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Evaluation of different species of *Cymbidium* under High Hills of Uttrakhand

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ABSTRACT

Eleven *Cymbidium* species were evaluated for morphological and floral characters in the high hill situation of Uttarakhand. Among the tested species, the survival rate were maximum in *C. hookerianum, C.longifolium* and *C.gigantium*. Due to heavy infestation of *Fusarium oxysporum* and *Alternaria alternata, C.tigrinum* and *C.lancifolium* were almost eliminated from population at the end of third year. Flowering did not occur in *C.devonianum* and *C.eburneum.* Based on an overall evaluation, *C.elegans,C.hookerianum C.gigantium* and *C. mastersii* were identified as the most promising genetic material could be used in breeding for evolving desirable hybrids and for their commercial cultivation in high hills of Himalayas in Uttarakhand.

Key words: *Cymbidium*, Pseudo bulb, Self-life, Spike, Vase life

Cymbidium is priced for the spray of large flowers and holds the leading position in the global floriculture trade (Barman *et al*. 2007). It has beautiful long spike, variety of colour and long lasting flowers, distinguished by a small hollow shape recess on the labellum. India has a tremendous potential for producing *Cymbidium* orchid in the north-eastern Himalayas of the country. Western Himalayas is richly endowed with orchid genetic resources and had about 250 species, out of total 1250 species in India. The climatic conditions of hills of Uttarakhand are similar to that of North-eastern state of our country. Therefore, an attempt was made to evaluate the performance of 11 species of *Cymbidium* in hills of Uttarakhand.

MATERIALS AND METHODS

The experiment was carried out in the polyhouse at the Floriculture Section of VCSG College of Horticulture, G B Pant University of Agriculture and Technology, Bharsar, Pauri Garhwal during April 2006 to February 2010.The VCSG college of Horticulture, Bharsar is located at a latitude of 30°03'35"N and longitude of 78°59'42"E and at an altitude of 2000 m above mean sea level. Planting materials were collected from private nurseries of Gangtok, Sikkim, Darjeeling and Kalimpong hills of West Bengal, and Institute of Himalayan Bioresources and technology, Palampur. Three year old flowering size plants of 11 species were planted in 25 cm size pots and again the plants were re-potted in 30 cm size pot after two year. The potting medium was prepared with saw dust, Leaf mould, farm yard manure, broken bricks and charcoal (1: 1: 1: 1: 1).The farmyard manure and leaf mould were sterilized by hot water for at least one hour. This mixture was also supplemented with half-burnt dry leaf chopping and charred wood chips of one cm size. The experiment was conducted in completely randomized design with five replications, in each treatment and each replication consists of three plants. Plants were irrigated uniformly and the Polyhouse Agro-shade Net (50%) of rolling systems was used to cover the plants during hotter months so as to avoid leaf injury or sun scorching. During rainy season or in winter season the Shade Net was rolled back. Water soluble fertilizer consisting of NPK (19: 19: 19) was given weekly at 1 g/liter. For post-harvest observations, flowers were harvested when the lower five to eight flowers were open with some buds on the top. Harvesting was done by removing the sheaths/bracts clasping at the base of the stem/spike and immediately immersed the cut-end in the sterile water in a bucket. Among the tested species of *Cymbidium*, some species was found to be attacked by two pathogens. The Pathogen was isolated on Potato Dextrose Agar medium as usual method used in plant pathology. Culture has been identified and deposited at Indian Type culture Collection, Division of Plant Pathology, Indian Agricultural Research Institute, New Delhi. Survival rate was calculated as number of plants survives at the end of year × 100/No. of plants at the starting time (April) of the year. The trial was conducted for four years but the results of second

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year third year and forth year were considered to take mean value. All the data were pooled and subjected to statistical analysis as suggested by Gomez and Gomez (1983).

