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Studies on the performance of *Barleria* (*Barleria cristata* L.) genotypes for growth and yield parameters under north Karnataka condition

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Abstract
An investigation with respect to studies on the performance of *Barleria* (*Barleria cristata* L.) genotypes for growth and yield parameters under North Karnataka condition was carried out during 2020-21 at the Department of Floriculture and Landscape Architecture, College of Horticulture, UHS, Bagalkot. The experiment was laid out in Randomized Complete Block Design (RCBD) with eleven treatments and three replications at 60 X 60 cm spacing under open field condition. Wide variation was observed among the genotypes for all morphological and yield traits. Among the eleven genotypes at 120 DAT, the genotype COHS-1 showed maximum plant height (72.27cm) and number of primary (9.23) and secondary branches (16.87), plant spread E-W (51.80 cm) was maximum in COHS-2, plant spread N-S was found to be maximum in COHS-4 (52.93 cm), number of leaves/plant (89.27) and chlorophyll content was maximum in COHS-2. Whereas, the genotype COHS-10 showed superior performance with respect to stem girth (13.12 mm). The leaf length (9.40 cm), leaf width (4.26 cm) and leaf area (22.84 cm$^{2)}$ was found to be maximum in the genotype COHS-12. The genotype COHS-1 showed maximum 100 flower weight (6.01g), flower yield per plant (25.53 g), flower yield per plot (306.34 g) and flower yield per hactare (709.17 kg). Among the genotypes evaluated COHS-1, COHS-4 and COHS-10 were found suitable to grow under North Karnataka condition based on growth and yield attributes.

Keywords: *Barleria***,** genotypes, morphological, *Barleria cristata* L.

1. Introduction
Government of India has identified floriculture as a sunrise industry and accorded it 100 per cent export oriented status. Owing to the steady increase in demand for flowers, floriculture has become one of the important commercial components in Agriculture. Floriculture products mainly consist of cut flowers, pot plants, cut foliage, seeds, bulbs, tubers, rooted cuttings and dried flowers or leaves. Wherein Kerala, Tamil Nadu and Madya Pradesh are the leading flowers producing states with respect to area in the country. Tamil Nadu, Madya Pradesh and Andra Pradesh are the leading states in loose flower production. Wherein, Uttar Pradesh, Assam and Karnataka bagged top three positions in cut flower production. (Anonymous, 2021) [1]. Cronquist (1981) [6] classified the Acanthaceae family comprising of 250 genera and 2500 species. Among which *Barleria* is the third biggest genus, with around 250 species, some of which have medicinal and aesthetic value (Bremekamp,1965) [4]. *Barleria*, known as the Philippines violet, is a member of the Acanthaceae family with a chromosome number of 2n=40, originated in India. The genus *Barleria* was named after Jacques Barrelier (1606-1673), a French Dominican friar who was a physician, botanist, plant collector and author. The name *Barleria cristata* derives from the Latin word cristatus, which means crested. Because it blooms in December, it is also known as Blue ball *Barleria*, Philippines blue or December flower. However, in North India, it flowers for a few weeks in the early cold months. The twigs are four-sided and the leaves are evenly spaced. The flower's limb is five lobed and stretched out, with one lobe almost spherical and the other four obliquely oval. *Barleria cristata* L. is a commonly cultivated ornamental plant that has recently gained appeal in South China, South East Asia and India's subtropical and tropical regions. It is also considered a possible environmental weed in wastelands and near highways. This plant is found all over India as hedges around farms and gardens (Choudhary, 2014) [5]. It is a compact shrub with erect and abundant species that can reach a height of 1.2m. These are perennial plants that require a temperature of 69.8°F in the summer and 50-59°F in the winter, as well as a sandy loamy soil.

This shrub is simple to cultivate and can be used as a garden hedge or closely cut into geometric patterns. The bitter juice of the leaves or roots is used as a diaphoretic and expectorant, and an infusion of the roots and leaves is used to boils and ulcers to reduce swelling. Through this research endeavour, we can select and promote improved genotypes that are appropriate for North Karnataka conditions and benefit the grower from the crop.

