

Breeding *Dendrobium phalaenopsis*-cane type hybrid in India: NRCO-42 (*Den.* “Emma White” x *Den.* “Pompadour”)

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(Received: August 2009; Revised: August 2009; Accepted: August 2009)

Abstract

A new *Dendrobium* hybrid, NRCO-42 is developed using *Dendrobium* “Emma White” and *Dendrobium* “Pompadour” as parents. The crossing and *in-vitro* raising of progeny was done during 2003-04 and flowering obtained in 2007-08. This double hybrid flowered with features of moth type *Dendrobium* (*D. phalaenopsis*-cane type) with bigger petals, overlapping petals and sepals (unlike *D. nobile*-cane types) and purple colored (RHS N78A) having whitish shade at base. Colour enrichment over male parent could be due to the parentage of the hybrids used in crossing program and their pedigree record. More numbers of flowers are recorded in *D.* “Emma White” (9.5) than NRCO-42 (5). The color of lip throat and column are whitish pink and white respectively in NRCO-42, helped as phonological markers. Side lobes of lip in new hybrid, NRCO-42 were semi-arching over column, unlike broadly open in male parent and semi open in female parent. Pedigree record of both the hybrids that were used as parents has been traced to origin with time frame which indicated that *D. phalaenopsis*, a native species to Australia and New Guinea, might have been extensively used in development of modern hybrids of moth type (or) double humped *Dendrobiums*. All the characters described support the novelty in the new *D. phalaenopsis*-cane type i.e., moth type hybrid, NRCO-42.

Key words: *Dendrobium phalaenopsis*, *Dendrobium* species, Hybridization, section *Ceratobium*, *Dendrobium nobile*-cane hybrids

Introduction

Genus *Dendrobium* is the second largest genus, established in 1799 by O. Swartz in *Nova Acta Regiae Societatis Upsaliensis* comprises 1400 species distributed from India cross to Japan, South to Malaysia, Indonesia and east to New Guinea, Australia,

Newzeland and the Pacific Island [1]. It belongs to sub-family: Epidendroideae, sub-tribe: Dendrobiinae [2, 3] of Orchidaceae. Even though breeding in *Dendrobiums* had been done by English and European firms earlier, later by Japan and Hawaii [4], but development of many hybrids was restricted to commercial firms only. The *D. nobile*-cane type *Dendrobiums* of Eastern Himalayas and *D. phalaenopsis*-cane type of Eastern Asia were the most frequently used parents in hybridization programs. Broad range of attractive hybrids, varieties or cultivars of genus *Dendrobium* have become economically important mainly as cut flowers and potted plants in view of expansion of hotels, resorts and eco-tourism industries. This could be one of the reasons for many hybrids produced in South-East Asian countries, where tourism is highly concentrated. So, to fulfill the marketing requirements, the introduction of new varieties with shape, color and long vase life is invariably required.

At present India is largely depending on Southeast Asian countries for importing new *Dendrobium* hybrids for domestic cut flower marketing and commercial exports. Only hybrid in India, *D.* “A. Abraham” was developed by Tropical Botanical Garden and Research institute (TBGRI), Kerala in 1986 using *D.* ‘Ng Eng Cheow’ and *D.* ‘Tay Swee Keng’ as parents, even though India possess rich biodiversity of Orchid species. Efforts were made to develop new *Dendrobium* hybrid using two popular hybrids available at this center. New hybrid developed, NRCO-42 derived from two popular hybrids, *D.* “Emma White” and *D.* “Pompadour” is characterized and discussed in this paper.

Materials and methods

Both the parents, *D.* “Emma White” and *D.* “Pompadour” were procured from ICL Flora Exotica, Guwahati, Assam during 2002. Hybridization was done using *D.* “Emma White” as female parent and *D.* “Pompadour” as source of pollen. Emasculation has done on the female parent to ensure cross pollination. The capsule developed from cross was harvested and raised under *in-vitro* conditions during 2003-04 [5]. Plantlets developed were shifted to *ex-vitro* conditions and the F₁ progeny flowered after three years during December 2007. The cross was evaluated for all morphological characters at the time of flowering. The hybrid developed is compared with both parents and standard variety developed in India, *D.* “A. Abraham” [6] as a check variety. Color of the flowers was recorded with help of ‘Royal Horticultural Society color chart’.

