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Evaluation of Barleria (*Barleria spp*.) genotypes for growth and yield under hilly zone of Karnataka

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Abstract
An investigation on evaluation of 15 genotypes of Barleria (*Barleria spp.*) with respect to growth and yield parameters of Barleria flowers was carried out at College of Horticulture, Sirsi, UHS, Bagalkot during the year 2019-20. The results revealed that among the genotypes at 120 DAT the maximum plant height was observed in COHS-12 (88.30 cm) number of leaves was more in COHS-7 (994.44), plant spread was maximum in COHS-2 (44.67 cm), higher number of primary shoots in COHS-6 (13.33), maximum total leaf area per plant was recorded in COHS-12 (16327 cm^2), avarage leaf area was maximum in COHS-6 (24.33 cm^2), more number of spikes per plant and more number of flowers per spike was recorded in COHS-5 (104.00 and 8.76 respectively), COHS-12 recorded maximum 100 flowers weight (22.86 g), highest flower yield per plant and also per hectare was recorded in COHS-9 (66.64 g/plant and 5.14 t/ha).

Keywords: Evaluation, Barleria, hilly, Horticulture *Barleria spp*.

Introduction
Flower is the gift of nature to the human being. In India we used flowers from birth to death of a man, it is one of our daily requirements, flowers are used as a source of honey, medicine preparation, food production, beauty, colour preparation, decoration of women's hair and decorative intent, based on the usage, flowers are divided as cut flowers and loose flowers.

Barleria is a famous traditional flower crop in South India belonging to the Acanthaceae family and its chromosome number (2n) is 40. Origin of barleria is Southern China to India and Myanmar. This genus comprises of about 300 species *viz*., *Barleria cristata*, *Barleria buxiflora*, *Barleria cuspidata*, *Barleria tomentosa*, *Barleria grandiflora*, *Barleria montana*, etc. dispersed in tropical and sub-tropical regions of the world, mostly in Africa (Jayanthi, 2006). More than 21 species of Barleria native to India and are widely distributed in the lower hills of West Bengal, the Deccan Plateau, Karnataka, Andra Pradesh, Madhya Pradesh and the North Eastern Himalayan Region (Meyer *et al*., 2004) [9]. *Barleria cristata* has been found globally in gardens and forests of Africa, Pacific region, tropical as well as temperate Asia. It is extensively distributed throughout tropical Asian regions including Indian subcontinent (Bangladesh, Bhutan, India, Nepal and Pakistan) and Indo-china region (Cambodia, Laos, Myanmar, Thailand and Vietnam).

The plant produces numerous compact bushy flowering shoots from the ground level with ovate to lanceolate and hairy leaves which are borne in opposite pairs being loaded with beautiful bell shaped flowers in axillary or terminal racemes for several months in a year in mild tropical climate. But in North India, it flowers in the early cold months for few weeks. The twigs are four sided and leaves decussately placed. The limb of flower is five lobed and spread out, one of the lobes being almost spherical and other four obliquely oval. Barleria cristata is a c ommonly cultivated ornamental plant, recently gaining popularity in South China, South East Asia, subtropical and tropical regions of India. It is also regarded as a potential environmental weed in waste lands and along roadside. This plant is distributed throughout India as hedges around fields and gardens. (Chowdhury, 2014) [4].

The plants bloom almost throughout the year under South-Indian conditions and peak season of flowering is December. 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.

Material and Methods

The experiment was carried out at Department of Floriculture and Landscape Architecture College of Horticulture, Sirsi, UHS, Bagalkot during the year 2019-20. The experiment was laid out in RCBD design with three replications with net plot size of 3 m x 3 m by leaving a spacing of 0.5 m between plots.