2. Material and methods

The experiment was conducted at the Department of Floriculture and Landscape Architecture, College of Horticulture, University of Horticultural Sciences, Bagalkot during 2020-2021 to evaluate the performance of 11 genotypes with three replications in Randomized Complete Block Design (RCBD) at spacing of 60 x 60 cm. Agronomical methods were followed to produce a healthy crop. The plot size of 2.4 x 1.8 m requisite dimension was prepared as per the plan. A gap of 0.5m between replications was provided for laying out the irrigation channels and working space. Nitrogen, phosphorous and potassium (100:60:60 kg NPK/ha, FYM- 25 t/ha) were applied in the form of urea, diammonium phosphate and muriate of potash, respectively. From each experimental plot, five plants were randomly selected and tagged for recording observations on growth and yield parameters for an experimental period of 5 months. Observations on growth parameters like plant height, number of primary and secondary branches per plant, number of leaves per plant, leaf length, leaf width, leaf area, stem girth, plant spread and chlorophyll content (Using SPAD Unit) were taken at 60 and 120 days after transplanting (DAT) and yield parameters such as 100 flower weight, flower yield per plant, flower yield per plot and flower yield per hactare were recorded. The 11 genotypes were collected from the Department of Floriculture and Landscape Architecture, College of Horticulture, Sirsi (COHS) Karnataka.

Treatment details

T_1: COHS-1	T_7:COHS-10
T_2: COHS-2	T_8: COHS-12
T_3:COHS-3	T_9:COHS-13
T_4: COHS-4	T_{10}:COHS-14
T_5:COHS-6	T_{11}: COHS-8
T_6:COHS-9	(COHS – College of Horticulture, Sirsi)

3. Results and Discussion

The results obtained from the present investigation are summarized in Table 1, 2 and 3.

Growth parameters

At 60 DAT the genotype COHS-1 significantly recorded maximum plant height (43.67 cm) which was on par with COHS-4 (43.33 cm) and COHS-2 (39.39 cm). Significantly minimum plant height was recorded in COHS-13 (18.93 cm). Among the genotypes evaluated at 120 DAT, COHS-1 was the highest with a plant height of 72.27 cm, followed by COHS-4 (71.53 cm) and COHS-2 (65.66 cm). The genotype COHS-13 showed a least plant height of 29.20 cm. The variation in plant height reported among genotypes at different stages of plant growth could be attributed to the genotype's genetic make-up and the climatic influences that existed during the experimental period. Similar variation was reported by Bhosle *et al.* (2015) [3] in crossandra.

At 60 DAT, plant spread (E-W) was much greater in COHS-2 (40.80 cm) and it was comparable to COHS-1 (37.84 cm). The genotype COHS-13 has the smallest plant spread (23.60 cm). At 120 days after transplanting, the plant spread (E-W) direction was notably maximal in genotype COHS-2 (51.80 cm) which was on par to COHS-4 (48.20 cm) and COHS-1 (44.99 cm). The minimum plant spread was observed in COHS-13 (28.87 cm). The plant spread (N-S) at 60 days after transplanting was notably maximum in COHS-4 (43.20 cm) which was comparable to COHS-1 (40.35 cm) and COHS-10 (39.93 cm). The genotype COHS-13 had the least amount of plant spread (20.33 cm). The plant spread N-S at 120 days recorded in the range from 26.47 to 52.93 cm. The genotype COHS-4 (52.93 cm) had a maximum plant spread followed by COHS-2 (49.61 cm). The minimum plant spread was observed in COHS-13 (26.47 cm). Differences in plant distribution could be due to genotypes' individual qualities as a result of genetic variation and adoptability. Similar findings were reported by Bhosle *et al*. (2015) [3] in crossandra.

