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Effect of growing media, pinching and paclobutrazol on growth and flowering of *Barleria cristata* for suitability as pot plant

PRIYANKA THAKUR[1], VIKRAM NICHAL[2], S R DHIMAN[3] and Y C GUPTA[4]

Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh 173 230

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ABSTRACT

A study was conducted to see the effect of three growing media (soil from natural habitat, soil from natural habitat and FYM (2:1), v/v and soil, sand and FYM (2:1:1), three pinching treatments (No pinch, single pinch and double pinch) and paclobutrazol (0, 75, 150 ppm) on growth and flowering of seedlings as well as vegetatively propagated (rooted stem cuttings) of Phillipines violet or blue bell barleria (*Barleria cristata* L.). Plants raised through seeds and rooted cuttings differed significantly among themselves for various growth and flowering parameters. Plants raised under both methods of propagation showed optimum plant height (1.5 to 2.5 times to the height of the pot) when grown in soil from natural habitat and FYM with single and double pinching in absence of application of paclobutrazol for growing as pot plant. Seedlings recorded maximum number of secondary side shoots (20.58), leaves (177.42), flower clusters (16.17), flowers (23.58)/plant when grown in soil from natural habitat and FYM with double pinching and with the application of 75 ppm paclobutrazol and seed raised plants showed early visible bud formation and flowering when grown in all growing media without pinching and application of 75 ppm paclobutrazol. However, the cutting raised plants recorded maximum number, of secondary side shoots (16.00), leaves (171.67), flower clusters (17.83), flowers (24.42)/plant when grown in soil from natural habitat and FYM with double pinching and with the application of 75 ppm paclobutrazol. Seed raised plants showed better results in case of plant height, length of primary side shoots and plant spread than cutting raised plants while cutting raised plants recorded early visible bud formation and flowering and maximum number of flower clusters/plant than seed raised plants. Based on the findings of present investigations, seed raised *Barleria cristata*. plants grown in pots containing soil from natural habitat added with FYM (2:1, v/v), double pinching and application of 75 ppm paclobutrazol is recommended for better growth and flowering.

Key words: Barleria, FYM, Growing media, Paclobutrazol, Pinching

Barleria is a diverse and highly cherished genus of flowering shrubs belonging to family Acanthaceae. The genus comprises of about 230 species of under-shrubs or shrubs and many xerophytes, dispersed in tropical and sub-tropical regions of the world, mostly in Africa (Jayanthi 2006). It is also found growing in Myanmar, East Asia and Philippines. There are about 21 species *of Barleria* native to India, widely distributed in lower hills of West Bengal, south and west Deccan plateau, Konkan, Malabar, Nilgiris, Western Ghats, and North-West Himalayan region. *Barleria cristata* L. commonly known as Phillipines violet or blue bell barleria and its vernacular names are Jhate or Bansa or spatika or mullu jaji or gorate. In western Himalaya, it grows profusely between altitudal range of 600-2000 m amsl and flowers during August-October. Its flowering brightens up the landscape during rainy season. It can be used as a hedge, in shrubbery borders, as pot plant as well as in foundation plantings in hilly slopes (Thakur *et al.* 2009).

The plants bloom almost throughout the year under South-Indian conditions. Though the flowers are not having any fragrance or aroma, it is very popular because of attractive range of beautiful colours. Its flowers are mostly dominated by violet colour including numerous shades and hues of blue, pink, purple, mauve, lilac and white. Flowers are borne on spiny, hairy calyx, which are persistent even after the flowering is over. The seed capsules are found hidden among the dried calyx with 2-4 black coloured seeds, which are hairy and compressed. When the seeds reach maturity stage, the capsule split open and seeds are thrown out like fire crackers in the sunlight (by spring action mechanism of the pods). *Barleria* can be cultivated in almost all types of soil, except waterlogged soils; hence well drained soil with pH of 6-7 is better. It requires tropical and sub-tropical climate and prefers sunny situation for its

[1] Floriculturist (e mail: priyanka.thakur@gmail.com), Regional Horticultural Research and Training Station, Dhaulakuan, District Sirmour, Himachal Pradesh; [2] M Sc Student, [3] Senior Floriculturist (e mail: sitaramdhiman@gmail.com), [4] Professor and Head (e mail: ycgupta2006@yahoo.co.in), Department of Floriculture and Landscape Architecture

proper growth. It requires full sun light but can flower fairly well in semi-shady conditions.

