वार्षिक प्रतिवेदन

ANNUAL REPORT

2005-2006

राष्ट्रीय आर्किड्स अनुसंधान केन्द्र

पाक्योंग- 737 106, सिक्किम

National Research Centre for Orchids

Pakyong-737 106, Sikkim

NRC Orchids

भाकृअनुप
ICAR

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Published by
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Correct citation
NRCO, 2006. Annual Report 2005-06
National Research Centre for Orchids
Pakyong, Sikkim

January 2007

Preface

INDIA had vast potential to emerge as a major player in the flower export market, which is estimated at $ 11 billion at present and expected to grow up to $16 billion by 2010. The flower trade of the country is accounted for just 0.2 per cent of world flower exports last year at Rs 305 Crore. Though many states in the country had the conducive weather for production of quality floriculture material, they lagged behind in flower exports due to various bottlenecks being faced by growers and exporters including non availability of quality planting material, lack of market facilities, high freight rates, failure to take up periodical re-plantation of flower plants and reluctance of large land holders to enter the field of floriculture. There is an urgent need to showcase India as a reliable supplier of quality floriculture products. It needs joint effort from various agencies like National Horticulture Mission, National Horticulture Board, APEDA, Union and state governments in this direction. The need of the hour is to form a common forum to take care of common issues.

World orchid trade allured Indians to set up modern farms to go for orchid cultivation. Commercial orchid production requires not only entrepreneurial skills coupled with knowledge to manage and operate a disease and pest free farms and production of quality flowers acceptable in international markets, but it is also vitally important to achieve global production standards in order to become price competitive. Growers in India are dire in need of quality planting materials of internationally accepted varieties/hybrids, hybrids from indigenous germplasm for cut flower and pot plants, advanced farm management and growing skill, updated information on cost benefit ratio, latest scientific inputs from research institution to produce and cultivate new and disease free varieties round the year, development of cost effective greenhouse technology suitable to Indian conditions for growing international standard orchids, etc. Considering the fact this centre is working on multidimensional research projects so that present constraints can be minimized and entrepreneurship development trend established for employment generation in this country.

I take this occasion to express my gratitude to Dr Mangala Rai, Secretary DARE and Director General, ICAR and Dr G Kalloo, DDG (Horticulture & Crop Science) for their keen interest in the research activities of the Centre and providing necessary suggestions and support for its strengthening. My thanks are also due to Dr V S Nagrare, Dr T K Bag and Dr Ramgopal Devdas for their dedicated efforts for compilation and editing of Annual Report 05–06. I also place on record the support that I enjoyed during the year from scientists as well as the technical, administrative and auxiliary staff of this Centre.

(R C Upadhyaya)
Director

Pakyong
October 2006

Executive Summary

- Leaf samples of 188 Indian orchids species were extracted and quantified for foliar pigments—chlorophyll-a, chlorophyll-b, total chlorophyll and carotenoids. In all the species significant variation in pigment concentrations was observed.
- In peloric flowers of *Cymbidium* hybrid significant variation in lip colour observed and the sepals of peloric flowers showed the presence of anthocyanin pigments whereas this pigment was absent in the normal flowers.
- Total phenol was estimated in 50 species out of which 15 species showed very high phenol content.
- About 1,023 crosses were made in different combinations of orchid species to study the crossability behavior of orchids to understand the compatibility and success of pod formation. The overall success of crossing in orchids was found to be 51.6%.
- About 51 selfing and crossing in different combination was made in *Cymbidium* species and hybrids and the capsules harvested were cultured for raising progeny through *in vitro* culture.
- The F_1 progeny derived from the cross of *Epidendrum radicans* and *Epidendrum xanthinum* resulted in lengthy lateral sepal (1.9 cm) and appealing orche color which was distinguishing character of the progeny.
- Out of 70 selfed and crossed capsules of different orchids species, embryos from 9 responded and formed Plbs, while 17 did not respond to any media.
- In *in vitro* and pre-hardening of *Cym.* 'Sleeping Nymph', seedling growth and development was found best in MS media supplemented with 100 ml coconut water, as it recorded maximum plant weight, shoot length with well developed leaves, roots and roots diameter.
- In *in vitro* differentiation of *Cym.* 'Soul Hunt-I' in media supplemented with different cytokines showed significant differences for shoot length, leaf length, root number and plant weight.
- Growing *Cymbidium* in cattus bark + maize cob + leaf mould (1 : 1 : 1) media and application of nitrofoska (19 : 19 : 19) at 1 g/l weekly twice improved vegetative growth as well as flowering.
- Growing *Cymbidium* in 75% shade and application of 50% water (300 ml) in 6" pot improved vegetative growth in terms of leaf number (8.00), leaf length (44.17 cm), pseudobulb girth (2.45 cm) and leaf area index (515.1 cm^2).
- Module containing leaf mould + FYM + charcoal + coconut husk + rotten logs (2 : 1 : 1 : 1 :1) and spraying with N 200 ppm, P 100 ppm K 100 ppm + BA 100 ppm and GA_3 100 ppm produced maximum plant height (73 cm), highest number of shoot (5.15), spike length (77.9 cm) and number of flower/spike (17) in *Cym.* Soul Hunt 6.
- Basal application of VAM along with NPK produced greatest length (40.9 cm) and number of leaves (8.2)/ plant in *Gladiolus.*
- The soaking of bulblets of Asiatic lily cv. Nove Cento in aqueous solution of ethylene (50 mg/l) increased the weight of bulb nearly twice that of control.
- The bulb scales of Asiatic lily cv. Brunello when slated at the base at different depth increased the number of bulblets production per scale
- During survey in Darjeeling, orchid diseases like black rot on several *Cymbidium* hybrids, orchid wilt on *Paphiopedilum insigne* and *Sclerotinia* rot on *Goodyera* and *Anoectochilus* were recorded.
- A new orchid disease *Sclerotinia* white rot caused by *Sclerotinia sclerotiorum* was isolated, characterized and documented on *Goodyera* and *Anoectochilus.*

- A new rust orchid disease caused by *Puccinia* sp. on *Satyrium nepalense* was isolated, characterized and documented.
- Orchid wilt caused by *Sclerotium rolfsii* was monitored and recorded on *Cymbidium elegans*, *C. erythraeum*, *C. dayanum*, *C. grandiflorum*, *C. traceyanum*, *C. longifolium*, *C. hookerianum* and *Vanda stangeana*.
- Different orchid isolates of *Sclerotium rolfsii* were isolated and purified on PDA. So far 6 isolates of *Sclerotium rolfsii* were collected on different orchid species.
- Black rot was recorded on *Cymbidium hookerianum*, *C. erythraeum*, *C. ensifolium*, *C. munronianum*, *C. tigrinum*, *C. aloifolium*, *C. traceyanum*, *C. devonianum* and *C. iridiodes*. The disease was also recorded on *Cym.* Arabian night, *Cym.* Yankalila and *Cym.* Sara Gean, *Dendrobium nobile* and *Oncidium* Gower Ramsey.
- In black rot management of *Cymbidium* through fungicides, Metalaxil @ 0.01% gave encouraging results with lowest rate of infection (5.33%) followed by thiophanate methyl (7.33%) and carbendazim (11.33%).
- During the year under report orchids were observed to be re-infested by various kind of pests. The pests infested on orchids, plant portion affected an duration of occurrence was recorded.
- The plants of *Dendrobium nobile* were infested by different pest during the year, viz. biosdual scal shoot borer, aphid, black thrips and yellow beetle.
- Least shoot borer damage was observed whe *Dendrobium nobile* plants were grown in medi coconut husk followed by bare rooted plants an coco peat.
- In the management of shoot borer *Peridaedala* sp. o *Dendrobium*, treatment of econeem (10,000 ppm) 2. ml/l and chlorpyriphos 20 EC 2.5 ml/l resulted i least damage as compared to the other treatmen and control.
- The centre produced seedlings of *Cymbidium* – 2,09 seedlings of Marigold – 6,000 and 4 kg seed seedlings of *Chrysanthemum* – 10,000, corms *Gladiolus* – 10,000 and cormels – 1 lakh, corms *Freesia* – 2000, seeds of seasonal flowers – 8 kg.
- The centre organized six training programmes various topics and trained 20 trainers from sta Department of Horticulture/Agriculture and 7 farmers of Northeastern states.

Contents

1 Introduction

THE CENTRE

The National Research Centre for Orchids was established by the Indian Council of Agricultural Research (ICAR), New Delhi on 5th October 1996 in order to improve the productivity, quality and utility of orchids. Sikkim State authorities handed over 22.19 acres of land belonging to regional agricultural centre along with all other assets. In October 1997 the centre also took over the Darjeeling campus from of CPRI.

In the initial years of the establishment the major focus of research was on collection, evaluation, characterization and utilization of available germplasm in the region in particular, and in the country in general. With the changing scenario of floriculture in the country, the centre has modified its approach and thrust areas of research to meet the challenges. Today the focus is on development of exportable varieties, standardization of agro-techniques, post harvest management, production of quality planting material and creation of repository of information related to all aspects of temperate orchids. On the recommendations of consecutive RACs all the research projects have been modified on the mission oriented research programme on crop improvement, crop production, crop protection and post harvest management.

Accordingly for resolving major constraints in production of orchids, the Centre has mission mode approach with following mandate.

- To collect, evaluate, characterize and conserve germplasm of orchids and other bulbous flowering plants.
- To develop hybrids/varieties suitable for domestic and export market.
- To develop production, protection, and post-harvest technologies for orchids and flowering bulbous plants.
- To act as a national repository for scientific information on mandate flower crops.
- To coordinate research with other scientific organizations and act as centre for training.

The research work is being carried out under 9 projects. In addition to these, research work is also carried out under externally funded projects- Technology Mission on Integrated Development of Horticulture in North Eastern States including Sikkim, Uttaranchal, Himachal Pradesh and Jammu & Kashmir (Mini-Mission I), AP Cess fund Project and two network Projects on Distinctiveness, Uniformity and Stability of seed and Utilization of wild species in crop improvement.

SALIENT RESEARCH ACHIEVEMENT

Crop improvement

Leaf samples of 188 Indian orchids species were extracted and quantified for foliar pigments - chlorophyll-a, chlorophyll-b, total chlorophyll and carotenoids, in all the species significant variation in pigment concentrations was observed. The overall success of crossing in orchids was found to be 51.6%. The F_1 progeny derived from the cross of *Epidendrum radicans* and *Epidendrum xanthinum* resulted in lengthy lateral sepal and appealing orche color. In *in vitro* differentiation of *Cym.* 'Soul Hunt-I' in media supplemented with different cytokines showed significant difference for shoot length, leaf length, root number and plant weight.

