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STUDY ON FOLIAR APPLICATION OF PLANT GROWTH REGULATORS FOR IMPROVING REPRODUCTIVE EFFICIENCY AND YIELD OF GROUNDNUT (*Arachis hypogaea* L.) GENOTYPES

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ABSTRACT

A field experiment entitled "Study on foliar application of plant growth regulators for improving reproductive efficiency and yield of groundnut (*Arachis hypogaea* L.) genotypes" was carried out during *Rabi*, 2023-24 at wetland farm of S. V. Agricultural College, Tirupati campus of Acharya N. G. Ranga Agricultural University, Andhra Pradesh. The present experiment was laid out in randomized block design with factorial concept and replicated thrice, with four genotypes as factor-I (G_1-Nithyaharitha, G_2-Dharani, G_3-K-6, G_4-Vishista) and plant growth regulators as Factor-2 (T_1- Control + RDF of NPK, T_2-Prohexadione calcium@105 g a.i/ha at before and after peak flowering, T_3- Putrescine@100 ppm at before and after peak flowering, T_4-Paclobutrazol@ 100ppm at before and after peak flowering. With the objectives to study the effect of growth retardants on plant Phenological and Morpho-Physiological parameterss of Groundnut, to study the effect of growth retardants on reproductive efficiency of Groundnut and to study the effect of plant growth regulators on yield and yield components. Among the plant growth regulators studied, the maximum yield per plant was observed with T2 (Prohexadione Calcium@105 a.i/ha) (36.9g) and maximum harvest index was observed with T2 (Prohexadione Calcium@ 105 a.i/ha) (36.4%).

KEYWORDS: Reproductive efficiency, Paclobutrazol, Prohexadione calcium, Putrescine.

INTRODUCTION

Groundnut (*Arachis hypogaea L.*) is an important leguminous oilseed crop. Groundnut is valued for its high oil content and edible seeds and is mostly grown under rainfed situation in scarce Rainfall zone of AndhraPradesh. Groundnut belongs to the division *Papiolionaceae* of the family *leguminosae*.

Globally, Groundnut is cultivated under 327 lakh hectares, producing 539 lakh tonnes with the productivity of 1648 kg per hectare (FAOSTAT, 2021). India ranks first in Groundnut area under cultivation (54.2 Lakh Ha) and is the second largest producer in the world (101 Lakh Tonnes) and has productivity of 1863 kg per hectare. In Andhra Pradesh, groundnut is cultivated in an area of 8.23 lakh hectares with a production of 5.19 lakh tonnes, contributing 6.20 per cent to India's groundnut production. Groundnut seed contains 44 to 56 per cent oil and 22 to 30 per cent protein. Kernels are rich sources of riboflavin, thiamine, nicotinic acid and vitamin E and is rich in minerals like P, Ca, Mg and K and vitamins. (Crop outlook reports of Andhra Pradesh, Annual report, January to December 2022).Flowering and reproductive efficiency plays an important role in determining yield of Groundnut. Reproductive efficiency of groundnut depends primarily on light absorption, assimilates production, production of viable flowers, pegs, flower to peg ratio, conversion of flowers and pegs to filled pods (Swethasree *et al.,* 2021).

Flowering in Groundnut commences at 25 days and plant reaches 50 per cent of flowering by 30-35 days after sowing. The prolonged vegetative phase and excessive vegetative growth reduces the yield and dry matter partitioning also hampers the Harvest Index. Pod yield can be considered as the result of sequential processes of flower production, peg initiation, conversion of peg to pods and pod filling. The objective of this study is to evaluate the responses of peanut genotypes and plant growth regulators on reproductive efficiency.

Putrescine is a naturally occurring organic compound that belongs to the class of polyamines. In plants, Putrescine is involved in various physiological processes, including growth, development and stress responses. It promotes root development, leading to increased nutrient uptake and overall plant biomass. It is also known to enhance the tolerance of crops to various abiotic stresses such as drought, salinity, and extreme temperatures. Putrescine helps in maintaining cellular integrity, regulating osmotic balance and scavenging reactive oxygen species, thereby reducing stress-induced damage and also play a role in the defense response of plants against pathogens and pests. Due to its positive effects on growth promotion, stress tolerance and disease resistance, Putrescine application results in increased crop yields (Deotale *et.al.,*2018).

