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Effect of Paclobutrazol on Succeeding Crop Summer Groundnut (*Arachis hypogaea* L .) after Potato

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ABSTRACT

The field experiment was conducted at the District seed farm under Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal during summer season (February to May) of 2012 and 2013 to study the effect of paclobutrazol on succeeding crop summer groundnut (*Arachis hypogaea* L.) after potato. Paclobutrazol had no significant influence on plant height at the early stage but at a later stage upto 200 ppm of it significantly reduced the plant height upto 5–6 cm. Double spraying was more conducive than single spraying either at 30 DAE or at 50 DAE only. Higher dry matter production was found at 150 ppm of paclobutrazol with double spraying during all the growth stages; thereafter dry matter production decreased with a further increase in the doses of paclobutrazol. No significant influence was noticed on yield attributes for either single or double spraying of paclobutrazol. Paclobutrazol in different concentrations increased the pod yield upto 7–18% over control and significantly highest result was recorded with the application of 150 ppm of paclobutrazol with double spraying at 30 and 50 DAE. However, haulm yield did not vary significantly due to the application of paclobutrazol. It had also no significant influence on nitrogen uptake in groundnut plants but it had a positive response to increasing the phosphorus, potassium and oil content upto 100–150 ppm and double spraying was more advantageous as compared to single spraying. Application of 150 ppm paclobutrazol with double spraying at 30 and 50 DAE gave the highest net return: cost ratio.

KEYWORDS: Groundnut, paclobutrazol, plant height, yield, economics

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Data Availability Statement: Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

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1. INTRODUCTION

Groundnut is the king of oilseeds and amongst all it has got the first place in India (Rai et al., 2016). It being a leguminous crop its nitrogen requirement from the soil is very less (20–40% only); therefore, it can be cultivated during summer after potato using the residual nutrients from previous crop. It is a semi-determinate crop and has vegetative growth continuously even after reach to the flowering stage and its cultivation after potato usually has very high vegetative growth due to excess residual nutrient in soil (Maiti and Rodriguez, 2010; Fagbemigun and Oguntola, 2019). However, excessive vegetative growth tends to increase disease incidence and is detrimental to the good harvest of groundnut. Alterations of the distribution pattern of assimilates may therefore be one of the most important factors to increase yield and improve management of groundnut (Arzani and Roosta, 2004; Shekh *et al*., 2018) and in order to maximize assimilate for filling the pod, it is necessary to investigate source size modification and sink source balance in this crop. In this case plant growth regulators (PGRs) would have very beneficial role to play (Mabvongwe et al., 2016; Pan et al., 2013). PGRs include a wide variety of chemicals that are often used to regulate plant growth at various crop stages. Some PGRs which restrict vegetative growth of plants have been tested in several field crops in an effort to reduce stem length and improve yield. Therefore, these plant growth retardants as a growth regulators can be used for regulating plant growth balance. Growth retardants have been found with wide usage in the agricultural practice with main focus on the improvement of resistance to lodging and canopy structure of crop plants. These synthetic compounds are being used to reduce the shoot length of plants in a desired way without altering developmental process and/or being phytotoxic (Rademacher, 2000). This is achieved primarily by reducing cell elongation but also by lowering the rate of cell division (Hartmann et al., 2011). Hence, growth retardants are antagonistic to gibberellins (GAs) and auxins which are primarily responsible for shoot elongation (Rademacher, 1991).

Paclobutrazol is one of those plant growth retardants and a fungicide of triazole group. It also acts by inhibiting gibberellins biosynthesis, reducing inter-nodal growth to give stouter stem, increasing root growth and causing better fruit set (Berova and Zlatev, 2000; Fletcher et al., 2000). Besides, the concentration and time of application of paclobutrazol had also positive response in case of different yield attributes, which ultimately influence the yield of crop (Chen and Zhang, 1995; Christov et al., 1995; Singh, 2000). The use of paclobutrazol as a growth regulator in groundnut is not a common practice and less research work has been done in this aspect. Hence, the present investigation is aimed to reduce the excessive vegetative growth of groundnut by spraying paclobutrazol in different concentrations as well as at different growth stages and to find its contribution to the reproductive growth i.e. pod formation which is directly correlated to the yield.