Crop production

Growing of *Cymbidium* in cattus bark + maize cob + leaf mould (1 : 1 : 1) media and application of nitrofoska (19 : 19 : 19) at 1 g/l weekly twice improved vegetative as well as flowering. Growing of *Cymbidium* in 75% shade and application of 50% water (300 ml) in 6" size pot improved vegetative growth in terms of leaf number, leaf length, pseudobulb girth and leaf area index. Module containing leaf mould + FYM + charcoal+ coconut husk + rotten logs (2 : 1 : 1 : 1 : 1) and spraying

with N 200 ppm, P 100 ppm K 100 ppm + BA 100 ppm and GA_3 100 ppm produced maximum plant height, highest number of shoot, spike length and number of flower/spike in *Cym.* Soul Hunt 6. The soaking of bulblets of Asiatic lily cv. Nove Cento in aqueous solution of ethylene (50 mg/l) increased the weight of bulb nearly twice that of control.

Crop protection

Two new orchid diseases, viz. *Sclerotinia* white rot caused by *Sclerotinia sclerotiorum* on *Goodyera* and *Anoectochilus* and rust caused by *Puccinia* sp. on *Satyrium nepalense* was isolated, characterized and documented. So far 6 isolates of *Sclerotium rolfsii* were collected on different orchid species. Black rot was recorded on many *Cymbidium* species and hybrids. Application of Metalaxil @ 0.01% gave encouraging results with lowest rate of infection (5.33%) followed by thiophanate methyl (7.33%) and carbendazim (11.33%). The plants of *Dendrobium nobile* were infested by 5 different pest during the year, viz. biosdual scale, shoot borer, aphid, black thrips and yellow beetle. In the management of shoot borer *Peridaedala* sp. on *Dendrobium*, treatment of econeem (10,000 ppm) 2.5 ml/l and chlorpyriphos 20 EC 2.5 ml/l resulted in least damage.

EXTENSION AND TRANSFER OF TECHNOLOGY

The centre organized six training programmes on various topics and trained 20 trainers from state department of Horticulture/Agriculture, and 71 farmers to cater the specific needs and demand of Northeastern states.

LINKAGES AND COLLABORATION

The centre established linkages with DAC, Ministry of Agriculture, New Delhi, IIHR, Bangalore, CIMAP, Pantnagar Centre, CITH, Srinagar, NBPGR New Delhi and Regional Centre at Shillong and Shimla, IARI Regional station Katrain, GBPUA&T, Pantnagar, VPKAS, Almora, ICAR Research Complex for NEH region, Barapani and its Regional Centers, HPKV, Palampur, CPCRI, Regional Centre Kahikuchi, UHF, Solan, CPRI Regional station Shillong, SKUAST(J) & (K), Srinagar, CAU, Imphal and AAU, Assam.

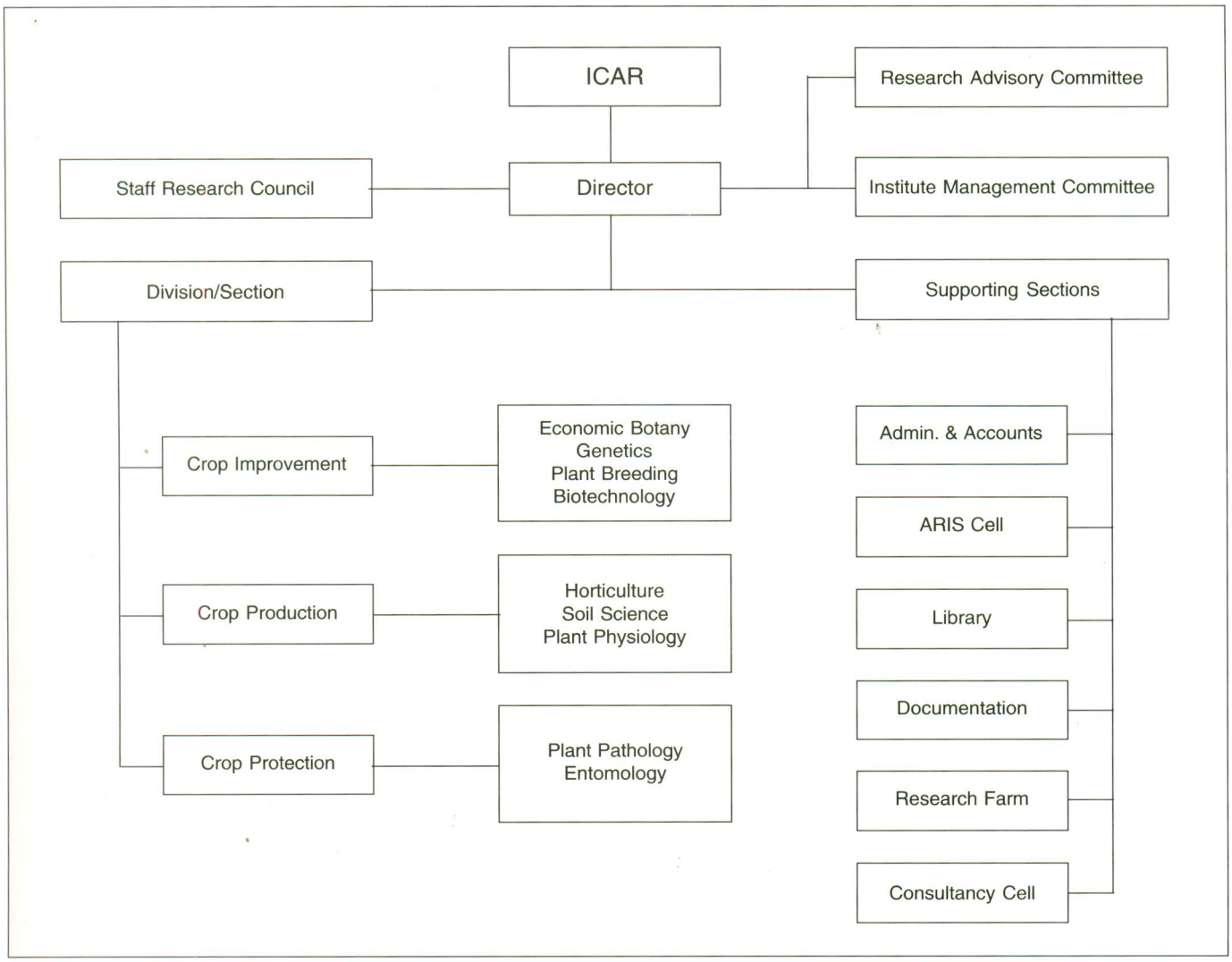
FARM DEVELOPMENT

Six poly houses under institute fund and 2 under DUS project have been constructed. Transformer and generator were ready for handing over from CPWD.

PLANTING AND SEED MATERIAL

The centre produced seedlings of *Cymbidium* – 2,093, seedlings of marigold – 6,000 and 4 kg seeds, seedlings of *Chrysanthemum* – 10,000, corms of *Gladiolus* – 10,000 and cormels – 1 lakh, corms of *Freesia* – 2,000, seeds of seasonal flowers – 8 kg.

ORGANIZATIONAL SET UP



Staff Strength
(As on 31.03.2006)

Staff	Sanctioned	Filled
Scientific	15	8
Technical	6	5
Administrative	6	5
Supporting	5	5
Total	32	23

Financial statement

(Figures in Rupees)

Head of Account	Non-Plan		Plan	
	Sanctioned	Utilized	Sanctioned	Utilized
Establishment Charges	50,00,000	48,65,435	–	–
Labour wages	–	–	7,00,000	6,98,358
Traveling allowances	90,000	1,09,807	4,00,000	3,38,155
Other charges	8,00,000	7,45,892	33,50,000	30,06,234
Works	10,000	–	65,00,000	59,17,560
HRD	–	–	50,000	39,632
Total	59,00,000	57,21,134	1,10,00,000	99,99,939

Revenue generation

Particulars	Amount (Rs)
Sale of farm produce	24,043
Sale of tender form	8,600
Training	79,000
Forfeiture of EMD	15,000
Total	1,26,643

Reseach Achievements

CROP IMPROVEMENT

Cytogenetical research on orchids

Biochemical Analysis of orchids

Estimating foliar pigment concentrations of Indian orchids

Plant pigments especially chlorophyll, chlorophyll-a, chlorophyll-b and carotenoids are the most important pigments to convert the light energy to chemical energy. As a result leaf pigment quantification is a useful parameter to study the variation both between and within the species. The amount of solar radiation absorbed by a leaf is largely the function of the foliar pigment concentrations responsible for photosynthesis. Therefore low concentration of foliar pigments mainly the chlorophyll can directly limit the photosynthetic potential.

Moreover much leaf nitrogen is generally incorporated in chloroplasts, so the estimation of chlorophyll contents can gives an indirect measure of nutrient status of the plant. Considering the above facts leaf samples of 188 species, which are maintained in the polyhouses of this centre were collected for the extraction and quantification of the foliar pigments—chlorophyll-a, chlorophyll-b, total chlorophyll and carotenoids. The result revealed significant variation in pigment concentrations in all the species under study.

Cluster/multivariate analysis was carried out according Euclidean distances based on Single Linkage method using the software STATISTICA 5.0 to know

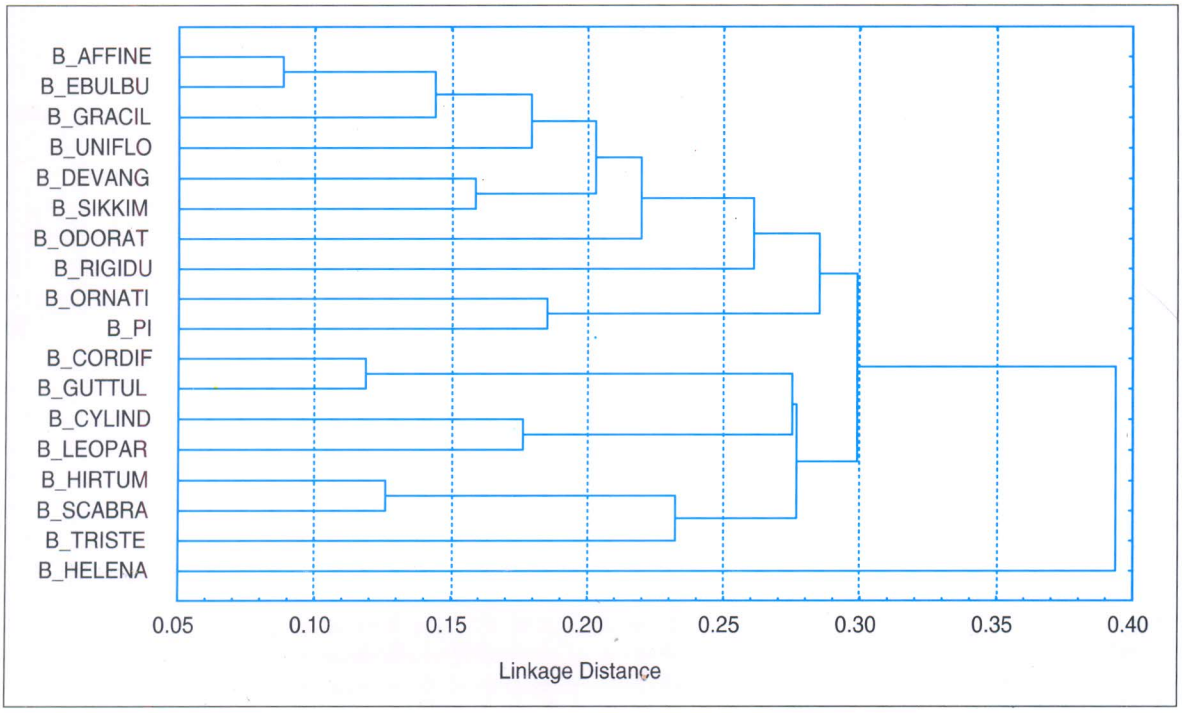


Fig. 1. Linkage distance in genus *Bulbophyllum*

the relationships of different species of some important genus like *Bulbophyllum*, *Coelogyne*, *Cymbidium*, *Dendrobium*, *Eria* and *Vanda*.

