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Impact of Soil Applied Paclobutrazol on Vegetative Growth of Litchi (*Litchi chinensis* Sonn.) cv. Rose Scented

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Abstract
Paclobutrazol a plant growth regulator (PGR) has been reported to be very effective for dwarfing a wide range of crops including litchi. It is a cell elongation and internode extension inhibitor that retards plant growth by inhibition of gibberellins biosynthesis. The effect of paclobutrazol at varying time intervals of litchi as soil drench application (1.00-4.00 g a.i. per meter canopy diameter) on vegetative growth of litchi (*Litchi chinensis* Sonn.) was investigated during 2016-18 in Pantnagar condition. The vegetative growth was significantly reduced due to higher dose of paclobutrazol (2.0-4.0 g a.i./meter canopy diameter). Application of paclobutrazol at the rate 2.0, 3.0 a.i./tree through soil application method was noted to be more efficient in reducing tree height, shoot length, internodal length and emergence of vegetative flush. The paclobutrazol applied at the rate 40 ml/tree was the most effective in reducing the plant height (3.70 m) followed by 80 ml/tree (3.94 m) and 60 ml/tree (3.95 m), while the maximum plant height was recorded under control (4.38 m). The application of paclobutrazol @ 40 ml/tree, the shoot length of litchi tree was found to be minimum (16.79 cm) as compared to control (19.60 cm). At varying time intervals, in the month of October estimated the minimum shoot length (17.72 cm) followed by September, while the maximum shoot length was noted under November (18.16 cm). The main purpose of this study is to focus upon contemporary information about paclobutrazol in litchi growth.

Keywords: Paclobutrazol; tree height; shoot length; internodal length; vegetative flush

Introduction
Litchi is the most important sub-tropical evergreen tree. It is botanically designated as Litchi (*Litchi chinensis* Sonn.) and commonly known as litchi or lychee. It belongs to family Sapindaceae, under sub-family Napheleae. The family Sapindaceae have 125 genera and 1000 species, which are widely distributed throughout the world. Litchi is originated in China, but now found in most of the South - East Asian countries. Litchi entered in Eastern India (Tripura) first via. Burma by the end of 17th Century and thereafter by the end of 18th Century it was introduced to Bengal. It is also known as 'queen of the fruit' due to its attractive deep pink/red colours, sweet deliciously flavoured and juicy aril. Litchi being a non-climacteric fruit requires to be harvested after attaining full maturity on the tree. Litchi is a delicious, juicy, sweet and very fragrant fruit, which is usually available in the summer month. The litchi can grow in a wide variety of soil but it makes best growth in deep, well-drained loam soil, which is rich in organic matter and the pH ranges between 5.0 to 5.5 for best growth. Botanically, the fruit type of litchi is a nut but possession of a white translucent fleshy and juicy aril developing from the funicle and surrounding the seed at maturity makes it fleshy. Litchi fruits are among the most delicious one having high nutritional and medicinal values. Edible portion of the fruit is a thick, translucent juicy aril with high sugar content. The fruits of litchi on an average contain 70-86% aril, 4-18% seed and 8-15% skin. The ripe fruits are also a rich source of sugars which ranges from 10-22% and minerals (0.7%) like calcium, phosphorus and iron. The dominant organic acid present in the fruit is malic acid, which constitutes 80% of the total acids. The value addition of litchi through processing is less than 2.00 per cent of total litchi produced in India.

Paclobutrazol [(2RS, 3RS)-1-(4-chlorophenyl-4, 4-dimethyl-2-(1H-1, 2, 4 triazol-1-yl) pentan-3-ol] is commonly known as "Cultar" and used as a way of improving crop productivity (Davis and Andersen, 1989). It is water soluble and acts as a plant growth retardant. Paclobutrazol comes under the triazolic group of fungicides with plant growth regulating properties through interfering with the ent-kaurene oxidase activity. It inhibits cytochrome P-450, which mediates oxidative dimethylation reactions in the ent-kaurene oxidation pathway and is a key step in gibberellic acid biosynthesis resulting in a decrease of gibberellic acid levels. Some plants induce stress protection against drought and temperature as it increases

the levels of abscisic acid after the application of Paclobutrazol (Zhu *et al.*, 2004) [21].

