035

Influence of Zinc and Spacing on Growth and Yield Traits of Groundnut (*Arachis hypogea* L.)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2022/v34i1531010

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/86351

Original Research Article

Received 07 February 2022
Accepted 17 April 2022
Published 21 April 2022

ABSTRACT

During Summer (*zaid*) of 2021, the current study conducted at CRF (Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, (U.P). The experiment used a RBD (Randomized Block Design) with 3 replications. There are 9 treatments used, each with distinct levels of spacing and Zinc applied. The agricultural field was found to be uniformly sandy loam with neutral pH (7.4). The treatments consisted of Zinc levels at 10 kg/ha, 12.5 kg/ha and 15 kg/ha and spacing at 25 × 10, 30 × 10 and 35 × 10 whose effect is observed in Groundnut (Var – K6). The treatment 6 with (Zn 15 kg/ha + 30×10) recorded significantly maximum in plant height (40.36 cm), number of nodules/plant (49.43), plant dry weight (21.88 g). The treatment 6 with (Zn 15 kg/ha + 30×10) also recorded significantly higher in yield attributes *viz.,* pods/pant (27.72), kernels/pod (1.92) and seed index (100 seed weight) (39.21 g), pod yield (2773.30 kg/ha), seed yield (1494.67 kg/ha), Haulm yield (5907.67 kg/ha), harvest index (20.18%), oil content (48.26%). The treatment 6 with (Zn 15 kg/ha + 30×10) also recorded significantly the maximum cost of cultivation (50,449.50 INR/ha), gross return (119218.55 INR/ha), net return (68769.05 INR/ha) and B: C ratio (1.36).

Keywords: Groundnut; zinc; spacing; yield; oil content; economics.

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1. INTRODUCTION

The world's most significant oilseed and supplementary food crop is groundnut (*Arachis hypogea* L.). It is a member of the Leguminaceae family. After China, India is first in terms of area and second in terms of production. The crop is grown on 26.4 Million hectares around the world, with average yield of 37.1 million MT. It is grown on 4596.33 hectares in India, with a yield of 6733.33 metric tonnes.

Zinc shortage is now almost an all-India problem, with 9-68 % of soils in West Bengal being zinc deficient [1]. Zinc is used as a catalyst in a variety of metabolic processes. Zinc also boosts the protein, calorie, amino acid, and fat content of oilseed crops. The quality of the crop can be improved with balanced fertilizing [2]. Zinc deficiency causes leaves to yellow from the lamina to the base, with the mid-rib and veins remaining green. In Maharashtra, 34% of soils were zinc deficient, suggesting that applying zinc to such soils could increase the quality of agriculture produce [3].

Planting geometry is a nonmonetary agronomical management method that plays major role in enhanced crop production. Crops produced in proper geometry make greater use of resources and agricultural inputs. The groundnut crop competes with itself both above and below ground. Planting geometry varies depending on the species and locality [4]. Plant population must be adjusted using planting practices that reduce overcrowding. A higher plant population per unit area than the optimum limit results in plant competition for natural resources, resulting in a weaker plant population with significant lodging problems [5].

2. MATERIALS AND METHODS

The current experiment taken place in CRF, Department Of Agronomy, SHUATS, Prayagraj, 25^0 30' 42''N latitude, 81^0 60' 56" E longitude and 98 m altitude above mean sea level during summer (*Zaid*) of 2021 (U.P.). The treatments consisted of Zinc levels at 10 kg/ha, 12.5 kg/ha and 15kg/ha and spacing at 25 × 10, 30 × 10 and 35 × 10 whose effect is observed in Groundnut (Var – K6). The treatment combinations which are T_1: 25X10 cm + 10 kg/ha, T_2: 25X10 cm + 12.5 kg/ha, T_3: 25X10 cm + 15 kg/ha, T_4: 30X10 cm + 10 kg/ha, T_5: 30X10 cm + 12.5 kg/ha, T_6: 30X10 cm + 15 kg/ha, T_7: 35X10 cm + 10 kg/ha, T_8: 35X10 cm + 12.5 kg/ha, T_9: 35X10 cm + 15 kg/ha. The land cultivated had sandy-loam soil with neutral pH with low organic carbon (0.536 %), medium accessible nitrogen (163.42 kg/ha), low phosphorus (21.96 kg/ha), and high potassium (256.48 kg/ha). To meet the NPK requirements, recommended fertilizer doses (RDF) were provided (20:40:20 NPK kg/ha) as basal doses in all plots. Nutrient sources were Urea, DAP and MOP. Whereas, based on the treatment combinations Zinc ($ZnSO_4$) is supplied to the plots as basal wherever required as soil application. Various plant growth metrics like Plant height, number of nodules per plant, and dry weight per plant were all measured at regular intervals during the crop growth. The yield metrics, such as the number of pods/ plant, kernels/plant, weight of 100 seeds (Seed index), Seed yield, Haulm yield, and Harvest index. Analysis of variance (ANOVA) was used to statistically examine all of the data recorded during experiment (Gomez and Gomez, 1984).