COHS-1 (4.43) had the most number of primary branches at 60 days after transplanting, which was identical to COHS-4 (4.13), COHS-2 (4.11), and COHS-10 (4.07). COHS-13 had the lowest number of primary branches with 3.47. Whereas, genotype COHS-1 (9.23) had the most number of primary branches per plant at 120 DAT, trailed by COHS-4 (9.07), COHS-2 (8.93), COHS-10 (8.87) and COHS-9 (8.60). The genotype COHS-13 had the lowest number of primary branches per plant (6.57). At 60 DAT the genotype COHS-1 showed a considerable increase in the number of secondary branches that is 12.60, which was comparable to COHS-4 (11.61), COHS-2 (11.59) and COHS-10 (11.33). The genotype COHS-13 (3.87) had the lowest number of secondary branches. The genotype COHS-1 has the most number of branches at 120 DAT (16.87), followed by COHS-2 (16.27), COHS-4 (16.27), COHS-10 (16.07) and COHS-9 (15.87). The genotype COHS-13 has the least number of secondary branches per plant branches (6.50). The genetic traits of a particular genotype, as well as its interaction with the environment in which it develops, affects the branch growth. An increase in the number of branches leads to increase in photosynthetic activity, which leads to a rise in the amount of leaves. Aswath (2007) [2] and Swaroop (2008) [18] also reported similar findings in crossandra and chrysanthemum respectively.

The number of leaves was significantly higher in genotype COHS-2 (51.74) than in COHS-4 (49.66). The genotype COHS-13 (34.08) has the least number of leaves in average. At 120 days COHS-2 (89.27) had the maximum leaves, followed by COHS-4 (86.89), COHS-1 (82.21), and COHS-10 (81.92). The genotype COHS-13 was identified to have the minimum leaves per plant (73.71). The increased plant height and number of shoots resulted in the production of more leaves in these cultivars. A similar type of discovery was also made in China aster (Poornima *et al*., 2006) [11].

Stem girth at 60 days after transplanting varied from 6.09 to 11.14 mm. The genotype COHS-10 showed superior performance with respect to stem girth (11.14 mm), preceded by COHS-4 (10.92 mm) and COHS-1 (10.29 mm). However, minimum stem girth was recorded in COHS-13 (6.09 mm). Stem girth at 120 days after transplanting fluctuated from 7.37 to 13.12 mm. The genotype COHS-10 outperformed COHS-1 and COHS-4 with a maximum stem girth of 13.12 mm, followed by 12.94 and 11.69 mm. Whereas, COHS-13 recorded minimum stem girth of 7.37 mm. This could be attributed to the genetic makeup of vegetative parameters and environmental conditions. This finding is in agreement with Priyanka *et al*. (2015) [13] in crossandra and Manoj *et al*. (2018) [9] in marigold.

There was a considerable difference in leaf length between genotypes. The genotype COHS-12 (7.89 cm) had the longest leaf length, followed by COHS-2 (7.51 cm). The genotype COHS-8 had the shortest leaf length (3.62 cm) at 60 DAT. At 120 DAT, the genotype COHS-12 grew faster, with a leaf length of 9.40 cm, followed by COHS-2 (8.87 cm). The genotype COHS-8 had the shortest leaf length of 4.68 cm. In case of leaf width, the genotype COHS-12 had the greatest leaf width (3.99 cm) at 60 days after transplanting, which was equivalent to COHS-2 (3.84 cm). In genotype COHS-13, the smallest leaf width was measured (1.70 cm). The genotype COHS-12 (4.26 cm) had the highest width at 120 days after transplanting, followed by COHS-2 (4.00 cm). The genotype COHS-13 had the narrowest leaf width (2.47 cm). Whereas, leaf area was found to be maximum in genotype COHS-12 (17.94 cm^2) (22.84 cm^2), which was on par with COHS-2 (16.42 cm^2) (20.25 cm^2) at 60 and 120 DAT. The minimum leaf area was recorded in genotype COHS-13 (3.69 cm^2) at 60 DAT and the genotype COHS-9 recorded a minimum leaf area of 5.72 cm^2 at 120 DAT. This variation in the leaf might be due to variation in agro climatic condition along with genetic factor. There were several reports conflicting to this parameter which was observed by Verma *et al*. (2004) [19] and Nagashree and Kulkarni (2019) [10] in marigold.

The genotype COHS-2 showed a maximum chlorophyll content of 85.19 SPAD unit which was comparable with COHS-1 (80.06 SPAD unit). On the other hand the genotype COHS-6 had a minimum chlorophyll content of 43.51 SPAD unit at 60 DAT. At 120 days after transplanting there was a significant increase in chlorophyll content in COHS-2 (95.13 SPAD unit) followed by COHS-1 (88.83 SPAD unit). Chlorophyll content was minimum in genotype COHS-6 (52.84 SPAD unit). Variation in the chlorophyll content among the genotypes was due to genetic constituents of the genotypes. Minimum chlorophyll content was observed in the genotype COHS-6. Similar variations with respect to chlorophyll content among the genotypes was also previously reported by Kulkarni (2003) [8] in chrysanthemum.