2. MATERIALS AND METHODS

The field experiment was conducted at District seed farm (23.5°N latitude and 89.0°E longitude) under Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal during the summer season (February to May) of 2012 and 2013. The soil of the experimental field was alluvial and sandy loam in texture having good water holding capacity (WHC), medium fertility status and neutral in reaction. The experiment was laid out in split plot design with five treatments in main plot and three treatments in sub plot and replicated three times. The treatments in main plot were five levels of paclobutrazol *viz*., T_1= Paclobutrazol @ 50 ppm; T_2= Paclobutrazol @100 ppm: T_3= Paclobutrazol @ 150 ppm; T_4= Paclobutrazol @ 200 ppm; T_5= Control and in sub plot were 3 levels of time of application *viz*., S_1= Single spraying at 30 DAE (days after emergence); S_2= Single spraying at 50 DAE and S_3= Double spraying at 30 DAE and 50 DAE. The recommended doses of inorganic fertilizers were 20:60:40 kg ha^{-1} of N, P_2O_5 and K_2O and farmyard manure @ 7.5 t ha^{-1}. Gypsum @ 400 kg ha^{-1} was applied uniformly in all the treatments during both years. The variety TG51 was sown on 23rd and 27th February during 2012 and 2013, respectively. The previous crop potato was planted during winter season following the recommended package of practices in West Bengal.

3. RESULTS AND DISCUSSION

Application of paclobutrazol upto 200 ppm had positive response to reduce the plant height at later stage of the crop growth as well as towards maturity. The decreasing trend of the plant height at harvest was exhibited upto 100 ppm of paclobutrazol application (T_2) thereafter plant height was increased with increase the doses of paclobutrazol (T_3 and T_4) though they were statistically at par with each other but all these treatments were significantly superior to control (T_5). Plant height was reduced with double spraying as compared to single spraying either 30 DAE or 50 DAE at harvest. Similar result was recorded by Barman et al. (2017). Therefore, foliar application of paclobutrazol @ 50–100 ppm at the initial stage and at 10–15 days after flower initiation had been proved better in reducing excessive vegetative growth which ultimately reflected as increased yield of groundnut (Kathmale and Kamble, 2010; Senoo and Isoda, 2003; Tang et al., 1992). Due to application of paclobutrazol the dry matter production was increased steadily over control during later stages of the crop. From the table 1 it was revealed that the dry matter production was found maximum in treatment T_3 (Paclobutrazol @ 150 ppm). It was also found that dry matter production increased with increasing doses of paclobutrazol upto 150 ppm thereafter dry matter production decreased with further increase in the doses of paclobutrazol (200 ppm) though they were not varied significantly. Single spraying of paclobutrazol at 50 DAE showed the highest value of dry matter production as compared to the other two treatments but they were not varied significantly among each other. The data depicted in the table 1 indicated that paclobutrazol reduced the size of the plant canopy but did not affect the plant dry matter and was more conducive when spraying at later stage. This finding is in agreement with Taksina et al. (1993), Senoo and Isoda (2003) and Win et al. (2017).

Table 1: Effect of paclobutrazol on growth and yield attributes of groundnut (pooled over two years)

Treatments	Plant height at harvest (cm)	Dry matter production at 75 DAE	No. of pods plant^{-1}	Shelling (%)	100 Kernel weight (g)
Doses of paclobutrazol (T)					
T_1: Paclobutrazol @ 50 ppm	51.34	378.7	17.77	69.30	49.87
T_2: Paclobutrazol @ 100 ppm	48.68	428.2	18.70	70.67	51.17
T_3: Paclobutrazol @ 150 ppm	49.75	445.0	19.10	70.40	51.82
T_4: Paclobutrazol @ 200 ppm	50.39	416.9	17.23	69.30	49.46
T_5: Control	55.06	389.7	16.50	68.13	48.17
SEm±	0.362	6.241	0.450	0.560	0.494
CD (p=0.05)	0.887	NS	NS	NS	NS
Time of application(s)					
S_1: Single spraying at 30 DAE	52.35	404.5	17.56	69.08	49.54
S_2: Single spraying at 50 DAE	51.08	419.3	17.98	69.98	50.41
S_3: Double spraying at 30 DAE and 50DAE	49.70	411.3	18.04	69.62	50.35
SEm±	0.572	9.868	0.711	0.885	0.780
CD (p=0.05)	1.401	NS	NS	NS	NS

Yield attributing characters of groundnut *viz*., number of pods plant^{-1}, Shelling percentage and hundred kernel weight did not vary significantly due to the application of paclobutrazol in different concentrations either single and/or double praying at 30 and 50 DAE. Although treatment differences (T_1–T_4) showed the highest value as compared to control (T_5) in the entire yield attributes but they were failed to reach significant levels.