The plant height was measured from the bottom of the plant (ground level) to tip of the main stem at intervals of 30, 60, 90 and 120 DAT by using measuring scale in all the tagged plants and mean was worked out. The total number of leaves per plant was counted at intervals of 30, 60, 90 and 120 DAT and average was worked out. Shoots arising from main stem up to the top portion of central stem in each plant were counted and average was worked out. The spread of tagged plants in East-West and North-South direction was measured right angle to each other and the mean was calculated. The leaf area was calculated using leaf area meter, taking 3 leaves per plant *i.e.*, from bottom, middle and top portion were collected from the field from tagged plants and placed in the leaf area meter. The mean was calculated and expressed in terms of cm^2. The average leaf area of plant is multiplied with number of leaf in a plant. It gives total leaf area of the plant and the mean was calculated.

Land preparation and planting

Repeated ploughing and harrowing brought the main field to a fine tilth. The growing area used for experiment was then leveled and divided into plots, 3 m x 3 m in size. To lay out the irrigation channels and working space, a spacing of 0.5 m between the replications and 0.5 m between two plots was provided. The properly rooted healthy seedlings, aged 30-45 days, were selected from 10 cm to 15 cm and transplanted according to the spacing required. Gap filling was completed within one month. All seedlings were planted to a depth of 5-6 cm in each row at a spacing of 60 cm x 60 cm along the sides of the ridges. The seedlings were planted on October 21, 2019 and irrigation was given immediately after the planting. Well decomposed farm yard manure at the rate of 25 tonnes per hectare was applied to the entire experimental plot at time of last ploughing and incorporated into the soil before planting the seedlings. The fertilizers *viz*., Urea, SSP and MOP were used as the sources of N, P2O5 and K2O (50:100:60 kg NPK/ha) respectively. Full dose of phosphorus and potassium was given as basal dose whereas; the nitrogen was applied in three splits at 30, 90 and 120 days after planting. Irrigation was done before transplanting for the cuttings and once in 2-3 days after the planting of the seedlings for better establishment. Gap filling operation was conducted to maintain the necessary plant population, when ever gaps were found. Periodic hand weeding kept the experimental plot clean. Irrigation was provided during the crop cycle, it depends on the soil moisture status and climatic conditions, in an interval of 3-4 days during the experimental period. After 20 days of transplanting, pinching was in order to produce uniform side shoots. Timely and effective plant safety steps were taken to protect the experimental plot plants from pest and disease attacks. The flowers were plucked when they attained full bloom size. Picking of flowers has to be done on alternate days to record growth and yield parameters.

Results and Discussions

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

Growth parameters

Growth parameters of barleria genotypes *viz.*, plant hieght, number of primary branches, number of leaves, plant spread and leaf area were examined and presented below.

Plant height at 90 days after transplanting ranged from 37.66 cm to 71.99. Genotype COHS-12 recorded significantly higher plant height (71.99 cm) which was followed by COHS-12 (58.33 cm) whereas, the least plant height was recorded in the genotype COHS-14 (37.66 cm).

Among the barleria genotypes evaluated at 120 days after transplanting, COHS-12 grows as tallest plant with the height of 88.30 cm which was followed by the genotype COHS-2 (78.63 cm) and the least plant height was observed in the genotype COHS-13 (44.63 cm). These variations in the plant height are due to the fact that the plant height is genetically controlled factor and may vary with genotype to genotype. Similar variation in height of the plant among the genotypes was observed in marigold (Ramchandru and Thangam, 2010) [14] and in china aster by Munikrishnappa *et al.* (2013) [10].

At 90 days after transplanting, the number of leaves was observed in the range of 189.33 to 650.33. Among all the genotypes COHS-7 was reported highest number of leaves (650.33) which was followed by COHS-8 (549.33). The least was found in COHS-14 (189.33).

At 120 days after transplanting, the highest number of leaves was recorded in the genotype COHS-7 (994.44) which was followed by COHS-8 (911.11) and COHS-6 (906.44). Whereas, minimum number of leaves reported in the COHS-14 (396.11) may be due to varietal difference The variation for number of leaves per plant was also observed in marigold (Deepthi and Anil, 2005) [6] and china aster (Mahanta *et al*., 2003) [8].