Paclobutrazole (PBZ) is a plant growth retardant that belongs to the class of triazole compounds, commonly used in agriculture to regulate plant growth, enhance

The field experiment soil was sandy loam in texture, neutral in reaction (pH - 6.8), low in organic carbon (0.38%)and available nitrogen (120.3 kg ha^{-1}), high in available phosphorus (27.2 kg ha^{-1}) and medium in potassium (214 kg ha^{-1}). The plots of 3 m × 2 m size were used for each treatment. The experiment was laid out in random block design with factorial concept replicated thrice. with four Genotypes as factor-1 and plant growth

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crop quality and improve productivity. Paclobutrazole is primarily known for its ability to inhibit the biosynthesis of gibberellins, which promote stem elongation, thereby it slows down stem growth, resulting in compact plants with shorter internodes with stouter stem, increasing root growth and causing better fruit set (Berova and Zlatev, 2000). This can be particularly beneficial in crops where reduced height and compactness are desirable.This results in development of more secondary shoots, which can increase the overall plant density, foliage volume and flower or fruit production. It is also reported to improve drought resistance by reducing water loss through stomatal closure and improving water use efficiency and also enhances tolerance to low temperatures and salinity in some plant species (Goswami *et al.,* 2022).

Prohexadione calcium inhibits the synthesis of gibberellins, a group of plant hormones that promote stem elongation. By reducing gibberellin production, it can control excessive vegetative growth, resulting in shorter internodes and a more compact plant structure. This causes strength in stems, which leads to lodging resistance and improved plant stability. It is also reported to have indirect effects on disease resistance. By reducing plant height and canopy density, it can improve air circulation and sunlight penetration within the crop, which can help reduce the incidence and severity of certain fungal diseases that thrive in humid and shaded conditions. Prohexadione calcium can suppress apical dominance, leading to increased branching and lateral bud development. This can result in a bushier plant with more side shoots and increased overall plant density. Prohexadione Calcium increased yield and decreased pod loss percentage in peanut (Beam *et al.,* 2002).

MATERIAL AND METHODS

The experiment entitled "Study on foliar application of plant growth regulators for improving reproductive efficiency and yield of Groundnut (*Arachis hypogaea* L.) genotypes" was conducted during *Rabi*, 2023-24 in field number. 43 of wetland farm, S.V. Agricultural College, Tirupati campus of Acharya N.G. Ranga Agricultural University which is geographically situated at 13.5° N latitude and 79.5° E longitude at an altitude of 182.9 m above mean sea level in the Southern Agro-climatic Zone of Andhra Pradesh.

regulators as factor-2 .The foliar sprays were applied at before (30 DAS) and after flowering stage(60 DAS). All the weeds were removed by hand weeding twice at 20 and 40 days after sowing and crop irrigated at regular intervals up to one week before harvesting. The plants in net plot were harvested, dried for 2 days and then threshed. Pod yield from five plants per plot recorded and expressed as yield per plant(g). The protein content of the kernels was determined by Lowry method and expressed in (per cent). The data were recorded during the investigation was statistically analyzed following the analysis of variance for Factorial randomized block design as suggested by Panse and Sukhatme (1985). Statistically significance was tested with "F" value at five percent level of probability.

Application of chemicals

Preharvest chemical treatment Sprays were prepared and applied at before and after peak flowering.

In order to prepare 105 g a.i./ha Prohexadione calcium, 105 g of chemical active ingredient is dissolved in 500 lit of water and applied per hectare.

In order to prepare 100 ppm of Putrescine, 100 mg of chemical was dissolved in 1 litre of water. And in order to prepare 100ppm of Paclobutrazol, 100 mg of chemical is dissolved in 1 litre of water.

RESULTS AND DISCUSSION

Yield per plant (g)

Influence of genotypes and plant growth regulators on yield per plant of groundnut was recorded and depicted in table 2. and in fig.2.

The genotypes of study and plant growth regulator treatments were found to be differed significantly with respect to per plant yield. However, the interaction effects (G × T) did not vary significantly with respect to per plant yield.

