Advances in Research

Volume 25, Issue 4, Page 57-63, 2024; Article no.AIR.116411
ISSN: 2348-0394, NLM ID: 101666096

Effect of Growth Retardants on Plant Yield and Seed Quality of Groundnut (*Arachis hypogaea* L.)

B. Srikanth [a++], B. Santhosh [a#*], P. Sandhya Rani [a†] and K. John [b‡]

[a] Department of Crop Physiology, S.V. Agricultural College, Tirupati -517502, Andhra Pradesh, India.
[b] Institute of Frontier Technology, Tirupati -517502, Andhra Pradesh, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AIR/2024/v25i41081

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/116411

Original Research Article

Received: 02/03/2024
Accepted: 04/05/2024
Published: 08/05/2024

ABSTRACT

A field experiment was carried out during *Kharif,* 2023 at dryland farm of S. V. Agricultural College, Tirupati campus of Acharya N. G. Ranga Agricultural University, Andhra Pradesh. The experiment was laid out in a split-plot design with three replications and two Genotypes as main factor (G_1- Dharani, G_2- K-6), growth retardants as sub factor (T_1- Control + RDF of NPK, T_2- MH @ 2000 ppm at 20 DAS, T_3- MH @ 2000 ppm at 45 DAS, T_4- PBZ @ 250 ppm at 20 DAS, T_5- PBZ @ 250 ppm at 45 DAS , T_6- ABA @ 250 ppm at 20 DAS, T_7- ABA @ 250 ppm at 45 DAS, T_8- ABA @ 500 ppm at 20 DAS, T_9- ABA @ 500 ppm at 45 DAS, T_{10}- CCC @ 5000 ppm at 20 DAS, T_{11}- CCC @ 5000 ppm at 45 DAS). The current experiment was conducted with an objective to study the impact of

[++]P.G. Research Scholar;
[#]Assistant Professor;
[†]Professor & Head;
[‡]Principal Scientist (Plant Breeding);
**Corresponding author: E-mail: b.santhosh@angrau.ac.in;*

growth retardants on reduction of plant stature thereby enhancing the reproductive and assimilates partitioning efficiency. Results revealed that application of T_5- PBZ @ 250 ppm at 45 DAS recorded higher Pod yield, Kernel yield, 100 kernel weight, protein content and oil content.

Keywords: Groundnut; maleic hydrazide; paclobutrazol; cycocel; abscisic acid.

1. INTRODUCTION

Groundnut often referred to as the ‘unpredictable legume’, goes also by different local names such as earthnut, peanut, monkey nut, and manilla nut. It belongs to the family Fabaceae and order fabales. It is a widely cultivated annual crop that exhibits dicotyledonous behaviour and self-pollination. The term ‘Arachis’ originates from Greek, signifying a legume, while ‘hypogaea’ refers to its geocarpic nature of pod formation. Groundnut is grown in tropical, sub-tropical and warm climate zones between the latitudes of 40° N and 40° S. Groundnut is a rich source of edible oil (47-54%), high-quality protein (22-30%), starch (6-24%), cellulose (1-2%), minerals (2-3%) and calories (5-6%). Groundnut. India ranks second next to China in Groundnut producing countries. Nigeria, Senegal, Sudan, Burma and United States are the top producers, with most of the production concentrated in Asian and African nations.

India ranks first in Groundnut area under cultivation and is the second largest producer in the world with 102 lakh tonnes with productivity of 1831 kg ha^{-1} in 2020-21. Gujarat, Andhra Pradesh and Tamil Nadu are some of the top producing states. In Andhra Pradesh, Groundnut was grown under 8.09 lakh hectares with a production of 5.35 lakh tonnes and productivity of 661 kg ha^{-1} during 2021-22, according to 2^{nd} advance estimates [1].