4. Yield parameters

Statistics on yield parameters such as 100 flower weight, flower yield per plant, flower yield per plot, and flower yield per hectare in different *Barleria* genotypes are depicted below.

The weight of 100 flowers varied greatly between *Barleria* genotypes, ranging from 4.36 to 6.01g. The genotype COHS-1 achieved a maximum blossom weight of 6.01g. COHS-4 (5.86 g) was the next genotype in the list for having higher 100 flower weight, which was on par by COHS-10 (5.82 g). The genotype COHS-13 had the smallest 100 flower weight (4.36 g). The variation in weight of hundred flowers is due to length of flower and width of flower and of different genotype. Similar findings also reported by Ramchandrudu and Thangam (2010) in crossandra, Radhakrishna (2012) [14] in single and double type tuberose.

Flower yield per plant differed substantially between genotypes, ranging from 18.06 to 25.53 g. The genotype COHS-1 had the highest flower yield per plant (25.53 g), followed by COHS-4 (25.08 g), and COHS-10 (24.76 g). COHS-13 recorded the lowest bloom production per plant (18.06 g). Variation in yield among genotypes could be related to genetic differences as well as environmental factors. Similar variation in flower yield per plant was reported by Singh *et al*. (1997) [16] and Poornima *et al*. (2006) [11] in China aster. The data showed that the yield varied greatly from 216.69 to 306.34 g depending on the genotype. COHS-1 (306.34 g) had a considerably greater floral production per plot compared to COHS-4 (301.00 g) and COHS-10 (297.15 g). The genotype COHS-13 achieved a significant minimum floral output of (216.69 g) per plot. Variation in yield among genotypes could be attributed to both genetic and environmental variables. Similar variations in crossandra were discovered by Ramachandrudu and Thangam (2010) Renu Gulia *et al*. (2017) [7] and Preeti *et al*. (2019) in marigold. Flower yield per hectare varied greatly amongst *Barleria* genotypes, ranging from 501.58 to 709.17 kg. COHS-1 had the highest flower yield per hectare (709.17 kg), followed by COHS-4 (696.76 kg) and COHS-10 (687.88 kg). COHS-13 yielded the least amount of flowers per hectare (501.58 kg). This is due to a combination of genotypic and physiological factors. Ramachandrudu and Thangam identified similar changes in crossandra (2010) Singh and Misra (2008) [17], Shivakumar *et al*. (2015) [15] in marigold.

Table 1: Growth parameters of *Barleria* genotypes at different growth stages

Genotypes	Plant height (cm)		Plant spread E-W (cm)		Plant spread N-S (cm)		Primary branches		Secondary branches		Number of leaves per plant		Stem girth (mm)	
	60 DAT	120 DAT	60 DAT	120 DAT	60 DAT	120 DAT	60 DAT	120 DAT	60 DAT	120 DAT	60 DAT	120 DAT	60 DAT	120 DAT
COHS-1	43.67	72.27	37.84	44.99	40.35	42.40	4.43	9.23	12.60	16.87	46.48	82.21	10.29	12.94
COHS-2	39.39	65.66	40.80	51.80	31.20	49.61	4.11	8.93	11.59	16.27	51.74	89.27	7.58	10.77
COHS-3	25.67	49.13	24.93	35.47	23.33	30.60	3.93	8.07	7.40	14.40	42.28	76.78	7.11	8.42
COHS-4	43.33	71.53	36.67	48.20	43.20	52.93	4.13	9.07	11.61	16.27	49.66	86.89	10.92	11.69
COHS-6	25.27	39.07	24.20	30.00	25.60	36.73	3.87	7.73	6.93	11.93	34.30	75.00	7.16	9.07
COHS-9	29.40	51.60	26.40	39.73	29.07	41.87	4.00	8.60	9.52	15.87	43.79	78.61	7.43	9.90
COHS-10	29.67	56.20	31.40	42.07	39.93	46.91	4.07	8.87	11.33	16.07	45.60	81.92	11.14	13.12
COHS-12	25.60	45.33	25.80	39.33	26.93	39.80	3.93	8.00	7.36	14.00	42.67	76.81	7.26	9.61
COHS-13	18.93	29.20	23.60	28.87	20.33	26.47	3.47	6.57	3.87	6.50	34.08	73.71	6.09	7.37
COHS-14	24.60	30.27	24.93	33.40	24.33	34.67	3.86	6.70	8.47	11.67	37.03	75.60	6.89	8.32
COHS-8	28.67	49.27	29.53	40.00	27.07	41.00	3.94	8.47	8.47	15.80	44.57	80.34	7.37	9.78
S.E(m) ±	1.58	3.24	1.39	2.49	1.31	1.92	0.14	0.48	0.57	0.84	1.77	2.98	0.32	0.49
C.D at 5%	4.66	9.58	4.11	7.35	3.87	5.67	0.42	1.41	1.70	2.49	5.22	8.79	0.95	1.46

