Original Research Article

Effect of Plant Growth Regulators at different levels of Zinc on Growth and Yield of Groundnut (*Arachis hypogea* L.)

Abstract

The field experiment entitled **"Effect of Plant Growth Regulator at different levels of Zinc on growth and yield of Groundnut *(Arachis hypogea* L.)"** was conducted during *kharif* season of 2021 at Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P). The ~~soil of the~~ experiment plot was sandy loam in texture, nearly acidic in soil reaction (P^H 6.9), low in organic carbon (0.112%), available N (278.93Kg/ha), available P(10.8Kg/ha) and available K (206.4Kg/ha). The experiment was laid out in Randomized Block Design, treatments of different ~~consists of~~ plant growth regulator levels (75, 100 and 125 ppm) and zinc levels *viz*.(20,25 and 30 kg/ha) were imparted in the experiment and were replicated thrice. Results obtained indicated that there was significant increase in growth parameters at harvest *viz*., plant height (58.40cm), ~~N~~number of nodules/plant (59.77), dry weight accumulation(38.1g),and yield attributes viz., No.pods/plant(19.3), No.kernals/pod (4.3), seed index(44.50), seed yield (3169 kg/ha), Haulm yield (4747.3kg/ha) were recorded with the application of ($GA_3$125ppm+ $ZnSO_4$ 30kg/ha). However, Maximum Gross return (142636.5 INR/ha), Net return (102971.1INR/ha) and B:C ratio (2.59) was recorded with the application of ($GA_3$125ppm+ $ZnSO_4$ 30kg/ha). Therefore, it is concluded that the application of ($GA_3$125ppm+$ZnSO_4$30kg/ha) was more productive and economically feasible,

Comment [ASS1]: Needs complete rewriting as the abstract is written very poorly without any continuity

Keywords: Groundnut, Plant Growth Regulator (GA_3), Zinc, Economics.

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INTRODUCTION

Groundnut (*Arachis hypogea* L.) is one of the important commercial crops of the world that rank 13th among the food crops grown over an area of 5.40 million ha and production of 5.43 million tonnes with a productivity of 910kg/ha (AICRP 2020). Groundnut is the most important food legume in India in terms of consumption and area under production. Groundnut is a self -pollinating, annual herbaceous legume. It is ~~Groundnut is~~ the world's fourth most important source of edible oil and third most important source of vegetable protein. It is an annual legume, native of South America (Brazil), but it is grown throughout the tropical and warm temperate regions of the globe. Cultivated groundnut is also known as peanut and the seeds are also known as kernel, these kernels/seeds are used for manufacturing of confectionary nut flour, protein and peanut milk **(Woodroof,1966).** About two third of the world's groundnut production is used as oil and remaining one third is consumed as food.

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It is a unique crop, having the attributes of both oilseed and legume crop in the farming system of Indian agriculture. Oil seeds serve as a rich source of food, feed, energy, employment and commerce. India also enjoys a distinct position in terms of rich diversity of annual oil seed crops. The country is blessed with the agro- ecological conditions favorable for growing all the nine annual oilseed crops and oil bearing tree spices.

In India, groundnut is known as poor man's almond. Groundnut kernels are an excellent source of plant protein and contains 45 to 50% oil, 27 to 33% protein as well as essential minerals, carbohydrates and vitamins. They play an important role in the dietary requirement of poor women and children and haulms are used as livestock feed. Groundnut oil is composed of mixed glycerides and contains a high proportion of unsaturated fatty acids *viz.* oleic (50 to 65%) and linoleic (18 to 30%). Groundnut contains amino acids including cystines which are essential for animal growth. The by-products of this crop like haulm and cake have good nutritive value. The groundnut cake obtained after oil extraction is rich in protein and considered as valuable organic manure and animal feed, which contains 7 to 8%N, 1.5% P_2O_5 and 1% K_2O. some industrials products like paints, varnishes, soap and lubricating oils are also manufactured from groundnut. The seed has several uses, as whole seed or processed to make peanut butter, oil, soups, stews and other products. They contain a good deal of oil which is very easily digested and for this reason they are useful consumptive. The oil is regarded as an excellent aperients or mild laxative and emollient which is soften the skin.