3. RESULTS AND DISCUSSION

3.1 Growth Attributes

Data represented in (Table 1) revealed that highest plant height was observed in the treatment with spacing of 30x10 cm (S_2) + Zinc at 15 kg/ha (40.36 cm) which was significantly highest than other treatments except treatment five (39.85 cm) with spacing of 30x10 cm (S_2) + Zinc at 12.5 kg/ha and treatment nine (40.34 cm) with spacing of 35x10 cm (S_3) + Zinc at 15 kg/ha which were statistically comparable with spacing of 30x10 cm (S_2) + Zinc at 15 kg/ha. Plant height (cm) was affected by the spacing methods; nevertheless, optimal spacing resulted in reduced competition for solar light, water, nutrients, and space between the plants, resulting in increased plant height. Gadade et al. [6] reported similar findings. The involvement of micronutrients in several physiological processes such as enzyme activation, electron transport, chlorophyll production, stomatal regulation, and others could explain the increase in plant height. Plant height increased as zinc levels increased, which could be owing to enhanced photosynthetic activity and chlorophyll production as a result of zinc fertilisation, resulting in improved vegetative development. The results were in accordance to Upadhyay and Anita Singh [7].

Significantly highest plant dry weight (21.88 g/plant) was observed in the treatment with spacing of 30x10 cm (S_2) + Zinc at 15 kg/ha.

However, dry weight (21.62 g) with spacing of 30x10 cm (S_2) + Zinc at 12.5 kg/ha and (21.74 g) with spacing of 35x10 cm (S_3) + Zinc at 15 kg/ha which were statistically comparable with spacing of 30x10 cm (S_2) + Zinc at 15 kg/ha Higher dry matter production was seen at 30x10 cm spacing due to improved photosynthetic activity as a result of increased sunshine exposure and higher nutrient availability. The findings were consistent with those of Gadade et al. [6]. The highest of biomass increase was observed because of increasing levels of zinc. Although the application of zinc as basal dose to groundnut increased its dry matter significantly, long plant height, high stem girth, and high root weights result in high dry matter under those treatments Shekhawat et al. [8].

Highest nodules per plant observed in the treatment with spacing of 30x10 cm (S_2) + Zinc at 15 kg/ha (7.23) which was significantly higher over rest of the treatments except treatment five (6.83) with spacing of 30x10 cm (S_2) + Zinc at 12.5 kg/ha and treatment nine (6.90) with spacing of 35x10 cm (S_3) + Zinc at 15 kg/ha which were statistically comparable with spacing of 30x10 cm (S_2) + Zinc at 15 kg/ha. Zinc is a necessary micronutrient for nodulation and nitrogen fixation, as well as the formation of leg-haemoglobin. Zn deficiency in legumes has been linked to a reduction in the number and size of nodules due to its role in leghaemoglobin production. As a result, higher zinc levels resulted in the most root nodules. Debnath et al. [9] findings were found to be similar.

