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COLLECTION, CONSERVATION, AND CHARACTERIZATION OF *CYMBIDIUM ELEGANS* LINDL. GERMPLASM FROM DARJEELING DISTRICT OF WEST BENGAL

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Abstract

Nineteen genotypes of *Cymbidium elegans* Lindl. (Orchidaceae) were collected from different parts of Darjeeling district of West Bengal. The collected accessions were characterized for 23 morphological characters. The analysis of the observed data showed wide variation with respect to morphological traits like plant height (23.0-53.1 cm), plant spread (17.5-49.9 cm), pseudobulb length (3.5-10.0 cm), pseudobulb girth (8.2-13.3 cm), inflorescence length (34.13-40 cm), inflorescence diameter at base (0.29-0.53 cm) and flower count (17.4-40.0). The flower height was found to be most variable (cv 53.83 %) parameter followed by vegetative shoot per pseudobulb (cv 42.17) and flower width (cv 37.77 %). Dorsal sepal length was the least (cv 4.93 %) variable parameter. The distance among various genotypes was determined by Hierarchical cluster analysis using Euclidian distance. The highest value (35.51) was observed between OCD-1331 and OCD 1157 while the lowest distance (6.75) found between OCD-1147 and OCD-1165. The dendrogram revealed 6 clusters. The cluster 2 had largest (5) membership and cluster 3, 5 and 6 had 3 members and cluster 2 and 4 had 2 members in each.

Introduction

THE GENUS *Cymbidium* consists of 44 species of which 22 are found in India. The two species namely *Cymbidium gammieanum* King and Pantl. and *Cymbidium whitae* King & Pantl. are endemic to the country (Sathish Kumar and Manilal, 1994). *Cymbidium elegans* Lindl., an endangered orchid species of great horticultural value; an unusual species in which inflorescence carries a dense bunch of beautiful funnel shaped buttercup yellow blossoms. It grows epiphytically and lithophytically, at an elevation of 1500 to 2500 m (Kumar *et al.,* 1994). Pradhan (1979) mentioned that species is found in Nepal, Sikkim, Darjeeling, Bhutan, Khasi Hills, at an elevation of 1600 to 2000 meters. Many attractive hybrids of *Cymbidium* like Ides of March (*Cymbidium pumilum* x *Cymbidium elegans*), *Cym* Ireland (*Cymbidium elegans* x *Cym* Monsoon), Sun God (Ireland X Lunagrad), Sunflower (OISO x Ireland) have been developed by using this species. According to Chowdhery (2001), the species is extremely rare and threatened in its natural habitat. Indiscriminate collection and habitat loss are the two major factors responsible for declining its population in nature (Kataki, 1977). India being signatory of the World Trade Organization (WTO) it has become imperative to document and preserve our genetic wealth in order to safeguard our rights on them. Though this species is under cultivation, in some of private nurseries and personal collections in Darjeeling district of West Bengal but the advents of new exotic hybrids having greater appeal are exerting pressure on species as well as on old varieties. Hence, it necessitates the conservation measures for their protection as well as further utilization. The information on conservation and characterization of this species either on the basis of quantitative morphological characters or molecular basis are rarely available. Hence, an attempt was made to collect, conserve and characterize it on the basis of their morphological characters.

Materials and Methods

The explorations for collection of *C. elegans* genotypes were conducted to various parts of Darjeeling during 2001-2003. The full grown plant or plant part having at least one backbulb, two leads, and 1-2 vegetative shoots were collected. The accessions were brought to National Research Centre for Orchids, Darjeeling Campus, Darjeeling (2150 m elevation) cleaned for dried or decayed leaves. If necessary, divided and then soaked in aqueous solution of Bavistin (1.5 g l^{-1}) for 30 minutes and then air dried. The plants were grown in plastic pots (12 inch diameter) in a potting mixture containing FYM: perlite: leaf mould (4: 1: 4) v/v. The watering was done at weekly/fortnightly interval to keep potting mixture moist. The plants were also fertilized with NPK (30:10:10) during the season of active growth (March-September) and with NPK (10:30:10) during flowering/dormant season (October-February) with irrigation water at 15 days interval. All the collected accessions were grown in naturally ventilated polyhouse to protect them from rain. The observations on vegetative characters *i.e.,* plant height, plant spread, pseudobulb