Genus *Bulbophyllum* – 18 species were evaluated under this genus for the four important foliar pigments (Fig 1).

Genus *Coelogyne* – 11 species were studied under this genus. All the species are grouped in 4 groups (Fig 2).

Genus *Cymbidium* – 18 species were evaluated under this genus. The result revealed that all the species are grouped in 4 distinct group except the species *C. elegens* and *C. tigrinum* (Fig 3).

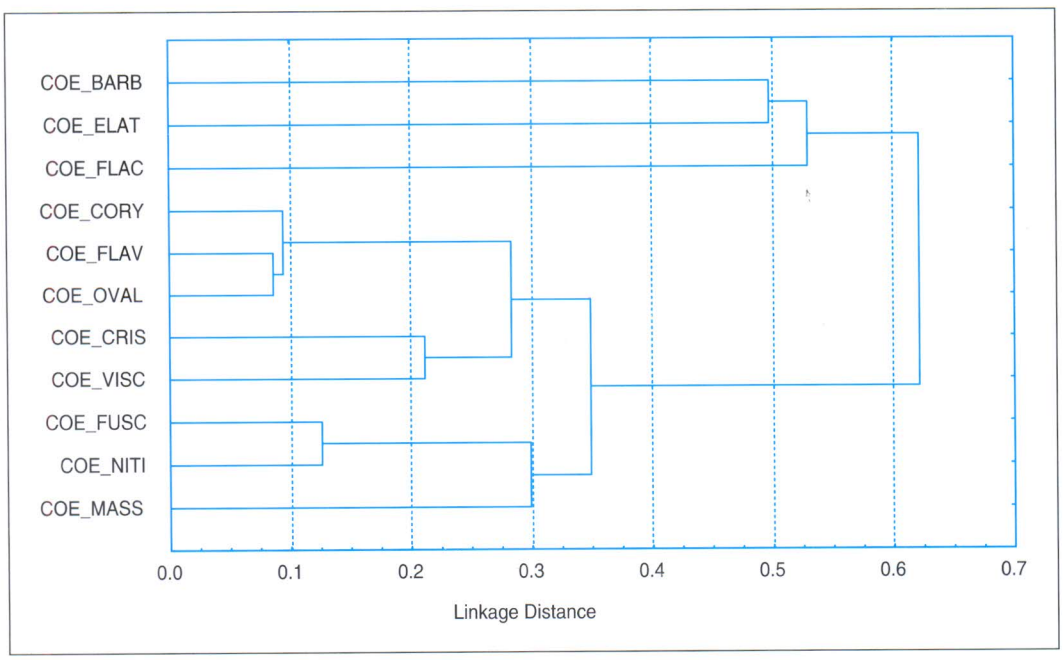


Fig. 2. Linkage distance in genus *Coelogyne*

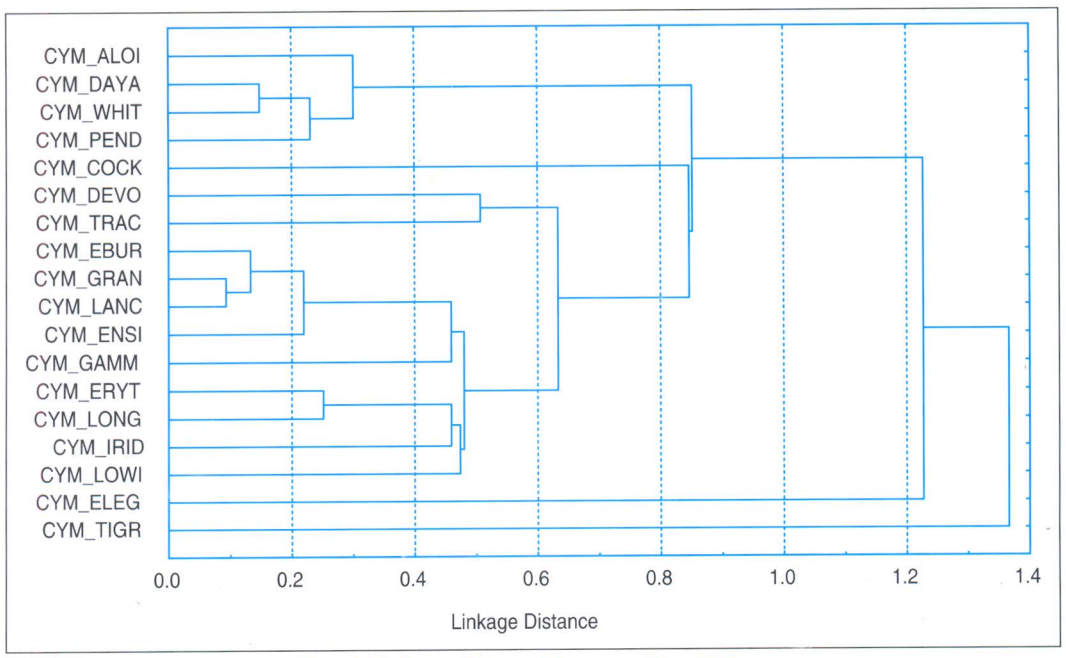


Fig. 3. Linkage distance in genus *Cymbidium*

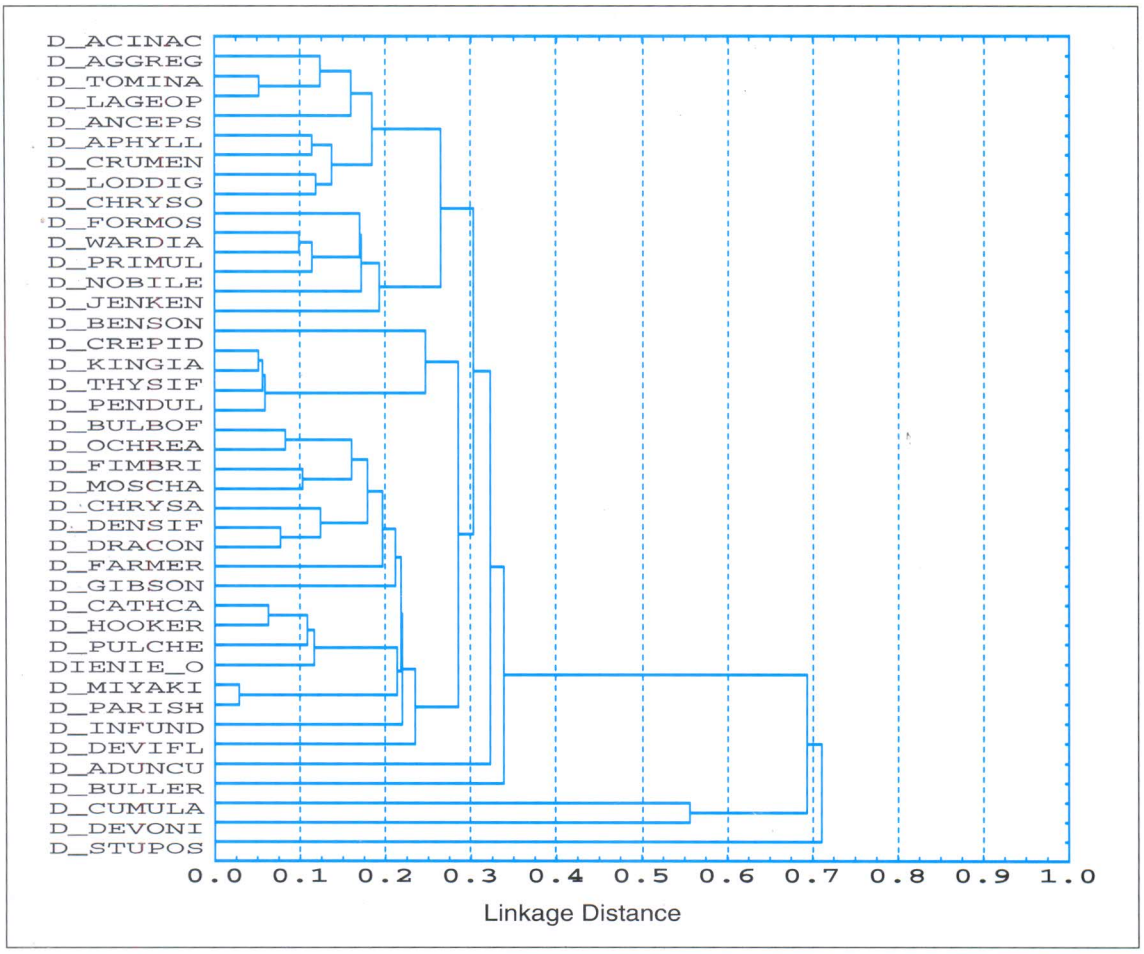


Fig. 4. Linkage distance in genus *Dendrobium*

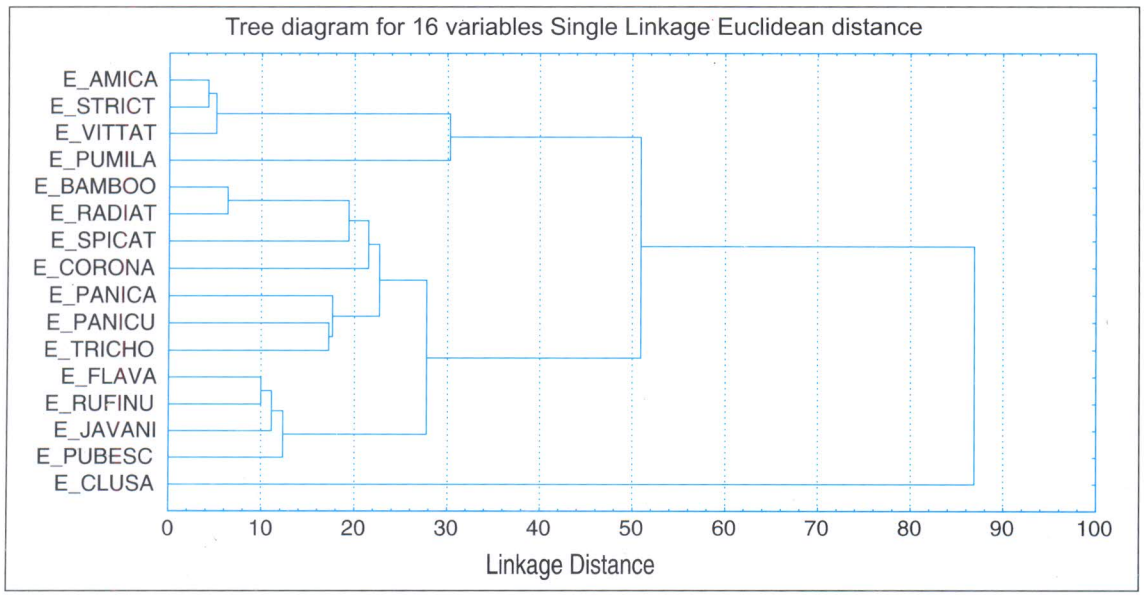


Fig. 5. Linkage distance in genus *Eria*

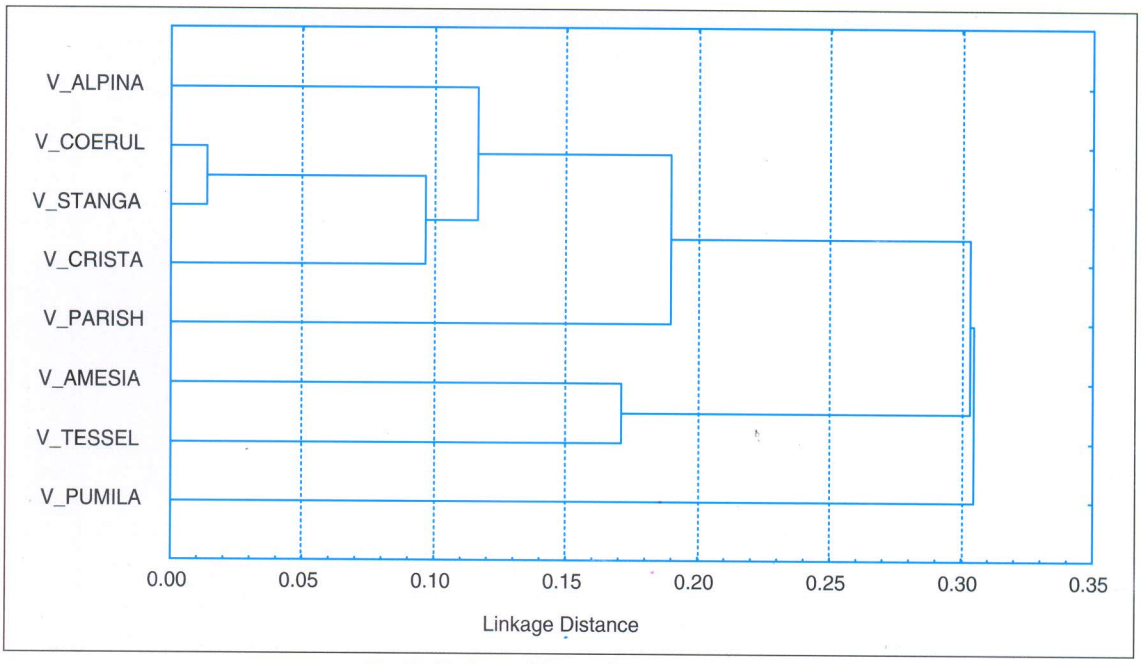


Fig. 6. Linkage distance in genus *Vanda*

Genus *Dendrobium* – 41 species were studied under this genus (Fig 4).

Genus *Eria* – Cluster multivariate analysis was calculated based on the four pigments content, viz. chlorophyll-a, chlorophyll-b, total chlorophyll and carotenoids of the 16 *Eria* species. In the diagram, 15 out of 16 *Eria* species were divided into four distinct clusters that represented four groups of pigment contents. The species *E. clusa*, which had highest content of all the four pigments is separated from the four clusters groups owing to its extreme attributes (Fig 5).

Genus *Vanda* – 8 species were evaluated under this genus and the species are grouped in two distinct group (Fig 6).

Estimation of anthocyanin pigments in orchid species

Leaf anthocyanin pigments were estimated in 135 species. It was observed that out of 135 species under study anthocyanin pigment was present in the leaves of only 3 species, viz. *Aerides multiflora*, *Dendrobium aduncum* and *Eria coronaria*.

Anthocyanin pigment variation in peloric flowers of *Cymbidium* hybrid

Peloric forms of flowers were observed in the flower spike of one *Cymbidium* hybrid grown in the polyhouse in the month of January, 2006. Out of 14 flowers in the spike, 3 flowers showed peloric forms which gave a fascinating look. Floral morphology showed remarkable variation in colour, number and shape. As anthocyanin pigment is the key factor for flower colour, its content in normal and peloric flowers was estimated. The result revealed significant variation in lip colour. Even the sepals of peloric flowers showed the presence of anthocyanin pigments whereas this pigment was absent in the normal flowers. This peloric form of flower is a useful trait for breeding superior hybrids and recommended to use as parental lines.

Estimation of phenol

Total phenol was estimated in 50 species. Out of 50 species 15 species showed very high phenol content.

Breeding for superior hybrids of *Cymbidium* and other important Orchids

Studies on crossability behavior of orchids

A total of 1,023 crosses were made in different combinations of orchid species and genera existing at the centre to study the crossability behavior of orchids to understand the compatibility and success of pod formation. The overall success of crossing in orchids was

