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Effect of paclobutrazol and benzyl adenine on oriental lily hybrids

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ABSTRACT

Studies on the effect of growth regulators viz., Paclobutrazol and Benzyl Adenine (PBZ and BA, respectively) on Oriental Lily Hybrids, 'Star Gazer Pink' and 'Star Gazer White' in the second year were carried out at Department of Floriculture and Landscaping, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan (H.P). The effect of growth regulators applied in the first year, was studied on growth and flowering of Oriental lily hybrids in the second year. Plant height and number of leaves plant^{-1} were recorded maximum when PBZ 25 ppm was applied in the first year. Maximum plant height and number of leaves plant^{-1} were found in 'Star Gazer White' (84.46 cm; 35.04 cm). Bulbs of 'Star Gazer White' when dipped in PBZ 25 ppm for 12 h in the first year resulted in maximum plant height (102.50 cm) in the second year. Leaf area in the second year was recorded maximum in 'Star Gazer White' (34.40 cm^2) when PBZ 50 ppm was applied as bulb dip in the first year. Flower buds were initiated earlier in 'Star Gazer White' (84.48 days) as compared to 'Star Gazer Pink' (85.90 days). Days to bud initiation were also recorded minimum (75.81 days) when PBZ 25 ppm was applied as pre-plant bulb dip. More number of flowers plant^{-1} was recorded in 'Star Gazer White' (5.42) which lasted longer on stems (16.77 days). Bulbs dipped in growth regulators in the first season produced maximum number of flowers plant^{-1} (5.72) and duration of flowering was also maximum (18.28 days).

Key words: PBZ, BA, *Lilium*, Star Gazer Pink, Star Gazer White

INTRODUCTION

Lilium is one of the most beautiful geophytes in the flower world and ranks among the top ten traded cut flowers. Oriental lilies occupy a prestigious position among the group owing to its large fragrant flowers and long vase life. The size of bulbs reduces after flowering in Lilium. These bulbs cannot be reused for commercial flower production due to their small size which subsequently produces poor quality flowers. Although, Lilium cultivation is gaining popularity among the farmers in India but one of the major bottlenecks in large scale cultivation is the high cost of planting material which has to be purchased every year. The present investigation was therefore planned to increase the size of Lilium oriental hybrid bulbs by using growth regulators (PBZ and BA) for the production of commercial flower crop.

MATERIAL AND METHODS

Studies on two oriental lily hybrids, viz. 'Star Gazer Pink' and 'Star Gazer White' were carried out at the experimental farm of Department of Floriculture and Landscaping, Dr. Y.S. Parmar University of Horticulture and Forestry Nauni, Solan (H.P) during 2000-2001. Bulbs of uniform size (10/12 cm) were planted in January and growth regulators viz., Paclobutrazol (PBZ) and Benzyl Adenine (BA) were applied (at two levels each i.e., 25 ppm and 50 ppm). As treatment, 3 methods of application were selected i.e., pre plant bulb dip (12h), foliar spray (up to the level of droplet formation) and soil drench (200 ml around stem base). Foliar spray and soil drench applications were made when plants attained a height of 15 cm. The plants were raised as per standard cultural practices. Plants were debudded and the bulbs were harvested after drying of the plant. Data on bulb size of the harvested bulbs is presented in Table 1. After cold treatment of bulbs at 4°C for two months in moistened sawdust, planting was done and the crop was grown following standard cultural practices. No growth regulator treatment was applied in the second year. Different vegetative and flowering parameters were recorded from time to time. Overall the experiment consisting of 30 treatment combinations including 2 cultivars, 5 levels parameters were recorded from time to time. Overall the experiment consisting of 30 treatment combinations including

Table 1. Bulb circumference (cm) of harvested bulbs of *Lilium* cultivars 'Star Gazer Pink' and 'Star Gazer White' upon application of growth regulators