Materials and Methods

This experiment was carried out during the year 2016 to 2018 at Horticultural Research Centre, Patharachatta, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar (Uttarakhand). Pantnagar is situated at 29.5^0 North latitude and 79.3^0 East longitudes at an altitude of 243.94 meters above mean sea level in the Tarai region of Himalayas. The experiment was conducted on 20-year old litchi tress of cv. Rose Scented planted at a spacing of 5m×5m under the high density planting. The selected trees were vigorously growing and healthy in nature. The experiment was laid out in randomized block design. All the treatments were replicated thrice with a unit of one plant in a treatment. The total 45 plants of Rose scented were included in this experiment.

Experimental Details

These five treatments were Control (P_0); 1.0 g a.i. per meter canopy diameter (20ml/tree) (P_1); 2.0 g a.i. per meter canopy diameter (40ml/tree) (P_2); 3.0 g a.i. per meter canopy diameter (60ml/tree) (P_3); 4 .0 g a.i. per meter canopy diameter (80ml/tree) (P_4) and three date of application of paclobutrazol i.e., 15 September (120 days before expected date of bud break) (D_1);15 October (90 days before expected date of bud break) (D_2);15 November (60 days before expected date of bud break) (D_3). Paclobutrazol was applied through ring basin method which is 20 cm wide and 15 cm deep around the tree trunk. The strength of used paclobutrazol was 25% only. Hence, for obtaining 100% strength the quantity of paclobutrazol was taken 4 times and thus the final doses used in the experiment were 20ml/tree, 40ml/tree, 60ml/tree and 80ml/tree of per meter tree canopy spread. The measured quantity of paclobutrazol was dissolved in 10 liter of water in a bucket and thoroughly stirred before pouring in the ring. The control trees were treated with equal quantity of tap water. The above treatments were applied during the second week of September, October and November 2016 and 2017 only. During entire course of experiment (2 years) tree basins along with treated zones were kept moist mainly during the rainfed season.

Observations Recorded

The data were observed for the various parameters described below under the following heads.

Vegetative growth character

Plant height (m)

The height of plants was measured from the base of the trunk at the collar region to the highest crown level with the help of pre marked bamboo pole and expressed in meters.

Shoot length (cm)

Ten shoots were randomly selected in all four directions of the plant and tagged on each treatment. The length of shoots was measured by measuring scale just before panicle emergence and expressed in centimeter.

Internodal length

The length of the five internodes of each of the ten tagged shoots in all four directions on a tree was measured by measuring scale in centimeter. The data was recorded simultaneously, while measuring shoot length, just before panicle emergence in month of January in 2017 and 2018.

Emergence of vegetative flush

Emergence of vegetative flush was recorded by visual observation of each treated tree by regular visit at frequent intervals during the month of Ferbery, July and September in the two successive years 2017 and 2018. It is observed in all four directions and expressed in days.

Statistical Analysis

The statistical analysis was carried out for each observed character by using MS-Excel, OPSTAT. All the data pertaining to growth, yield and quality attributes were statistically analyzed as per design of experiment (Randomized Block Design) suggested by Gomez and Gomez (1983). The level of significance was tested for different variables at 5 per cent level of significance. The results are presented by way of tables and graphs.

Results and Discussion

Effect of paclobutrazol on vegetative growth characters

Plant height (m)

The data pertaining to effect of different doses of paclobutrazol at varying dates as soil drench application on plant height of litchi for the year 2016-17 and 2017-18 are presented in table 1. A close perusal of data on plant height under different doses and varying time intervals of paclobutrazol application including control were statistically analysed by two factorial randomised block deign. It indicates significant differences under the different doses of paclobutrazol as well as interaction between paclobutrazol and its time of application however the effect at varying time intervals was non-significant during the 2017. The minimum tree height (3.85 m) was recorded under treatment P_2 (40 ml/tree) followed by P_3 (4.12 m), while it was maximum under control (4.50 m). The time of application of paclobutrazol showed minimum height (4.15 m) in D_2 (October), while the maximum height was found in D_3 (November) i.e., 4.17 m. Thus, the treatment combination P_2D_2 recorded the minimum plant height (3.76 m), while the maximum was found under P_0D_2 (4.66 m) in the first year of experiment. During the second year the result revealed that the different doses of paclobutrazol at varying time intervals and interaction between paclobutrazol and its time of application (P×D) showed significant differences on tree height. The minimum tree height (3.56 m) was recorded in treatment P_2 (40 ml/tree), followed by P_4 (3.67 m) and P_3 (3.78 m), while the maximum tree height (4.26 m) was noted under P_0 (control). The time of application of paclobutrazol showed minimum height (3.70 m) in D_3 (November), while the maximum height was estimated in D_1 (September) i.e. 3.97 m. Thus, the treatment combination P_2D_2 recorded the minimum plant height i.e., 3.31 m, however the maximum was estimated under P_0D_1 (4.57 m).