Table 1. Present status of F_1 crosses under hardening stage

F_1 crosses	Parentage	Stages	No. of plants in hardening stage
CH (A)	*C.* 'Oriental Legend' × *C.* 'Showgirl Cooksbridge'	Protocorm, Plantlet	156
AB × Sg	*C.* 'Oriental Legend' × *C.* 'Showgirl Cooksbridge'	Protocorm, Plantlet	250
F × H	*C.* 'Jung Frau Dos Peblos' × *C.* 'Showgirl Cooksbridge'	–	70
B × H	*C.* 'Goldengirl' × *C.* 'Sleeping Nymph'	–	50
H × B	*C.* 'Sleeping Nymph' × *C.* 'Goldengirl'	R C	55

found to be 51.6%. The success of pod formation after crossing resulted only 45.3% in *Cymbidium* crosses. The present study on the selfing showed the presence of self incompatibility among all *Dendrobium* species. The selfing among *Dendrobium densiflorum*, *Dendrobium moschatum*, *Dendrobium aphyllum*, *Dendrobium aduncum*, etc., resulted with no pod formation. Among the strictly selfed crosses, only 66.6% success of pod set was observed in different species of orchids.

Present status of F_1 Crosses under hardening stage

The F_1 crosses developed earlier years were under different stages and evaluation. The selection will be done in among these crosses for identifying the best F_1 lines for registration. The list of the crosses is given in Table 1.

Cultured capsules from selfing and crossed *Cymbidium* crosses

The selfing and crossing in different combination was made in *Cymbidium* species and hybrids and the capsules harvested were cultured for raising progeny through *in vitro* culture. A total of nine (self) and forty two (crossed) capsules were cultured and their present status is given in Table 2.

Table 2. Present status of cultured capsules from selfing and crossed *Cymbidium* crosses

S.N.	Parentage	Stage
PBS-05–03	*C. whitae* (Selfed)	Cultured
PBS-05–17	*C.* 'Showgirl' (Selfed)	
PBS-05–22	*C. traceyanum* (Selfed)	
PBS-05–276	*C. aloifolium* (Selfed)	
PBS-05–278	*C. aloifolium* (Selfed)	
PBX-05–10	*C.* 'Fancy Free' × *C.* 'Tetraploid Oklahama'	
PBX-05–18	*C.* 'Ammesbury' × *C.* 'Red Beauty'	
PBX-05–26	*C.* 'Canny Wine' × *C.* 'Fancy Free'	
PBX-05–27	*C.* 'Canny Wine' × *C.* 'Fancy Free'	
PBX-05–23	*C.* 'Ammesbury' × *C.* 'Fancy Free'	
PBX-05–31	*C.* 'Yankililla' × *C.* 'Red Star'	
PBX-05–33	*C.* 'Red Star' × *C.* 'Fancy Free'	
PBX-05-38	*C.* 'Fancy Free' × *C.* 'Tetraploid Oklahama'	
PBX-05–42	*C.* 'Red Star' × *C.* 'Fancy Free'	
PBX-05–56	*C. lowianum* × *C. tigrinum*	
PBX-05–57	*C. lowianum* × *C. tigrinum*	
PBX-05–61	*C. tigrinum* × *C. lowianum*	
PBX-05–71	*C.* 'Ritim Retewar' × *C.* 'Golden elf'	
PBX-05–359	*C. aloifolium* × *C. pendulum*	
PBS-05–07	*C.* 'Red Beauty' (Selfed)	Swelling
PBS-05–25	*C.* 'Fancy Free' (Selfed)	
PBX-05–14	*C. traceyanum* × *C.* 'Fancy Free'	
PBX-05–24	*C.* 'Ammesbury' × *C.* 'Fancy Free'	
PBX-05–901	*C.* 'Yankililla' × *C.* 'Red Star'	
PBX-05–903	*C.* 'Yankililla' × *C.* 'Red Star'	
PBX-05–946	*C.* 'Hawtescens' × *C.* 'Red Star'	
PBX-05-947	*C.* 'Hawtescens' × *C.* 'Red Star'	