Growth regulator treatment (ppm) (T)		Cultivar (cv.)		Mean	Method of Application (M)		
		Star Gazer Pink	Star Gazer White		Dip	Drench	Spray
PBZ	25	16.73	17.30	17.02	18.85	16.60	15.60
	50	16.00	16.27	16.13	17.65	16.00	14.75
BA	25	15.57	16.04	15.81	16.90	16.15	14.37
	50	14.93	15.90	15.42	16.55	15.15	14.55
Control (distilled water)		13.60	14.10	13.85	13.85	13.85	13.85
Mean		15.37	15.92	16.76		15.55	14.62
$CD_{0.05}$							
cv.		0.24					
T		0.38					
M		0.30					
T x M		0.66					

2 cultivars, 5 levels of growth regulators and 3 levels of methods of application of growth regulators was conducted in factorial randomised block design. Recorded data was subjected to analysis of variance.

RESULTS AND DISCUSSION

Bulb circumference was found to be better in PBZ 25 ppm followed by PBZ 50 ppm when compared to other treatments (Table 1). Dipping the bulb gave better results than other methods of application (Table 1).

It is evident from the data (Table 2a) that mean height of plants of 'Star Gazer White' was more (84.46 cm) as compared to 'Star Gazer Pink' (81.38 cm). Bulbs/plants treated with PBZ 25 ppm in the first year produced plants of maximum height in both 'Star Gazer White' (93.13 cm) and 'Star Gazer Pink' (90.20 cm). The effect of dip and drench treatments did not differ significantly from each other. Interaction data (Table 2b) also shows that maximum plant height (102.50 cm) was recorded when bulbs were dipped in PBZ 25 ppm in the first year. The effect of PBZ in increasing the plant height in second year was due to better bulb size.

In a similar study Simmonds and Cumming (1977) found that the inhibitory effects of the retardants CCC and ancymidol on stem elongation were carried over into the replacement stems of Lilium cultivar 'Enchantment' in the next growing season but the degree of inhibition was considerably reduced. On the contrary, ethrel, which inhibited stem elongation of cvs 'Enchantment' and 'Harmony' during the first season's growth produced a significant increase in stem elongation, during the second season's growth.

More number of leaves per plant (Table 3) was recorded in 'Star Gazer White' (35.04) as compared to 'Star Gazer Pink' (34.07). Number of leaves was also maximum in 'Star Gazer White' (40.22) in PBZ 25 ppm treated plants /bulb in the first year. Plants treated with BA also produced more number of leaves per plant. Number of leaves on a plant could directly be correlated with plant height in the respective treatment, which could further be correlated with their respective bulb size at the time of planting.

Data (Table 4a) also shows that more leaf area per plant (28.09 cm^2) was produced by plants of cultivar 'Star Gazer White' as compared to 'Star Gazer Pink' (27.05 cm^2). Maximum leaf area per plant (28.81cm^2) was also recorded when PBZ 25 ppm was applied in the first year. BA at both the levels also showed an increase in leaf area over control. Leaf area per plant was recorded maximum when PBZ 25 ppm was applied as pre plant bulb dip (35.25 cm^2) in the first season. Growth regulators applied as bulb dip produced comparatively larger leaf area (29.49 cm^2) in the second growing season as compared to drench and spray application. Data in Table 4b also reveals the similar results i.e. leaf area per plant was maximum (34.40 cm^2) when PBZ 50 ppm was applied as pre plant bulb dip in 'Star Gazer White'. Increased leaf area can again be correlated to the increased bulb size and circumference in the respective treatments.