Results and discussion

The Dendrobium hybrid, NRCO-42 (*D.* “Emma White” x *D.* “Pompadour”) flowered with purple color flowers (RHS N78A) with white shading at base (Table 3, Fig. 1) having features of *D. phalaenopsis*-cane type Dendrobium is rare combination (Fig. 1). Sepals and petals of NRCO-42 are characterized by overlapping, compact, flat and broader than both parents. The petals and sepals had red purple color, inherited from male parent, which supports the view of red flower color dominant over white [7, 8]. Purple floral pigments of flower color of *D.* “Pompadour” were due to the presence of two rare anthocyanins (cyanidin 3-(6-malonylglucoside)-7,3'-di(6-sinapyglucoside) and demalonyl derivative and other flavonol glycosides [9]. Similarly, color of column is almost white (pale whitish pink) like both parents. But, unlike floral color characters, the out curved (up right) dorsal sepal and narrow white margin to sepals from base of male parent (Fig. 3) had not expressed in new hybrid, NRCO-42 (Fig. 1). Side lobes of lip in new hybrid, NRCO-42 were semi-arching over column, unlike broadly open in male parent (Fig. 3) and semi open in female parent (Fig. 2).

Colour enrichment of new hybrid NRCO-42 over male parent could be due to the parentage of the hybrids used in crossing program and their pedigree record. Pedigree record of the parents along with check variety is shown in Table 1. Schematic representation of pedigree record of both the hybrids that were used as parents has been traced to origin with time frame is depicted in flow chart (Fig. 9). It is evident that *D. phalaenopsis*, a native species to Australia and New

Guinea [10] was used extensively in development of modern hybrids of moth type Dendrobiums. Flowers of *D. phalaenopsis* Lindl., characterized with broad overlapping sepals and petals, longer oblong mid lobe & pointed, with deep-lilac color having deep color throat, side lobes arching and spur broad was widely used in hybridization [11] for improvement of Dendrobiums. This is due to preference of compact *Dendrobium* hybrids [12] across world than *D. nobile* type hybrids. Popular old hybrid, *D.* “Pompadour” was derived using *D. phalaenopsis* Lindl., (as male parent) introduced in Thailand in 1934, proved to be land mark as it brought popularity to Orchid cultivation [13] and led to the export status of that country. The genome of *D. phalaenopsis* Lindl., had been introgressed into NRCO-42 from both the parents to a considerable extent, as female parent used, *D.* “Emma White” is a complex hybrid with a genetic make of five Dendrobium species (*viz.*, *D. phalaenopsis* Lindl., *D. tokai* Rchb.f., *D. stratoites* Rchb.f., *D. lineale* Rolfe. & *D. gouldii* Rchb.f.) and *D. phalaenopsis* Lindl., has been used five times in seven breeding programmes since 1938. Similarly, male parent used, *D.* “Pompadour” is a genetic make up of two species (*viz.*, *D. discolor* Lindley. & *D. phalaenopsis* Lindl.) and *D. phalaenopsis* was used in a backcrossing fashion constituting 87.5 % genome like BC₂ progeny since its evolving from 1929 (Fig. 9).

The source of white clouded Dendrobiums like *D.* ‘Emma white’ could be traced and attributed to *D. gouldii*, a native species from Papua, New Guinea & Solomon Islands and *D. lineale* Rolfe. & *D. stratoites* Rchb.f., from Indonesia were used in earlier breeding programmes belong to section Ceratobium [14] of genus Dendrobium. Mentum shape of female parent used in current breeding programme is white and with greenish broadly blunt mentum (Fig. 6), where as in NRCO-42, it is observed to be broadly straight, pointed (Fig. 5); conical in male parent (Fig. 7) and conical, pointed & curved in *D.* “A. Abraham” (Fig. 8) could make the level of differences. Pseudo-stem length is recorded higher in *D.* “Pompadour” than female parent and hybrid. The morphological characters of hybrid and parents are shown in Table 2.

The flower size (6.9 cm x 7.7 cm), dorsal sepal size (4 cm x 1.8 cm), lateral sepal size (4.4 cm x 2 cm), petal size (4.4 cm x 3.8 cm) of hybrid, NRCO-42 (Fig. 1) showed superiority over both the parents and check cultivar (Table 3). But, more numbers of flowers are recorded in *D.* “Emma White” (9.5) than NRCO-42 (5). The color of lip throat and column is whitish pink and



Fig. 1. Flower of NRCO-42 (*D.* “Emma White” x *D.* “Pampadour”)



Fig. 5. Mentum shape of NRCO-42



Fig. 2. Flower of *D.* “Emma White” (Female parent)



Fig. 6. Mentum shape of *D.* “Emma White”



Fig. 3. Flower of *D.* “Pampadour” (Male parent)



Fig. 7. Mentum shape of *D.* “Pampadour”



Fig. 4. Flower of *D.* “A. Abraham” (Standard check)



Fig. 8. Mentum shape of *D.* “A. Abraham”



Fig 9. Schematic representation of pedigree record of parents and their lineage with time frame

Table 1. Pedigree record of parents *D.* “Emma White”, *D.* “Pompadour” and check variety