Table 2 *(concluded)*

S.N.	Parentage	Stage
PBX-05–948	*C.* 'Hawtescens' × *C.* 'Red Star'	
PBS-05–19	*C.* 'Ammesbury' (Selfed)	Germination
PBX-05–21	*C. traceyanum* × *C.* 'Fancy Free'	
PBX-05–37	*C.* 'Yankililla' × *C.* 'Red Star'	
PBX-05–68	*C.* 'Ammesbury' × *C.* 'Red Star'	
PBS-05–447	*C.* 'Jung Frau Dos Peblos' (Selfed)	Plbs
PBX-05–29	*C.* 'Golden elf' × *C.* 'Red Beauty'	
PBX-05–34	*C.* 'Red Star' × *C.* 'Fancy Free'	
PBX-05-46	*C.* 'Red Star' × *C.* 'Ammesbury'	
PBX-05–55	*C.* 'Golden elf' × *C.* 'Red Star'	
PBX-05-67	*C.* 'Ammesbury' × *C.* 'Red Beauty'	
PBX-05–771	*C. irridioides* × *C.* 'Concerto'	
PBX-05–490	*C. grammieanum* × *C. dayanum*	Greening
PBX-05–751	*C.* 'Nonina Paleface' × *C. irridioides*	
PBX-05–772	*C.* 'Concerto' × *C. irridioides*	
PBX-05–819	*C.* 'Red Beauty' × *C.* 'Concerto'	
PBX-05–820	*C.* 'Nonina Paleface' × *C.* 'Red Beauty'	
PBX-05–826	*C. irridioides* × *C.* 'Concerto'	
PBX-05–835	*C.* 'Nonina Paleface' × *C.* 'Concerto'	
PBX-05–836	*C.* 'Concerto' × *C.* 'Nonina Paleface'	
PBX-05–842	*C.* 'Sanfrancisco Stephenson' × *C.* 'Red Star'	
PBX-05–884	*C.* 'Showgirl' × *C.* 'Red Star'	
PBX-05–897	*C.* 'Red Star' × *C.* 'Yankililla'	
PBX-05–898	*C.* 'Red Star' × *C.* 'Yankililla'	

Table 3. Attributes of parents and F_1 progeny of *Epidendrum* cross

Characters	*E. radicans*	*E. xanthinum*	F_1 Cross
Plant height (cm)	86.2	26.4	56.9
Leaf length (cm)	12.6	6.0	7.2
Leaf breadth (cm)	2.6	2.0	2.4
Pigmentation of leaf	Less	More	More
Flower length (cm)	3.5	3.3	3.4
Flower width (cm)	3.3	3.0	3.1
Flower color	Red	Orange	orche
Dorsal sepal length (cm)	1.8	1.8	1.8
Dorsal sepal width (cm)	0.6	0.6	0.6
Dorsal sepal color	Red (46B)	Orange (28A)	Orche (44A)
Lateral sepal length (cm)	1.6	1.7	1.9
Lateral sepal width (cm)	0.6	0.6	0.7
Lateral sepal color	Red	Orche	Orche
Petal length (cm)	1.6	1.5	1.7
Petal width (cm)	0.8	0.7	0.6
Petal colour	Red	Orange	Orche
Petal margin	Serrated	Plain (serrated)	Plain
Curvature of lip	Flat	Reflexed	Flat
Color of lip	Yellow	Yellow (N25D)	Mixed of red & yellow (N30)
Fringing of lip	Coarse	Coarse	finely
Column color	Red	Yellow	Orange

Epidendrum (F_1) cross with parents

Evaluation of F_1 progeny of *Epidendrum* cross

The F_1 progeny derived from the cross of *Epidendrum radicans* and *Epidendrum xanthinum* were evaluated for flowering traits. The lengthy lateral sepal (1.9 cm) and appealing orche color of the progeny were the distinguishing character of the hybrid. The comparison of the F_1 progeny along with parents is given in Table 3.

In vitro propagation of orchids: *Cymbidium* and important rare and endangered species

Morphogenetic response of embryos of various orchid crosses and species *in vitro*

A total of seventy selfed as well as crossed capsules of different *Cymbidium*, *Dendrobium*, *Vanda*, *Zygopetalum*,

Table 4. Morphogenetic response of embryos of various orchid crosses and species *in vitro*

Species/Hybrid	Media	Days taken for			
		Swelling	Greening	Germination	Plbs
Celogyne corymba	G5	32	52	63	86
	G5 + YE 200 mg/l	22	41	53	68
Cymbidium elagans	Na + 200 mg YE	66	84	101	134
	MS + 0.5 mg/l BAP	58	71	75	89
Papilionanthe teres	G5	49	65	80	89
	MS	34	41	58	74
	MS + 100 ml/l CW	50	63	79	78
Cymbidium aliofolium	MS + 0.5 mg/l BAP	33	39	45	63
PBX-05–104	MS + 100 ml CW	11	18	21	25
	B5 + 200 mg/l Malt	10	17	22	28
	MS	12	19	25	34
PBX-05–290	MA + 20 mg Y. Ext	28	32	37	
	Nitsch	25	33	35	–
	MS	29	35	37	–
PBS-05–241	GA	39	46	56	74
	GA + 150 ml CW	38	56	58	84
PBX-05-02	MS + 200 mg/l Y. Ext	55	–	–	–
	MS+0.5mg/l BAP	65	–	–	–
	B5	76	–	–	–
Cymbidium elegans × *C. gammeanum*	G5+ 100 ml/l CW	35	46	52	68

Aerides, *Rhynchostylis*, *Hygrochilus*, *Oncidium*, *Epidendrum*, *Renenthera*, *Papilionanthe*, *Phaius* and *Phalaenopsis* were harvested at 8–9 month after pollination. The harvested capsules were sterilized and aseptically cultured in different media, viz. MS (Murashige and Skoog), Gamborg (G5) and Nitsch (Na) media containing activated charcoal supplemented with (BAP), yeast, peptone, and maltose and coconut water. The different parameters like swelling, greening, global formation and germination per cent were recorded. Germinated seeds were further sub-cultured into different media for their proliferation and differentiation.

Among 70 crossed/selfed species, embryos from 9 responded and formed Plbs, while 17 did not respond to any media. The variations were noticed from 9 crossed/selfed species for swelling, germination and Plbs development. The media and its supplements had played an important role for early swelling, germination and Plbs development (Table 4).

The *Cymbidium* crosses/selfed (33) were cultured on different media using MS, Nitsch, B5 and Knudson C media with or without activated charcoal, supplemented by plant growth substances (BAP, NAA, Triacontanol and Paclobutrazol) and growth adjuvant (yeast extract, malt extract, peptone, and coconut water). The crosses showed differential response for swelling, globular formation followed by Plb development. The presence of BAP, yeast extract and coconut water in the media resulted an early swelling, globular formation and shoot initiation.

The protocorm like bodies (Plbs) regenerated from two crosses, i.e. PBX-05–178 and PBX-05–01 were cultured in six different media, viz. MS, Nitsch, Gamborg, Knudson's, Street and White with and without activated charcoal (AC). The different crosses and species responded differently to morphological characters with different media. Addition of activated charcoal in the media improved plantlet growth and established better. PBX-05–01 cross respond better for Plb multiplication in Gamborg media with and without 1.5 mg activated charcoal, followed by MS media. However, the differentiation of Plbs was early in White media with 1.5 mg activated charcoal. The protocorm of PBX-05–178 cultured on MS media with 1 mg activated charcoal recorded the fastest multiplication of Plb.

Influence of activated charcoal on *in vitro* propagation of orchid

The embryos cultured on media, without activated charcoal resulted browning due to phenol compounds extracted from seeds. The addition of activated charcoal in the media improved the plantlets growth and establishment. The MS media with 1 gm/l activated charcoal and supplemented with 0.5 mg/l BAP and 100 ml/l coconut water showed early Plbs formation. In *Cymbidium* crosses, the days taken for germination ranged from 4 weeks to 10 weeks. The responses for swelling in *Vanda* selfed ranged from 3 weeks to 6 weeks, followed by early development of protocorm. In case of *Dendrobium* crosses, the seed germination occurred within 4 weeks after culture.

Micropropagation of *Cym* 'Jung Frau Dos Peblous' and *Dendrobium* hybrid

The meristem excised from the newly emerged shoot of pseudobulb of *Cym* 'Jung Frau Dos Peblous' and Dendrobium hybrid (NRCO-42) were cultured *in vitro* on Murashige and Skoog (MS) and Nitsch media. The shoot-tip of *Cym* 'Jung Frau Dos Peblous' successfully formed the protocorm in MS with BAP 0.5 mg/l + NAA 0.25 mg/l and zeatin 1.00 mg/l+ NAA 0.25 mg/l, while the nodal of NRCO-42 cultured on Nisch media supplemented with 0.25 mg/l BAP + 0.25 NAA gave better results. The protocorm were separated and cultured for further proliferation and differentiation.

Effect of potting mixture on Epidendrum Cross (*Epidendrum radicans* x *Epidendrum xanthinum*)

The eleven months old plantlets with well developed root and shoot were transferred to hardening house. The plantlets were potted to different potting mixture. The plants, which were grown in potting mixture containing charcoal, showed better response for flower initiation, color and size. The flower initiation was early and the flower size was bigger than the other treatments. It was also noticed that the leaf color of the plant grown in charcoal, as compared to other potting mixture was deep purple. However, plant was lanky and tall. The leaves of plantlet grown in potting mixture comprising white moss + coconut husk, were very hard as compared to other treatments.

CROP PRODUCTION

Development of agro – techniques for commercial scale production of orchids in protected condition

Effect of growing media and interval of nutrient spraying on growth and flowering of *Cymbidium* under low cost poly house

The experiment was carried out with 14 treatments consisting various growing media, viz. T_1 – perlite + cocopeat + brick pieces, T_2 – cocopeat + brick pieces + leaf mould, T_3 – perlite + brick pieces, T_4 – thermocol + cocopeat + brick pieces, T_5 – rotten log + sand + coconut husk + brick pieces, T_6 – cattus bark + maize cob + leaf mould, T_7 – leaf mould + sand + brick pieces + coconut husk + charcoal (farmers' practice) with foliar application of polyfeed, viz. N_1 – NPK (19 : 19 : 19) 1 g/l – daily and N_2 – NPK (19 : 19 : 19) 1 g/l – weekly twice.

The results revealed that growing of *Cymbidium* in cattus bark + maize cob + leaf mould (1 : 1 : 1) media and application of nitrofoska (19 : 19 : 19) at 1 g/l weekly twice improved vegetative growth as well as flowering of *Cymbidium*. It was interesting to note that growing of *Cymbidium* in that media increased flower yield (14.25) and spike length (70.35 cm) as compared to farmers' practice (Fig 7). Media comprise of cattus bark + maize cob + leaf mould possessed a pH – 6.34 and electrical conductivity – 1.03 mMoh/cm followed by rotten log + sand + coconut husk + brick pieces (pH – 6.3, EC – 1.04 Moh/cm) where as media of farmers' practice showed pH – 6.89 and EC (1.5 mMoh/cm). The water holding capacity was maximum (65%) in farmers' practice media where as minimum (40%) at cattus bark + maize cob + leaf mould and rotten log + sand + coconut husk + brick pieces. The plant grown in cattus bark + maize cob + leaf mould consisted of higher nutrient content N – 2.18%, P – 1.03% and K – 2.16% (Fig 8).