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length, girth, diameter, leaf length, leaf width, and reproductive characters like inflorescence per pseudobulb, inflorescence length, raceme length, and flower number and flower characters *i.e.,* flower height (dorsal sepal to lip), flower width (sepal to sepal distance), dorsal sepal length, pedicel diameter and length were recorded for two consecutive year 2005 and 2006. The collected data were analyzed for maximum, minimum, mean, standard deviation, and coefficient of variation (cv). The various morphological parameters were subjected to Hierarchical cluster analysis using Euclidian distance (SPSS 12.0 Version).

Results and Discussion

The plants were collected from natural habitats. Two accessions were collected from Sukhia-pokhari, 3 from Aloobari, 2 from Lebong, 2 from Mangpoo, 1 from Jalapahar Cantonment, 2 from Sonada, 1 from 6th Mile, 1 from Maney bhanjung, 2 from Takdah, 1 from Rishihat Valley and 2 from Takbar Valley. Thus, altogether 19 Genotypes were collected.

Vegetative Characters

The collected accessions showed wide variability with respect to vegetative parameters (Table 1). The plant height varied from 23.0-51.7 cm, plant spread from 24.6-57.4 cm, leaf and length from 43.2-76.3 cm. Among the plant characters, the number of vegetative shoots per pseudobulb was found to be the most variable character (cv 39.83 %) followed by inflorescence per pseudobulb (cv 35.47 %), pseudobulb diameter (cv 26.48 %) and plant height (cv 23.34 %). The leaf width was found to be least variable (cv 14.53 %) factor. The number of vegetative shoots per pseudobulb ranged between 0-3, whereas inflorescence per pseudobulb from 1-2. Since *Cymbidium elegans* is sympodial in growth habit *i.e.,* a new growth flowers only once in its life span. Both number of vegetative shoots per pseudobulb and inflorescence per pseudobulb could be helpful in increasing the productivity per plant. Though the *Cymbidium elegans* flowers once from its new growth, however two genotypes namely OCD-1140 and OCD-1166 have been found to flowers twice from the same pseudobulb. The length, diameter, and circumference of pseudobulb varied from 3.50-10.0 cm, 1.6-3.23 cm, 8.20-13.3 cm and leaf number, leaf length and leaf width from 8.5-16, 37.93-56.2 cm, and 1.63-2.5 cm respectively. While describing the species Pradhan (1979) mentioned that pseudobulbs are 5-7 cm long, leaves are many and 40-60 cm long and 1.6-2.0 cm broad.

Reproductive Characters

The variability parameters with respect to flower spike and flower are mentioned in Table 2. The inflorescence length varied from 34.13-49.5 cm and raceme length 10.85-20.50 cm. The peduncle of the inflorescence was found to be weak (0.29-0.53 cm in diameter) hence inflorescence were pendulous. The raceme carried 17-40 flowers. The pendulous inflorescence and floriferous character make it a very attractive potted flowering plant. Pradhan (1979) also observed that

Table 1. Morphological characters of *Cymbidium elegans* plants grown in *ex situ* environment.