RESULTS AND DISCUSSION

Considerable variation in the survival rate of different species of *Cymbidium* was observed. The survival rate were maximum 95% in *C. hookerianum*, *C. langifolium*, and *C. gigantium*. However *tigrinum* and *C. lancifolium* have the minimum survival rate (2%) and eliminated from population at the end of third year (Table 1). The heavy infestation of diseases like leaf spot, color rot at rainy season were the main reason behind mortality of the above two species. The Pathogen were isolated and observed under research microscope. On The basis of culture and morphological character of the fungal fruiting body (mycelium, spore), it was identified and confirmed that leaf blight and color rot was caused by *Fusarium oxysporum*. Leaf spot and blight was caused by *Alternaria alternata*. It has also been proved by the Koch's postulate test. However, Chang *et al.* (1998) in their trail on *Cymbidium* hybrids, reported that *Fusarium proliferatum was* the causal organism for leaf spot disease. Due to these two major diseases, *C.tigrinum* and *C. lancifolium* could not survive at floriculture section of the College. Variation in survival rate among species might be mainly due to genetic nature, growing situation and environmental conditions of the plants. Remaining nine species were grown successfully and their performance studies. In winter season, haulm of *C. devonianum* was completely destroyed. However, it again re-appears in the spring season.

Flowering did not occur in *C. devonianum* and *C. eburneum*. In hills the climate is governed by variation in altitude and aspects (Upadhyaya 2006). *C.devonianum* and *C.eburneum* performed well in cool and humid hills having altitude of 900 m to 1800 m above mean sea level (Hegde 1996). The experimental site is situated on 2000 m above mean sea level experiencing snow and frost creating cost climate without humidity might be the reason behind not flowering of above two species. Earlier workers (Lee and Lee 1993 and Fung 2002) suggested that *Cymibidium* requires good sunlight, temperature range of 10°C–25°C, circulation of air and humidity 40–70% for good growth and flowering. It is also postulated that low humidity and temperature for two months (December and January) at least partially attributed to this outcome.

Table 1 Survival rate (%) of various species of *Cymbidium*

Varieties	First year	Second year	Third year
C.longifolium	95.00	95.00	95.00
C.hookerianum	95.00	95.00	95.00
C.elegans	75.00	60.00	96.50
C.mastersii	75.00	52.50	91.50
C.devonianum	77.50	75.00	70.00
C.cochleare	75.00	55.00	55.00
C. tigrinum	25.00	5.00	2.00
C.lancifolium	25.00	4.00	2.00
C.gigantium	95.00	95.00	95.00
C.iriodiodes	62.50	25.00	50.00
C.eburneum	50.00	20.00	40.00

The result indicates significant variation among species for all the morphological characters (Table 2). The mean plant height varied from 38.90 cm to 82.20 cm at the time of spike emergence. Among the species *C.gigantium* recorded maximum plant height (82.20cm) while minimum was in *C.cochleare* (38.9cm). Shoots/pots varied significantly and ranged from 2.4 (*C. cochleare*) to18 (*C. gigantium)*. Pseudobulbs/pot also followed the same pattern. This might be due to reason that a vigorous plant produces more numbers of shoots and Pseudo bulbs. Our findings are supported by Barman *et al*. (2007) study, in which *C.hybrids* grown in mid hill situation of Sikkim had similar response. Fresh weight of the plant at the time of flowering was also varied with species. Maximum fresh weights of the plant were observed in *C.gigantium* (118.8 g), followed by *C.iriodiodes* (88.8 g) and *C.mastersii*(58.8 g), whereas, minimum was in *C.cochleare*. Dry weight of plants also exhibits same pattern. Significant differences could be observed among the species for leaf numbers, lengths, fresh weight and dry weight. Maximum numbers of leaves were noticed in *C. elegans* (19.3), followed by *C.gigantium* (17.81) which was at par with *C.hookerianum* (17.80) and *C.longifolium* (17.50). However, it was recorded minimum in *C.cochleare* (10.90) The average lengths of new emerged leaves at six month and at the time of spike emergence were maximum in *C.gigantium* (63.16 and 83.66), followed by *C. hookerianum* (31.67 and 74.33), whereas, in *C.cochleare* leaf had minimum (11.60cm and 19.67cm) length at both stages of observation. The maximum fresh and dry weight of leaves at spike emergence was also noticed in *C.gigantium* (6.53 g and 1.84 g) and minimum was in *C.cochleare*(2.68 g,0.42 g). Variation in numbers, length, fresh weight and dry weight of leaves were might be due to the genetic make-up of the plants. Barman *et al*. (2008) also observed the similar results in hybrids of *Cymbidium* at Sikkim. The length of pseudo bulb ranged form 2.80 cm to 11.33 cm and girth ranged form 1.06 cm to 6.24 cm. Longer and thicker pseudo bulbs were recorded in case of *C.hookerianum* (11.33 cm, 6.24cm) *C.gigantium* (10.83 cm, 5.9 cm) and *C. mastersii* (9.33 cm, 5.46 cm). The fresh weight of Pseudo bulb was maximum (55.5 g) in *C. elegans* followed by *C.mastersii* (44.83 g) and *C. longifolium* (35.51 g).Dry weight of Pseudo bulb also exhibit same patterns. It indicates that these species have higher capacity for storing reserve food materials for growth and developments. Similar results were also noticed by Barman *et al*. (2007) for various hybrids of *Cymibidium*. Further, *C.gigantium* registerd maximum numbers of roots/clump (632.4), length (78.2cm)