Plant growth regulators (PGR’s) can change a plant’s growth and developmental pattern in various ways, such as stem elongation, flowering, fruiting and overall architecture. That being said, the growth retardants can be utilized to manage the Groundnut’s indeterminate nature, which can lead to improved distribution of reserves to the early-formed pods, increasing the number of full pods and reducing the number of unfilled and immature pods.

Maleic hydrazide (MH) is used to inhibit the seed germination in peanuts. The results of various studies indicate that, within five days of the spraying, differences in height could be identified and in six weeks after planting, the untreated plants started to bloom. Even at the lowest dose, plants that had received maleic hydrazide treatment bloomed very weakly Naylor et al. [2].

Paclobutrazol (PBZ) is known to minimize the plant stature, improve the yield and also increases the relative water content, leaf area, which further reduces evapo-transpiration, lowers plant moisture stress and increases plant tolerance to both biotic and abiotic stress. It also functions as a highly effective systemic fungicide and is used to treat a number of economically significant fungal diseases.

Growth inhibitor cycocel is known to suppress endogenous gibberellin levels, which may aid in limiting vegetative growth and promoting blooming, with increase in laterals and earlier flowering time. Variations in developmental rates, suppression of internode elongation and impacts on apical growth have all been thought to be indicators that CCC affects the endogenous gibberellin regulating system.

Abscisic acid (ABA) quickens the abscission of leaves and fruits. It also delays flowering in long-day plants kept under short days. It resembles the impact of short days for many reactions, Wittwer et al. [3].

The information on the choice of Plant growth retardants and proper concentrations of application on groundnut cultivars for improving the yield and seed quality is lacking. Keeping this in view, the present investigation ‘Effect of growth retardants on plant yield and biochemical parameters of Groundnut (*Arachis hypogaea* L.) was undertaken.

2. MATERIALS AND METHODS

The experiment entitled “Effect of growth retardants on plant growth and morphology of groundnut (*Arachis hypogaea* L.)” was conducted during *Rabi*, 2022-23 in Field No. 17 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

Picture 1. Layout of the experimental field

Agro-climatic Zone of Andhra Pradesh. The experimental field 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 3.15 m × 2 m size were used for each treatment. The experiment was laid out in split-plot design with main plots and sub plot treatments replicated thrice. with two Genotypes as main factor and Growth retardants as sub factor. The foliar sprays were applied at 20 and 45 days after sowing. 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. The seed and yield from each net plot were recorded separately and expressed as kg ha^{-1}. The protein content of the kernels was determined by Lowry method and expressed in (%). The data were recorded during the investigation was statistically analyzed following the analysis of variance for split–plot design as suggested by Panse and Sukhatme [4]. Statistically significance was tested with 'F' value at five per cent level of probability.

2.1 Application of Chemicals

Pre-harvest chemical treatment Sprays were applied at 20 and 45 days after sowing harvest. The particulars of preparation and application of treatments to Groundnut is detailed hereunder.

In order to prepare 2000 ppm of maleic hydrazide, 6 g of MH was diluted in NaOH to aid in dissolving the chemical. It was added to 3 litres of water.

To prepare 250 ppm of PBZ 750 mg was diluted in NaOH to aid in dissolving the chemical and added to 3 litres of water.

In order to prepare @ 250 ppm of ABA 750 mg is dissolved in 3 litres of water. 1.5 g of ABA was dissolved in 3litres of water to prepare @ 500 ppm of ABA. And 15 g of Cycocel chemical was dissolved in 3litres of water to prepare Cycocel @ 5000 ppm.