Comment [ASS2]: Introduction has to be rewritten in a concise and precise manner

In India, zinc is now considered as the fourth most important yield limiting nutrient after nitrogen, phosphorus and potassium, respectively. Among oilseeds, groundnut in particular suffers from Zn deficiency **(Singh, 2007).** Zinc deficiency start yellowing of leaves from lamina to base, mid-rib and veins remain green, later on necrotic brown spots are developed and dorsal leaf veins become brown. It is likely

UNDER PEER REVIEW

to occur when soils are low in organic matter and alkaline under high levels of soil p and soils are cool and wet during the vegetative phase, zinc increases the chlorophyll content in the leaves and nodule number, pod production and weight. Zinc's function in cell membrane integrity will also be discussed especially for root cells along with its role in suppressing free radical damage to cells **(Cakmak, 2000).** Zinc increases the resistance of plants to pathogens by bringing changes in anatomy and physiology of host plant.

Among plant growth regulators, Gibberellin play a vital role in regulating developmental processes within plant bodies (Gou et al. 2010). GA are a class of endogenous plant growth substances exerts pleiotropic effects on developmental processes. So far 55 different gibberellins are known to occur in plants as native plant hormones.

Gibberellin helps in cell growth of stem, leaves and other aerial parts b causing cell elongation, and increase in intermodal length. A higher concentration of gibberellins increases plant growth **(Bora and Sarma 2006).** The different concentrations of GA had significant effect on growth in mustard **(Akter *et al.* 2007). Baydar (2000)** reported that oil synthesis increases with increasing dose of GA in safflower. GA_3 is an important growth regulator that may have many uses to modify the growth, yield and yield attributing characters of plant **.** Plant growth regulators are used widely to improve plant performance. GA_3 is one of those growth regulators that have positive effect on plant as enhancing vegetative growth and plant yield and increasing dry weight **(Islam *et al*., 2007).** GA_3has been widely used to improve germination rate, seedling growth and consequently yield.

Comment [ASS3]: Add recent references and literature

MATERIALS AND METHODS:-

The experiment was carried out during *Kharif* season of 2021 at the CRF (Crop Research Farm) SHIATS, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh. The ~~c~~Crop Research Farm is situated at 25.75^0 N latitude, 87.19^0 E longitude and at an altitude of 98m above mean sea level. This area is situated on the right side of the river Yamuna and by the opposite side of Prayagraj City. All the facilities required for crop cultivation were available. .The ~~soil of the~~ experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 6.9), low in organic carbon (0.112%), available N (278.93 Kg/ha), available P (10.8 Kg/ha) and available K (206.4 Kg/ha). The crop was sown on 20th july 2020 using variety Shekhar. The experiment was laid out in Randomized Block Design comprised of 3 replications and total 9 treatments viz. T_1: (GA3) 75PPM + 20 kg/ha $ZnSO_4$, T_2: (GA_3) 75PPM + 25 kg/ha $ZnSO_4$, T_3: (GA_3) 75PPM+ 30 kg/ha $ZnSO_4$, T_4: (GA_3) 100PPM + 20 kg/ha $ZnSO_4$, T_5: (GA_3) 100PPM +25 kg/ha $ZnSO_4$, T_6: (GA_3) 100PPM + 30 kg/ha $ZnSO_4$, T_7: (GA_3) 125PPM + 20 kg/ha $ZnSO_4$, T_8: (GA_3) 125PPM + 25 kg/ha ZnSO4, T_9: (GA_3) 125PPM + 30 kg/ha $ZnSO_4$. All nutrients were applied into the soil in the form of Urea, Single super phosphate (SSP) and Muriate of potash (MOP). Entire ~~Full~~ dose of P and K was applied basal for respective plots, half dose of N

UNDER PEER REVIEW

(as urea) was applied as basal, one-fourth at 30 days after sowing and remaining one-fourth at the time of flowering. Zinc levels are (20,25,30 kg/ha) was applied as soil application along with NPK fertilizers before sowing .Plant growth regulator levels are (75,100,125 ppm) was applied as foliar spray through Knapsack sprayer as two doses. One at 22 DAS and another one at 45DAS. The growth parameters were recorded at periodical intervals of 15,30,45,60,75 DAS and at harvest stage from the randomly selected five plants in each treatment. Statistically analysis was done for all the parameters in one way Annova and mean compared at 5% probability level of significant results.

