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Effect of bulb sizes, growing substrates and paclobutrazol doses on potted Chincherinchee (*Ornithogalum thyrsoides* Jacq.)

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ABSTRACT

The experiment was carried out during 2010- 2011 to find out the suitable bulb size, growing substrate and paclobutrazol dose for desirable growth, flowering and display ability of potted chincherinchee (*Ornithogalum thyrsoides* Jacq.). The experimental treatments comprised of three sizes (>2.0-2.5, >2.5-3.0 and >3.0-3.5 cm) and five growing substrates and three doses of paclobutrazol (0, 10 and 20 ppm). In general, bulb sizes, growing substrates and paclobutrazol doses have exhibited significant effects on various growth, flowering and pot display ability attributes of chincherinchee. The highest values for most of the desirable parameters, *viz*., plant spread (23.39 cm), number of florets opening at a time (28.56), duration of flowering (39.11 days) and pot display ability score (80.44) were recorded in $S_3 \times M_3 \times P_2$ in rhododendron forest soil + FYM + vermicompost (2:1:1, v/v) and spraying of plants with 20 ppm paclobutrazol.

Key words: Bulb size, growing substrates, paclobutrazol, *Ornithogalum thyrsoides* Jacq.

INTRODUCTION

Chincherinchee (*Ornithogalum thyrsoides* Jacq. belongs to the family Hyacinthaceae and is native to South Africa. It is a tall stemmed species and has been used for cut flower production since the early 1900's (Littlejohn and Blomerus, 10). Besides cut flowers, it is also suitable for herbaceous borders, naturalizing wild gardens, rockery, pot culture, bouquets and flower arrangements as well. Scapes even if cut after complete drying on the plant, remained presentable for much longer duration and thus, can be used in dry decoration profitably. It is pertinent to note that cut flowers of chincherinchee last relatively for much longer duration than the vase-life of most of the other cut flowers. The size of bulbs plays an important role for obtaining good vegetative growth, producing quality flowers and bulb production in various ornamental bulbous plants including chincherinchee. Good quality bulbs of adequate size are the basic and most important inputs for flower production of all bulbous plants, as the initial growth of plants largely depends upon the quality and size of bulbs. Generally, the flowers and bulb yield per plant are found to be higher in large sized bulbs in comparison to the smaller bulbs. The growing substrates also have considerable effects on growth, flowering and grace of potted plants. The selection and composition of an appropriate growing medium is critical for the success of all production stages of chincherinchee. Besides, bulb sizes and growing substrates, growth retardants have been proved to be of immense importance in controlling plant height and improving flowering as well as pot grace attributes in many flowering potted plants including ornithogalum. Therefore, attempts were made to use different forest soils, which are easily available to the growers at the affordable expenses in combination of bulb size and paclobutrazol doses to produce good quality potted chincherinchee.

MATERIALS AND METHODS

The experiment was carried out at the Experimental Farm of Department of Floriculture and Landscaping, Dr Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan. The healthy, disease-free and adequately rested bulbs of *Ornithogalum thyrsoides* Jacq. were selected and graded size wise as s1 (>2.0-2.5 cm), s2 (>2.5-3.0 cm) and S_3 (>3.0-3.5 cm). The selected bulbs were planted gradewise in the pots of 20 cm size containing sterilized growing mediums M1 (sand + soil + FYM + vermicompost (1:1:1:1, v/v), M_2 (Rai Forest soil + FYM + vermicompost (2:1:1, v/v) 14th November. In each pot, three bulbs were planted. After planting, the pots were gently irrigated regularly to ensure sufficient and uniform moisture level in the growing substrate. A single application of different doses of paclobutrazol (@ 0, 10 and 20 ppm) was given on 21st February. In every pot, 150 ml solution of each concentration of PP^{333} was applied as per

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the treatment. Before application of paclobutrazol, all pots were irrigated thoroughly. To maintain the health of the plants, standard plant protection measures were adopted throughout the experimentation. In all, there were 45 treatment combinations each having 5 pots replicated thrice in a completely randomized design (CRD).

RESULTS AND DISCUSSION

The data in Table 1 indicated that largest bulbs (S_3) produced maximum number of leaves per plant (23.47) compared to the smallest ones (S_1), which recorded the minimum number of leaves per plant (12.12). This might be due to the greater initial vigour of bulbs or food reserves (carbohydrates, proteins, and water) in largest size bulbs. On contrary, the smaller bulbs contain limited food reserves and the growth of resulting plants is poor particularly in terms of number of leaves. The present results are also in conformity with earlier findings of Luria *et al.* (11) and Kaneythipe (7), who reported highest number of leaves in largest sized bulbs in *Ornithogalum dubium* and *O. arabicum*, respectively.