3.2 Yield Traits

Data represented in (Table 2), pods per plant (27.72) was more and significant in treatment with treatment six with spacing of 25x10 cm (S_2)+Zinc at 15 kg/ha which was significantly higher than other treatments except treatment 5 with (26.68) spacing of 25x10 cm (S_2)+ Zinc at 12.5 kg/ha and treatment nine with spacing of 30x10 cm (S_3)+ Zinc at 15 kg/ha which was statistically comparable with spacing of 25x10 cm (S_2) + Zinc at 15kg/ha. Zinc is necessary for glucose metabolism, cellular membrane integrity, protein synthesis, and auxin production and pollen formation regulation. It has an impact on the activity of growth enzymes as well Srivastava et al. [10] was found to be similar. Kernels per pod (1.92) was more and significant in treatment with treatment six with spacing of 25x10 cm (S_2) + Zinc at 15 kg/ha which was significantly higher than other treatments except treatment five (1.85) with spacing of 25x10 cm (S_2)+ Zinc at 12.5 kg/ha and treatment nine (1.88) with spacing of 30x10 cm (S_3)+ Zinc at 15 kg/ha which were statistically comparable with spacing of 25x10 cm (S_2) + Zinc at 15 kg/ha. Zinc supplementation to groundnut crops promotes fruit growth by promoting the synthesis of tryptophan and auxinThe good impact of zinc on nutrient metabolism, biological activity, and growth parameters was related to positive impact of zinc on pods/plant and kernels/pods. As a result, zinc application resulted in taller and more active enzymes, resulting in more pods/plants and kernels/pods. Mohammed and Getnet [11] have previously observed similar findings. Seed Index (39.21) was more and significant in treatment six with spacing of 25x10 cm (S_2) + Zinc at 15 kg/ha which was significantly higher than other treatments except treatment nine with spacing of 30x10 cm (S_3)+ Zinc at 15 kg/ha which were statistically comparable with spacing of 25x10 cm (S_2) + Zinc at 15 kg/ha. Pod yield (3565.00 kg/ha) was more and significant in treatment with treatment six with spacing of 25x10 cm (S_2) + Zinc at 15 kg/ha which was significantly higher over rest of the treatments except treatment nine (3468.67 kg/ha) with spacing of 30x10 cm (S_3) + Zinc at 15 kg/ha which were statistically comparable with spacing of 25x10 cm (S_2) + Zinc at 15 kg/ha. Haulm yield (5907.67 kg/ha) was more and significant in treatment with treatment six with spacing of 25x10 cm (S_2) + Zinc at 15 kg/ha which was significantly higher than other treatments except treatment nine (5787.33) with spacing 30x10 cm (S_3) + Zinc at 15 kg/ha which were statistically comparable with spacing of 25x10 cm (S_2) + Zinc at 15 kg/ha. Zinc is important for improving haulm output since it is involved in several physiological processes in plants, including chlorophyll generation, stomatal control, starch use, and biomass accumulation. Zinc also aids crop yield by converting ammonia to nitrate. Haider et al. [12] reported comparable findings. Harvest index (20.19 %) was more and significant in treatment with treatment nine with spacing of 30x10 cm (S_3) + Zinc at 15 kg/ha which was significantly higher than other treatments except treatment three (19.86 %) with spacing 20x10 cm (S_1) + Zinc at 15 kg/ha, treatment four (19.23 %) with spacing of 25x10 cm (S_2) + Zinc at 10 kg/ha, treatment five (19.96 %) with spacing of 25x10 cm (S_2) + Zinc at 12.5 kg/ha and treatment six (20.18 %) with spacing of 25x10 cm (S_2) + Zinc at 15 kg/ha which were statistically comparable with spacing of 30x10 cm (S_3) + Zinc at 15 kg/ha. Zinc fertilization improves physiological processes, plant metabolism, and plant development, resulting in increased yield. Increased pod production and haulm yield with zinc application, as well as optimum spacing of 30x10 cm, which provided needed room for plant growth and increased groundnut yield. Debnath et al. [9] and Sokoto et al. [13] corroborated the similar findings (2013).

Table 1. Influence of zinc (ZnSO4) levels and spacing on growth attributes in groundnut

S. No.	Treatments	Plant height (cm)	Dry weight (g/plant)	Root nodules / plant
T_1	1. 25 X 10 cm (S_1) + Zn 10 kg/ha	37.85	19.96	5.30
T_2	2. 25 X 10 cm (S_1) +Zn 12.5 kg/ha	38.38	20.52	5.83
T_3	3. 25 X 10 cm (S_1)+ Zn 15 kg/ha	39.62	21.49	6.20
T_4	4. 30 X 10 cm (S_2)+ Zn 10 kg/ha	38.61	20.93	5.83
T_5	5. 30 X 10 cm (S_2)+ Zn 12.5 kg/ha	39.85	21.62	6.83
T_6	6. 30 X 10 cm (S_2)+ Zn 15 kg/ha	40.36	21.88	7.23
T_7	7. 35 X 10 cm (S_3)+ Zn 10 kg/ha	38.17	20.16	5.50
T_8	8. 35 X 10 cm (S_3)+ Zn 12.5 kg/ha	39.24	21.20	6.00
T_9	9. 35 X 10 cm (S_3)+ Zn 15 kg/ha	40.34	21.74	6.90
	SEm±	0.20	0.16	0.25
	CD (P=0.05)	0.60	0.48	0.76

Table 2. Influence of zinc levels and plant geometry on yield and yield traits in groundnut