MATERIALS AND METHODS

The present studies were conducted on *Barleria cristata* plants raised through seeds and rooted terminal shoot cuttings. Seeds were sown by using standard nursery techniques during 2nd week of April 2009. Plants which attained 4-leaf stage, were ready for transplanting after one month. For rooted terminal shoot cuttings, straight terminal shoots (8-10 cm in length) were taken as explants from healthy and vigorous plants growing naturally from Nauni (Solan, Himachal Pradesh) during 3rd week of April 2009. Shoot cutting were subjected for rooting under intermittent mist until rooting (Thakur *et al.* 2009). Plants raised through seeds and rooted cuttings of *Barleria cristata* were transplanted in pots (10 cm diameter) containing three different well prepared growing media on 31 May 2009 (Table 1). Vermicompost slurry @ 100 ml/ pot were applied after one month of planting followed by foliar spray of 19:19:19 NPK @ 200 ppm at an interval of 8-10 days started after two months of planting. Repotting in 15 cm pots was done after three months of planting for facilitating more growing space.

Single pinching was done by removing the terminal shoot at 4-5 node stage in order to produce uniform side shoots after 25-30 days of planting. While in double pinching, pinching was done in all the shoots at 3-4 node stage in order to produce maximum side shoots after 20-25 days of single pinching. The plants in pots were sprayed with the solution of paclobutrazol of different concentrations after double pinching (after 55-60 days of transplanting). All treatments were replicated thrice, with 4 plants/ treatment. The data were subjected to statistical analysis employing a completely randomized design (factorial) (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

Results showed significant effect on vegetative and flowering characteristics of seed and cutting raised *Barleria cristata* plants. Among different growing media used, medium having 2:1 (v/v) ratio of soil from natural habitat and well rotten farmyard manure (FYM) proved best for

Table 1 Physico-chemical properties of growing media

	Growing media	pH	Electrical conductivity (dS/m)	Organic carbon (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
Before planting	Soil from natural habitat (M_1)	7.50	0.565	0.885	306.88	114.24	95.42
	Soil from natural habitat + FYM (M_2)	7.20	0.955	1.635	566.72	141.12	193.31
	Soil + Sand + FYM (M_3)	7.37	0.814	1.290	528.64	127.68	165.09
After planting	Soil from natural habitat (M_1)	8.28	0.339	0.983	268.80	82.88	83.10
	Soil from natural habitat + FYM (M_2)	8.22	0.441	1.748	515.20	109.76	148.51
	Soil + Sand + FYM (M_3)	8.26	0.325	1.418	470.40	91.84	122.30

Table 2 Effect of growing media, pinching and paclobutrazol on vegetative growth of seed raised *Barleria cristata* in pots

Plant growth characteristics	Plant height (cm)	No. of primary side shoots/ plant	No. of secondary side shoots/ plant	Length of primary side shoots (cm)	Plant spread (cm)	Number of leaves
Growing media						
Soil from natural habitat (M_1)	26.57	9.42	6.01	10.85	18.84	105.31
Soil from natural habitat + FYM (M_2)	29.37	10.41	8.73	11.82	20.70	144.20
Soil + Sand + FYM (M_3)	24.82	9.01	5.75	10.26	17.75	109.73
Pinching						
No pinch (P_1)	35.56	14.85	0.00	10.32	13.99	93.06
Single pinch (P_2)	23.88	7.17	6.75	13.06	19.78	126.12
Double pinch (P_3)	21.32	6.82	13.73	9.56	23.52	140.06
Paclobutrazol						
0 ppm (G_1)	31.67	8.91	5.97	13.03	21.38	112.95
75 ppm (G_2)	26.61	10.44	7.69	10.89	18.97	126.70
150 ppm (G_3)	22.48	9.49	6.90	9.02	16.93	119.58
CD (P=0.05) for						
Growing media (M)	0.72	0.17	0.18	0.20	0.52	0.51
Pinching(P)	0.72	0.17	0.18	0.20	0.52	0.51
Paclobutrazol (G)	0.72	0.17	0.18	0.20	0.52	0.51

Table 3 Effect of growing media, pinching and paclobutrazol on flowering characteristics of seed raised *Barleria cristata* in pots

Plant growth characteristics	Number of days taken for visible bud formation	Number of days taken for flowering	Number of flower clusters/plant	Number of opened flowers/plant	Duration of flowering (days)
Growing media					
Soil from natural habitat (M_1)	106.29	111.37	9.23	16.02	20.20
Soil from natural habitat +FYM (M_2)	106.17	111.58	11.12	18.68	21.70
Soil +Sand +FYM (M_3)	106.71	111.68	9.00	15.38	19.08
Pinching					
No pinch (P_1)	102.26	107.37	7.72	14.42	17.63
Single pinch (P_2)	106.34	111.72	9.25	16.68	20.33
Double pinch(P_3)	110.57	115.54	12.37	18.97	23.02
Paclobutrazol					
0 ppm (G_1)	109.17	114.65	7.67	14.28	19.28
75 ppm (G_2)	102.51	107.49	11.91	19.03	21.32
150 ppm (G_3)	107.50	112.49	9.76	16.77	20.38
CD (P=0.05) for					
Growing media(M)	0.37	0.22	0.22	0.22	0.56
Pinching (P)	0.37	0.22	0.22	0.22	0.56
Paclobutrazol (G)	0.37	0.22	0.22	0.22	0.56