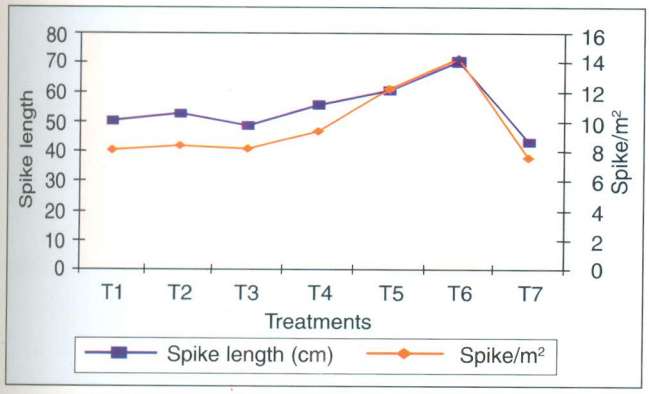


Fig. 7. Effect of growing media and spraying of nutreints on flower production of *Cymbidium*

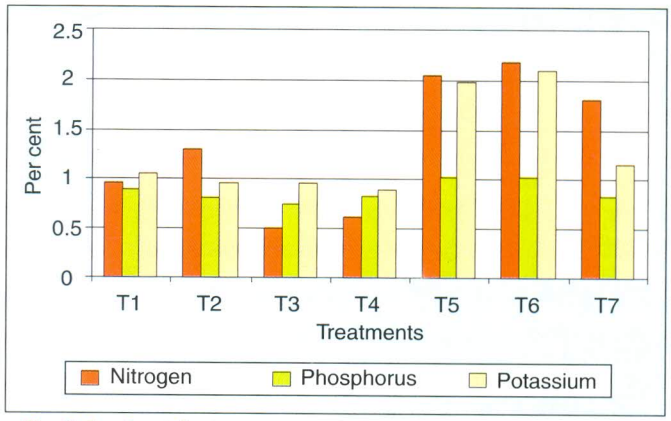


Fig. 8. Leaf nutrient content as influenced by various growing media and nutrient spray

Studies on shade requirement and moisture regime for growth and flowering of *Cymbidium*

The experiment consisted of four shade levels (0%, 30%, 50% and 75%) and four moisture regimes (25%, 50%, 75% and 100%). The results showed that growing of *Cymbidium* in 75% shade and application of 50% water (300 ml) in 6" size pot improved vegetative growth in terms of leaf number (8), leaf length (44.17 cm), pseudobulb girth (2.45 cm) and leaf area index (515.10 cm^2). However, highest number of shoot/plant (2.20) was recorded at the plant having no shade and 100% water regime (600 ml) on the basis of water holding capacity. It was noted that lower intensity of light and temperature persisted at 75% shade level (Fig 9).

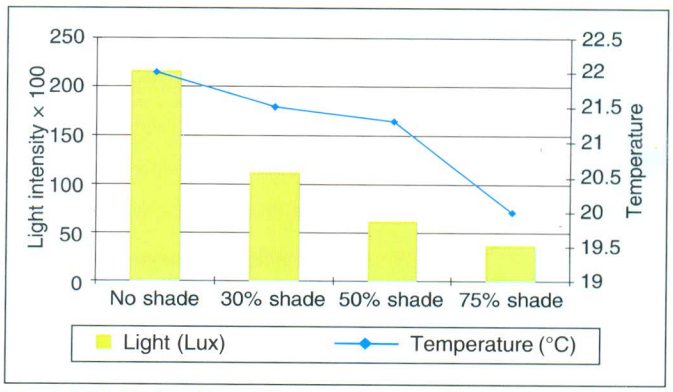


Fig. 9. Light intensity and temperature at different level of shade

To evaluate the effect of inorganic nutrients and growth regulators on reducing pre-blooming in *Cymbidium*

The experiment was conducted to standardize the dose of inorganic nutrients (NPK) and growth regulators (GA_3 and BA) for reducing pre-blooming period of *Cymbidium* hybrid. There were five doses of nutrients, viz. $N_{10}P_{10}K_{10}$ – 0.1%, $N_{10}P_{20}K_{20}$ – 0.1%, $N_{10}P_{20}K_{20}$ – 0.2%, $N_{10}P_{30}K_{30}$ – 0.1%, $N_{10}P_{30}K_{30}$ – 0.2% with a control (distilled water) and six doses of growth regulators, viz. GA_3 100 ppm, GA_3 200 ppm, BA 100 ppm, BA 200 ppm, GA_3 100 ppm+ BA 100 ppm, GA_3 200 ppm + BA 200 ppm and a control (distilled water). The results (Fig 10) revealed that weekly spraying of $N_{10}P_{10}K_{10}$ – 0.1% concentration improved the length of leaves (40.59 cm) as compared to other treatments. However, application of $N_{10}P_{30}K_{30}$ – 0.2% increased the leaf number (7.5), pseudobulb girth (2.25 cm) and pseudobulb number (1.60).

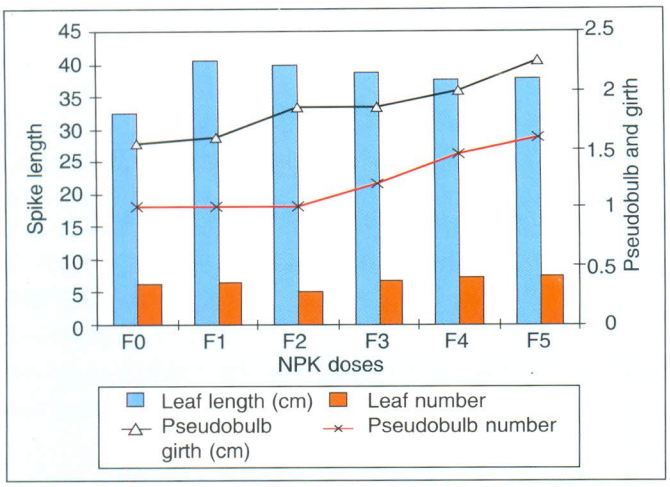


Fig. 10. Response of *Cymbidium* hybrid to the nutrients

Effect of various growing media, nutrients and plant growth regulators on growth and flowering of *Cym* Soul Hunt 6

The experiment was conducted to study the effect of growing media, nutrients and plant growth regulators. The experiment was consisted of 11 treatments in modular form and replicated five times in completely randomized block design. The module 1 was the farmers' practice. It was recorded that M-3 containing leaf mould + FYM + charcoal + coconut husk + rotten logs (2 : 1 : 1 : 1 : 1) and spraying with N 200 ppm P 100 ppm K 100 ppm+ BA 100 ppm & GA_3 100 ppm produced maximum plant height (73 cm), highest number of shoot (5.15), spike length (77.9 cm) and number of flower/ spike (17).

CROP PROTECTION

Investigation on fungal diseases of Orchids

Survey and monitoring of orchid diseases in private orchid farms

Survey of private orchid farms in Darjeeling was conducted in the month of August for monitoring and recording of orchid diseases. Black rot was recorded on several *Cymbidium* hybrids at Mirik. Orchid wilt caused by *Sclerotium rolfsii* was recorded in *Paphiopedilum insigne* at Takdah, Darjeeling. *Sclerotinia* rot was recorded on *Goodyera and Anoectochilus* in Darjeeling. Besides, another survey was conducted for collection of disease samples from natural habitats at Tsango, East Sikkim. During the survey, Leaf rust caused by *Puccinia* sp. was recorded to cause severe damage in *Satyrium nepalense* in natural habitat in Sikkim. Herbarium samples of rust infected plants of *Satyrium nepalense; Calanthe*, *Phaius*

Table 5. Orchid diseases identification report

Sample No	Disease	Host	Global Plant Clinic No	IMI No	Identification Report
1	Rust	*Calanthe plantaginea*	W9348	393018	*Uredo* sp.
2	Rust	*Calanthe discolor*	W9349	393019	*Uredo* sp.
3	Rust	*Phaius tankervilliae*	W9350	393020	*Uredo* sp.
4	Rust	*Satyrium nepalense*	W9664	393619	*Puccinia* sp.
5	Rust	*Anthogonium gracile*	W9665	393620	*Coleosporium* sp.

and *Anthogonium* made in the year 2004 and 2005 were sent to the Global Plant Clinic, Diagnostic and Advisory Service, CABI Bioscience UK Centre, UK for identification and confirmation. The report is given in Table 5.

Isolation, characterization and documentation of Sclerotinia white rot on *Goodyera* and *Anoectochilus* as a new orchid disease

Terrestrial leafy herbaceous orchids *Goodyera* and *Anoectochilus* are also known as 'Jewel orchids' as they have beautiful shiny, multicoloured decorated foliage with prominent veins in elaborate patterns. They are distributed in Khasia hills in Meghalaya, Manipur, Arunachal Pradesh and in the hills of Sikkim Himalayas including Darjeeling, India. During August 2005, severe white rot and blight was recorded in the beds of *Goodyera schlechtendaliana* Reichb. and *Anoectochilus lanceolatus* Lindl. in the orchidarium of National Research Centre for Orchids (ICAR), Darjeeling Campus, Darjeeling (2,200 M MSL), India.

***Symptoms*:** Plants were chlorotic, wilted and collapsed. There was a soft watery rot at the basal portion, which gradually rot the whole plants. Sometimes, several plants infected at a time and all the plants fall down showing damping off symptoms. White mycelium gradually covered the collapsed plants. Black small sclerotia formed on the rotted stem tissues. The rot caused death of 5% and 2% of *Goodyera schlechtendaliana* and *Anoectochilus lanceolatus* plants in the bed respectively.

***Isolation, characterization and identification of the pathogen*:** The infected plants of *Goodyera schlechtendaliana* and *Anoectochilus lanceolatus* were collected and the diseased stem tissue was surfaced sterilized for 1 min in 1% NaOCl and placed on potato dextrose agar (PDA) and incubated 25 ± 1°C for 5 days. In both the cases, the fungus produced profuse white mycelia on the petridishes. The fungus produced sclerotia on PDA around the boarder of petridishes within 8–10 days, which measured 3.86–2.18 × 3.13–1.95 mm (Average size 3.02 × 2.54 mm and maximum and minimum size of sclerotia measured 6 mm and 2 mm respectively). Based on the morphological and cultural characters the fungus was identified as *Sclerotinia sclerotiorum* (Lib.) de Bary. Pathogenicity was proved by pot inoculation of both *Goodyera schlechtendaliana* and *Anoectochilus lanceolatus*. *Sclerotinia sclerotiorum* was reisolated from infected test plants. This is the first report of *Sclerotinia* rot of *Goodyera schlechtendaliana* and *Anoectochilus lanceolatus*.