Significant differences were obtained among the barleria genotypes with respect to leaf area per plant recorded at 120 days after transplanting. Maximum leaf area was reported in COHS-12 (16327.04 cm^2) followed by COHS-2 (16125.19 cm^2) and the minimum leaf area was reported in COHS-14 (3564.99 cm^2).

The average leaf area was maximum in the genotype COHS-2 (24.33 cm^2**)** which was on par with COHS-12 (21.67 cm^2**)** and the minimum average leaf area was reported in the genotype COHS-14 (9.00 cm^2**).** Since cultivars varied for their number of leaves accordingly their leaf area also varied. The similar variation was seen in china aster (Tirakannanavar *et al*., 2015) [15] and gaillardia (Bhaskarwar *et al*., 2016) [1].

The genotypes differed significantly for plant spread at 90 days after transplanting and it was observed in the range of 22.00 cm to 35.00 cm. COHS-12 and COHS-2 reported maximum plant spread of (35.00 cm) which was on par with the COHS-9 (33.00 cm). The minimum plant spread was observed in COHS-8 (22.00 cm)

After 120 days after transplanting the maximum plant spread was reported in the genotype COHS-2 (44.67 cm) which was on par with genotype COHS-12 (43.33 cm). The least plant spread of 29.00 cm was observed in COHS-8. The variation in plant spread is purely due to genetic expression of the genotype. Similar results were also observed in marigold (Bhati and Chitkara, 1988) [2], chrysanthemum (Choi *et al*., 1993 and Dahiya *et al*., 2007) [3, 5].

After 30, 60, 90 and 120 days of transplanting highest number

of primary shoots were reported in genotype COHS-6 (4.35, 9.78, 11.23 and 13.33 respectively). The least number of primary shoots at 30 and 60 DAT was reported in COHS-2 (1.72 and 2.11 respectively) and at 90 and 120 DAT genotype COHS-1 (5.07 and 6.50 respectively) recorded minimum. The differences in the number of primary branches could be attributed to the genetic makeup of the genotypes. The variation for number of leaves per plant was also observed in marigold (Deepthi and Anil, 2005) [6] and china aster (Mahanta *et al*., 2003) [8].

Yield parameters

The yield components, such as the number of flowers per spike, number of spikes per plant, weight of 100 flowers and flower yield per plant, per plot and per hectare were recorded and statistics pertaining to yield parameters of different barleria genotypes are shown in Table 2.

Significant difference among the different barleria genotypes was noticed for the number of flowers per spike. Significantly highest number of flowers per spike were reported in COHS-5 (8.76) followed by COHS-6 (8.42) while least flowers per spike obtained in COHS-2 (4.76). The variation in number of flowers among the genotypes may be due to the difference in the spike length which has influence the number of flowers. These findings are in line with the observations of marigold (Bhati and Chitkara, 1998) and chrysanthemum (Choi *et al*., 1993 and Dahiya *et al.*, 2007) [3, 5].

Among the barleria genotypes evaluated, significant differences was obtained for number of spikes per plant. Significantly the maximum number of spikes per plant was reported in COHS-5 (104.00) which was at par with COHS-6 (98.33). The least number of spikes per plant was reported in COHS-2 (45.00). This is may be due to presence of more number of primary and secondary branches which further influenced on number of spikes per plant. Similar variations were reported in marigold (Deepthi and Anil, 2005) [6] and china aster (Mahanta *et al*., 2003) [8].

Significant results were obtained in genotype COHS-12 (22.82 g) recorded maximum weight of 100 flowers which was at par with COHS-2 (21.56 g) whereas, the minimum was reported in COHS-7 (8.46 g). Variation in the flower weight among the genotypes was mainly because of flower size, petal thickness and also due to genetic factor This findings are in line with the observations of gerbera and gladiolus (Rajivkumar and Yadav, 2005) [13].