most of the growth and flowering parameters studied. As far as vegetative growth and flowering are concerned, different parameters like; plant height, number of primary and secondary side shoots, length of primary side shoots, plant spread, number of leaves, days taken for visible bud formation and flowering, number of flower clusters and opened flowers and duration of flowering were best in this medium. Maximum support for achieving better growth and flowering of *Barleria cristata* in pots containing soil from natural habitat and farmyard manure (2:1, v/v) may be due to the fact that this medium among all had maximum nitrogen, phosphorus, potassium and organic carbon. The optimum pH (7.2) value and electrical conductivity might further have helped in better uptake of nutrients from the soil. Further, this medium had maximum organic matter which may also have helped in proper root development and absorption of nutrients. Comparatively poor health of the plants (vegetative growth parameters) in other growing media like; soil from natural habitat and soil+ sand+ FYM might have led to the poor performance of *Barleria cristata* with respect to flowering characters.

As the primary side shoots arise from the axils of the leaves on the main stem, these were reduced significantly in pinched plants due to decapitation of the apical portion of

Table 4 Effect of growing media, pinching and paclobutrazol on vegetative growth of cutting raised *Barleria cristata* in pots

Plant growth characteristics	Plant height (cm)	No. of primary side shoots/ plant	No. of secondary side shoots/ plant	Length of primary side shoots (cm)	Plant spread (cm)	Number of leaves
Growing media						
Soil from natural habitat (M_1)	19.01	6.23	2.94	7.84	14.55	70.32
Soil from natural habitat +FYM (M_2)	23.93	8.77	7.49	10.78	18.51	140.96
Soil +Sand +FYM (M_3)	22.06	8.00	6.46	9.63	17.08	128.57
Pinching						
No pinch (P_1)	26.45	11.63	0.00	8.91	12.57	103.74
Single pinch (P_2)	19.96	5.83	5.56	10.92	17.43	109.00
Double pinch(P_3)	18.59	5.53	11.33	8.42	20.13	127.11
Paclobutrazol						
0 ppm (G_1)	24.73	6.52	4.76	11.31	18.34	105.19
75 ppm (G_2)	20.90	8.69	6.48	9.34	16.72	123.12
150 ppm (G_3)	19.37	7.78	5.56	7.60	15.07	111.54
CD (P=0.05) for						
Growing media (M)	0.95	0.21	0.16	0.20	0.24	0.64
Pinching (P)	0.95	0.21	0.16	0.20	0.24	0.64
Paclobutrazol (G)	0.95	0.21	0.16	0.20	0.24	0.64

Table 5 Effect of growing media, pinching and paclobutrazol on flowering of cutting raised *Barleria cristata* in pot

Plant growth characteristics	Number of days taken for visible bud formation	Number of days taken for flowering	Number of flower clusters/ plant	Number of opened flowers/ plant	Duration of flowering (days)
Growing media					
Soil from natural habitat (M_1)	94.05	99.18	8.38	11.16	17.54
Soil from natural habitat + FYM (M_2)	93.94	98.94	13.54	18.16	22.61
Soil + Sand + FYM (M_3)	93.89	98.87	12.91	16.14	20.93
Pinching					
No pinch (P_1)	89.42	94.52	9.96	11.91	17.64
Single pinch (P_2)	94.34	99.36	12.00	15.95	20.41
Double pinch (P_3)	98.11	103.11	12.86	17.59	23.03
Paclobutrazol					
0 ppm (G_1)	96.84	101.94	9.20	12.94	19.01
75 ppm (G_2)	90.64	95.55	13.62	17.44	21.95
150 ppm (G_3)	94.39	99.51	12.00	15.08	20.12
CD (P=0.05) for					
Growing media (M)	NS	NS	0.26	0.26	0.23
Pinching (P)	0.35	0.35	0.26	0.26	0.23
Paclobutrazol (G)	0.35	0.35	0.26	0.26	0.23

the plant. The formation of secondary side shoots was observed only in case of pinched plants which may probably be because of apical dominance in case of pinched plants. The primary side shoots in both type of plants were maximum when they were single pinched. This may be because of the fact that due to apical dominance, growth of side shoots in unpinched plants was reduced, whereas in case of double pinched plants, growth was reduced due to second pinching of the side shoots. As there was more number of side shoots in unpinched plants, number of leaves were maximum in double pinched plants which were darker green in colour as compared to other plants. *Barleria cristata.* with pinching coupled with paclobutrazol treatment reduced the plant height and increased the number of side shoots per plant (Abou-Dahab and Habib 2005).