3. RESULTS AND DISCUSSION

3.1 Yield Attributes

Maximum pod yield was associated with T_5 (PBZ @ 250 ppm at 45 DAS) (3719 kg/ha) on par with T_4 (PBZ @ 250 ppm at 20 DAS) (3662 kg/ha) followed by T_{11} (CCC @ 5000 ppm at 45 DAS) (3275 kg/ha) minimum value was observed in T_1 (Control +RDF of NPK) (2869 kg/ha) (Table 1). This increment in pod yield might be 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 CO_2 assimilation rates. A similar finding was also reported by Win et al. [5]. The Table 1 compares the pod yield between two different groundnut genotypes, G_1 (Dharani) and G_2 (K-6). Genotype G_1 (Dharani) exhibited a significantly higher pod yield of 3415 kg/ha, while genotype G_2 (K-6) had a lower pod yield of 2932 kg/ha. This superior pod yield in G_1 (Dharani) might be attributed to higher number of pegs, mature pods per plant. Similar observations were also made by Attarde et al. [6]. They reported that JL 220 recorded highest yield per hectare (1257 kg ha^{-1}) when compared with TAG-24. Pod yield plot was found to be highly related to the number of mature pods per plant, 100- seed weight, height and number of primary branches per plant [7]. The Table 1 provides data on the interaction effects between treatments and genotypes (T × G) and between genotypes and treatments (G × T).The interaction effects (T × G and G × T) did not vary significantly with respect to pod yield. This suggests that the influence of treatments on pod yield and the response of different genotypes to treatments did not vary significantly.

The maximum kernel yield (Table 1) was observed in treatment T_5, where PBZ @ 250 ppm was applied at 45 DAS, resulting in a kernel yield of 2654 kg ha^{-1}. Treatment T_4, which involved PBZ @ 250 ppm at 20 DAS, also resulted in a relatively high kernel yield of 2545 kg ha^{-1}. Among other treatments, those involving the plant growth regulator CCC @ 5000 ppm (T_{10} and T_{11}) showed higher kernel yields. The control treatment (T_1), which received no growth retardants but was treated with the recommended dose of NPK, had the lowest kernel yield at 1938 kg/ha. This increment in kernel yield might be due to alteration of dry-matter distribution from vegetative parts to kernels because of the reduction of stem elongation. These results are close vicinity to the Isoda et al. [8], who reported that seed output was increased by PBZ treatment. The timing of paclobutrazol administration is important for changing the distribution of dry matter and increasing seed yield. The kernel yield between two different groundnut genotypes, G_1 and G_2 is compared in Table 1. Genotype G_1 exhibited a significantly higher kernel yield of 2429 kg/ha, while genotype G_2 had a lower kernel yield of 2001 kg/ha. Data on the interactions between treatments and genotypes (T × G) and between genotypes and treatments (G × T) are included in the table. Kernel yield was unaffected considerably by the interaction effects (T × G and G × T).

Different concentrations of growth retardants had not shown any significant difference with respective 100 kernel weight (Table 1). With respect to the treatments T_4 and T_5, which involved the application of PBZ @ 250 ppm at 20 DAS and 45 DAS respectively, resulted in the maximum 100 kernel weight of 47.23g and 48.62g respectively (Table 1). The minimum 100 kernel weight was observed in T_1 control 39.65 g. This increment in kernel yield by treatment of PBZ, might be due to alteration of dry-matter distribution from vegetative parts to kernels because of the reduction of stem elongation. These results are in concurrence with Senoo and Isoda [9]. Similar results were reported by Goswami et al*.,* [10], where in highest kernel yield (2879 kg ha^{-1}) was reported in treatment of PBZ @ 150 ppm and minimum in control (2386 kg ha^{-1}).The Table 1 describes the 100 kernel weight of two different groundnut genotypes, G_1 and G_2. There was significant different found among genotypes with respect to 100 kernel weight. Genotype G_1 exhibited a higher 100 kernel weight of (44 g), while genotype G_2 had a lower 100 kernel weight with a value of (39 g). The better assimilation efficiency because of higher chlorophyll content and better dry matter partitioning of genotype G1 (Dharani) could be the reason behind this greater kernel weight over G2 (K-6). Data on the interactions between treatments and genotypes (T × G) and between genotypes and treatments (G × T) are depicted in the table. This shows that there were no significant differences in the effects of treatments on 100 kernel weight or in how various genotypes responded to treatments in this study.