The pooled data presented in table 1 clearly visualizes the significant effect of various levels of Paclobutrazol (P), its time of application and their interaction (P×D). The paclobutrazol applied at the rate 40 ml/tree (P_2) was the most effective in reducing the plant height (3.70 m) followed by P_4 (3.94 m) and P_3 (3.95 m), while the maximum plant height was recorded under control (4.38 m). Among different time intervals the D_3 (November) was estimated the minimum plant height (3.93 m) followed by D_2 (October) i.e., 3.97 m, while the maximum plant height was noted under D_1 (September). The differences among the time intervals of paclobutrazol application D_2 and D_3 were statistically *at par* with each other.

The above results are in the accordance with Wood (1984) and Khader (1991) [8] who found that soil applied paclobutrazol reduced the tree height. The application of paclobutrazol (12 and 16 ml/tree) reducing the tree height in mango cv. Dashehari is also observed by Ram *et al.* (2005) [14]. Murthi *et al*. (2001) [13] found that the application of paclobutrazol at the rate 5 and 10 g a.i./tree given during the months of Aug–Sept in mango cv. Alphonso reduced tree height. Paclobutrazol is the triazole group compound, which reduces the plant growth viz; plant height, shoot length, internodal length. The capacity of paclobutrazol to reduce plant growth is due to their inhibiting activity of the kauren oxidation. The kaurene oxidation is catalyzed by the kaurene cytochrome oxidase P-450, which was directly inhibit of gibberellins synthesis pathway. Paclobutrazol also acts on the inhibition of sterol biosynthesis, which decrease the amount of ethylene, abscisic acid as well as indole-3-acetic acid, while increases the level of cytokinins (Arteca, 1995) [1].

Table1: Effect of paclobutrazol at different time of application on plant height (m) of litchi.

Factors	Year	2017				2018				Pooled data			
Paclobutrazol (ml/tree)	Doses	September (D_1)	October (D_2)	November (D_3)	Mean P	September (D_1)	October (D_2)	November (D_3)	Mean P	September (D_1)	October (D_2)	November (D_3)	Mean P
	Control (P_0)	4.63	4.66	4.22	4.50	4.57	4.28	3.95	4.26	4.60	4.47	4.08	4.38
	20 ml (P_1)	4.13	4.04	4.18	4.13	3.95	3.93	3.63	3.84	4.04	3.99	3.91	3.98
	40 ml (P_2)	3.82	3.76	3.97	3.85	3.75	3.31	3.63	3.56	3.78	3.53	3.80	3.70
	60 ml (P_3)	4.08	4.09	4.20	4.12	3.82	3.84	3.69	3.78	3.95	3.96	3.95	3.95
	80 ml (P_4)	4.14	4.20	4.27	4.20	3.78	3.66	3.59	3.67	3.96	3.93	3.93	3.94
Factor D	Mean D	4.16	4.15	4.17		3.97	3.80	3.70		4.06	3.97	3.93	
Factors		CD at 5%		Sem ±		CD at 5%		Sem ±		CD at 5%		Sem ±	
Factor P		0.13		0.04		0.12		0.04		0.10		0.03	
Factor D		NS		0.03		0.09		0.03		0.07		0.02	
Factor P×D		0.23		0.08		0.21		0.07		0.17		0.05	

Shoot length (cm)

The data indicates the significant differences under the different doses of paclobutrazol, its time of application as well as interaction between paclobutrazol and its time of application during both the years. During 2017 the minimum shoot length (17.53 cm) was noted under treatment P_2 (40 ml/tree) followed by P_3 (17.64), while the maximum length was under control (19.60 cm). The time of application of paclobutrazol showed the lowest shoot length (18.18 cm) in D_2 (October), while the maximum shoot length was found in D_3 (November) i.e., 18.44 cm. Thus, the treatment combination P_2D_2 recorded the minimum shoot length i.e., 17.26 cm, while the maximum shoot length was under P_0D_1 i.e., 19.72 cm. During 2018 the lowest shoot length (16.05 cm) was recorded in treatment P_2 (40 ml/tree) followed by P_3 (16.15 cm), while the highest under P_0 (19.60 cm). The time of application of paclobutrazol showed the lowest shoot length (17.26 cm) in D_2 (October), while the highest shoot length was estimated in D_3 (November) i.e., 17.88 cm. Thus, the treatment combination P_2D_2 recorded the minimum shoot length i.e., 15.29 cm, however the maximum shoot length (19.50 cm) was noted under P_0D_1.