Isolation, characterization and documentation of rust on *Satyrium nepalense* as a new orchid disease

Satyrium nepalense is a native terrestrial orchid flora of Sikkim found in higher altitude ranging from 6,000–13,000 ft. It is an annual and has underground bulb and pseudo stem come out of the bulb with dark green thick leaves. The species is found in hilly slope with a large number of populations in natural habitats. During our survey and collection of orchid germplasm to East Sikkim in August 2005, new leaf rust was observed on *Satyrium nepalense* at an altitude of about 12000 ft. near Tsongu, East Sikkim.

***Symptoms*:** The symptom first appeared as minute yellow dot, which gradually enlarged. The spots were mainly found on the lower side of the leaves. Teleutosori appeared as dark brown, measuring 0.5–1 mm × 1–1.5 mm. Several sori coalesced and cover larger areas of the leaves. Infected leaves puckered and wrinkled. Severely affected leaves gradually dry out and stayed hanging. In disease affected plants, flower spike are smaller than healthy plant. The frequency of the disease in the population was mild to moderate. The diseases usually appeared in the month of July to August when the plants come out with profuse green leaves during the period of heavy rainfall in the area.

***Characterization and identification of the pathogen*:** The leaf samples were collected and taken to the laboratory for identification. When transverse section of infected leaf were viewed under microscope, teleutosori were distinctly found on the lower side of the leaf. Several teleutospores were observed to come our rupturing the lower epidermis. Teleutospores were dark brown in colour, single septate, two celled, club shaped, thick walled with single germ pore at the top or little side on the top, lower cell loner, larger and stalked. Urediospores observed were light brown, spherical to oval, echinulate, thin walled. Frequency of urediospores appeared very less as compared to teleutospores. The rust was identified as *Puccinia* sp.

Monitoring the occurrence of orchid wilt

Orchid wilt caused by *Sclerotium rolfsii* was monitored in our collected germplasm through out the year. The disease was recorded on *Cymbidium elegans*, *C. erythraeum*, *C. dayanum*, *C. grandiflorum*, *C. traceyanum*, *C. longifolium*, *C. hookerianum and Vanda stangeana* in the orchid house. The pathogens were isolated on PDA and identified.

Studies on the variation of orchid isolates of *Sclerotium rolfsii*

Different orchid isolates of *Sclerotium rolfsii* were isolated and purified on PDA. So far 6 isolates of *Sclerotium rolfsii* were collected on different orchid species. Out of them, 4 isolates were from *Cymbidium* and one from each of *Vanda* and *Paphiopedilum*. All the isolates were grown on PDA at 27°C for 10 days to study their sclerotial characters. Among the isolates, *Cymbidium elegans* isolate grew faster followed by *C. hookerianum*, *C. erythraeum*, *C. pendulum*, *Paphiopedilum insigne* and *Vanda stangeana*. Highest number of sclerotia produced per petridish by isolate *V. stangeana* followed by *C. pendulum*, *C. elegans*, *C. hookerianum*, *P. insigne* and *C. hookerianum*. Largest sclerotia were found to produce by the isolate *C. erythraeum* followed by *P. insigne*, *C. elegans*, *V. stangeana*, *C. hookerianum* and *C. pendulum*.

Monitoring the occurrence of Black rot of orchids

Black rot, a major disease of orchid, was monitored in collected germplasm through out the year. The disease was recorded on *Cymbidium hookerianum*, *C. erythraeum*, *C. ensifolium*, *C. munronianum*, *C. tigrinum*, *C. aloifolium*, *C. traceyanum*, *C. devonianum* and *C. iridiodes*. The disease was also recorded on *Cym.* Arabian night, *Cym.* Yankalila and *Cym.* Sara Green, *Dendrobium nobile* and *Oncidium* Grower Ramsey.

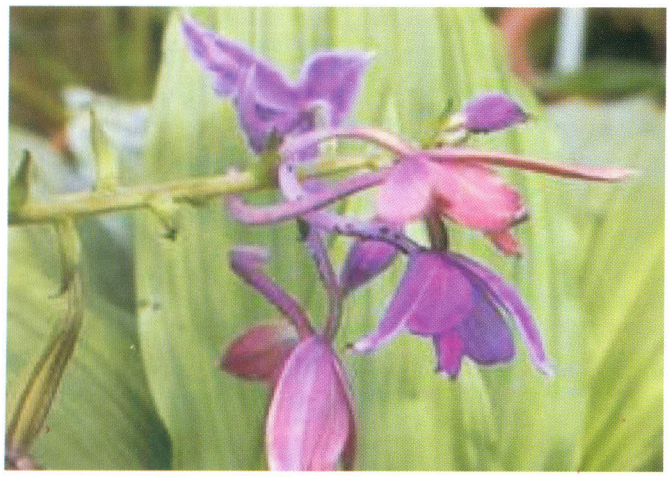
Management of Black rot of *Cymbidium* through fungicides

An experiment was laid out on the fungicidal management of black rot with six treatments [metalaxyl (0.1%), indofil M 45 (0.2%), dithane Z 78 (0.2%), carbendazim (0.2%), thiophanate methyl (0.1%) and check (water)] with five replications. Each replication was consisted of 5 pots and spraying was given as soil drenching at an interval of 15 days for 6 times. Disease incidence was recorded at 15 days intervals. It was observed that metalaxil @ 0.01% gave encouraging results with lowest rate of infection (5.33%) followed by thiophanate methyl (7.33%) and carbendazim (11.33%).

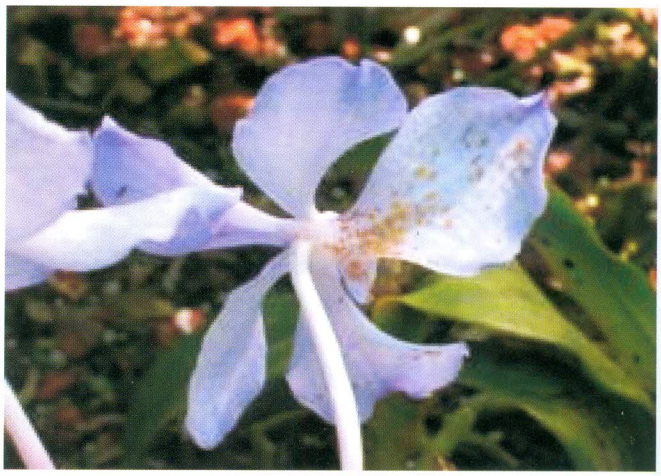
Pest management in orchids and bulbous flowering plants

Aphid fauna on orchids

Aphid *Macrosiphum luteum* and *Toxoptera aurantii* recorded on many orchid hosts. Aphid *Macrosiphum luteum* found to infest *Vanda coerulea*, *Oncidium* Gower Ramsay, *Oncidium spacealatum* while black aphid *Toxoptera aurantii* have been recorded on *Epidendrum radicans*, *Calanthe masuca*, *Dienia ophrides*, *Anthogonium gracile* and *Nephallophyllum cordifolium*.



Black aphid on *Calanthe masuca*



Yellow aphid on *Vanda coerulea*

Monitoring of pests on orchids

During the year under report orchids were observed to be reinfested by various kind of pests. The pests infested on orchids, plant portion affected and duration of occurrence is given below (Table 6).

Table 6. Pest re-infestation on orchids hosts

Name of pest	Orchid infested	Plant portion affected	Duration of occurrence
Scale *Pinnaspis buxi*	Many Cymbidium hybrids	Leaf/petiole/ pseudobulb	Round the year
Scale *Coccus hesperidum*	*Eria paniculata*, *E. spicata*, *E. radiata*, *Eria pumila*, *Oncidium* Golden Shower, *Aerides racemform*, *Calanthe triplicata*, *Vanda coerulescence*	Leaf/Pseudobulb	Round the year
Scale *Lecanium* sp.	*Phaius flavus*	Stem/spike	Round the year
Scale *Diaspis boisduvalii*	*Cattleya*, *Dendrobium nobile*	Leaf/petioles/root	Round the year
Other Scale insects	*Dendrobium densiflorum*, *D. moschatum*, *D. cruentum*, *D. fimbriatum*, *C. eburneum*, *Cymbidium elegans*, *C. ensifolium*, *C. whitae*, *Anoectochillus* sp.	Leaf/Pseudobulb	Round the year
Mite *Tetranychus urticae*	*Cymbidium* species, seedlings and hybrids, *D. fimbriatum*, *D. bulboflorum*	Leaf/flower	March–September
Aphid *Macrosiphum luteum*	*Vanda coerulea*, *Oncidium* Gower Ramsay, *Oncidium spacealatum*, *Dendrobium nobile*	Flower	At the time of flowering
Aphid *Toxoptera aurantii*	*Epidendrum radiacum*, *Calanthe masuca*, *Dienia ophrides*, *Anthogonium gracile*, *Nephallophyllum cordifolium*	Flower bud/flower	January–June
Shoot borer (Black moth) *Peridaedala* sp.	Many species of *Dendrobium*, *Acampe*, *Aerides*, *Eria*, *Arachnanthe*, *Ascocentrum*, *Epidendrum*, *Liparis*, *Vanda*, *Acampe rigida*, *Stauropsis undulate*	Shoot	Rainy season
Black weevil *Sipalinus* sp.	Species of *Pholidota*, *Coelogyne*, *Aerides*, *Ascocentrum* and *Cymbidium devonianum*	Pseudobulb	September–October
Chloropid fly *Melanochaeta* sp.	*Thunia alba*	Root	Rainy season
Thrips *Frankliniella* sp.	*Dendrobium nobile*, *D. chrysotoxum*, *Otochilus* sp.	Flower	March–April
Snail	*Oncidium* Gower Ramsay, *Aerides odoratum*	Leaf	Rainy season
Yellow beetle *Anomala* sp.	*Dendrobium nobile*	Flower	March–April

Pest complex on *Dendrobium nobile*

The plants of *Dendrobium nobile* were infested by 5 different pest during the year. Biosdual scale *Diaspis boisduvalii* suck the sap from leaves and cane and weaken the plant. Shoot borer *Peridaedala* sp. (Lepidoptera: Tortricidae) was observed to cause damage on by boring into the shoots, dead shoots or yellow shoots flag on the stem observed. Aphid *Macrosiphum luteum* suck the sap from new shoot, flower bud and opened flower. Affected plants retard growth and flower quality affected. Black thrips and Yellow beetle also infest the plants of *Dendrobium nobile*.

Influence of growing media on incidence of shoot borer *Peridaedala* sp. on *Dendrobium nobile*

Six growing media, viz. bare rooted plants, tree fern, wooden log, mixed media, coconut husk, coco peat were tested against the pest incidence of *Peridaedala* sp. on *Dendrobium nobile*. The results showed least shoot borer damage where plants were grown in media coconut husk followed by bare rooted plants and coco peat. However *Peridaedala* sp. damage was at par in media tree fern, wooden log and mixed media.