Data presented in table 2 revealed that Paclobutrazol in different concentrations had a positive response to increase the pod yield. The highest pod yield was found in the treatment T_3 (4083 kg ha^{-1}) which was closely followed by T_4 (4068 kg ha^{-1}) but significantly superior to T_1, T_2 and T_5. It was also observed that paclobutrazol application in groundnut was remunerative and 7–18% of pod yield was increased over control. Double spraying at 30 DAE and 50 DAE (S3) recorded the highest pod yield (3926 kg ha^{-1}) which was closely followed by single spraying at 50 DAE (3894 kg ha^{-1}) but significantly superior to single spraying at 30 DAE (3760 kg ha^{-1}). Single spraying of paclobutrazol at early stage i.e. at 30DAE had no significant response to increase the pod yield as compared to either single spraying at a later stage i.e. at 50 DAE or double spraying at 30 DAE and 50 DAE. This effect 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 Jeyakumar and Thangaraj (1996), Senoo and Isoda (2003), Lubis et al. (2011), Win et al. (2017) and Barman et al. (2018). The interaction effect of different doses of paclobutrazol and their time of application did not vary pod yield significantly. Significantly higher haulm yield (4712 kg ha^{-1}) was obtained with the treatment T_4 (Paclobutrazol @ 200 ppm) which was closely followed by T_3 (Paclobutrazol @ 150 ppm) but statistically superior to T_1, T_2 and T_5. Double spraying at 30 DAE and 50 DAE showed the highest value of haulm yield as compared to single spraying either 30 DAE or 50 DAE but all these treatments were statistically at par with each other. Kernel yield was found maximum under the treatment T_3 (2879 kg ha^{-1}) which was closely followed by T_2 and T_4 but significantly

Table 2: Effect of paclobutrazol on yield and economics of groundnut (Pooled over two years)

Treatments	Yield (kg ha^{-1})			Economics			
	Pod	Haulm	Kernel	Gross return (₹ ha^{-1})	Total cost (₹ ha^{-1})	Net return (₹ ha^{-1})	Net return : Cost
Doses of paclobutrazol (T)							
T_1: Paclobutrazol @ 50 ppm	3677	4344	2569	147609	37385	110225	2.95
T_2: Paclobutrazol @ 100 ppm	3992	4581	2825	160252	38598	121655	3.15
T_3: Paclobutrazol @ 150 ppm	4083	4690	2879	163906	39811	124095	3.12
T_4: Paclobutrazol @ 200 ppm	4068	4712	2835	163315	41025	122291	2.99
T_5: Control	3479	4245	2386	139670	35503	104167	2.94
SEm±	19.583	65.082	37.75	952.231		952.231	0.026
CD (p=0.05)	47.99	159.38	92.34	2332.97		2332.97	NS
Time of application (s)							
S_1: Single spraying at 30 DAE	3760	4405	2613	150938	37724	113214	3.00
S_2: Single spraying at 50 DAE	3894	4537	2738	156335	37724	118611	3.14
S_3: Double spraying at 30 DAE and 50DAE	3926	4602	2747	157579	39945	117634	2.95
SEm±	30.964	102.904	28.05	1505.61	37385	1505.61	0.041
CD (p=0.05)	75.862	252.115	54.41	3688.74	38598	3688.74	0.100

superior to T_1 and T_5. Senoo and Isoda (2003) and Barman et al. (2017) also found positive result of paclobutrazol on kernel yield of groundnut. Data summarized in table 2 revealed that gross return increased with an increase in the paclobutrazol doses and the highest (₹ 163906) was recorded in the treatment T_3 which was statistically at par with T_4 but significantly superior to T_5 and T_2 and T_1. The maximum net return was found in the treatment T_3 which was statistically at par with T_4 but significantly superior to T_2, T_1 and T_5. Maximum net return: cost ratio was found T_2 which was closely followed by T_3. Barman et al. (2018) was also found positive response of paclobutrazol to net return: cost ratio.