The pooled data for shoot length clearly indicates the significant effect of various levels of Paclobutrazol (P), its time of application and their interaction (P×D). The paclobutrazol applied at the rate 40 ml/tree (P_2) recorded the most effective in reducing the shoot length (16.79 cm) followed by P_4 (16.90 cm), while the maximum shoot length was found under control (19.60 cm). Among all the doses of paclobutrazol P_3 and P_4 were statistically *at par* with each other. In different time intervals the D_2 (October) estimated the minimum shoot length (17.72 cm) followed by D_1 (September), while the maximum shoot length was noted under D_3 (18.16 cm). All the differences among the time intervals of paclobutrazol application recorded significant.

In accordance to our present findings, Subbaiah *et al.* (2017) [18] examined that the soil applied paclobutrazol at the rate 4 ml/m canopy estimated minimum shoot length (34.74 cm), while the maximum shoot length (36.24 cm) was recorded under control in mango. These results are in conformity with Desai and Chundawat (1994) [5], who reported that the application of paclobutrazol reduces the shoot length in litchi cv. Calcuttia. Minimum length (11.5 cm) of terminal shoots was recorded in soil application @ 7.5 ml/tree, which was closely followed by Cultar @ 5ml/tree. Paclobutrazol at the rate 250 mg/ lit reduced the 34.1-42.4% shoot growth in apricot is also noted by Kuden *et al.* (1995) [9]. Faizan *et al.* (2000) [6] observed that higher dose of paclobutrazol (5 ml/m^2 plant spread) proved effective than the lower dose (3 ml/m^2 plant spread) in controlling shoot length in litchi. The reduction in shoot length and internodal length of various fruit crops due to the paclobutrazol inhibiting activity. Paclobutrazol inhibit the gibberellin biosynthesis which was blocking the oxidation of GA precursors viz; ent ent-kaurene to ent-kaurenoic acid and reduced the vegetative growth of plants (Sugavanum, 1984) [19].

Table 2: Effect of paclobutrazol at different time of application on shoot length (cm) of litchi.

Factors	Year	2017				2018				Pooled data			
Paclobutrazol (ml/tree)	Doses	September (D_1)	October (D_2)	November (D_3)	Mean P	September (D_1)	October (D_2)	November (D_3)	Mean P	September (D_1)	October (D_2)	November (D_3)	Mean P
	Control (P_0)	19.72	19.65	19.44	19.60	19.50	19.41	19.89	19.60	19.62	19.53	19.66	19.60
	20 ml (P_1)	18.97	18.98	19.23	19.06	18.80	18.87	18.52	18.73	18.88	18.93	18.88	18.89
	40 ml (P_2)	17.37	17.26	17.60	17.53	16.02	15.29	16.83	16.05	16.70	16.28	17.40	16.79
	60 ml (P_3)	17.53	17.42	17.97	17.64	16.45	15.60	16.40	16.15	16.99	16.52	17.19	16.90
	80 ml (P_4)	17.62	17.59	17.96	17.72	17.25	17.16	17.75	17.39	17.44	17.38	17.68	17.50
Factor D	Mean D	18.24	18.18	18.44		17.60	17.26	17.88		17.92	17.72	18.16	
Factors		CD at 5%		Sem ±		CD at 5%		Sem ±		CD at 5%		Sem ±	
Factor P		0.21		0.07		0.28		0.09		0.18		0.06	
Factor D		0.16		0.05		0.22		0.07		0.12		0.04	
Factor P×D		0.37		0.13		0.49		0.17		0.31		0.10	

Internodal length (cm)

The data presented in table 3 make it evident that the application of different doses of paclobutrazol at varying time intervals showed significant differences, however the interaction between paclobutrazol and its time of application (P×D) was non-significant during both the years. The respective value of minimum internodal length i.e., 3.32 cm and 2.81 cm was estimated under treatment P_2 (40 ml/tree) followed by P_3 (3.41 cm and 2.89) and P_4 (3.74 cm 3.37 cm), while the maximum under control (4.30 cm and 4.29 cm), in 2017 and 2018. The time of application of paclobutrazol showed the lowest internodal length i.e., 3.63 cm and 3.36 cm in D_2 (October), while the highest internodal length was noted in D_3 (November) i.e., 3.92 cm and 3.66 cm, respectively in the year of 2017 and 2018. Thus, the treatment combination P_2D_2 recorded the minimum internodal length during 2017 (3.09 cm) and 2018 (2.61 cm).