The maximum number of leaves per plant (20.43) were recorded when grown in the substrate consisting rhododendron forest soil + FYM + vermicompost (2:1:1, v/v), whereas minimum leaves per plant (15.16) were produced in growing medium comprising sand + soil + FYM + vermicompost (1:1:1:1, v/v). This growing medium might have supplied more nutrients in available forms especially nitrogen, which have contributed for better plant growth and production of more biomass. These findings are in consonance with earlier reports of (Powell and Bunt, 13) in alstroemeria, (Singh *et al.*, 17) in anthurium in gerbera.

The application of paclobutrazol could not influence the production of leaves per plant significantly. These findings got the support from the earlier reports (Sachs and Hackett, 14) who found that leaf initiation may not be inhibited, when regulators reduce sub-apical meristematic activity without concomitant disruption of apical meristematic function. Plants from the largest bulbs (S_3) attained more plant spread (20.46 cm) as compared to the smallest ones (Table 2). These results get the support from the findings in ornithogalum and in narcissus (Andrade *et al*., 1; Kaneythipe, 4).

The plant spread was found to be maximum (20.15 cm) in growing substrate consisting rhododendron forest soil + FYM + vermicompost (2:1:1, v/v) and minimum (17.30 cm) in Sand + Soil + FYM + vermicompost (1:1:1:1, v/v). The more availability in terms of nitrogen allows the plant to utilize other nutrients optimally leading to put up more vegetative growth and plant spread accordingly. These results got support from the work of on hydrangea, (Singh, 16) in geranium and (Singh *et al*., 17) in anthurium. As regards the effect of paclobutrazol doses, maximum plant spread (20.21 cm) was recorded with the application of 20 ppm paclobutrazol. However, minimum plant spread (17.37 cm) was obtained with no application of paclobutrazol. The interactive effects of bulb sizes × growing substrates × paclobutrazol doses recorded maximum plant spread (23.39 cm) in $S_3 \times M_3 \times P_2$ (Table 3), whereas, minimum plant spread (14.56 cm) was recorded in $S_1 \times M_1 \times P_0$. The more plant spread of the plants grown from larger size bulbs in rhododendron forest soil based substrate and sprayed with 20 ppm dose of paclobutrazol could be attributed to the better availability of photosynthates in larger size bulbs as well as better physico-chemical properties of rhododendron forest soil especially coupled with application of higher doses of paclobutrazol which incited the production of more laterals at expense of reduction in plant height, hence contributed for greater plant spread. These results are in conformity with the findings of

Table 1. Effect of bulb sizes, growing substrates and paclobutrazol doses on number of leaves per plant.

Growing medium	Bulb size (cm)											
	S_1 (>2.0-2.5)				S_2 (>2.5-3.0)				S_3 (>3.0-3.5)			
	P_0	P_1	P_2	Mean	P_0	P_1	P_2	Mean	P_0	P_1	P_2	Mean
M_1	11.40	11.92	11.63	11.65	15.07	15.40	14.96	15.15	19.77	18.47	17.81	18.69
M_2	11.63	12.11	12.07	11.94	17.59	15.15	15.00	15.91	21.37	21.00	21.66	21.34
M_3	14.25	15.07	14.37	14.56	22.00	21.92	21.63	21.85	24.74	25.03	24.85	24.87
M_4	11.89	11.26	11.44	11.53	18.70	18.29	18.77	18.59	27.74	27.88	28.26	27.96
M_5	11.37	10.70	10.78	10.95	14.81	14.44	14.18	14.48	25.03	24.07	24.40	24.50
Mean	12.11	12.21	12.06	12.12	17.63	17.04	16.91	17.19	23.73	23.29	23.40	23.47

$CD_{0.05}$: Bulb size (B) = 0.35, Growing substrate (M) = 0.45, Paclobutrazol (P) = 0.35, B × M = 0.77, M × P = 0.77, B × P = 0.61, B × M × P = 1.36.

Table 2. Effect of bulb sizes, growing substrates and paclobutrazol doses on plant spread in ornithogalum.

