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RESEARCH ARTICLE

GROWTH AND DEVELOPMENTAL ASPECTS IN DENDROBIUM ORCHIDS

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ABSTRACT

Dendrobium orchids are popular flowering potted plants and cut flowers throughout the world due to their floriferousness, diversity in flower size, shape and colour, round the year availability and long keeping qualities. The present investigations were carried out with 16 hybrids of Dendrobium in CRD design with four replications. Significant variations were also observed with both vegetative and reproductive parameters. The spike length varies from 21.9cm in 'Triple Pink' to 47.7 cm in case of 'Madam Pink'. Highest number of spikes/cane was recorded in 'Julie' (4.0) followed by 'Thongchai Gold' (3.0) and 'Big White Jumbo'(3). 'Madam Pink' had highest number of florets/spike (15) while 'Emma White' had minimum (5.4). The hybrid 'Triple Pink' had the highest vase life (40 days) and lowest in 'Madam Pink' (15.3 days). There were significant variations in the content of carbohydrates in pseudobulbs and flowers and chlorophyll content in leaves. In flower, maximum amount of carbohydrate was estimated in 'Kating Dang' (260 mg/g) and minimum in Lervia (112mg) and 'Big White Jumbo'(112 mg/g). In pseudobulb, carbohydrate content ranges from 46 mg/g in 'Fatima' to 279 mg/g in case of 'Erika'. In variable response to chlorophyll content in leaves, 'Ear Sakul' had maximum (47.8 mg/100 g) followed by 'Madam Pink' (46.5 mg/100g), 'Erika' (44.6 mg/100g) and minimum in 'Kating Dang'(27.5 mg/100g).

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INTRODUCTION

Dendrobium orchids and their hybrids are the second largest group of orchids after *Bulbophyllum*. They consist of more than 1500 epiphytic species that are native to tropical to subtropical Asia, Australia and Pacific Islands. Some dendrobiums are deciduous while others are evergreen. Some have pseudobulbs while others have jointed stems resembling canes. Dendrobiums usually bloom both from the old pseudobulbs and from the new growth. They are popular flowering potted plants and cut flowers throughout the world due to their floriferousness, diversity in flower size, shape and colour, round the year availability and long keeping qualities (Kuehnle, 2006). The plants prefer a temperature range of 24 to 30°C and higher light intensities for rapid vegetative growth and flowering. Like other flowering plants, orchid plants also have to attain certain stage of growth and fulfill the energetic demand to initiate flowering. It may vary from 3 years to 7 years depending upon the type of species and hybrids. Orchid pseudobulbs are engaged in the control of physiological processes that are important for growth and survival. The ability to store water, mineral and carbohydrates in the pseudobulb has greater impact for survival in the harsh and nutrient limited epiphytic biotope. Pseudobulb photosynthesis recycles respiratory carbon that would contributing positively to whole plant carbon economy. The present study was undertaken to evaluate the varietal performance as well as changes in total carbohydrate content in pseudobulbs and flowers and chlorophyll content in leaves amongst them.

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MATERIALS AND METHODS

All together 16 Dendrobium orchid hybrids were collected from Bangkok, Thailand and the experiment was conducted at NRC For Orchids, Pakyong, Sikkim in CRD design with 5 replications under protected conditions at a temperature of 25-28°C (Day) and 15-20°C (Night) during summer and 20-25°C (Day) and 10-15°C (Night) during winter season. A potting mixture consisting of coco chips + coco peat + leaf mould+ brickpieces (4: 2:1:2) was used a growing media. Plants were watered at 2-3 days intervals in summer and 7-10 days intervals in winter and fertilized at 15 days intervals with 0.2% NPK (30:10:10) in spring season followed by 19:19:19 in summer season and 10:30:20 in autumn season to grow the crop successfully. Observations were recorded on