3.2 Seed Quality Attributes

Among various treatments T_4 and T_5, which involved the application of PBZ @ 250 ppm at 20 DAS and 45 DAS respectively, resulted in the highest protein content, with values of 29.65% and 29.72%, respectively (Table 1). These treatments with PBZ application significantly increased the protein content compared to all other treatments and minimum content was reported in control with (24.43%). Application of PBZ not only increased kernel yield and pod yield but also increased protein and oil content in groundnut. Ewais et al*.* [11] Suggested that application of paclobutrazol at 25 and 50 ppm induced that decrement in protein content in sesame (86.31mg/g dry weight) and (115.6231 mg/g dry weight) respectively over control (120.2931 mg/g dry weight).

Table 1. Effect of growth retardants on Yield and seed quality of groundnut genotypes

	Treatments			Pod yield (kg/ha)	Kernel yield (kg/ha)	100 Kernal weight (g)	Protein content (%)	Oil content (%)
Treatments								
1	T_1	:	Control + (RDF of NPK)	2869	1938	39.65	24.43	46.92
2	T_2	:	MH @ 2000 ppm at 20 DAS	2902	1971	39.77	24.56	46.79
3	T_3	:	MH @ 2000 ppm at 45 DAS	2978	2031	39.85	24.62	47.11
4	T_4	:	PBZ @ 250 ppm at 20 DAS	3662	2545	47.23	29.65	52.51
5	T_5	:	PBZ @ 250 ppm at 45 DAS	3719	2654	48.62	29.72	52.59
6	T_6	:	ABA @ 250 ppm at 20 DAS	2992	2082	39.98	24.76	45.58
7	T_7	:	ABA @ 250 ppm at 45 DAS	3044	2144	40.05	24.83	45.65
8	T_8	:	ABA @ 500 ppm at 20 DAS	3122	2175	40.18	24.96	45.78
9	T_9	:	ABA @ 500 ppm at 45 DAS	3135	2256	40.26	25.02	45.85
10	T_{10}	:	CCC @ 5000 ppm at 20 DAS	3205	2278	40.38	25.16	45.97
11	T_{11}	:	CCC @ 5000 ppm at 45 DAS	3275	2288	40.45	25.15	46.05
	SEm±			80.31	68.46	1.10	0.74	1.99
	CD (P = 0.05)			488.75	416.63	6.70	4.50	12.12
Genotypes								
	G_1	:	Dharani	3415	2429	39	24	45
	G_2	:	K-6	2932	2001	44	28	50
	SEm±			47.92	33.51	0.50	0.26	0.77
	CD (P = 0.05)			136.98	95.80	1.45	0.77	2.21
Interaction								
	T × G							
	SEm±			137.66	96.27	1.45	0.77	2.21
	CD (P = 0.05)			NS	NS	NS	NS	NS
	G × T							
	SEm±			119.63	90.27	1.40	0.84	2.33
	CD (P = 0.05)			NS	NS	NS	NS	NS

The genotypes of the study were found to be significantly differ with respect to protein content Among the genotypes protein content Genotype G_2 exhibited a higher protein content with a value of (28%) compare to G_1 (24%).Data on the interactions between treatments and genotypes (T × G) and between genotypes and treatments (G × T) are included in the table. The protein content was not significantly affected by the interaction effects (T × G and G × T). These results are in accordance with Sharma et al., [12].

Among various treatments, treatments T_4 and T_5, which involved the application of PBZ @ 250 ppm at 20 DAS and 45 DAS respectively resulted in the highest oil content of 52.51% and 52.59% respectively (Table 1). These treatments with PBZ significantly increased the oil content compared to the all other treatments and minimum oil content recorded in T_6 (45.58). It was found that paclobutrazol had a significant influence on oil content in groundnut kernel. Application of PBZ not only increased kernel yield and pod yield but also increased protein and oil content in groundnut. The highest oil and protein yield/ha was observed with Cycocel applied at 750 ppm, followed by Alar at 250 ppm [13]. These results in concurrence with Barman et al*.,* [14]. The Table 1 compares the oil content (%) between two different groundnut genotypes, G_1 and G_2. There was significant different found in between the genotypes. Genotype G_2 exhibited higher oil content with a value of 50%, while genotype G_1 had lower oil content with a value of 45%. Data on the interactions between treatments and genotypes (T × G) and between genotypes and treatments (G × T) are included in the table. The oil content was not significantly affected by the interaction effects (T × G and G × T).