Plant characters	Minimum	Maximum	Mean* ± S.D.	CV
Plant height (cm)	23.00	51.73	32.41 ±6.28	23.34
spread (cm)	17.50	47.70	32.67 ±6.11	17.96
Pseudobulb length (cm)	3.50	10.00	6.16 ±1.36	22.36
diameter (cm)	1.60	3.23	2.44 ±0.50	26.48
circumference (cm)	8.20	13.30	10.78 ±1.58	18.37
Leaf number (cm)	8.50	16.00	12.26 ±1.86	21.91
length (cm)	37.93	56.20	46.05 ±5.38	16.85
width (cm)	1.63	2.50	2.07 ±0.19	14.53
Sheath length (cm)	4.40	8.40	6.53 ±0.85	16.86
Inflorescence/ pseudobulb	1.00	2.00	1.27 ±0.38	35.47
Vegetative shoot/ pseudobulb	0.00	3.00	1.22 ±0.60	39.83

*Average of (n=19) ± standard deviation of the mean

Table 2. Morphological characters of flowering spike and flowers of *Cymbidium elegans* grown in *ex situ* environment.

Inflorescence and flower characters	Minimum	Maximum	Mean* ± S.D.	CV
Inflorescence length (cm)	34.13	49.50	41.52 ±4.38	24.84
Raceme length (cm)	10.85	20.50	14.10 ±2.32	16.36
Inflorescence diameter (cm)	0.29	0.53	0.36 ±0.06	21.89
Bract number	4.50	9.00	6.68 ±0.98	28.65
length (cm)	6.15	11.70	8.61 ±1.52	28.29
Flower number	17.40	40.00	25.60 ±5.67	37.69
height (cm)	0.70	2.20	1.55 ±0.45	59.06
width (cm)	1.10	4.25	2.66 ±0.99	5.61
Lip lobe distance (cm)	0.30	1.80	0.68 ±0.36	12.73
Dorsal sepal length (cm)	3.75	4.60	4.17 ±0.21	28.81
Pedicel length (cm)	1.50	2.40	1.98 ±0.25	24.84
diameter (cm)	0.02	0.04	0.06 ±0.04	16.36

*Average of (n=19) ± standard deviation of the mean

inflorescence is up to 60 cm long and raceme 10-25 cm long. According to him, the flowers are pale lemon yellow, often flushed with pink or brown. Our accession also showed variability in colors ranging greenish yellow to pure yellow and some were flushed with pink. The flowers were tubular in shape 3.75-4.60 cm long and degree of opening was varied with the accessions which was measured in flower width (sepal to sepal distance), flower height (dorsal sepal to lip) and lip lobe distance. The flower width varied from 1.10-4.25 cm flower height 0.70-2.20 cm and lip lobe distance from 0.30-1.80 cm. The height of the flower was found to be the most variable factor (cv 59.06 %) followed by flower number (cv 37.69 %) dorsal pedicel length (cv 28.81 %) and sepal length (cv 28.81 %). The flower width was found to be the least variable (cv 5.61 %) factor. It is evident that a lot of variability with respect to morphological parameters exists in natural population of the species hence a careful selection of the parents should be made for crop improvement program. The orchids have weak reproductive barriers hence many interspecific, intergeneric cultivars have been developed. According to Vij and Shekhar (1987) *Cymbidium elegans* carries 40 somatic (2n) chromosomes. The other Indian *Cymbidium* species *C. aloifolium* (L) Sw., *C. bicolor, C. cochleare* Lindl., *C. cyperifolium* Lindl., *C. dayanum* Reichb.f., *C. devonianum* Paxt., *C. eburneum* Lindl., *C. ensifolium* Griff ex. Lindl., *C. gammieanum* King & Panlt., *C. iridoides* d. Don., *C. hookerianum* Reichb. f., *C. lowianum* Reichb. f., *C. mastersii* Griff. ex. Lindl., *C. pendulum, C. tracyanum* L. Castle and *C. whiteae* King & Pantl. contain similar chromosome number as of *Cymbidium elegans.* The *C. elegans* Lindl. may breed well with these species and may be helpful in developing cultivars suitable for cut flower as well as potted flowering plant.