The pooled observations showed the significant differences of various levels of paclobutrazol (P) and its time of application however, their interaction (P×D) was non- significant. The paclobutrazol applied at 40 ml/tree (P_2) recorded the most effective in reducing the internodal length (3.07 cm) followed by P_4 (3.15 cm), while the maximum internodal length was noted under control (4.29 cm). Treatment P_3 and P_4 were statistically *at par* with each other. Among different time intervals the D_2 (October) recorded the minimum internodal length (3.50 cm) followed by D_1 (September), while the maximum internodal length was estimated under D_3 (November). All the differences among the time intervals of paclobutrazol application recorded significant. Thus, the treatment combination P_2D_2 recorded the minimum internodal length (2.85 cm), however the maximum was noted under P_0D_3 (4.42 cm).

The above findings are in agreement with the findings of Semirat and Qrunfleh (1989) ascertained that the application of paclobutrazol before the spring and summer flushes caused a remarkable reduction in internodal length by the various concentration of paclobutrazol in lemon. The maximum reduction in internodal length was recorded at 2000 mg/lit paclobutrazol (66%) followed by 1000 mg/lit (60%) and 500 mg/lit (32.8%). Salem *et al.* (1991) reported that the application of paclobutrazol at the rate 1000 or 2000 ppm/tree reduces the internodal length at 2, 4 or 6 weeks after full bloom in Asian pear cv. 'Leconte'.

Table 3: Effect of paclobutrazol at different time of application on internodal length (cm) of litchi.

Factors	Year	2017				2018				Pooled data			
Paclobutrazol (ml/tree)	Doses	September (D_1)	October (D_2)	November (D_3)	Mean P	September (D_1)	October (D_2)	November (D_3)	Mean P	September (D_1)	October (D_2)	November (D_3)	Mean P
	Control (P_0)	4.47	4.11	4.32	4.30	4.20	4.14	4.52	4.29	4.34	4.13	4.42	4.29
	20 ml (P_1)	4.31	4.07	4.23	4.20	3.94	3.98	3.99	3.97	4.13	4.03	4.12	4.09
	40 ml (P_2)	3.32	3.09	3.56	3.32	2.71	2.61	3.11	2.81	3.02	2.85	3.34	3.07
	60 ml (P_3)	3.35	3.25	3.63	3.41	2.78	2.76	3.13	2.89	3.07	3.01	3.38	3.15
	80 ml (P_4)	3.76	3.61	3.86	3.74	3.26	3.31	3.55	3.37	3.51	3.46	3.70	3.56
Factor D	Mean D	3.84	3.63	3.92		3.38	3.36	3.66		3.61	3.50	3.79	
Factors		CD at 5%		Sem ±		CD at 5%		Sem ±		CD at 5%		Sem ±	
Factor P		0.20		0.07		0.17		0.06		0.12		0.04	
Factor D		0.15		0.05		0.13		0.04		0.09		0.03	
Factor P×D		NS		0.12		NS		0.10		NS		0.07	

Emergence of vegetative flush (%)

The data pertinent to the emergence of vegetative flush on litchi tree during the course of study in the month of Ferbery, July and September 2017 to 2018, are presented in table 4. It showed significant differences under the different doses of paclobutrazol, while its time of application had significant except in the month of February and September. The interaction between paclobutrazol and its time of application (P×D) was also significant except in the month of July during the 2017. The minimum number of vegetative flush in the treatment P_3 (60 ml/tree) was emerged in the month of February (34.53%), followed by P_2 (40 ml/tree) in the month of July (62.22%) and P_3 (60 ml/tree) in the month of September (77.33%), whereas the maximum emergence of vegetative flush was under control (P_0) i.e., 45.22 (February), 71.55 (July) and 92.44 (September). On the other hand the effect of different time intervals of paclobutrazol application was found minimum in D_1 in the month of Ferbery (38.86%) followed by D_2 in the month of July and September i.e., 64.93 and 82.93% . However the maximum number of vegetative flush was noted in D_2 (October) in the month of February (39.20%) followed by D_3 (66.20%) in the month of July and D_1 (83.66%) in the month of September.