The highest yield per plant of groundnut was recorded with the G1(Nithyaharitha)(38.8 g) which is significantly superior to the rest of the genotypes of study. Minimum yield per plant recorded in genotype G4(Vishista)(29.1 g). The higher yield of Nithyaharitha

Table 1. Shelling percentage (%) and harvest index (%) of groundnut genotypes at different growth stages as influenced by plant growth regulators

Treatments	Shelling (%)					Harvest index (%)				
	T_1	T_2	T_3	T_4	Mean value of genotypes	T_1	T_2	T_3	T_4	Mean value of genotypes
G_1	68.8	75.9	72.5	73.9	72.8	34.2	37.8	35.4	36.7	36.0
G_2	64.4	72.4	68.4	69.8	69.3	34.8	38.4	36.2	37.3	36.7
G_3	63.7	72.8	66.5	69.1	68.0	25.6	29.7	27.2	28.5	27.7
G_4	66.8	73.8	70.3	71.7	70.6	36.3	39.9	37.5	38.7	38.1
Mean value of treatments	66.5	73.7	69.4	71.1		32.7	36.4	34.1	35.3	
	G	T	G × T			G	T	G × T		
SEm	0.37	0.37	0.73			0.40	0.40	0.81		

CD(P=0.05)	1.06	1.06	NS			1.17	1.17	NS	

G1 : Nithyaharitha; G2: Dharani; G3: K-6; G4: Vishista
T1 : Control + (RDF of NPK); T2 : Prohexadione Calcium 105 a.i /ha; T3 : Putrescine @ 100 ppm, T4 : Paclobutrazol @ 100 ppm

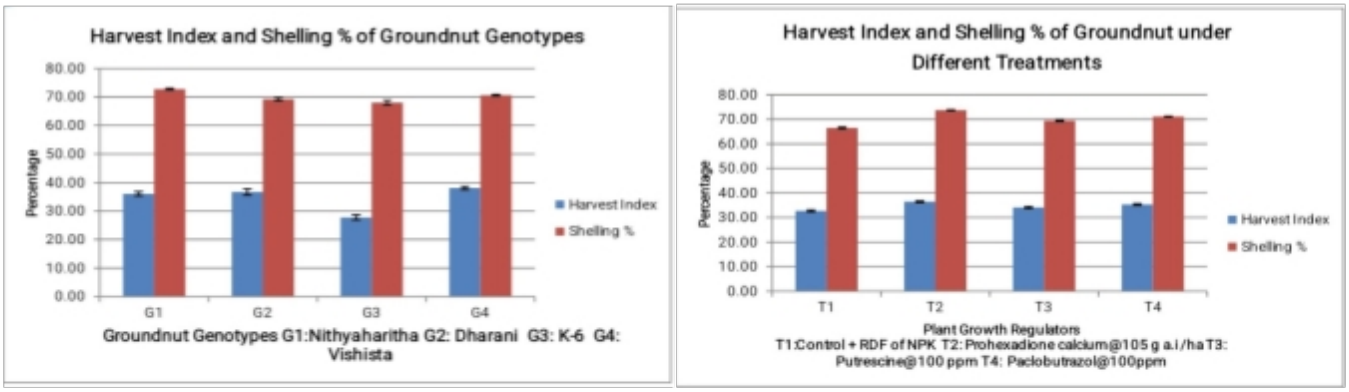


Fig. 1. Shelling percentage (%) and harvest index (%) of groundnut genotypes at different growth stages as influenced by Plant growth regulators

genotype might be attributed to higher number of pegs, higher mature pods per plant of the genotype.

Similar observations were also made by Attarde *et al*. (2001). Pod yield is highly related to the number of mature pods per plant, 100 seed weight, height and number of primary branches per plant (Labana *et al.,* 1980).

Among the plant growth regulators studied, the maximum yield per plant was observed with T2 (Prohexadione Calcium@105 a.i/ha) (36.9g) followed by T4 (Paclobutrazol@100ppm) (35.6g) which were significantly superior over the rest of treatments tested. Minimum yield per plant recorded with T1 (control + RDF of NPK) (29.7g).

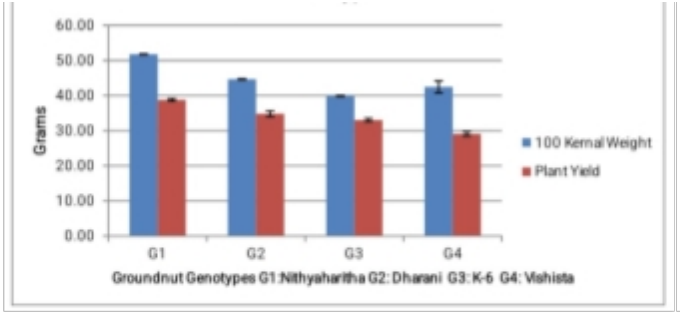
The table -provides data on the interaction effects between genotypes and treatments (G×T). Genotype G1 (Nithyaharitha) treated with T2(Prohexadione Calcium@ 105 a.i/ha) recorded maximum yield per plant (46.3 g). This increment in pod yield might be due to acceleration of dry matter distribution to the early-bearing pods, which resulted from the inhibition of stem growth, increased chlorophyll content resulting in enhanced CO_2 assimilation rates by PGRs application. And minimum yield recorded in genotype G4(Vishista) (26.6 g) treated with T1 (control + RDF of NPK).

