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Effect of Different Levels and Time of Application of Paclobutrazol on Morphology, Yield and Yield Attributing Characters and Economics of Groundnut (*Arachis hypogaea* L.)

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ABSTRACT

Background: Groundnut is one of the most important oilseed crops of Odisha and grown in both in *kharif* and *rabi-summer* seasons. Because of excessive vegetative growth in *kharif* season, the yield potential is lower than *rabi-summer* resulting in low yield. Keeping this in view, an experiment was set up to investigate the effect of different concentration and time of paclobutrazol application on growth and yield of groundnut.

Methods: A field experiment was conducted during *kharif* 2016 to 2018 at AICRP on Groundnut Research Farm, OUAT, Bhubaneswar, Odisha. The experiment was laid out in split plot design with different concentration of paclobutrazol in main plot and time of application in sub plot and replicated thrice. Recommended dose of 20:40:40 kg of N, P_2O_5 and K_2O entirely applied as basal. Yield and yield attributing characters were taken at the time of harvest.

Conclusion: Application of paclobutrazol at different concentration significantly reduced groundnut plant height and significant reduction was observed with application at 30 DAE. Among various yield attributing characters; pod/plant and pod yield increased significantly (24.6% and 27.4%, respectively) with application of paclobutrazol @ 100 ppm with higher benefit cost ratio of 1.97 and upto (8.4% and 17.5%) with application at 30 DAE.

Key words: Aerial peg, Aclobutrazol, Days after emergence, Economics, Groundnut, Growth parameters, Yield components.

INTRODUCTION

The groundnut (*Arachis hypogaea* L.) is an important food legume in India, belongs to the family Leguminaceae and it is known as the 'king of oilseed' crops. It ranks 13th among the principal economic crops of the world. In India the groundnut is grown in an area of about 5.34 m ha, producing 7.5 mt with a productivity of 1486 kg/ha (2016-17). Around 85.7% area is covered in *kharif* in 260 districts mostly as rainfed crop on well drained sandy soils. The productivity of *kharif* groundnut is 1408 kg/ha (2015) which is much below national average (1877 kg/ha) during *rabi-summer* (2015-16) (Gayathri *et al,* 2018). In Odisha, Groundnut is grown in an area of 2.21 l ha out of which *kharif* and *rabi* groundnut covers 0.85 and 1.36 l ha, respectively (Odisha Agriculture Statistics 2016-17). The yield potential was lower *in kharif* than *rabi-summer* because of excessive vegetative growth resulting in mutual shading leading to low yield. Keeping this in view, an experiment was set up to investigate the effect of different concentration and time of paclobutrazol application on growth, yield of groundnut.

MATERIALS AND METHODS

The experiment was conducted at AICRP on Groundnut Research Farm, Orissa University of Agriculture and Technology, Bhubaneswar, Odisha during *kharif* 2016, 2017 and 2018. Geographically the experimental area is located at 20°15′N latitude and 85°52′E longitude at the elevation of 25.9 m above mean sea level. The soil texture of the experimental site was sandy loam and acidic in reaction (6.2) with low organic carbon content (0.38%), nitrogen (234 kg/ha), medium in phosphorus (17 kg/ha) and low potassium (102 kg/ha) contents. The experiment was laid out in split plot design having 6 main plots and 3 sub plots with 3 replications. The main plot consisted of different concentration of Paclobutrazol *viz*., T_1: 25 ppm, T_2: 50 ppm, T_3: 100 ppm, T_4; 150 ppm, T_5: 200 ppm and T_6: Control) and sub plots consisted of 3 different time of application (S_1: Single spraying at 30 DAE, S_2: Single spraying at 50 DAE and S_3: Double spraying at 30 and 50 DAE). The groundnut variety used in the experiment was "Devi" of 95 days duration, having potential yield of 30 q/ha, sown at a spacing of 30 × 10 cm. Recommended dose of 20:40:40 kg of N, P_2O_5 and K_2O through Urea, DAP and MOP, respectively and entirely applied as basal.

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Five plants in each plot were selected randomly for taking different biometric observations. Growth parameters, *viz.* plant height, number of branches/plant, dry-matter accumulation were measured by using standard procedures. For growth analysis, crop growth rate (CGR) was computed according to formula given by Watson *et al.* (1952) and Watson (1958). All the yield attributing characters were recorded before harvesting of the crop and the pod yield was recorded at 10% moisture after harvesting from net plot and converted into kg/ha basis. Statistical analysis of the data was carried out using analysis of variance technique (Gomez and Gomez, 1984). The treatment comparisons were made using t-test at 5% level of significance. Economic analysis was done based upon cost of cultivation, pod and haulm yield and prevailing market prices of groundnut during the respective crop seasons.