RESULTS AND DISCUSSION

Effect of Plant Growth Regulator at different levels of Zinc on growth parameters of Groundnut

Effect of Plant Growth Regulator and Zinc on growth parameters of Groundnut of are presented in Table1. In the results revealed that maximum plant height (58.40cm), number of nodules/plant(59.77), dry weight(38.1),was observed with application of (GA_3) 125PPM + 30Kg/ha $ZnSO_4$ where crop growth rate(10.00) and relative growth rate(0.009) was observed with application of(GA_3) 125PPM + 30Kg/ha $ZnSO_4$ as closely followed by the Plant height(56.86), number of nodules/plant(58.40), Dry matter accumulation(37.3) which was recorded in the treatment of ((GA_3) 125PPM + 25Kg/ha $ZnSO_4$). Maximum plant height and maximum number of nodules are obtained due to the corresponding increase in level of GA_3 at all the growth stages and the function of zinc is to produce chlorophyll to the plant, electron transportation, enzyme activation and Zinc can help in the nodulation activity due to enzymatic activity and nitrogen fixation which ultimately increase nodulation. Higher dry matter accumulation depends upon the photosynthesis and respiration rate, which finally increases the plant growth with respect to increased plant height, number of nodules etc. The favourable effect of plant growth regulator and zinc might influence the metabolism of the plant, effect on photosynthetic pigments and activity of enzymes which in turn helps to increase in the vegetative growth. The results on higher crop growth was also reported by **A Akter *et al.,* (2007) , Reddi Naveen kumar *et al*., (2021).**

Effect of Plant Growth Regulator at different levels of Zinc on yield parameters of Groundnut

Effect of Plant Growth Regulator at different levels of Zinc on yield parameters of Groundnut are presented in Table2. In the results revealed that higher No. pods/ plant (19.3), No. kernels/ pod(4.3), Seed index (44.50), Seed yield (3169.7 kg/ha) and Haulm yield (4747.3 kg/ha) was recorded with application of (GA_3)

UNDER PEER REVIEW

125PPM + 30Kg/ha $ZnSO_4$ and Harvest Index (41.6) was observed with application of (GA_3) 125PPM + 25Kg/ha $ZnSO_4$ as closely followed by the No. pods/ plant(18.8), No. kernels/ pod(3.9), Seed index (41.40), Seed yield (2923.6kg/ha) was observed with the application of (GA_3) 125PPM + 25Kg/ha $ZnSO_4$). The favourable combination of GA3 and zinc plays a vital role in increasing seed yield because they both takes place in many physiological processes like increasing the chlorophyll content, carbohydrate metabolism, protein synthesis, regulating the stomata, cell elongation, pod formation, increasing the flowering set which enhance the seed yield. The yield of a crop is the cumulative effect of yield attributing characters such as pods per plant, kernels per pod and seed index. Thus, the seed yield of ground nut also increased significantly due to application of zinc as a consequence of highest values of above parameters. The increase in seed yield due to zinc and GA_3 application might be due to the cumulative effect of increased plant height, number of nodules per plant and dry matter production i.e., increased growth parameters. The seed and haulm yields combined together showed significant increase in biological yield of ground nut. The results of the present investigation are in close conformity with the findings of **Sai Surya Goutami V. and Ananda N (2018)**

Effect of Plant Growth Regulator at different levels of Zinc on economics

Effect of Plant Growth Regulator at different levels of Zinc on economics of Sesame presented in Table 3. The highest gross returns (142636.5INR/ha), higher net returns (102971.1INR/ha) and maximum B:C ratio (2.59) was recorded with the application of (GA_3) 125PPM + 30Kg/ha $ZnSO_4$ This was mainly due to higher seed and haulm yields compared to other treatment combinations. Gross returns, net returns and B: C ratio increased significantly due to successive increase in varying levels of PGR and Zinc with application of ($GA_3$75ppm +$ZnSO_4$ 30Kg/ha). This might be attributed to higher seed and haulm yields obtained with comparatively less cost than additional income under these treatments. Similarly results were also reported by **Chittam Ravi Kishore Reddy et al.,(2019)**

UNDER PEER REVIEW

Table 1. Effect of Plant Growth Regulator at different levels of zinc on growth parameters at harvest of groundnut