Paclobutrazol used as a growth retardant did not influence the harvest index significantly either in single or double spraying. From table 3, it was found that paclobutrazol had a significant influence on oil content in groundnut kernel and maximum oil content was recorded in the treatment T_2. Double spraying at 30 and 50 DAE gave the maximum oil content as compared to single spraying at either 30 or 50 DAE. Kathmale and Kamble (2010) and Barman et al. (2017) opined alike. Paclobutrazol had no significant influences on nitrogen content in the plant; similar finding was also recorded by Lubis et al. (2011). However, phosphorus and potassium content in the plant were significantly varied due to the application of paclobutrazol and the highest phosphorus and potassium content in the plant was found in treatment T_2 and the lowest was recorded in treatment T_5 (control). Double spraying at 30 DAE and 50 DAE showed statistically significant results as compared to single spraying at either 30 DAE or 50 DAE.

Table 3: Effect of paclobutrazol on harvest index, oil content, nitrogen, phosphorus and potassium concentration in the plant at harvest of groundnut (Pooled over two years)

Treatments	Harvest index (%)	Oil content (%)	N, P_2O_5 and K_2O concentration (%)		
			N	P_2O_5	K_2O
Doses of paclobutrazol (T)					
T_1	45.77	47.57	3.06	0.22	1.05
T_2	45.97	48.95	3.13	0.26	0.96
T_3	46.16	47.75	3.23	0.25	0.96
T_4	46.20	45.80	3.21	0.185	0.92
T_5	45.27	45.82	2.84	0.21	0.82
SEm±	0.301	0.622	0.132	0.007	0.012
CD (p=0.05)	NS	1.636	NS	0.184	0.031
Time of application (s)					
S_1	45.72	45.87	3.21	0.17	0.84
S_2	45.97	46.79	2.67	0.22	1.00
S_3	45.93	48.87	3.39	0.285	0.98
SEm±	0.476	0.417	0.055	0.003	0.010
CD (p=0.05)	NS	1.020	0.134	0.007	0.024

4. CONCLUSION

The shortest groundnut plant and highest plant dry matter was found in 150 ppm of paclobutrazol application. Though the yield attributes showed non-significant effect, the yield of pod, kernel and haulm had positive influence of paclobutrazol. In addition, same outcome was observed for oil content and economics. 150 ppm of paclobutrazol with double spraying at 30 and 50 DAE was beneficial as well as economical for groundnut plants which was grown after potato.

5. REFERENCE

Arzani, K., Roosta, H.R., 2004. Effect of paclobutrazol on vegetative and reproductive growth and leaf mineral content of mature apricot (*Prunus armeiaca* L.) trees. Journal of Agricultural Science and Technology 6, 43–45.

Barman, M., Gunri, S., Puste, A., Das, P., 2018. Effects of paclobutrazol on growth and yield attributes of groundnut (*Arachis hypogaea* L.). Indian Journal of Ecology 45(2), 321–324.

Barman, M., Gunri, S., Puste, A., Paul, S., 2017. Effect of paclobutrazol on growth and yield of kharif groundnut (*Arachis hypogaea* L.). International Journal of Agriculture, Environment and Biotechnology 10, 513–518.

Berova, M., Zlatev, Z., 2000. Physiological response and yield of paclobutrazol treated tomato plants (*Lycopersicon esculentum* Mill.). Plant Growth Regulation 30, 117–123.

Chen, Y.Z. and Zhang, G.Y., 1995. Effect of Paclobutrazol (PP333) on the anatomical structure of leaf and stem in peanut (*Arachis hypogaea* L.). Acta Agriculture Boreali Sinica 10, 87–91.

Christov, C., Tsvetkov, I., Kovachev, V., 1995. Use of paclobutrazol to control vegetative growth and improve fruiting efficiency of grapevines (*Vitis vinifera* L.). Bulgarian Journal of Plant Physiology 21, 64–71.