RESULTS AND DISCUSSION

Growth parameters of groundnut as influenced by Paclobutrazol

Plant height

There was significant variation in plant height among treatments due to application of paclobutrazol after 30 DAE because paclobutrazol was not applied before. After application of paclobutrazol, plant height decreased with increased concentration of paclobutrazol after 30 DAE till harvest. Plant height was lowest with application of 200 ppm paclobutrazol (52.4 cm) over control (72.5 cm). Significant variation in plant height was observed and the plant height reduced between 4.3%-27.7% over control. The plant internode elongation was reduced to 53.1 cm when paclobutrazol was applied at 30 and 50 DAE, which was at par with 50 DAE (59.6 cm). The plant height taken at harvest with application of paclobutrazol applied at 30 and 50 DAE, showed an average of decrease of 9.6 and 19.4% over single application at 30 and 50 DAE, respectively. The shortening effect of the double application of paclobutrazol was due to reduction of the number of stem nodes per plant. Paclobutrazol, being a triazole growth retardant inhibit biosynthesis of gibberellins by blocking kaurene oxidase resulting in decreased inter-nodal elongation. Similar results on variation in height due to application of paclobutrazol was also reported by Kumar *et al.* (2012), Koutroubas *et al.* (2015), Kumar *et al.* (2016) and Barman *et al.* (2017).

Crop growth rate (CGR)

Among different main plot treatments, crop growth rate (CGR) varied significantly from 30-45 DAE to 90 DAE -harvest. The CGR was highest when paclobutrazol was applied @100 ppm over other treatments irrespective of different intervals. Application of paclobutrazol @ 100 ppm obtained maximum CGR (0.064 g/plant/day) at 30-60 DAE, (0.308 g/plant/day) at 61-90 DAE and (0.075 g/plant/day) over all other treatments. Significant result was found with different time of application. Application of paclobutrazol at 30 DAE registered maximum CGR (0.247 g/plant/day) at 61-90 DAE and (0.075 g/plant/day) at 91 DAE-at harvest expect 30-60 DAE although it was at par with application of paclobutrazol at 30 and 50 DAE with CGR (0.052 g/plant/day).This may be due to increased photosynthetic rate through synthesis more cytokinin, which in turn enhanced chlorophyll biosynthesis, because of application of paclobutrazol. This results are in tune with (Kumar *et al*., 2012), Dewi *et al*. (2016) and Barman *et al*. (2017).

Branch No. plant

The branches/plant increased with increased concentration of paclobutrazol till 100 ppm and then there was a reduction in branches/plant. Highest number of branches/ plant was observed with application of paclobutrazol @ 100 ppm (4.9) followed by 50 ppm (4.8) and lowest was with 200 ppm (4). In case of time of spraying, branches/plant was highest with single spraying at 30 DAE (4.7) followed by single spraying at 50 DAE (4.4). Similar results were also reported by Senoo and Isoda, (2003).

Root dry weight

Dry root of plants varied significantly amongst different treatments comprising different concentrations of paclobutrazol. Among different main plots, application of paclobutrazol @ 100 ppm accrued highest root dry weight/ plant (3.80 g) which was at par with application of paclobutrazol @ 150 ppm (3.61 g/plant). Comparing different time of application, application of paclobutrazol at 30 DAE recorded highest root dry weight (3.32 g/plant). The interaction effect was non-significant. The application of paclobutrazol might have helped in increased root activity which resulted higher root growth and root vigour. Similar type of results was obtained by Kamran *et al*. (2018).

Effect of Paclobutrazol on yield and yield attributing parameters

The different yield attributes of groundnut differed significantly due to foliar spray of various concentration of paclobutrazol. Number of pods/ plant was not varied due to foliar application of different concentration of paclobutrazol. Maximum no. of pods/plant were noted with application of paclobutrazol @ 100 ppm (17.7) which was at par with paclobutrazol @ 50 ppm (17.2) and lowest no. of pods/ plant with highest no. of aerial pegs was noted in control (14.2). Similarly, it also obtained highest 100 kernel weight (38.3 g) which was at par with application of paclobutrazol @ 50 ppm (37.1 g). Foliar spray of paclobutrazol at 30 DAE obtained maximum no. pods/plant (18) compared which was at par with double spraying of 30 and 50 DAE (17.2). Number aerial pegs varied significantly due to foliar spray of different concentration of paclobutrazol. Among different concentration of paclobutrazol, application of paclobutrazol @ 100 ppm produced significantly minimum no. of aerial pegs (19.7/plant) over all other treatments and maximum no. were observed in control (37.1). Among different time of application, significantly lowest number of aerial pegs were produced when paclobutrazol was applied 30 DAE (24.3) over other

treatments. This might be due to decreased height of plant in paclobutrazol treated plants in comparison to control.

Groundnut pod yield increased significantly due foliar application of paclobutrazol at different levels. The pod yield increased by 1.2%, 9.5%, 16.7% and 3.4%, respectively when compared to control with application of 25 ppm, 50 ppm, 100 ppm and 150 ppm of paclobutrazol as indicated in Table 2. But the pod yield reduced by 8.4% with foliar application of paclobutrazol @ 200 ppm in comparison to control. Regarding time of application, the highest pod yield was recorded with application of paclobutrazol at 30 DAE (1954 kg/ha) which was at par with 50 DAE (1819). The pod yield increased by 17.5% and 9.4%, respectively at single application of 30 DAE and 50 DAE over dual application of paclobutrazol at 30 and 50 DAE.