Table 1. Vegetative growth in Dendrobium orchids

Name of hybrids	Length of flowering pseudobulb (cm)	Number of internodes	Length of longest internode (cm)	Diameter of longest internode (cm)	Number of leaves/cane	Maximum Leaf length (cm)	Leaf width (cm)
Big White 4N	41	10.5	5.2	1.2	6.43	11.80	4.5
Bangkok Blue	21	11	2.76	1.1	6.3	8.8	3.0
Big White Jumbo	55	17	4.5	2.0	13	13.5	4.25
Madam Pink	31.5	9.5	5.25	1.15	5.5	10.5	4.00
DaangSaard	34.5	11	5.5	2.6	4.5	14.5	6.5
Erika	25.5	9	4.75	2.0	4.0	13.25	5.75
Julie	22	9.5	3.75	2.25	8.0	13.5	2.0
KatingDang	34.5	12	5.5	1.75	6.5	13.75	6.25
Lervia	35	10	6	1	5.5	12.5	4.00
Madam Pompadour	34.5	10.5	5.5	1.75	4	13.5	4.75
Triple Pink	26.5	9	4.5	1.75	5	13	4
Emma White	42	16	4.5	1.75	6.5	11	3.75
Ear Sakul	26	8	4.75	1.5	3.5	9	3.75
Thongchai Gold	25.5	8	4.5	1.5	5.5	10	4.75
SE m	1.66	1.06	0.31	0.23	0.48	1.10	0.41
CD 5%	2.73	1.76	0.52	0.37	0.80	1.83	0.68

Table 2. Flowering behaviour in Dendrobium orchids

Name of hybrids	Spike length (cm)	Rachis length (cm)	Number of spikes/cane	No of florets/spike	Diameter of floret (cm)	Flower Longevity on plants (days)	Vase life (days)
Big White 4N	36.7	25.2	2	9	7.3	54	20.6
Bangkok Blue	34	17.4	2	11	5.4	48	21
Big White Jumbo	31	17.4	3	7	6.8	41	29.5
Madam Pink	47.7	32.7	2	15	6.8	44	15.3
DaangSaard	25.5	16.5	2	10	6	33	27.5
Erika	41.9	27.5	2	6.2	15	50	34.8
Julie	29.25	15	4	12	3.5	38	25
KatingDang	28.7	16.3	2	6.7	12	45	28
Lervia	22.8	11.8	2	7.8	5.25	41	28.2
Madam Pompadour	32	17.95	1	9.6	6.25	50	37
Triple Pink	21.9	16.9	1	6.4	6	70	40
Emma White	26.9	16.4	2	5.4	6	50	37
Ear Sakul	30	17	1	9	7.5	71	33.5
Thongchai Gold	25.4	14.2	3	7.6	10.5	69	30.4
SE m	1.56	0.70	0.34	0.82	0.74	1.98	5.36
CD 5%	2.58	1.16	0.56	1.36	1.23	3.27	8.85

Table 3. Changes in carbohydrates in pseudobulbs and flowers and chlorophyll content in leaf in Dendrobium orchids

Name of hybrid	Carbohydrate content in Flower (mg/g)	Carbohydrate content in pseudobulb (mg/g)	Chlorophyll content in leaf (mg/100g)
Big White 4N	227	240	34.5
Bangkok Blue	192	203	43.9
Fatima	----	46	32.9
Big White Jumbo	112	136	36.4
Madam Pink	218	259	46.5
Channel	----	65	32.6
Daang Saard	125	71	33.28
Erika	259	279	44.6
Julie	192	197	36.3
Kating Dang	260	248	27.5
Lervia	112	147	41.3
Madam Pompadour	177	185	43.4
Triple Pink	185	144	37.6
Emma White	199	134	31.4
Ear Sakul	209	127	47.8
Thongchai Gold	172	163	34.6
SE m	1.87	1.67	1.24
CD 5%	3.08	2.75	2.05

length of flowering pseudobulb (cm), number of internodes of flowering pseudobulb, length of longest internode of flowering pseudobulb (cm), diameter of longest internode (cm), number of leaves/cane, maximum leaf length (cm), leaf width (cm), spike length (cm), rachis length (cm), number of spikes/cane, no of florets/spike, diameter of floret (cm), longevity on plants (days) and vase life (days). Changes in total carbohydrate