In the month of Ferbery, July and September 2018, pattern of vegetative flush emergence was almost similar to the preceding year 2017; hear too, the data indicates significant differences under the different doses of paclobutrazol, while its time of application was also significant except the month of September. However the interaction between paclobutrazol and its time of application (P×D) was significant during the 2018. The minimum vegetative flush in the treatment P_3 (60 ml/tree) emerged in the month of February (27.88%), followed by P_2 (40 ml/tree) in the month of July (54.11%) and P_3 (60 ml/tree) in the month of September (75.11%), while maximum under control. Among all the treatments, in the month of February P_2 and P_3, in the month of July P_3 and P_4 and in the month of September P_2 and P_3 were statically *at par* with each other. The time of application of paclobutrazol was found minimum number of vegetative flush in D_3 in the month of February (34.26%) followed by D_1 in the month of July (59.40%) and D_2 in the month September (78.60%). However the maximum number of vegetative flush was noted in D_1 (35.46%) in the month of February followed by D_3 (60.40%) in the month of July and D_1 (79.66%) in the month of September.

These results are in conformity with Chaitrakulsub *et al.* (1992) who determined the interactive effect of soil applied paclobutrazol at the rate 1.0 or 1.5 g a.i./m canopy diameter reduced vegetative flush during the month of Ferbery and July compared to the control in litchi.. Shukla and Bajpai (1977) [16] also reported that more than 70% vegetative flush was estimated during the month of September and July under the control in litchi as well as less than 45% in February. Paclobutrazol reduced the vegetative flushes have also been observed in litchi by Menzal and Simpson (1990) [11] and in mango by Kurian and Iyer (1993) [10]. High soil moisture and elevated air temperature mixed with higher atmospheric humidity causes for increased vegetative flushing during in

September and July was noticed by Menzal and Simpson (1990) [11]. Menzal and Simpson (1992) [12] found that the higher water content of plant tissue and elevated air temperature of 25-32 ^{0}C was good for the vegetative growth in litchi. The emergence of vegetative shoots is reduced by the inhibiting activity of paclobutrazol. Paclobutrazol is a triazole derivative that inhibits gibberellin biosynthesis and also inhibit the oxidation of the GA precursors ent-kaurene to ent- kaurenoic acid (Dalziel and Lawrence, 1984) [3].

Table 4: Effect of paclobutrazol on different time of application on emergence of vegetative flush (%) of litchi.

Treatment	Year 2017						Year 2018					
Factor P	Mean P						Mean P					
	February		July		September		Feb		July		September	
P_0	45.22		71.55		92.44		47.33		72.00		87.33	
P_1	41.33		67.00		86.66		37.55		61.44		81.11	
P_2	36.66		62.22		81.11		28.66		54.11		75.44	
P_3	34.55		63.11		77.33		27.88		55.22		75.11	
P_4	37.22		64.55		78.77		32.00		56.11		77.22	
CD at 5%	1.20		1.30		1.29		1.01		0.95		1.20	
Sem ±	0.41		0.44		0.44		0.34		0.32		0.41	
Factor D	Mean D						Mean D					
D_1	38.86		65.93		83.66		35.46		59.40		79.66	
D_2	39.20		64.93		82.93		34.33		59.53		78.60	
D_3	38.93		66.20		83.20		34.26		60.40		79.46	
CD at 5%	NS		1.01		NS		0.78		0.74		NS	
Sem ±	0.32		0.34		0.34		0.27		0.25		0.32	
Interaction	CD	Sem±	CD	Sem±	CD	Sem±	CD	Sem±	CD	Sem±	CD	Sem±
PXD	2.08	0.71	NS	0.77	2.25	0.77	1.76	0.60	1.66	0.57	2.09	0.71

Conclusion

From the investigation, it was concluded that different doses of paclobutrazol at varying time intervals reduces the vegetative growth of litchi. Paclobutrazol a plant growth regulator (PGR) has been reported to be very effective for controlling the vegetative growth. Application of paclobutrazol at the rate 2.0 and 3.0 a.i./meter canopy diameters through soil application method was noted to be more efficient to reducing tree height, shoot length, internodal length and emergence of vegetative flush. These findings demonstrate the positive effects, no negative effect and most promising commercial applications of paclobutrazol on litchi.

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