Results shows that the application of PBZ in the first year has significantly enhanced all vegetative parameters in the second year. It is apparent from the data that the retardation effect of PBZ was not carried to the next generation. Although the metabolic fate of triazoles has not been studied in great detail but a few studies suggest that root applied PBZ is acropetally transported to the leaves primarily via xylem in apple (Lever, 1986; Richardson and Quinlan, 1986). Further soil applied PBZ is relatively immobile and transpiration by leaves is required to pull the chemical to meristematic region. Only a small portion reaches the

Table 2 a. Effect of growth regulators applied in the first year on plant height (cm) in *Lilium* cultivars 'Star Gazer Pink' and 'Star Gazer White'

Growth regulator treatment (ppm) (T)		Cultivar (cv.)		Mean	Method of Application (M)		
		Star Gazer Pink	Star Gazer White		Dip	Drench	Spray
PBZ	25	90.20	93.13	91.67	98.25	90.95	85.10
	50	90.13	90.33	90.23	96.15	92.75	81.80
BA	25	77.40	84.33	80.87	77.40	84.90	80.30
	50	83.98	85.68	84.83	84.37	88.32	81.81
Control (distilled water)		65.20	68.80	67.00	67.00	67.00	67.00
Mean		81.38	84.46	84.77	84.78	79.20	
Method of application							
Dip		81.82	87.73				
Drench		82.49	87.08				
Spray		79.84	78.56				
$CD_{0.05}$							
cv.		0.75					
T		1.19					
M		0.92					
cv. X T		1.69					
cv. X M		1.31					
T X M		2.08					

Table 2 b. Interaction effect of growth regulators applied in the first year on plant height (cm) in *Lilium* cultivars 'Star Gazer Pink' and 'Star Gazer White'

Growth regulator treatment (ppm) (T)		Star Gazer Pink			Star Gazer White		
		Dip	Drench	Spray	Dip	Drench	Spray
PBZ	25	95.40	89.20	86.00	102.50	92.70	84.20
	50	94.90	91.10	84.40	97.40	94.40	79.20
BA	25	73.40	79.40	79.40	81.40	90.40	81.20
	50	80.20	87.53	84.20	88.53	89.10	79.40
Control (distilled water)		65.20	65.20	65.20	68.80	68.80	68.80
$CD_{0.05}$ cv. X T X M		2.93					

growing point where it can effectively inhibit the growth (Davis *et al*, 1988). As far as foliar applications of the PBZ is concerned, Wang *et al* (1986) reported that foliar applied PBZ was not transported to stem or roots and thus has localized effects. In the light of above studies it could be concluded that in the present experiment the persistence and further movement of PBZ into daughter bulbs is either absent or negligible. Lever (1986) has proposed that a threshold concentration of paclobutrazol is needed in the shoot apex to maintain the GA biosynthesis suppression. It seems that paclobutrazol, if present in the second year bulbs, is in a concentration lower than the threshold for inducing height reduction in the next growing season. Increased plant height, more number of leaves and larger leaf area, may therefore be attributed to larger quantity of food reserves in the bulbs. In Lilium Asiatic Hybrids 'Elite' and 'Jolanda', Lee and Yang (1997) have found that the stem height, node number and leaf area are positively correlated with bulb circumference.

Data in Table 5 shows that flower buds were initiated earlier in cultivar 'Star Gazer White' (84.48 days) as compared to 'Star Gazer Pink' (85.90 days). In 'Star Gazer White', PBZ 50 ppm applied in the first season resulted in earliest flower bud initiation (80.31 days). It has been observed by

Table 3. Effect of growth regulators applied in the first year on number of leaves per plant in *Lilium* cultivars 'Star Gazer Pink' and Star Gazer White'

Growth regulator treatment (ppm) (T)		Cultivar (cv.)		Mean
		Star Gazer Pink	Star Gazer White	
PBZ	25	36.60	40.22	38.41
	50	35.13	40.10	37.62
BA	25	33.73	32.62	33.18
	50	32.77	34.07	33.42
Control (distilled water)		32.10	28.20	30.15
Mean		34.07	35.04	
Method of application				
Dip		36.06	34.77	35.42
Drench		34.16	34.87	34.52
Spray		31.98	35.48	33.73
$CD_{0.05}$				
cv.		0.96		
T		1.53		
M		1.18		
cv.X T		2.16		
cv.X M		1.68		