The possible increments in pod yield might be due to the change in canopy coverage, in which the plant developed broader canopy due to decreased height, which in turn facilitated improved light interception for better photosynthesis in leaves and stems of paclobutrazol treated plants. This may explain increased dry matter accumulation in stem and root and simultaneous yield. Similar result was witnessed by Hua *et al*. (2014) and Barman *et al*. (2017).

Further, decreased yield due to dual application of paclobutrazol might be due to synchronization of application with maximum flowering stage, this in turn reduced number of flowers so also yield.

Effect of Paclobutrazol on economics

Economics of different levels of paclobutrazol indicated that highest benefit cost ratio (1.97) and net return (` 41293/ha) were obtained with application of paclobutrazol @ 100 ppm followed by 50 ppm (1.86 and ` 39374/ha). Among different time of application, application of paclobutrazol at 30 DAE

Table 1: Effect of different concentration and timing of application of paclobutrazol on growth parameters of groundnut (Pooled over 3 years).

Treatment	Plant height(cm)				Crop growth rate(g/plant/day)			Branch	Root dry
	30 DAE	60 DAE	90 DAE	At harvest	30-60 DAE	60-90 DAE	90 DAE-AH	no. at harvest	wt. (g)at harvest
T1 : Paclobutrazol @ 25 ppm	30.4	49.5	62.6	69.4	0.060	0.146	0.066	4.4	3.30
T2 : Paclobutrazol @ 50 ppm	30.2	46.7	55.5	62.5	0.054	0.136	0.065	4.8	3.19
T3 : Paclobutrazol @ 100 ppm	29.7	43.8	52.1	57.3	0.055	0.284	0.067	4.9	3.80
T4 : Paclobutrazol @ 150 ppm	30.3	39.3	49.7	55.1	0.048	0.259	0.060	4.5	3.61
T5 : Paclobutrazol @ 200 ppm	31.2	37.8	47.5	52.4	0.045	0.184	0.058	4	3.18
T6 : Control	31.3	53.1	68.4	72.5	0.064	0.308	0.075	4.3	2.36
SEm (±)	1.14	1.53	1.72	1.6	0.003	0.004	0.004	0.14	0.151
CD (p=0.05)	3.39	4.56	5.14	5.1	0.010	0.014	0.013	0.45	0.477
Time of Application									
S1 : Single spraying at 30 DAE	30.3	47.6	61.5	65.9	0.047	0.247	0.075	4.7	3.32
S2 : Single spraying at 50 DAE	30.8	45.3	57.4	59.6	0.058	0.214	0.064	4.4	3.16
S3 : Double spraying at 30 and 50 DAE	31.3	38.2	52.3	53.1	0.052	0.198	0.057	4.1	3.25
SEm (±)	0.57	2.12	2.6	3.1	0.002	0.003	0.003	0.12	0.081
CD (p=0.05)	1.7	6.38	7.77	9.2	0.006	0.007	0.008	0.35	0.218

Table 2: Effect of different concentration and timing of application of paclobutrazol on yield and yield attributes and economics of groundnut (Pooled over 3 years).

Treatment	Pod /plant	100 kernel wt.(g)	Dry pod yield (kg/ha)	Haulm yield (kg/ha)	Net return (Rs)	BCR
T1 : Paclobutrazol @ 25 ppm	15.7	35.2	1767	4003	32768	1.72
T2 : Paclobutrazol @ 50 ppm	17.2	37.1	1911	3786	39374	1.86
T3 : Paclobutrazol @ 100 ppm	17.7	38.3	2038	3838	41293	1.97
T4 : Paclobutrazol @ 150 ppm	16.2	34.4	1806	3647	34923	1.76
T5 : Paclobutrazol @ 200 ppm	15.2	32	1599	3279	25031	1.57
T6 : Control	14.2	32.5	1746	4043	32883	1.72
SEm (±)	0.58	1.12	73.7	136	-	-
CD (p=0.05)	1.07	3.51	233.2	481	-	-
Time of application						
S1 : Single spraying at 30 DAE	18.1	37.3	1954	3975	42268	1.92
S2 : Single spraying at 50 DAE	17.0	34.8	1819	3614	35316	1.80
S3 : Double spraying at 30 and 50 DAE	16.7	32.4	1663	3186	27725	1.66
SEm (±)	0.4	0.7	54.5	115	-	-
CD (p=0.05)	1.28	1.9	152.6	329	-	-

excelled over treatments with highest net return (` 41293/ha) and benefit cost ratio (1.92).

CONCLUSION

Application of paclobutrazol reduced plant height in comparison to control. The study clearly indicated that application of paclobutrazol @ 100 ppm concentration at 30 DAE in groundnut significantly reduced plant height to an optimum level with highest yield and net return in *kharif* season. So, it could be recommended for *kharif* groundnut growing areas of Odisha.

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