Fagbemigun, O.V., Oguntola, E.A., 2019. Effect of organomineral nitrogen starter fertilizer on the growth and yield of groundnut (*Arachis hypogeal* L.). Advances in Plants & Agriculture Research 9(1), 86–94. DOI: 10.15406/apar.2019.09.00416

Fletcher, R., Gilley, A., Sankhla, N., Davis, T., 2000. Triazoles as plant growth regulators and stress protectants. Horticultural Reviews 24, 55–137.

Hartmann, A., Senning, M., Hedden, P., Sonnewald, U., Sonnewald, S., 2011. Reactivation of meristem activity and sprout growth in potato tubers require both cytokinin and gibberellin. Plant Physiology 155(2), 776–796.

Jeyakumar, P., Thangaraj, M., 1996. Effect of Mepiquat Chloride on Certain Physiological and Yield Characteristics of Groundnut (*Arachis hypogaea* L.). Journal of Agronomy and Crop Science 176 (3), 159–164.

Kathmale, D.K., Kamble, B.M., 2010. Yield maximization of winter groundnut (*Arachis hypogaea* L.) through integrated input management under polythene mulch in the Konkan region of Maharashtra. International Journal of Plant Sciences 5(1), 215–224.

Lubis, I., Kusumawati, A., Ghulamahdi, M., Purnamawati, H., Kusumo, Y.W.E., Mansyuri, A.G., Rais, S.A., 2011. Paclobutrazol application effectiveness on growth of two peanut (*Arachis hypogaea* L.) Varieties. Proceedings of the7th ACSA Conference, 225–229.

Mabvongwe, O., Manenji, B.T., Gwazane, M., Chandiposha, M., 2016. The effect of paclobutrazol application time and variety on growth, yield, and quality of potato (*Solanum tuberosum* L.). Advances in Agriculture, 1–5.

Maiti, R., Rodriguez, H.G., 2010. Plant architecture determines the productivity potential of a crop. International Journal of Bio-resource and Stress Management 1(3), 1–3.

Pan, S., Rasul, F., Li, W., Tian, H., Mo, Z., Duan, M., 2013. Roles of plant growth regulators on yield, grain qualities and antioxidant enzyme activities in super hybrid rice (*Oryza sativa* L.). Rice 6, 6–9.

Rademacher, E., 2000. Growth retardants: effects on gibberellin biosynthesis and other metabolic pathway. Annual Review of Plant Physiology and Plant Molecular Biology 51, 501–531.

Rademacher, W., 1991. Inhibitors of gibberellin biosynthesis: applications in agriculture and horticulture. In: Takahashi, N., Phinney, B.O., MacMillan, J. (Eds.), Gibberellins. Springer, New York, 296–310.

Rai, S.K., Charak, D., Bharat, R., 2016. Scenario of oilseed crops across the globe. Plant Archives 16(1), 125–132.

Senoo, S., Isoda, A., 2003. Effects of paclobutrazol on dry matter distribution and yield in peanut. Plant Production Science 6(1), 90–94.

Senoo, S., Isoda, A., 2003. Effects of paclobutrazol on podding and photosynthetic characteristics in peanut. Plant Production Science 6(3), 190–194.

Shekh, M.A., Mathukia, R.K., Sagarka, B.K., Chhodavadia, S.K., 2018. Evaluation of some cow-based bio-enhancers and botanicals for organic cultivation of summer groundnut. International Journal of Economic Plants 5(1), 43–45.

Singh, Z., 2000. Effect of (2RS, 3RS) paclobutrazol on tree vigour, flowering, fruit set and yield in mango. Acta Horticulture 525, 459–462.
Taksina, S., Prayad, P., Sa-ngobphai, N., 1993. Proceedings of the eleventh Thailand national groundnut meeting, Department of Agricultural Extension, Bangkok (Thailand). 17-21 May, 1993, 345–347.
Tang, R.S., Mei, C.S., Zhang, J.Y., Cai, X.N., Wu, G.N., Guan, Y.X., Ma, J.F., Tang, W., Ji, Y.F., Cao, T.S., Dong, Z.H., Zhong, X.Y., Chiu, B.J., 1992. Effects of pp333 (paclobutrazol) on groundnut growth and yield and application techniques. Jiangsu Agricultural Aciences 3, 26–28.