Table 4 a. Effect of growth regulators applied in the first year on leaf area (cm^2) in *Lilium* cultivars 'Star Gazer Pink' and `Star Gazer White'

Growth regulator treatment (ppm) (T)		Cultivar (cv.)		Mean	Method of Application (M)		
		Star Gazer Pink	Star Gazer White		Dip	Drench	Spray
PBZ	25	28.80	28.82	28.81	35.25	27.43	26.75
	50	27.23	29.34	28.29	32.15	26.37	26.35
BA	25	27.63	26.93	27.28	27.65	26.95	27.25
	50	27.49	28.97	28.23	30.15	28.20	26.33
Control (distilled water)		24.10	26.40	25.25	25.25	25.25	25.25
Mean		27.05	28.09	29.49	26.84	26.39	
Method of application							
Dip		28.58	30.40				
Drench		26.16	27.52				
Spray		26.41	26.36				
$CD_{0.05}$							
cv.	0.48						
T	0.75						
M	0.58						
cv.X T	1.07						
cvX M	0.83						
TXM	1.32						

Table 4 b. Interaction effect of growth regulators applied in the first year on leaf area (cm^2) in *Lilium* cultivars 'Star Gazer Pink' and Star Gazer White

Growth regulator		Star Gazer Pink			Star Gazer White		
Treatment (ppm) (T)		Dip	Drench	Spray	Dip	Drench	Spray
PBZ	25	31.40	26.70	28.30	33.10	28.17	25.20
	50	29.90	25.40	26.40	34.40	27.33	26.30
BA	25	28.40	26.40	28.10	26.90	27.50	26.40
	50	29.10	28.20	25.17	31.20	28.20	27.50
Control (distilled water)		24.10	24.10	24.10	26.40	26.40	26.40
$CD_{0.05}$							
cv. X T X M	1.86						

Table 5. Effect of growth regulators applied in the first year on days to bud initiation in *Lilium* cultivars 'Star Gazer Pink' and Star Gazer White'

Growth regulator		Cultivar (cv.)		Mean	Method of Application (M)		
treatment (ppm)	(T)	Star Gazer Pink	Star Gazer White		Dip	Drench	Spray
PBZ	25	82.56	80.51	81.54	75.81	82.16	86.63
	50	84.91	80.31	82.54	79.07	82.67	86.08
BA	25	85.81	85.91	85.86	83.84	85.68	88.05
	50	87.11	87.36	87.23	84.95	87.57	89.18
Control (distilled water)		89.12	88.30	88.71	88.71	88.71	88.71
Mean		85.90	84.48	82.48	85.36	87.73	
Method of application							
Dip		84.44	80.51				
Drench		86.11	84.61				
Spray		87.15	88.32				
$CD_{0.05}$							
cv.		1.26					
T		1.99					
M		1.54					
cv.X M		2.18					
TXM		3.45					

Table 6. Effect of growth regulators applied in the first year on number of flowers per plant in *Lilium* cultivars 'Star Gazer Pink' and Star Gazer White'

Growth regulator		Cultivar (cv.)		Mean	Method of Application (M)		
treatment (ppm)	(T)	Star Gazer Pink	Star Gazer White		Dip	Drench	Spray
PBZ	25	5.66	6.36	6.01	6.65	5.95	5.45
	50	5.56	6.03	5.80	6.50	5.70	5.20
BA	25	5.16	5.66	5.41	5.95	5.25	5.05
	50	5.00	5.23	5.11	5.75	4.85	4.75
Control (distilled water)		3.70	3.80	3.75	3.75	3.75	3.75
Mean		5.02	5.42		5.72	5.10	4.84
$CD_{0.05}$							
cv.	0.098						
T	0.15						
M	0.12						
cv.X T	0.22						
TXM	0.27						