Growing medium	Bulb size											
	S_1 (>2.0-2.5 cm)				S_2 (>2.5-3.0 cm)				S_3 (>3.0-3.5 cm)			
	P_0	P_1	P_2	Mean	P_0	P_1	P_2	Mean	P_0	P_1	P_2	Mean
M_1	14.56	15.44	17.44	15.81	15.33	17.39	19.22	17.31	17.50	19.00	19.78	18.76
M_2	16.28	17.67	18.56	17.50	18.06	18.89	20.22	19.06	19.56	20.67	20.94	20.39
M_3	16.78	18.28	19.83	18.30	18.56	19.61	21.17	19.78	21.39	22.39	23.39	22.39
M_4	15.72	18.67	19.06	17.81	17.39	19.56	20.78	19.24	19.44	20.06	21.94	20.48
M_5	15.22	16.39	18.28	16.63	16.17	17.56	20.83	18.19	18.56	20.61	21.67	20.28
Mean	15.71	17.29	18.63	17.21	17.10	18.60	20.44	18.71	19.29	20.54	21.54	20.46

$CD_{0.05}$: Bulb size (B) = 0.14, Growing substrate (M) = 0.18, Paclobutrazol (P) = 0.14, B × M = 0.31, M × P = 0.31, B × P = 0.23, B × M × P = 0.54

Table 3. Effect of bulb sizes, growing substrates and paclobutrazol doses on duration of flowering (days) in ornithogalum.

Growing medium	Bulb size											
	S_1 (>2.0-2.5 cm)				S_2 (>2.5-3.0 cm)				S_3 (>3.0-3.5 cm)			
	P_0	P_1	P_2	Mean	P_0	P_1	P_2	Mean	P_0	P_1	P_2	Mean
M_1	23.33	25.89	29.78	26.33	26.00	30.22	33.00	29.74	28.11	30.89	34.78	31.26
M_2	26.00	27.78	30.56	28.11	27.78	30.00	31.89	29.89	30.00	31.89	34.00	31.96
M_3	27.56	31.11	34.78	31.15	30.89	32.78	36.89	33.52	33.22	35.78	39.11	36.04
M_4	26.67	28.89	31.89	29.15	28.78	31.00	33.11	30.96	31.00	32.56	34.89	32.81
M_5	24.00	27.33	31.00	27.44	26.89	31.00	33.78	30.56	29.67	32.11	35.89	32.56
Mean	25.51	28.20	31.60	28.44	28.07	31.00	33.73	30.93	30.40	32.64	35.73	32.93

$CD_{0.05}$: Bulb size (B) = 0.17, Growing substrate (M) = 0.22, Paclobutrazol (P) = 0.17, B × M = 0.37, M × P = 0.37, B × P = 0.27, B × M × P = 0.65

(Kariuki and Kako, 8) in ornithogalum. The maximum duration of flowering (32.93 days) was observed in the plants grown from largest size bulbs (S_3) and minimum (28.44 days) in the smallest ones (Table 4). This might be due to the reason that the larger sized bulbs improved various vegetative and flowering parameters that further led to the increase in duration of the flowering. Similar results were obtained in narcissus.

The maximum duration of flowering (33.57 days) was found in rhododendron forest soil + FYM + vermicompost (2:1:1, v/v), which may be due to the reason that his growing substrate might have provided congenial growing environment particularly in the root zone, besides supplying the requisite nutrients in available forms as well as engineered better physico-chemical and biological properties which have led to better growth and flowering of plants. Similar findings have been documented in geranium by Singh (16) and Latpate (9) in hydrangea. The spraying of paclobutrazol has increased flowering duration considerably and maximum duration of flowering (33.69 days) was recorded with the application of 20 ppm paclobutrazol. Our findings are in consonance with Andrade *et al.* (1) who have reported increase in the duration of flowering with the application of paclobutrazol in impatiens and in hibiscus and geranium. The plants grown from largest bulbs recorded maximum (24.84) number of florets opening at a time (Table 4). This could be due to the potentiality of bigger bulbs to produce more number of florets per spike and subsequently, majority of them remained open at a time. The plants grown in the rhododendron forest soil + FYM + vermicompost (2:1:1, v/v) recorded maximum number of florets remaining open at a time (24.47). This may be due to the fact that this growing medium could have provided congenial growing conditions required for the quality

The application of 20 ppm dose of paclobutrazol has recorded the highest number of florets remained open at a time (25.53), which may be due to the reason that paclobutrazol exhibited positive effect on the induction and opening of more number of florets per spike at a time. Similar results have been reported by Singh (16), and Latpate (9) in

Table 4. Effect of bulb sizes, growing substrates and paclobutrazol doses on number of florets open at a time per spike.