Table 2 Growth characteristics of various species of *Cymbidium*

	Shoots/ pot	Plant height (cm)	Plant FW (g)	Plant DW(g)	No of leaves	Length of new leaves at six month	Length of new leaves at flower emergence	FW (g) of leaves	DW of (g) leaves	No of Pseudo-bulb	length of pseudo-bulb (cm)	Girth of Pseudo-bulb (cm)	FW (g) of pseudo-bulb	DW of pseudo-bulb	Root's no/ clump	Length of root (cm)	Girth (cm) of roots	FW (g) of roots	DW (g) of roots
Cymbidium longifolium	10.0	69.30	55.00	15.00	17.50	31.66	61.00	3.74	1.70	2.70	5.80	3.72	35.51	10.55	418.00	61.60	1.08	497.40	40.50
Cymbidium hookerianum	5.60	80.40	52.80	16.75	17.80	31.67	74.33	5.64	1.20	3.67	11.33	6.24	31.25	9.83	366.40	59.40	0.90	196.98	50.31
C.elegans	7.60	60.70	58.00	14.50	19.30	28.33	55.00	3.72	0.95	1.33	5.33	3.96	55.50	11.86	92.00	51.20	1.09	97.28	24.50
C.mastersii	9.40	72.50	58.80	19.75	12.50	24.00	64.33	4.17	1.04	1.60	9.33	5.46	44.83	10.86	111.60	39.00	0.96	342.91	71.39
C.cochleare	2.40	38.90	21.60	3.90	10.90	11.66	19.67	2.68	0.42	1.00	2.80	1.06	19.80	3.60	59.20	19.40	1.14	71.92	12.83
C.gigantium	18.00	82.20	118.80	22.63	17.81	63.66	83.66	6.53	1.84	4.00	10.83	5.90	30.59	10.86	632.40	78.20	1.22	447.60	45.33
C.iriodiodes	3.40	59.90	88.80	21.75	14.10	19.00	42.33	5.96	0.47	1.00	3.83	2.88	15.63	9.56	49.40	25.40	0.48	42.50	11.13
CD (p=0.05)	1.160	3.31	1.764	0.88	1.560	2.211	2.660	0.219	0.107	0.930	0.750	0.610	1.350	0.731	19.310	0.170	0.104	2.370	0.870

FW = Fresh Weight,DW = Dry weight

and girth (1.22cm) of roots, followed by *C.longifolium* and *C. hookerianum* (366.40, 59.40 cm,0.90 cm). Length of roots and number/clump were minimum recorded in *C.cochleare* (59.20 cm, 19.40), however, girth of roots was minimum in *C.mastersii* (0.96cm). Considerable variation in fresh weight of roots/clump was also found in various species. Maximum fresh weights were observed in *C. longifolium* (497.40 g), followed by *C.gigantium* (447.60 g) and minimum was in *C.cochleare* (71.92 g). However, dry weight of roots was maximum in *C. mastersii* (71.39 g) and minimum was in *C. iriodiodes*. Adaptability of species under above climatic conditions could be possible reason for wide variation in root parameter.