Table 7 a. Effect of growth regulators applied in the first year on duration of flowering (days) in *Lilium* cultivars 'Star Gazer Pink' and Star Gazer White'

Growth regulator		Cultivar (cv.)		Mean	Method of Application (M)		
treatment (ppm)	(T)	Star Gazer Pink	Star Gazer White		Dip	Drench	Spray
PBZ	25	16.83	19.13	17.98	22.25	16.70	15.00
	50	16.83	18.10	17.47	20.60	16.30	15.50
BA	25	15.57	15.97	15.77	17.15	15.75	14.40
	50	15.93	15.93	15.93	16.90	15.35	15.55
Control (distilled water)		14.30	14.70	14.50	14.50	14.50	14.50
Mean		15.89	16.77	18.28	15.72	14.99	
$CD_{0.05}$							
cv.	0.23						
T	0.37						
M	0.28						
cv.X T	0.52						
TXM	0.64						

Table 7 b. Interaction effect of growth regulators applied in the first year on duration of flowering (days) in *Lilium* cultivars 'Star Gazer Pink' and Star Gazer White

Growth regulator		Star Gazer Pink			Star Gazer White		
reatments (ppm)	(T)	Dip	Drench	Spray	Dip	Drench	Spray
PBZ	25	20.40	15.20	14.90	24.10	18.20	15.10
	50	19.90	15.40	15.20	21.30	17.20	15.80
BA	25	17.10	15.80	13.80	17.20	15.70	15.00
	50	16.90	15.20	15.70	16.90	15.50	15.40
Control (distilled water)		14.30	14.30	14.30	14.70	14.70	14.70
$CD_{0.05}$							
cv.		0.90					

earlier workers also that plants with more vegetative growth initiated earlier flowering, which could be associated with higher plant height, more leaf number and leaf area in this treatment. The decrease in days to bud initiation could therefore be associated to larger bulb size in these treatments.

More number of flowers per plant (Table 6) was recorded in cultivar 'Star Gazer White' (5.42) as compared to 'Star Gazer Pink' (5.02). Maximum number of flowers per plant (6.01) were recorded when PBZ 25 ppm was applied in the first year. Growth regulators applied as bulb dip in the first season produced more number of flowers per plant (5.72). Maximum number of flowers per plant (6.65) were recorded when PBZ 25 ppm was applied as pre-plant bulb dip in the first year. The effectiveness of pre-plant bulb dip in the first year in increasing number of flowers per plant in the subsequent year could be correlated to larger bulb size in these treatments. Misra *et al* (2000) while studying the effect of bulb size on growth and flowering, flowering behaviour of Tuberose reported that the larger sized bulbs produced the highest number of spikes per plant.

Longer duration of flowering (Table 7a) was recorded in cultivar 'Star Gazer White' (16.77 days) as compared to 'Star Gazer Pink' (15.89 days). Flowers lasted longer (17.98 days) on plants when PBZ 25 ppm was applied in the first season. Both the concentrations of PBZ and BA increased duration of flowering over control. Duration of flowering could again be correlated to the bulb size (Table1) in the respective treatments. Maximum duration of flowering (22.25 days) was recorded when PBZ 25 ppm was applied as bulb dip in the first year. Interaction data (Table 7b) also shows that maximum duration of flowering (24.1 days) was achieved in 'Star Gazer White' raised from the bulb which were treated in the first year with PBZ 25 ppm. In cultivar 'Star Gazer Pink' also same treatment resulted in maximum duration of flowering (20.4 days).

Treatment of bulbs with PBZ in the first season resulted in the development of bigger sized daughter bulbs and ultimately helped in production of more number of flowers, which flowered for longer duration in comparison to untreated bulbs. Roxas (1986), while working with *Lilium regale* concluded that quantitative and qualitative flower yield parameters are strongly influenced by bulb size. Lee and Yang (1997) have also found that larger bulbs flowered for longer durations and produced more number of flowers per plant.

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