Characters	<i>D.</i> “Emma white”***	<i>D.</i> “Pompadour”	<i>D.</i> “A. Abraham”
Female parent	<i>D.</i> “Singapore White”	<i>D.</i> “Louis Bleriot”	<i>D.</i> ‘Ng Eng Cheow’
Male parent	<i>D.</i> “Joan Kushima”	<i>D. phalaenopsis</i>	<i>D.</i> ‘Tay Swee Keng’
Registrant name	T. Orchids, Thailand	V.	-
Originator name	O/U*	V.	TBGRI, Kerala
Date/year of registration with RHS	05/09/2006	01/01/1934	1986
Source	http://www.rhs.org.uk/plants/registerpages/orchiddetails.asp?ID=135363	http://www.rhs.org.uk/plants/registerpages/orchiddetails.asp?ID=48162	INGR No. 03094, IC 401584 (Orchid news’ Dec. 2004)

*O/U—early registrants and many originators un-known is indicated as per Royal Horticultural Society (RHS), London, ***D. x superbiens* is a natural hybrid of *D. phalaenopsis* var. *Schroederianum* and *D. discolor*, ***Introduced at center initially as *D.* ‘White’ in 2002

Table 2. Morphological characters of *D.* “Emma White”, *D.* “Pompadour” and their hybrid

*Characters	<i>D.</i> “Emma White”	<i>D.</i> “Pompadour”	NRCO-42
Plant	Size 55-60 cm, leaves - 15.5 cm x 3.5 cm, medium green color, narrow ovate with asymmetric acute tip, green margin at bottom, pseudostem – 32 cm x 1.05 cm, linear, semi-erect, grooves on old canes	Size 14.4-25 cm, leaves – 15 cm x 3.5 cm, medium green color, narrow elliptic with acute tip, margins maroon at lower side, 1.3 cm, linear, moderately stout, semi-erect, grooves prominent on old canes & tapering at top portion,	Size 32 cm, leaves – 19 cm x 2.9 cm, dark green color, narrow pseudostem – 42 cm x elliptic with acute tip, pseudostem – 20 cm x 1.5 cm, linear, semi-erect

*At the time of flowering

Table 3. Floral characteristics of NRCO-42 (*Dendrobium* “Emma White” x *Dendrobium* “Pompador”) with parents and a check variety

	F ₁	Female parent (1)	Male parent (2)	Std. check (3)
<i>Floral Traits</i>	NRCO-42	<i>D.</i> “Emma White”	<i>D.</i> “Pompador”	<i>D.</i> “A. Abraham”
<i>Flower size</i>	6.9 x 7.7 (cm)	4.85 x 4.85 (cm)	6.05 x 6.25 (cm)	5.5 x 5.8 (cm)
<i>Flower color</i>	Purple (RHS N78A) with white shading at base	White, Netting (RHS 145B)	Purple (RHS N78B) with white shading from base to sepals	Purple (RHS N78A)
<i>Flower type</i>	Overlapping & compact	Open & semi-compact	Open	Open and pointed
<i>No. of flowers</i>	5	9.5	4.5	4.5
<i>Dorsal sepal size</i>	4 x 1.8 (cm)	3.1 x 1.35 (cm)	3.7 x 1.45 (cm)	3.45 x 1.35 (cm)
<i>Dorsal sepal shape</i>	Elliptic with obtuse tip	Narrow oblong	Broadly elliptic, out curved with acute tip	Oblong moderately
<i>Lateral sepal size</i>	4.4 x 2 (cm)	3.15 x 1.5 (cm)	3.75 x 1.7 (cm)	3.3 x 1.5 (cm)
<i>Lateral sepal shape</i>	Elliptic with acute tip	Narrow oblong with obtuse tip	Broadly elliptic, curved & acute tip	Falcate, acute tip
<i>Petal size</i>	4.4 x 3.8 (cm)	3.3 x 2.05 (cm)	3.95 x 2.95 (cm)	3.6 x 1.9 (cm)
<i>Petal shape</i>	Obovate	Obovate	Obovate	Spatulate
<i>Lip size</i>	3.5 x 1.7 (cm)	2.6 x 1.7 (cm)	3.8 x 1.5 (cm)	2.8 x 1.65 (cm)
<i>Color of lip throat</i>	Whitish pink	Yellow green & fine fringing (RHS 145B)	Green Yellow (RHS 1D)	Purple (RHA N79B)
<i>Column color</i>	Whitish pink	White	Yellowish (RHS 2D)	Deep purple with Creamy white (RHS 157A) anther cap
<i>Column length</i>	1.8 cm	1.8 cm	1.6 cm	1.7
<i>Mentum shape</i>	Broad, straight & pointed	Broadly blunt	Conical	Conical, pointed & curved
<i>Flowering days</i>	25	28	31	-

1,2 & 3 are based on two years data (2007-08 & 2008-09)

white respectively in hybrid, NRCO-42 and purple and deep purple with creamy white anther cap in check cultivar (*D.* “A. Abraham”) respectively helped as phonological markers for recoding differences. Floral characters of hybrid NRCO-42 along with parents and *D.* “A. Abraham” as standard check is presented in Table 3 for comparison. All the characters described support the novelty in the new moth type hybrid, NRCO-42.