Floral characters

Significant differences were observed in floral characters of various species (Table 3). *C. elegans* produces maximum number of spike/plant (3.33) and per clump (6.2) However, It were minimum in *C. cochleare* (1 and 2.2). Variation in flower production in various species of *Cymbidium* might be due to genetic make-up and climatic adoptability of the species. Days taken to first flower opening from inflorescence emergence were maximum in *C. iriodiodes* (37.67 days) and early opening recorded in *C. elegans* (29.66 days) followed by *C. mastersii*.(31.67) and *C.longifolium*(32.00).Like other characters, the variation in spike length was also observed among species; longest spike length (49.0cm) was noticed in *C.hookerianum* followed by *C. elegans* (43.08 cm) and *C. iriodiodes* (41.20 cm). A minimum spike length was observed in *C. cochleare*(15 cm). Considerable variations in number of flowers D spike also existed. Maximum number of florets was recorded in *C. elegans* (39.66), followed by *C.mastersii* (35.66) and *C.cochleare* (23.66). *C.longifolium* (7.67) and *C. gigantium* (7.66) produces minimum number of flower/ spike. Distinguished variation in number of florets/spike might be due to climatologically as well as physical factors governing growth and flowering. Barman *et.al*. (2007) also reported variation in number of spike/pots, spike length and number of flowers/spike in his trail on performance of *Cymbidium hybrids* in mid hill situation of Sikkim. Bigger sizes of flowers were recorded in *C.iriodeods* (6.24 cm), *C.mastersii* (4.34 cm) and *C.gigantium* (4.34cm). Size of flower is one of the main dominating factors in floriculture market (Barman *et al*. 2007). Self life and vase life of flowers varies among species significantly. Maximum self life (70.80 days) and vase life (30.80 days) were recorded in *C.gigantium* followed by *C.elegans* (70, 29.80). Wide variation in the post harvest losting quality have also been observed amongst different species of flowers and ornamental crops and cultivars of the same species by Mayak *et al*. (1974). Anatomical or physical characteristics of flowers such as crispness, toughness etc. have direct bearing on their keeping quality (Halevy and Mayak 1979). The longevity of cut flowers is limited by their ephemeral nature and by several

Table 3 Floral characteristics of various species of *Cymbidium*

Variety/trai	No. of Spike/ plants	No. of spike/clump	Days to first flowers open	No. of flowers/ spike	Spike length (cm)	Diameter (cm) of single flower	Self life (days)	Vase life (days)
Cymbidiumlongifolium	2.33	3.20	32.00	7.67	30.90	4.10	68.20	24.00
Cymbidiumhookerianum	2.67	4.20	34.00	10.66	49.00	3.76	61.00	22.40
C.elegans	3.33	6.20	29.66	39.66	43.08	3.60	70.00	29.80
C.mastersii	3.00	4.40	31.67	35.66	18.24	4.34	69.60	20.20
C.cochleare	1.00	2.20	33.00	23.66	15.00	2.92	53.00	20.80
C.gigantium	2.33	3.40	36.67	7.66	39.08	4.30	70.80	30.80
C.iriodiodes	1.33	3.00	37.67	10.00	41.20	6.24	64.00	20.80
CD (p=0.05)	.0854	1.370	1.260	1.140	1.480	0.553	4.070	1.940

stresses leading to the decrease of water uptake, depletion of stored carbohydrates, increase of respiratory activities and ethylene production and by enhancing the flower sensitivity to ethylene. Variation in cut flower life might be due to variation in stem blockage may arise through the growth of micro-organisms,oxidation of the stem tannins,pectin degradation products,from plugging with tyloses or through yet unknown physiological factors (Tiwari *et al*. 2010). Based on these finding it may be concluded that *C.elegans, C. hookerianum C. gigantium* and *C mastersii*, were found promising for hills of Uttrakhand. These evaluated species can be used as genetic base material in breeding for evolving desirable hybrids for cut flowers, potted and foliage plants with attractive, color and long lasting quality with better climatic adaptability for Uttrakhand.

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