4. CONCLUSION

Hence, the present study concluded that higher Pod yield, Kernel yield, 100 Kernal weight, Protein content ,Oil content in groundnut can be realized with the foliar application of PBZ @ 250 ppm at 45 DAS in Southern Agro-climatic Zone of Andhra Pradesh.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Groundnut outlook, Agricultural Market Intelligence Centre. Annual Report; January 2021.
2. Naylor AW, Davis EA. Maleic hydrazide as a plant growth inhibitor. Botanical Gazette. 1950;112(1):112-126. Available:https://doi.org/10.1086/335632
3. Wittwer SH. Growth regulants in agriculture. Outlook on Agriculture. 1971;6(5):205-217. Available:https://doi.org/10.1177/0030727071006005
4. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research Publication. 1985;87-89.
5. Win A, Htwe NM, Myint NO, Toe K, Hom NH. Effects of paclobutrazol on growth of groundnut (*Arachis hypogaea* L.). Journal of Agricultural Research. 2017;4(1):15-22. DOI: 10.5958/2230-732X.2017.00063.8
6. Attarde DR, Suryawanshi RT, Wadile SC. Response of groundnut varieties to time of sowing in *kharif* season. Journal of Maharashtra Agriculture University. 2001;26(3):250-251.
7. Labana KS, Mohinder S, Sangha AS, Jaswal SV. Variability and interrelations among characters in F2 progeny of groundnut. Journal of Research, Punjab Agricultural University. 1980;17: 107-114.
8. Isoda A, Nakazato H, Nojima H, Takasaki Y. Effects of paclobutorazol on dry matter distribution and canopy structure in peanut. Technical Bulletin Fac. Hort. Chiba University. 1999;53:1-6.
9. Senoo S, Isoda A. Effects of paclobutrazol on podding and photosynthetic characteristics in peanut. Plant Production Science. 2003;6(3):190-194. Available:https://doi.org/10.1626/pps.6.190
10. Goswami P, Gunri SK, Sengupta A, Barman M. Effect of paclobutrazol on succeeding crop summer groundnut (*Arachis hypogaea* L.) after potato. International Journal of Bio-resource and Stress Management. 2022;13(10):1124-1129.
11. Ewais EEDA, Sharaf AEMM, Abd el-azim EA, Ismail MA, Amin MA. Improving growth, yield quality and chemical constituents of sesame plants by foliar application of ascorbic acid, benzyl adenine and paclobutrazol. Al-Azhar Bulletin of Science. 2013;24(2-C):1-16.

DOI: 10.21608/absb.2013.6416
12. Sharma P, Sardana V. Effect of growth regulating substances on the chlorophyll, nitrate reductase, leghaemoglobin content and yield in groundnut (Arachis hypogaea). The bioscan. 2012;7(1):13-7.
13. Sawan ZM, Basyony AE, McCuistion WL, El Farra AH. Effect of plant population densities and application of growth retardants on cottonseed yield and quality. Journal of the American Oil Chemist's Society. 1993 Mar;70 (3):313-7. DOI: https://doi.org/10.1007/BF02545314
14. Barman M, Gunri SK, Puste AM, Paul S. Effect of paclobutrazol on growth and yield of *kharif* groundnut (*Arachis hypogaea* L.). International Journal of Agriculture, Environment and Biotechnology. 2017;10(4):513-518. DOI: 10.5958/2230-732X.2017.00063.8

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/116411