content of pseudobulb and flowers for all the 16 treatments were estimated using Phenol Sulphuric Acid Method (Bhattacharjee and De, 2005). Each 100mg of the tissues were hydrolyzed by keeping in boiling water bath for 3 hours with 5ml of 2.5N HCl and cooled to room temperature. Then it was neutralized with sodium carbonate until effervescence ceases and made up to the volume to 100 ml and centrifuged. 0.2, 0.4, 0.6, 0.8 and 1 ml of the working standard were pipetted out into a series of test tubes. The sample solution of 0.1 ml and 0.2ml was pipetted out in two separate test tubes and made up the volume in each tube to 1 ml with water. A blank with 1ml of water was set. 1ml of phenol solution was added to each tube. 5ml of 96% sulphuric acid was added to each tube and shaken well. After shaking for 10 minutes, tubes were placed in water bath at 25 to 30^{o}C for 20 minutes. The colour was read at 490nm. The amount of total carbohydrate present in the sample was calculated using the standard graph. Chlorophyll content in leaf was estimated for all 16 treatments using SPAD Chlorophyll Meter.

RESULTS AND DISCUSSION

Out of sixteen hybrids of Dendrobium evaluated, fourteen hybrids came into flowering. Maximum length of flowering pseudobulb (55cm) and number of internodes (17) was recorded in 'Big White Jumbo', whereas longest internode (6cm) in 'Lervia' (Table 1). The hybrid 'Daang Saard' had highest diameter of longest internode (2.6cm), maximum leaf length (14.5cm) and leaf width (6.5cm). Number of leaves per cane (13) was found maximum in case of 'Big White Jumbo' and minimum in Ear Sakul (3.5). These variations may be due to varied genetic make up of different hybrids along with prevailing environmental conditions. Significant variations were also observed with reproductive parameters. It is evident from Table 2 that the spike length varies from 21.9cm in 'Triple Pink' to 47.7 cm in case of 'Madam Pink'. Rachis length was maximum in 'Madam Pink'(32.7cm) and minimum in 'Lervia'(11.8cm).

Highest number of spikes/cane was recorded in 'Julie' (4.0) followed by 'Thongchai Gold' (3.0) and 'Big White Jumbo'(3). 'Madam Pink' had highest number of florets/spike (15) while 'Emma White' had minimum (5.4). Flower diameter was recorded maximum in 'Erika' (15cm) followed by 'Kating Dang'(12cm). Flower longevity on plants was recorded highest in 'Ear Sakul' (71 days) and lowest in 'Daang Saard' (33 days). The hybrid 'Triple Pink' had the highest vase life (40 days) and lowest in 'Madam Pink' (15.3 days). It is clear from Table 3 that there were significant variations in the content of carbohydrates in pseudobulbs and flowers and chlorophyll content in leaves. Out of 16 hybrids evaluated, two hybrids viz. 'Fatima' and 'Channel' did not bloom and they had lower levels of carbohydrates and chlorophyll content.

'Fatima' had shown 46 mg/g carbohydrates in pseudobulbs and 32.9 mg/100g chlorophyll content in leaf whereas 'Channel had 65 mg/g carbohydrates in pseudobulbs and 32.6 mg/100g chlorophyll in leaves. In flower, maximum amount of carbohydrate was estimated in 'Kating Dang'(260 mg/g) and minimum in Lervia (112mg) and 'Big White Jumbo'(112 mg/g). In pseudobulb, carbohydrate content ranges from 46 mg/g in 'Fatima' to 279 mg/g in case of 'Erika' and other hybrids with higher levels of carbohydrate were 'Madam Pink' (259 mg/g), 'Kating Dang'(248 mg/g) and 'Big White 4N (240 mg/g).

In variable response to chlorophyll content in leaves, 'Ear Sakul' had maximum(47.8 mg/100 g) followed by 'Madam Pink' (46.5 mg/100g), 'Erika' (44.6 mg/100g) and minimum in 'Kating Dang'(27.5 mg/100g). Therefore, it is evident from Table 3 that carbohydrate content in pseudobulbs and flowers had significant effect on vegetative growth, flower quality and longevity in Dendrobium orchids. In cut flowers, opening of buds is determined by the status of stored carbohydrates as suggested by Van Doorn *et al*. ; Woodson, 1987; Sytsema Kalkman *et al*., 1995. Experimental evidences have shown that carbohydrates reserves of pseudobulbs and leaves have greatest impact on development of shoots and inflorescence in orchids (Hew and Ng, 1996; Ng and Hew, 2000). The pseudobulb is central in the distribution of carbon within the plant.

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