The data on flower yield per plant confirmed that there was significant variation among barleria genotypes. Flower yield per plant was ranged from 9.47 g to 66.64 g per plant. Higher yield (66.64 g/plant) was recorded in COHS-9 which was on par with the genotype COHS-5 (65.48 g/plant). Whereas, the genotype COHS-2 yield lesser (9.74 g/plant). Among the genotype evaluated in barleria, significant variation was observed for flower yield per plot. Highest flower yield per plot was reported in COHS-9 (1666.00 g) which was on par with COHS-5 (1637.00 g). Whereas, the flower yield per plot was least in the genotype COHS-2 (243.50 g).The data revealed that the significantly highest flower yield of 5141.97 kg/ha was recorded in genotype COHS-9 which was on par with COHS-5 yield of 5052.46 kg/ha. The minimum yield was reported in COHS-2 (751.54 kg/ha). It is clearly visible that there exists a relationship between number of flowers per spike and flower yield per plant. With the increase in number of flowers per spike, the yield also increases. These findings are in line with Ramachandrudu and Thangam, (2010) [14] in crosandra, Nandakishor and Ragahava, (2001) [11] and Narsude *et al.* (2010) [12] in marigold.

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

Genotype	Plant height(cm)		Number of leaves		Number of primary shoots		Plant spread(cm)		Leaf Area (cm^2)	
	90 DAT	120 DAT	90 DAT	120 DAT	90 DAT	120 DAT	90 DAT	120 DAT	Average leaf area (cm^2)	Total leaf area/plant (cm^2)
COHS-1	40.99	46.97	232.00	428.77	5.07	6.50	29.83	33.83	14.67	6290.05
COHS-2	58.33	78.63	339.33	662.77	5.90	8.23	35.00	44.67	24.33	16125.19
COHS-3	44.33	64.63	285.67	548.44	8.53	9.33	23.67	30.67	17.00	9323.48
COHS-4	38.66	52.97	238.67	470.44	5.53	7.00	24.00	29.33	15.00	7056.60
COHS-5	43.66	64.30	191.33	414.44	5.60	7.66	23.00	29.33	12.67	5250.95
COHS-6	48.66	56.97	526.00	906.44	11.23	13.33	25.33	30.00	11.33	10269.96
COHS-7	47.99	67.30	650.33	994.44	9.23	11.99	28.67	33.33	15.00	14916.60
COHS-8	44.99	57.63	549.33	911.11	8.28	10.00	22.00	29.00	10.33	9411.76
COHS-9	41.99	54.63	492.33	770.44	10.90	12.33	33.00	40.33	16.33	12581.28
COHS-10	41.66	51.30	256.33	459.44	6.26	8.99	27.00	32.67	15.00	6891.60
COHS-11	48.99	65.97	435.00	664.77	9.25	10.67	30.00	33.33	13.00	8642.01
COHS-12	71.99	88.30	459.33	753.44	7.23	8.33	35.00	43.33	21.67	16327.04
COHS-13	41.33	44.63	262.67	449.11	7.28	9.33	25.67	32.67	13.00	5838.43
COHS-14	37.66	45.63	189.33	396.11	8.28	9.66	28.33	32.00	9.00	3564.99
COHS-15	44.66	63.63	317.33	475.11	7.28	9.99	31.67	37.00	14.33	6808.32
CD@5%	4.31	6.57	45.66	53.15	2.11	2.78	4.09	2.99	3.99	2.54
S.Em ±	1.49	2.27	15.76	18.35	0.73	0.96	1.41	1.03	1.11	0.88
CV	5.55	6.52	7.549	5.123	16.33	17.41	8.66	5.24	12.99	6.53

Table 2: Yield parameters of barleria genotypes at different growth stage

Genotypes	No. of flowers/ Spike	No. of Spikes/plants	100 Flowers weight (g)	Flower yield/ plant(g)	Flower yield/ plot(g)	Flower yield/ hectare(kg)
COHS-1	6.76	67.33	14.69	30.55	300.55	2357.25
COHS-2	4.76	45.00	21.56	9.74	97.40	751.54
COHS-3	5.32	69.00	9.06	40.09	400.09	3093.36
COHS-4	5.76	66.67	15.56	24.27	242.70	1872.68
COHS-5	8.76	104.00	13.76	65.48	654.80	5052.46