The morphological data collected from various genotypes were subjected to Hierarchical cluster analysis using Euclidian distance to determine the distance among various genotypes (Table 3). A range of 6.75 to 35.51 Euclidian distance values were observed among the genotypes. The highest Euclidian distance (35.51) was observed between the genotype OCD-1331 and OCD-1157 followed by (34.73) between OCD-1331 and OCD-1170, (34.42) between OCD-1157 and OCD-1198 and (33.53) between OCD-1198 and OCD-1188. The lowest Euclidian distance (6.75) was observed between the genotype OCD-1147 and OCD-1165. The genotype OCD-1154 was found to be distanced at 7.29 from OCD-1175 and 7.63 from OCD-1188. The dendrogram (Fig. 1) revealed 6 clusters. The cluster membership and desirable traits of each group are summarized in Table 4. The genotype OCD-1198 did not cluster with any of the group. Hence, a lot of variability with respect to plant size, flower number, color, shape of flower, and inflorescence length exists in natural population of *Cymbidium elegans*. A careful selection in breeding programme would result cultivars of good quality. Rao (2006) also observed that some of the species exhibit lot of variation in wild population

OCD - 1165	0.00																		
OCD - 1109	19.47	0.00																	
OCD - 1174	13.95	27.03	0.00																
OCD - 1166	10.70	21.79	9.25	0.00															
OCD - 1140	9.76	24.05	14.42	15.49	0.00														
OCD - 1157	19.00	16.24	24.55	17.80	26.86	0.00													
OCD - 1170	18.34	18.81	24.01	16.30	25.90	13.96	0.00												
OCD - 1152	8.87	21.55	12.47	8.21	14.10	18.91	14.45	0.00											
OCD - 1147	6.78	17.08	15.10	11.08	11.46	19.01	17.51	9.87	0.00										
OCD - 1175	7.66	21.83	13.21	11.71	13.77	19.36	19.10	9.09	8.69	0.00									
OCD - 1106	13.09	31.39	12.30	15.38	13.17	28.57	26.93	13.67	16.82	12.66	0.00								
OCD - 1131	18.80	29.78	23.73	25.71	10.70	35.51	34.73	23.76	20.16	22.81	20.65	0.00							
OCD - 1188	8.93	21.70	16.10	13.19	12.61	21.80	19.39	9.53	8.86	10.26	14.61	19.68	0.00						
OCD - 1192	14.69	28.00	14.37	15.36	13.27	29.90	25.70	14.65	13.36	15.32	14.49	19.25	11.76	0.00					
OCD - 1198	25.49	33.41	25.15	23.34	27.31	34.42	27.94	23.67	21.58	23.85	26.50	33.53	22.38	16.38	0.00				
OCD - 1196	13.68	20.45	14.56	13.42	14.22	24.51	20.77	12.48	9.34	13.07	18.46	22.16	13.30	11.54	18.17	0.00			
OCD - 1154	9.05	23.13	14.69	12.66	14.20	20.17	19.40	8.75	10.58	7.29	12.07	22.58	7.63	15.67	24.91	15.13	0.00		
OCD - 1053	13.27	28.04	14.06	14.07	12.09	28.27	23.81	12.68	13.60	15.28	12.52	18.98	10.64	8.62	20.36	14.27	13.10	0.00	
OCD - 1052	13.57	28.07	13.39	9.99	18.42	22.24	18.13	8.87	15.21	12.89	12.53	27.77	13.32	15.65	22.57	16.91	12.00	13.89	0.00

Table 4. Cluster membership and desirable traits of each cluster.