Growing medium	Bulb size											
	S_1 (>2.0-2.5 cm)				S_2 (>2.5- 3.0 cm)				S_3 (>3.0 -3.5 cm)			
	P_0	P_1	P_2	Mean	P_0	P_1	P_2	Mean	P_0	P_1	P_2	Mean
M_1	14.44	17.56	20.56	17.52	16.44	19.67	22.89	19.67	18.11	21.56	23.44	21.04
M_2	18.67	22.11	23.56	21.44	20.56	23.56	26.56	23.56	22.33	25.33	27.67	25.11
M_3	19.44	22.89	23.11	21.81	22.89	25.11	27.33	25.11	24.56	26.33	28.56	26.48
M_4	18.22	21.67	24.56	21.48	20.78	23.67	26.44	23.63	23.11	25.22	28.56	25.63
M_5	19.33	22.11	23.78	21.74	21.78	23.67	27.33	24.26	23.78	25.56	28.56	25.96
Mean	18.02	21.27	23.11	20.80	20.49	23.13	26.11	23.24	22.38	24.80	27.36	24.84

$CD_{0.05}$: Bulb size (B) = 0.14, Growing substrate (M) = 0.18, Paclobutrazol (P) = 0.14; B × M = 0.31, M × P = 0.31, B × P = 0.23, B × M × P = 0.54

case of geranium and hydrangea, respectively. The interaction of bulb size × growing substrate × paclobutrazol dose exhibited maximum number of florets opened at a time (28.56) shown maximum pot presentability score (73.26). However, minimum pot presentability score (69.48) was found in the smallest ones. The reduction in size of bulbs puts limitation on food reserves and naturally, the growth of resulting plants is poor. These results are in agreement with the findings of Chaudhary (3) who recorded more presentable spikes of *Ornithogalum* from largest bulbs.

The growing substrate comprising rhododendron forest soil + FYM + vermicompost (2:1:1, v/v) exhibited highest pot presentability score (75.46). However, minimum pot presentability score (61.11) was observed in M_1, *i.e*. sand + soil + FYM + vermicompost (1:1:1:1, v/v, which may be due to the fact that this medium failed to provide the better root zone environment needed for production of the better presentable potted chincherinchee. In hydrangea, similar results were obtained by Latpate (9) by using forest soils. The application of 20 ppm dose of paclobutrazol recorded maximum pot presentability score (73.29). This may be due to the fact that paclobutrazol at higher concentration enhanced the presentability attributes by producing dwarf and more compact plants with balanced growth and good quality flowering. These results got support from the work of (Singh, 16) in geranium and (Pathak, 12) in begonia and primula. From the results, it is concluded that largest size bulbs, *i.e*. >3.0-3.5 cm when grown in the growing substrate comprising of rhododendron forest soil + FYM + vermicompost (2:1:1, v/v) and sprayed with 20 ppm dose of paclobutrazol resulted in the production of most desirable and best presentable potted plants of chincherinchee.

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Growing medium	Bulb size											
	S_1 (>2.0-2.5 cm)				S_2 (Bulb size >2.5-3.0 cm)				S_3 (Bulb size >3.0-3.5 cm)			
	P_0	P_1	P_2	Mean	P_0	P_1	P_2	Mean	P_0	P_1	P_2	Mean
M_1	54.67	60.44	61.78	58.96	58.22	62.00	63.56	61.26	60.89	63.11	65.33	63.11
M_2	70.67	72.44	74.00	72.37	71.33	74.22	77.33	74.30	74.22	76.44	78.00	76.22
M_3	71.78	73.56	75.33	73.56	73.78	74.67	77.33	75.26	75.56	76.67	80.44	77.56
M_4	70.67	72.22	74.00	72.30	70.89	73.78	74.22	72.96	73.56	75.78	76.67	75.33
M_5	68.89	70.44	71.33	70.22	70.44	71.56	73.78	71.93	72.00	74.00	76.22	74.07
Mean	67.33	69.82	71.29	69.48	68.93	71.24	73.24	71.14	71.24	73.20	75.33	73.26

$CD_{0.05}$: Bulb size (B) = 0.25, Growing substrate (M) = 0.33, Paclobutrazol (P) = 0.25, B × M = 0.57, M × P = 0.57, B × P = 0.44, B × M × P = 0.99

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