Flowering was delayed significantly due to pinching in both type of plants in the present investigation and the effect of pinching was more pronounced in case of double pinching. Pinching resulted in the increase of number of flower clusters and flowers/plant over the unpinched plants significantly as there was more number of primary and secondary side shoots in these plants. The pots of 'good' to 'very good' presentability grade were obtained only with double pinching treatment in both type of plants which also showed maximum duration of flowering.

Pinched plants were significantly shorter than the non-pinched ones and the effect was more pronounced in case of double pinching. This might be due to the fact that apical dominance was broken due to pinching which led to increase the spread of the plant in both the experiments. Smaller height of pinched plants of *Nerium oleander* L. has also been reported by Banon *et al.* (2001).

The present studies indicated that the use of 75 ppm paclobutrazol as a spray after second pinching (approximately 55-60 days of transplanting) improved various growth and flowering parameters of *Barleria cristata* L. plants such as; plant height, number of primary and secondary side shoots, length of primary side shoots, plant spread, number of leaves, days taken for visible bud formation and flowering, number of flower clusters and opened flowers and duration of flowering. In case *of Barleria cristata*, application of 100 mg/1 of Bonzi (paclobutrazol)

Table 6 Comparative performance of seed and cutting raised plants of *Barleria cristata* in pots using student's t-test

Parameters	Seed	Cutting	t-value
Plant height (cm)	26.97 (1.50)	21.67 (0.94)	3.0*
Number of primary side shoots	9.61 (0.75)	7.66 (0.65)	1.96
Number of secondary side shoots	6.30 (1.06)	6.06 (1.17)	0.15
Length of primary side shoots (cm)	10.98 (0.47)	9.42 (0.44)	2.42*
Plant spread (cm)	19.09 (0.90)	16.71 (0.75)	2.03*
Number of leaves/plant	119.97 (5.41)	113.07 (6.56)	0.81
Number of days taken for visible bud formation	102.67 (3.6)	93.98 (0.86)	2.35*
Number of days for flowering	111.54 (0.89)	99.60 (0.87)	10.06*
Number of flower clusters/plant	9.93 (0.59)	11.46 (0.63)	2.15*
Number of flowers/plant	16.51 (0.76)	17.13 (1.17)	1.46
Duration of flowering (days)	20.33 (0.52)	20.43 (0.64)	0.12
Flower size (cm)	2.44 (0.13)	2.42 (0.13)	0.11

* Significant at 5% level of significance. Figures within parenthesis are standard error values within the means.

was reported to produce more compact plants with darker foliage (Henny *et al*. 1994).

The application of growth retardants on pot plants improved the quality of pot plants in general by improving colour of the foliage, reducing plant height, plant spread and making the plants in balance with the pot. However, to achieve the most desired results, suitable growth retardant and its optimum concentration plays vital role which varies from plant to plant (Cathey and Heggestad 1972, McConnell and Struckmeyer 1971,Henny *et al.* 1995).

The seed and cutting raised plants of *Barleria cristata* were compared by using student's t-test. The seed raised plants differed significantly to cutting raised plants with respect to plant height, length of primary shoots, plant spread, number of days taken for visible bud formation and flowering and number of flower clusters/plant. Plant height of seed raised plants of *Barleria cristata* was more (26.97 cm) as compared to cutting raised plants (21.67 cm). Similarly, length of primary side shoots was also found to be more (10.98 cm) in seed raised plants as compared to plants raised through cuttings (9.42 cm). Also, plant spread (19.09 cm^2) was more in case of seed raised plants as compared to cutting raised plants (16.71 cm^2). However, early visible bud formation (93.98 days) was observed in cutting raised plants as compared to seed raised plants (102.67 days). Also, early flowering (99.60 days) was recorded in cutting raised plants as compared to seed raised plants (111.54 days). Further, cutting raised plants of *Barleria cristata* recorded more number of flower clusters/plant (11.46) compared to seed raised plants (9.93).

Other parameters like; number of primary and secondary side shoots, leaves, flowers/plant, duration of flowering and flower size was found to be non-significant.

It is concluded that seed raised plants of *Barleria cristata* when grown in pots containing soil from natural habitat and FYM (2:1, v/v) with the application of double pinching and 75 ppm paclobutrazol treatments as individual or in combination were found to be effective for all the vegetative and flowering parameters in most presentable forms as pot plants.

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