Cluster Number	Number	Cluster membership	Desirable traits
I	5	OCD – 1165; OCD – 1147; OCD – 1175;OCD – 1188; OCD – 1154	Medium height plants (31.05cm) with long flowering pseudobulbs (6.29 cm); medium size inflorescence (42.79 cm) and raceme (13.37 cm); low flower bud count (22.9).Flowers tubular and less spreading.
II	2	OCD – 1106; OCD – 1174	Medium height plants (36.4 cm), low flower bud count (22.33) flowers are less spreading, medium size inflorescence and raceme.
III	3	OCD – 1166; OCD –1052; OCD – 1152	Short plant height (27.14 cm) medium size inflorescence (36.14 cm) and raceme (11.26 cm), medium flower count (24.6) and flowers spreading and dorsal sepal curving upward.
IV	2	OCD – 1140; OCD – 1131	Tall plants (37.90 cm), small size pseudobulbs small inflorescence (30.58cm) and raceme (10.38 cm); lower flower bud count (20.92); higher flower spike per pseudobulb (1.83). flowers; lightly flushed with pink and open
V	2	OCD – 1109OCD – 1157; OCD – 1170	Plants short in height (29 cm) with long; pseudobulb (7.35 cm); long inflorescence(50.63 cm) and raceme (22.39 cm) high flower count (27.75)
VI	3	OCD – 1196; OCD – 1053; OCD – 1192	Medium height plants (31.67 cm) with high spreading habit; long inflorescence (48.32) and raceme (22.9); high flower count (29.50) flowers spreading.

which are very useful for breeding programme to develop hybrids of commercial value in the international market.

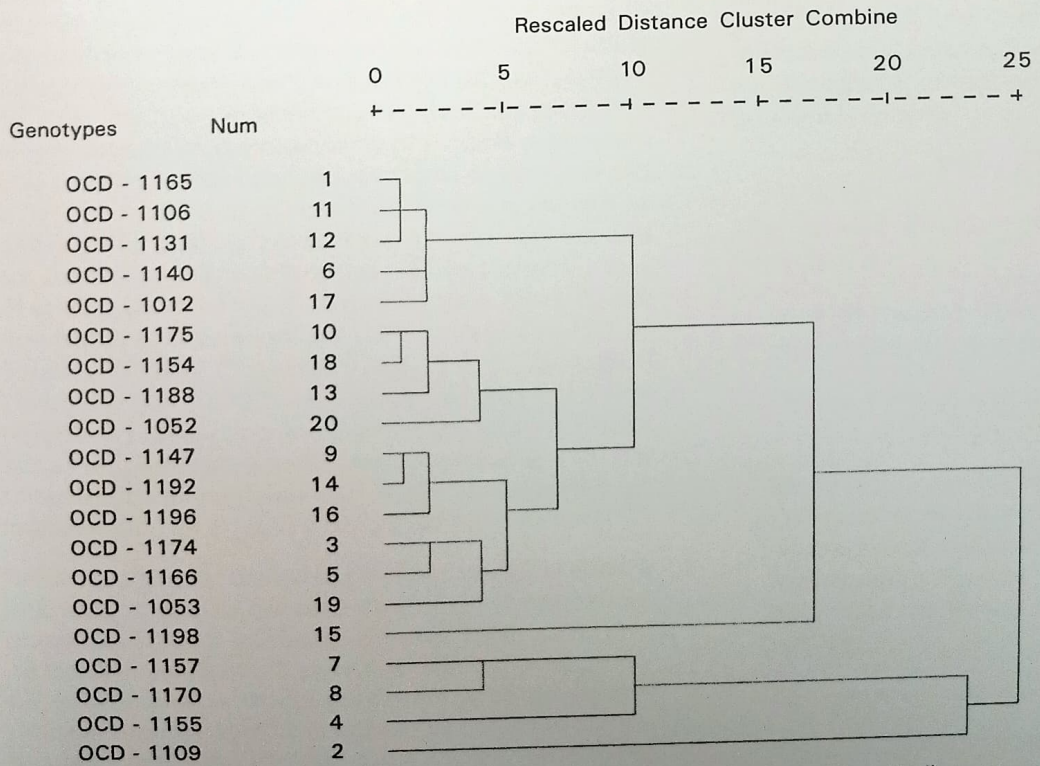

Fig.1. Dendrogram illustrating dissimilarity among genotypes *Cymbidium elegans* Lindl.

Conclusion

The results clearly demonstrate that wide variability in terms of plant size and flower shape and size is available in natural population of *Cymbidium elegans*. This variability need to conserved and utilised in further crop improvement prgrammes.

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