DAT-Days after Transplanting COHS- College of Horticulture, Sirsi

Table 2: Growth parameters and chlorophyll content of *Barleria* genotypes at different growth stage

Genotypes	Leaf length (cm)	Leaf width (cm)	Leaf area (cm²)	Leaf length (cm)	Leaf width (cm)	Leaf area (cm²)	Chlorophyll content of leaf (SPAD unit)	
	60 DAT			120 DAT			60 DAT	120 DAT
COHS-1	4.29	2.94	7.19	5.13	3.30	9.66	80.06	88.83
COHS-2	7.51	3.84	16.42	8.87	4.00	20.25	85.19	95.13
COHS-3	3.84	1.75	3.83	4.75	2.01	5.42	48.63	58.13
COHS-4	4.18	2.62	6.29	5.65	3.33	10.74	79.71	87.46
COHS-6	4.79	2.58	7.03	5.68	3.20	10.37	43.51	52.84
COHS-9	3.91	1.75	3.90	4.67	2.15	5.72	52.41	62.04
COHS-10	4.99	2.77	7.86	5.39	2.99	9.17	56.81	65.31
COHS-12	7.89	3.99	17.94	9.40	4.26	22.84	50.09	59.86
COHS-13	3.79	1.70	3.69	5.29	2.47	7.47	45.71	57.73
COHS-14	5.53	3.07	9.66	5.81	3.26	10.82	43.89	56.62
COHS-8	3.62	2.69	5.55	4.68	3.37	9.00	55.56	62.28
S.E(m) ±	0.17	0.13	0.44	0.30	0.12	0.82	1.83	2.35
C.D at 5%	0.49	0.38	1.29	0.89	0.35	2.41	5.41	6.93

DAT-Days after Transplanting COHS- College of Horticulture, Sirsi

Table 3: Yield parameters of *Barleria* genotypes

Genotypes	100 flower weight (g)	Flower yield per plant (g)	Flower yield per plot (g)	Flower yield per hactare (kg)
COHS-1	6.01	25.53	306.34	709.17
COHS-2	4.56	19.50	234.01	541.67
COHS-3	5.07	21.30	255.65	591.76
COHS-4	5.86	25.08	301.00	696.76
COHS-6	4.37	18.37	220.42	510.19
COHS-9	4.86	20.76	249.13	576.67
COHS-10	5.82	24.76	297.15	687.88
COHS-12	5.70	23.94	287.28	665.01
COHS-13	4.36	18.06	216.69	501.58
COHS-14	5.69	24.32	291.78	675.38
COHS-8	4.50	18.38	220.60	510.65
S.E(m) ±	0.16	0.41	4.89	11.33
C.D at 5%	0.46	1.20	14.44	33.43

COHS- College of Horticulture, Sirsi DAT-Days after Transplanting

5. Conclusion

The current investigation's findings conclude that the genotype COHS-1 have emerged as promising genotype with respect to growth and flower yield quality, followed by COHS-4 and COHS-10 which was found to be good in yield and flowering traits. This may be due to both genetic and environmental variables which was found to be suitable for growing in North Karnataka region.

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