Treatments	Plant height (cm)	No.of nodules/plant	Plant dry weight (g/plant)	Crop growth rate ($g/m^2/day$) at 45-60	Relative growth rate (g/g/day) at 45-60
1. (GA_3) 75PPM + 20 Kg/ha $ZnSO_4$	52.46	46.99	34.1	10.00	0.009
2 (GA_3) 75PPM + 25 Kg/ha $ZnSO_4$	53.40	48.77	34.8	7.41	0.006
3.(GA_3) 75PPM + 30 Kg/ha $ZnSO_4$	54.86	50.77	35.7	7.90	0.006
4. (GA_3) 100PPM + 20 Kg/ha $ZnSO_4$	54.53	49.55	35.1	7.53	0.006
5. (GA_3) 100PPM + 25 Kg/ha $ZnSO_4$	54.93	51.66	35.9	7.66	0.006
6. (GA_3) 100PPM + 30 Kg/ha $ZnSO_4$	55.86	53.99	36.6	7.29	0.005
7. (GA_3) 125PPM + 20Kg/ha $ZnSO_4$	55.93	52.55	36.2	7.41	0.005
8. (GA_3) 125PPM + 25Kg/ha $ZnSO_4$	56.86	58.40	37.3	6.91	0.005
9. (GA_3) 125PPM + 30Kg/ha $ZnSO_4$	58.40	59.77	38.1	7.16	0.005
F test	S	S	S	NS	NS
SEm (±)	0.62	0.63	0.33	0.95	0.0009
CD (5%)	1.88	1.09	0.99	-	-

UNDER PEER REVIEW

Table 2. Effect of Plant Growth Regulator at different levels of zinc on yield parameters of groundnut

Treatments	No.of pods/plant	No.of kernels/pod	Seed index (g)	Seed yield (kg/ha)	Haulm yield (kg/ha)	Harvest index (%)
1. (GA_3) 75PPM + 20 Kg/ha $ZnSO_4$	15.5	2.7	39.40	2460.7	3788.7	38.6
2 (GA_3) 75PPM + 25 Kg/ha $ZnSO_4$	17.3	3.2	39.51	2536.9	3985.3	38.9
3. (GA_3) 75PPM + 30 Kg/ha $ZnSO_4$	17.8	3.6	40.23	2463.8	4145.3	37.5
4. (GA_3) 100PPM + 20 Kg/ha $ZnSO_4$	17.4	3.3	39.93	2547.3	3640.3	41.2
5. (GA_3) 100PPM + 25 Kg/ha $ZnSO_4$	18.3	3.6	40.37	2633.4	3749.0	41.3
6. (GA_3) 100PPM + 30 Kg/ha $ZnSO_4$	18.6	4.0	41.10	2673.6	4526.7	37.9
7. (GA_3) 125PPM + 20Kg/ha $ZnSO_4$	18.5	3.8	40.93	2774.0	4378.0	38.8
8. (GA_3) 125PPM + 25Kg/ha $ZnSO_4$	18.8	3.9	41.40	2923.6	4098.7	41.6
9. (GA_3) 125PPM + 30Kg/ha $ZnSO_4$	19.3	4.3	44.50	3169.7	4747.3	40.0
F test	S	S	S	S	S	S
SEm (±)	0.22	0.14	1.08	13.06	130.36	0.73
CD (5%)	0.66	0.42	0.42	39.15	390.83	2.19

UNDER PEER REVIEW

Table 3. Effect of Plant Growth Regulator at different levels of zinc on Economics of groundnut

S. No	Treatments	Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C ratio
1	(GA_3) 75PPM + 20Kg/ha $ZnSO_4$	38790.4	110731.5	71941.1	1.85
2	(GA_3) 75PPM + 25Kg/ha $ZnSO_4$	38915.4	114160.5	75245.1	1.93
3	(GA_3) 75PPM + 30Kg/ha $ZnSO_4$	39165.4	110871.0	71705.6	1.83
4	(GA_3) 100PPM + 20Kg/ha $ZnSO_4$	38990.4	114628.5	75638.1	1.94
5	(GA_3) 100PPM + 25Kg/ha $ZnSO_4$	39115.4	118503.0	79387.6	2.02
6	(GA_3) 100PPM + 30Kg/ha $ZnSO_4$	39369.4	120312.0	80946.6	2.05
7	(GA_3) 125PPM + 20Kg/ha $ZnSO_4$	39290.4	124830.0	85539.6	2.17
8	(GA_3) 125PPM + 25Kg/ha $ZnSO_4$	39415.4	131562.0	92146.6	2.33
9	(GA_3) 125PPM + 30Kg/ha $ZnSO_4$	39665.4	142636.5	102971.1	2.59

UNDER PEER REVIEW

conclusion

It may be concluded that application of (GA_3) 125PPM + 30Kg/ha $ZnSO_4$ showed higher yield and economics. Therefore, it is recommended for farmers for receiving higher yield and economic benefits of Groundnut

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