COHS-6	8.42	98.33	14.09	58.09	580.90	4482.25
COHS-7	5.59	92.33	8.46	59.95	599.50	4625.77
COHS-8	6.59	60.00	10.82	36.01	360.10	2778.54
COHS-9	6.42	72.33	6.86	66.64	666.40	5141.97
COHS-10	5.86	62.00	13.32	26.83	268.30	2070.00
COHS-11	5.99	65.00	14.49	26.44	264.40	2040.12
COHS-12	5.49	56.67	22.82	13.40	134.00	1033.95
COHS-13	6.42	90.67	11.32	50.65	500.65	3908.17
COHS-14	6.42	66.00	15.56	26.83	268.30	2070.00
COHS-15	6.42	81.67	15.66	32.99	329.90	2545.52
CD@5%	1.19	11.47	1.65	3.08	35.84	92.74
S.Em ±	0.41	3.96	0.57	1.06	12.37	268.86
CV	11.2	9.37	7.10	5.22	6.1	5.5

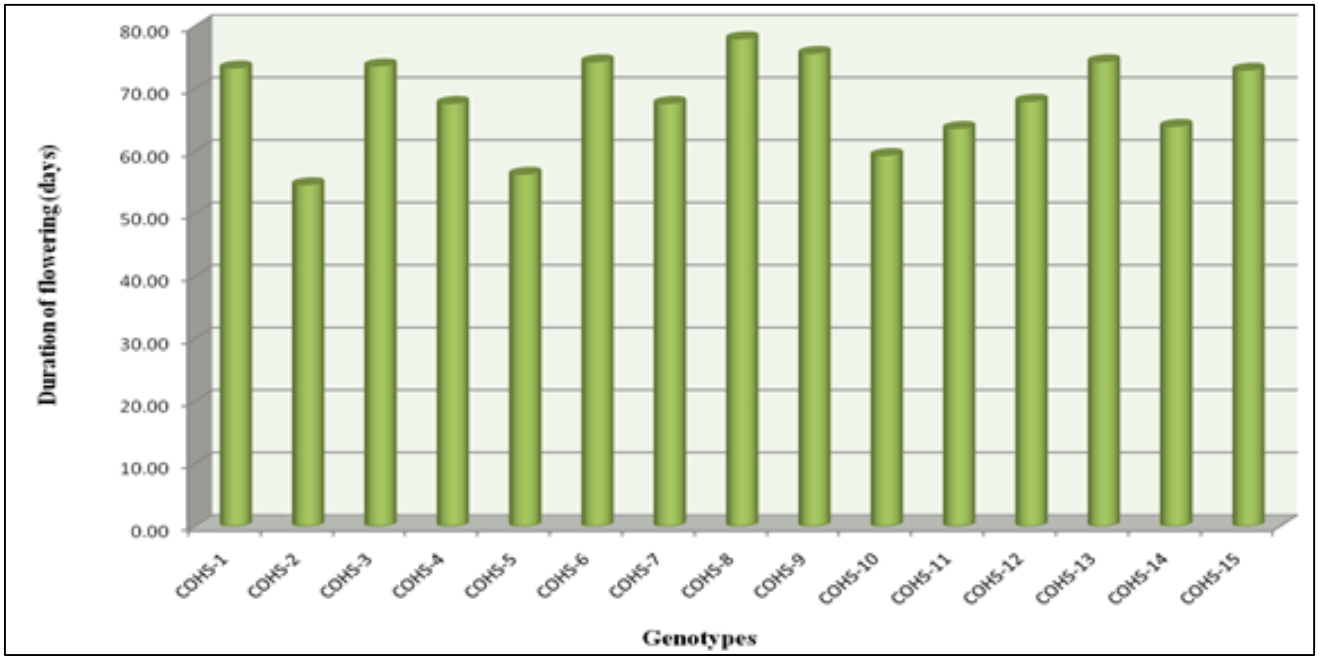

Fig 1: Show the genotypes

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