Treatments	Pods/Plant	Kernels/Pod	Seed index (g)	Pod yield (Kg. ha^{-1})	Haulm yield (Kg. ha^{-1})	Harvest index (%)
1. 25 X 10 cm (S_1) + Zn 10 kg/ha	24.71	1.61	36.12	2078.30	5241.67	18.10
2. 25 X 10 cm (S_1) +Zn 12.5 kg/ha	24.66	1.70	36.77	2228.00	5434.33	19.08
3. 25 X 10 cm (S_1)+ Zn 15 kg/ha	26.25	1.81	37.93	2497.30	5669.67	19.86
4. 30 X 10 cm (S_2)+ Zn 10 kg/ha	25.30	1.72	37.03	2272.70	5533.67	19.23
5. 30 X 10 cm (S_2)+ Zn 12.5 kg/ha	26.68	1.85	38.17	2519.30	5728.33	19.96
6. 30 X 10 cm (S_2)+ Zn 15 kg/ha	27.72	1.92	39.21	2773.30	5907.67	20.18
7. 35 X 10 cm (S_3)+ Zn 10 kg/ha	24.53	1.63	36.44	2172.30	5315.00	18.48
8. 35 X 10 cm (S_3)+ Zn 12.5 kg/ha	25.38	1.78	37.57	2396.30	5643.00	19.18
9. 35 X 10 cm (S_3)+ Zn 15 kg/ha	27.19	1.88	38.72	2669.00	5787.33	20.19
F-test	S	S	S	S	S	S
S.Em±	0.37	0.03	0.30	55.13	41.00	0.33
CD (5%)	1.12	0.08	0.91	165.27	122.92	0.99

4. CONCLUSION

Study suggested that with spacing 30x10 cm (S_2) + Zinc at 15 kg/ha were recorded higher growth and yield parameters and more productive (3565 kg/ha). The conclusions reached were based on only 1 year worth data, thus they need to be confirmed before they can be recommended.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Katyal JC, Rattan RK. Distribution of zinc in Indian Soils. Fert. News. 1993;38:15-26.
2. Katyal JC, Vlek PLG. Micronutrient problem in tropical Asia. Fertil. Res. 1985; 7:69–94.
3. Shukla AK, Tiwari PK, Prakash C. Micronutrients deficiencies vis-a vis food and nutritional security of India. Indian J. Fert. 2014;10:94-112.
4. Meena B. Effect of planting geometry and nitrogen management on groundnut (*Arachis hypogaea* L.) in loamy soil of Rajasthan, Indian J. of Agric. Sci. 2011; 81(1):1-9.
5. Jangir R, Arvadia LK, Kumar S. Growth and Yield of Mustard (*Brassica juncea* L.), Dry Weight of Weeds and Weed Control Efficiency Influence by Different Planting Methods and Weed Management. International Journal of Current Microbiology and Applied Sciences. 2017; 6(7):2586-2593.
6. Gadade GD, Dhopte RV, Khodke UM. Effect of Different Spacing on Growth and Yield of BBF Raised Summer Groundnut (*Arachis hypogea* L.) under Drip Irrigation. International Journal of Current Microbiology and Applied Sciences. 2018;Special Issue-6:593-597.
7. Upadhyay RG, Anita Singh. Effect of nitrogen and zinc on nodulation, growth and yield of cowpea (*Vigna unguiculata*). Legume Research. 2016;39(1):149-151.
8. Shekhawat PS, Narendra Kumawat. Response of zinc fertilization on productionand profitability of pearlmillet (*Pennisetum glaucum* L.) under rainfed condition of Rajasthan. Journal of Agricultural Research. 2017;4(4):251-254.
9. Debnath P, Pattanaaik SK, Sah D, Chandra G, Pandey AK. Effect of boronand zinc fertilization on growth and yield of cowpea (*Vigna unguiculata* L. Walp.) in Inceptisols of Arunachal Pradesh. Journal of the Indian Society of Soil Science. 2018;66(2):229-234.
10. Srivastava N, Dawson J, Singh RK. Interactioneffectofspacing, sources of nutrient and methods of zinc application on yield attributes and yields of greengram (*Vigna radiata* L.) in NEPZ. Journal of Pharmacognosy and Phytochemistry. 2017;6(4):1741-1743.
11. Mohammed BU, Getnet BE. Yield, yield components and quality of groundnut (*Arachis hypogaea* L.) as influenced by inter row spacing and weeding frequency. International Journal of Research. 2019; 7(11).
12. Haider MU, Hussain M, Farooq M, Nawaz A. Soil application of zinc improves the growth, yield and grain zinc biofortification of mungbean. Soil Environment. 2018; 37(2):123-128.
13. Sokoto MB, Bello I, Osemuahu EA. Effects of intra-row spacing on herbage yields of two groundnut (*Arachis hypogaea* L.) varieties in Sokoto, Semi-Arid Zone, Nigeria. International Journal of Applied Agricultural and Apicultural Research. 2013;9(1&2):11-17.

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The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/86351