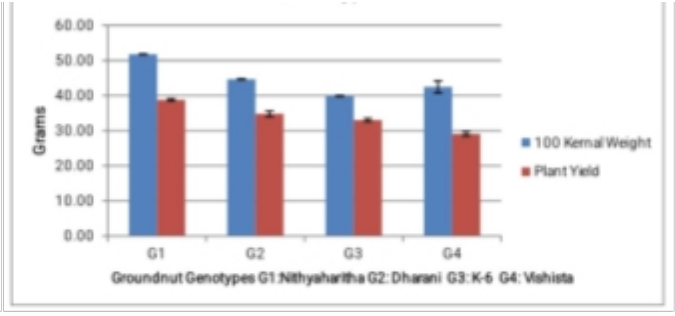
A similar finding was also reported by Win *et al*. (2017). Higher pod yield (4480 kg/ha) recorded in groundnut, when treated with Prohexadione calcium,

Table 2. 100 kernel weight (g) and yield per plant (g) of groundnut genotypes at different growth stages as influenced by Plant growth regulators

Treatments	100 kernel weight(g)					Yield per Plant (g)				
	T_1	T_2	T_3	T_4	Mean value of genotypes	T_1	T_2	T_3	T_4	Mean value of genotypes
G_1	47.9	54.6	51.9	52.9	51.8	34.5	46.3	37.9	40.6	38.8
G_2	41.6	46.4	44.9	45.9	44.7	30.1	38.0	34.7	36.4	34.8
G_3	36.6	42.6	39.9	40.6	39.9	27.5	36.6	32.5	35.6	33.0
G_4	38.7	44.5	43.0	43.8	42.5	26.6	31.0	28.8	29.9	29.1
Mean value of treatments	41.2	47.0	44.9	45.8		29.7	36.9	33.5	35.6	
	G	**T**	**G × T**			**G**	**T**	**G × T**		
SEm	0.403	0.403	0.806			0.040	0.040	0.080		
CD(P=0.05)	1.164	1.164	NS			1.16	1.16	NS		

G1 : Nithyaharitha; G2: Dharani; G3: K-6; G4: Vishista
T1 : Control + (RDF of NPK); T2 : Prohexadione Calcium 105 a.i /ha; T3 : Putrescine @ 100 ppm, T4 : Paclobutrazol @ 100 ppm





less pod yield (4210 kg/ha) recorded when treated with Cyclanilide over. Increased pod yield of peanut by prohexadione calcium was attributed to increased pod retention (Jordan *et al.*, 2004).

Paclobutrazol of 250 ppm, applied at 45 DAS of groundnut resulted in maximum pod yield (3719 kg/ha) when compared to control. This is due to an acceleration of dry matter distribution to the early-bearing pods, which resulted from the inhibition of stem growth by paclobutrazol application which increased chlorophyll content resulting in enhanced CO2 assimilation rates (Srikanth *et al.,* 2024).

100 Kernel Weight (g)

Influence of genotypes and plant growth regulators on 100 kernel weight of groundnut was recorded and depicted in table 2. and in fig.2. The genotypes of study and plant growth regulator treatments were found to be differed significantly with respect to 100 kernel weight. However, the interaction effects (G × T) did not vary significantly with respect to per plant yield.

Maximum 100 kernel weight of groundnut was recorded with the G1(Nithyaharitha) (51.8 g) which was significantly superior to the rest of the genotypes of study. Minimum 100 kernel weight (g) recorded in genotype G3-K-6(39.9 g). Higher 100 kernel weight

of Nithyaharitha might be attributed to it having sound mature kernels which is a genotypic trait.

Among the plant growth regulators studied, the maximum 100 kernel weight was observed with T2 (Prohexadione Calcium@ 105 a.i/ha) (47.0 g) followed by T4(Paclobutrazol@100ppm) (45.8g) which was significantly superior over the rest of treatments tested. Minimum 100 kernel weight recorded with T1 (control + RDF of NPK) (41.2 g).

Data on the interactions between genotypes and treatments (G × T) are included in the table 2. and in fig.2. Genotype G1(Nithyaharitha) treated with T2 (Prohexadione calcium@ 105 a.i/ha) recorded maximum 100 kernel weight (54.6 g) due to effective distribution of dry matter source to sink (pods). Minimum of 100 kernel weight recorded in genotype G3(K-6)(36.6 g) in T1(control + RDF of NPK) among in all interactions.