Preference of *D. phalaenopsis*-cane type cultivars over *D. nobile*-cane type cultivars is due to ever green type with long branching flowering inflorescence, unlike flowers attached to canes, epiphytic and pendulous in latter case. More over, the difficulty of flowering observed in *D. nobile*-cane type cultivars and related species of Asiatic origin (India, Southern China & Burma) in other counties is observed, as plants show semi-deciduous

nature after flowering and require cool winter phase and cannot be used as cut flowers. *D. phalaenopsis*-cane type cultivars have been developed from inter-sectional crossings of *Dendrobium* than *D. nobile*-type cultivars developed from species *D. nobile* Lindl. [5], could be the other reason on compatibility for successful breeding programmes. Counties like Thailand, Singapore, Malaysia and Japan are involved in *Dendrobium* cut flower trade. Even though, this hybrid development is done on academic interest, the novelty obtained in the hybrid could give good insight for further improvement, as commercial breeding ventures in India are at infancy stages, unlike crop oriented production programs like mass multiplication and commercial production of cut flowers.

Acknowledgements

The efforts and dedication of Late Dr. V. Nagaraju, Principal Scientist (Horticulture) for raising the progeny is highly acknowledged. Authors thank Mr. K.B. Monger for field assistance for proper maintenance during *ex-vitro* hardening phase of this hybrid.

References

1. **Lucksom S. Z.** 2007. The Orchids of Sikkim and North East Hilalaya. Concept, Siliguri 734 001, 607 p.
2. **Dressler R. L.** 1993. Phylogeny and classification of the Orchid family. Cambridge University Press.
3. **Pridgeon A. M., Cribb P. J., Chase M. W. and Rasmussen F. N.** 1999. Genera Orchidacearum. Vol. 1. Oxford: Oxford University Press.
4. **Abraham A. and Vatsala P.** 1981. Introduction to Orchids. Tropical Botanic Garden and Research Institute, Trivandrum 69 5 011, India. 533 p.
5. **Anonymous.** 2005. Annual Report 2004-05, National Research Centre for Orchids, ICAR, Pakyong 737106, Sikkim, pp. 4.
6. **Gupta V., Anjali K., Chaudhary A. B. and Singh A. K.** 2004. *Dendrobium* 'A Abraham' (INGR No. 030094; National identity IC No. 401584). *In: News from Orchid Centres, NBPGR, Pusa Campus. Orchid News*, **20**: 5-6.
7. **Kamemoto H. and Storey W. B.** 1955. Genetics of flower color in *Asystasia gangetica*, Linn. *Pacific Science*, **IX**: 62-68.
8. **Chongqing X. and Mosjidis J. A.** 2001. Inheritance and linkage study of isozyme of isozyme loci and morphological traits in red clover. *Euphytica*, **119**: 253-257.
9. **Williams C.A., Greenham J., Harborne J. B., Kong J. M., Chia L. S., Goh N. K., Saito N., Toki K. and Tatsuzawa F.** 2002. *Biochemical Systematics and Ecology*, **30**: 667-675.
10. **Veich J. and Sons.** 1887-1894. A manual of Orchidaceous plants cultivated under glass in Great Britain, Part III *Dendrobium*, *Bulbophyllum* and *Cirrhopetalum*. James Veitch & Sons, Royal Exotic Nursery, 544, King's Road, Chulesa, S.W. pp. 69.
11. **Baker M. L. and Baker C. O.** 1996. *Orchid Species Cultivation: Dendrobium*. Timber Press, Cambridge, UK.
12. **Charles M. F.** 2003. *Dendrobium hybrids. Orchids*, **72**: 662-665.
13. **Thammasiri K.** 1998. *Technology of Orchid Production*. Amarin Printing and Publishing PLC, Bangkok.
14. **Teoh E. S.** 2005. *Orchids of Asia*. Eds 3. Marshall Cavendish Publishers, 367 p.
15. **Ando T.** 1982. Crossability of selected species in the section *Eugenanthe* Schlechter. *In: Experimental taxonomy of the Genus Dendrobium Swarz. (Orchidaceae), Acylated anthocyanins and flavonols from purple flowers of Dendrobium cv. 'Pompadour'*. Technical Bulletin, Faculty of Horticulture, Chiba University, 1-6.