These results are close vicinity to the Isoda *et al*.(1999), who reported the increase in seed output by PBZ treatment. The timing of paclobutrazol administration is important for changing the distribution of dry matter and increasing seed yield. Higher 100 kernel weight recorded by paclobutrazol might be due to the acceleration of dry matter distribution to the early-bearing pod by PBZ (Goswami *et al.*,2022). Pod yield plot is highly related to the number of mature pods per plant, 100 seed weight, height and number of primary branches per plant (Labana *et al.,* 1980).

Shelling Percentage (%)

Influence of genotypes and plant growth regulators on shelling percentage of groundnut was recorded and depicted in Table 1 and in Fig. 1.

(Putrescine@100ppm) (69.4%) which was significantly superior over the rest of treatments tested. Minimum shelling percentage recorded with T1 (control + RDF of NPK) (66.5%).

Data on the interactions between genotypes and treatments (G × T) are depicted in the Table 1. This shows that there were not significant differences in the effects of treatments on shelling percentage or in how various genotypes responded to treatments in this study.

Genotype G1(Nithyaharitha) sprayed with T2 (Prohexadione Calcium@ 105 a.i/ha) recorded maximum shelling percentage (75.9%) and minimum recorded in genotype G3(K-6)(63.7 %) in T1(control + RDF of NPK) among in all interactions.

Maximum shelling percent recorded by application of Putrescine@100 ppm (76.79 %) over control (74.63 %) due to larger sized kernel was obtained by effective partitioning of accumulates from source and sink (Deotale *et al*., 2018).

Harvest Index (%)

Influence of genotypes and plant growth regulators on harvest Index of groundnut was recorded and depicted in table 1. and in fig.1.

Maximum harvest index of groundnut was recorded with the G4- Vishista (38.1%) which was significantly superior to the rest of the genotypes of study. The next best genotypes Dharani (36.7%), Nithyaharitha (36.0%), Minimum harvest index recorded in genotype G3-K-6 (27.7%). Higher harvest index of G4 genotype might be attributed to it having more number of mature pods along with sound mature kernels and less vegetative growth compared to other genotypes, which was a inherent

Maximum shelling percentage of groundnut was recorded with the G1-Nithyaharitha (72.8%) followed by G4(Vishista)(70.6%),G2-Dharani(69.3%). Minimum shelling percentage recorded in genotype G3-K-6 (68.0%). Higher shelling percentage of G1 genotype might be attributed to it having sound mature kernels which was a inherent character of genotype. The higher photosynthates production because of higher chlorophyll content and better dry matter partitioning of genotype and also may be due to more assimilate translocation efficiently to reproductive parts during pod development stages of G1 (Nithyaharitha) could be the reason behind this greater shelling Percentage.

Among the plant growth regulators studied, the maximum shelling percentage was observed with T2 (Prohexadione Calcium@ 105 g a.i/ha) (73.7%) followed by T4 (Paclobutrazol@100ppm) (71.1%) T3 character of this genotype.

Among the plant growth regulators studied, the maximum harvest index was observed with T2 (Prohexadione Calcium@ 105 a.i/ha) (36.4%) followed by T4(Paclobutrazol@100ppm)(35.3%) T3(Putrescine@100ppm) (34.1%) which was significantly superior over the rest of treatments tested. Minimum harvest index recorded with T1 (control + RDF of NPK) (32.7%).

The data in the table 1.0 show how genotypes and treatments (G × T) interact. The harvest index was not significantly affected by the interaction effects (G × T).

Genotype G4 (Vishista) treated with T2 (Prohexadione Calcium @ 105 a.i/ha) recorded maximum harvest index (39.9 %) and minimum recorded in genotype G3(K-6) in T1(control + RDF of NPK)(25.6

%) among in all interactions. Maximum harvest index recorded by application of PBZ@250 ppm (42.6 %) over control (37.8 %) due to the observed reduction in plant height and vegetative growth which possibly enhanced partitioning of assimilate to pods (Barman *et al.,* 2017).

Present study concludes that, the effective control of height and higher Phenological, morpho-physiological, reproductive efficiency, yield, quality parameters and biochemical parameters were obtained with Prohexadione Calcium@ 105 g a.i/ha in groundnut during *Rabi*,2023-24 season on sandy clay loam soils of Southern Agro-climatic Zone of Andhra Pradesh.

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