Management of shoot borer *Peridaedala* sp. on *Dendrobium*

On the second year also four insecticides, viz. phosalone, econeem, chlorpyriphos, and monocrotophos were tested against shoot borer *Peridaedala* sp. on *Dendrobium nobile* under low cost polyhouse. The results showed that treatment of econeem (10,000 ppm) 2.5 ml/l and chlorpyriphos 20 EC 2.5 ml/l results in less damage as compared to the other treatments and control.

Evaluation of bulbous ornamentals for pest damage

Thirtyfour bulbous ornamentals were re-evaluated. It was observed that mostly grasshopper damages the ornamentals by feeding on leaves and flower. The bulbous ornamentals infested by grasshopper were *Agapanthus africanus*, *Amaryllis belladona*, *Crinum* sp., *Crocosmis aurea*, *Eucaris amazonia*, *Hemanthes multiflorus*, *Iris pallida*, *Iris* sp. *Polyanthes tuberose*, *Zantedeschia albo maculate*.

DARJEELING CAMPUS

Collection, conservation, characterization, evaluation and maintenance of high altitude orchid germplasm

Collection

Two explorations were conducted to collect the orchids from natural habitat occurring in the district of Darjeeling. The exploration resulted in adding of 70 accessions of orchids. The new species of orchids include *Masdevaellia* and *Taeniophyllum*. Apart from collection from the wild 10 new *Cymbidium* hybrids were also added to the previous collection. Hybrids of *Aranda*, *Mokara*, *Phaaenopsis* and *Cattleya* have also been collected and maintained in the conservatory.

Evaluation

The collected species of orchids were being evaluated for the horticultural traits. The evaluated species included *Cymbidium ensifolium*, *C. lowianum*, *C. traceyanum*, *C. elegans*, *C. gammieanum* and *C. devonianum*. *C. eburneum*, *C. tigrinum* and *C. iridoides* did not flower. Among the *Paphiopedilum* species, *Paphiopedilum insigne*, *P. villosum* and *P. farrieanum* and among *Pleione* species, *Pleione praecox* and *P. humilis* have been evaluated.

Maintenance

All the species under conservation have either been maintained in low cost playhouses or in artificial natural habitat. The artificial natural habitat which aims at providing almost similar conditions as that of in wild in which epiphytes were tied on the tree trunks while terrestrials were grown on ground under the shady locations. The artificial natural habitat method for conservation of orchids considerably reduced the cost on maintenance.

Collection, conservation, evaluation and multiplication of bulbous ornamental crops

Collection

Seven hybrids of Oriental and 8 hybrids of Asiatic lily have been introduced. The collected hybrids of Lilium were: Simplon, Stargazer, Soldera, Yelloween, Fonopoli, Concordia, Siberia, Nove Cento, Elite, Pollyanna,

Dreamland, Novana, Tinos, Farfalla, Makino and Voltage.

Evaluation

The evaluation trial was conducted on 5 Asiatic and 2 Oriental lilies. These include pollyana, dreamland, novona, elite, nove cento, simplon, and stargazer. The best performance was recorded from Asiatic lily cv. Dreamland. It recorded highest number of flower buds/stem, highest number of leaves and longest flower stalk. The stargazer was found to be enlisted poorest performing cultivar as it recorded smallest stem length and lowest number of leaves/per plant. The other cultivars also performed well under Darjeeling conditions.

Studies on propagation of liliums

Effect of ethylene on growth and development of bulblets of Asiatic lily cv. Nove Cento

The soaking of bulblets in aqueous solution of ethylene (50 mg/litre) increased the weight of bulb nearly twice that of control. The higher concentrations reduced the weight, diameter, volume and circumference of the bulb. The highest bulb weight, diameter, circumference and volume were recorded as 6.06 gm, 6.96 cm, 2.15 cm and 7.7 ml respectively.

Effect of fertilizers on growth and development of bulbets of Asiatic lily cv. Nove Cento

Various combinations of NPK were tested to identify the suitable grade of fertilizer for the growth and development of bulblets of Asiatic lily cv. Nove Cento. The NPK (10 : 25 : 25) followed by NPK (10 : 20 : 20) were found best to increase the size of bulblets. With these treatments a 0.5 gm bulb could be converted to 9.02 gm in one season of planting. The treatments nearly doubled the weight of bulblets as compared to control (4.02 gm).

Effect of wounding of scales on propagation of Asiatic lily cv. Brunello

The bulb scales of Asiatic lily cv. Brunello when slated at the base at different depth increased the number of bulblets production per scale. However the bulblets found to be smaller in size and weight as compared to control. The highest number of bulblets was found when the basal portion of the scales was slated 2 × 2. The mean weight of the bulbets was recorded to be 0.22 grams. The least number of bulbets were obtained from the scales slated at 6 × 6 cm. The bulbets obtained from this treatment were lager in size (0.47 gm).

EXTERNALLY FUNDED PROJECTS

Technology Mission on integrated Development of Horticulture in North Eastern State including Sikkim, Uttaranchal, Himachal Pradesh and Jammu & Kashmir (Mini Mission I)

Activity 1: Development of conventional and micro propagation techniques

Effect of media and growth adjuvants on in vitro and pre-hardening of *Cym.* 'Sleeping Nymph'

Various growth adjuvants play an important role in the mass multiplication and growth of orchids *in vitro*. The protocorms from *in vitro* growth culture of *Cym.* "Sleeping Nymph" were cultured in three different media, viz. Murashige and Skoog (MS), Nitsch and Gamborg with activated charcoal and supplemented with yeast extract, peptone and coconut water. The significant variation was observed to various physical parameters in three different media supplemented with growth adjuvants after eight month of culture. Seedling growth and development was found best in MS media supplemented with 100 ml coconut water, as it recorded maximum plant weight, shoot length with well developed leaf number and root number and root diameter. The pre-hardening was better in basal Murashige and Skoog media.

In vitro multiplication of *Cym.* 'Pine clash' as influenced by different media

The efficiency of the tissue culture technique was markedly influenced by the culture media and the growth hormones supplemented in the media *in vitro* in the multiplication of *Cym* 'Pine clash'. The protocorm obtained from embryo culture were used as the explants. The protocorm were sub cultured in Murashige and Skoog (MS), Nitsch, and Gamborg media with 1 gm activated charcoal supplemented by yeast (200 mg/l), BAP (0.5 mg/l) and coconut water (100 ml/l). The Gamborg media supplemented with 1 gm/l activated charcoal and 0.5 mg/l BAP resulted in better

multiplication of protocorm. However, the shoot emergence was faster in Gamborg and MS media supplemented by 1 gm/l activated charcoal. Among the media, maximum shoot length with maximum number of leaf was observed in MS supplemented by 1 gm/l activated charcoal. The plantlets on MS supplemented with 1 mg/l activated charcoal and 100 ml/l coconut water showed maximum root elongation, root diameter and leaf width.

Influence of different media, activated charcoal and coconut water on Plb multiplication and growth of *Cymbidium* hybrids

Three widely used basal media, viz. MS, Nitsch and Gamborg, supplemented with various concentrations of coconut water (0, 50, 100, 150, 200 ml/l) and activated charcoal (1.0 and 1.5 g/l) were tested for Plb multiplication and growth. The Plbs of *Cym.* 'Sleeping Nymph' subcultured on Murashige and Skoog, Gamborg and Nitsch media containing with or without activated charcoal (AC) supplemented with various concentration of coconut water showed significant for multiplication and growth. The observations revealed that Nitsch media was found most suitable for fastest multiplication rate and formation of maximum number of protocorm. The early shoot and root emergence and more number of shoot and root differentiation was recorded in Nitsch media supplemented with 200 ml/l coconut water. The AC (1 g/l) had a profound influence on Plbs differentiation by producing maximum number of protocorm, shoot and root at fastest multiplication rate, besides early shoot, leaf and root initiation. The number of Plbs, shoots and roots increased with the increase in the amount of coconut water. The interaction of coconut water and AC revealed that incorporation of AC in the media was better for Plbs multiplication, as it favors early shoot initiation.

The influence of *in vitro* culture of Plbs of *Cym.* 'Pine Clash' in MS, Nitsch and Gamborg medium containing AC supplemented with coconut water showed significant variation in respect of Plbs multiplication and quality of plants for all the morphological characters. The observations revealed that, Nitsch media was most suitable for faster multiplication rate and formation of maximum number of protocorm followed by Gamborg. However, there was no significant difference among MS and Gamborg media for Plb multiplication. The early shoot and root emergence and differentiation were recorded in the Nitsch media with 1.5 g/l activated charcoal and supplemented with 50 ml/l coconut water.

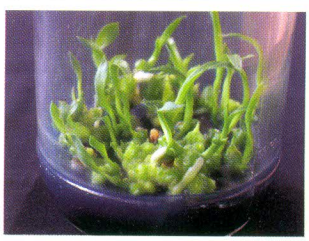
Effect of pH on Plbs multiplication of *Cymbidium* hybrids

The protocorm of *Cym.* 'Soul Hunt I', *Cym.* 'Lunavian Atlas' and *Cym.* Showgirl "Cooksbridge" were cultured in MS media with different range of pH (4.5, 4.75, 5.0, 5.25, 5.5 and 5.75) for multiplication. The pH affected the up take of ions and solidification of media. The pH of 5.7 or above made the media hard and inhibited the Plbs multiplication. The media with higher pH became too compact that retards the growth and development of plantlets after 20–30 days of culturing. Similarly, the pH of 4.7 or below lead to unsatisfactory solidification of media and reduces the Plbs multiplication and made Plbs brown.

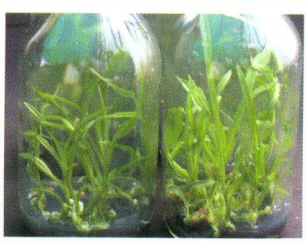
It was observed from the data that the optimum pH for PLB multiplication was 5.5, where the media was semisolid. The Plbs multiplication in such media was very fast and grown with bigger size. The plantlet growth and development was noteworthy in response to semisolid media.

Differentiation of *Cym.* 'Soul Hunt-1'

The result of *in vitro* differentiation of *Cym.* 'Soul Hunt-I' in media supplemented with different cytokines (6-benzyal aminopurine-BAP, TDZ, zeatin, kinetin, triacontonal) showed significant differences for shoot length, leaf length, root number and plant weight. Among the treatments, maximum plantlet weight was recorded in MS supplemented with 0.25 mg/l triacontonal. The longest plant was recorded on MS with 0.5 mg/l BAP and 0.5 mg/l TDZ. The maximum leaf length was recorded in MS with BAP at 0.5 mg/l. The



Plbs differentiation



Plantlet ready for *ex vitro* hardening

number of roots produced was maximum on MS media supplemented with triacontonal at 0.5 mg/l. Thus it clearly shows that MS media supplemented with BAP at 0.5 mg/l and triacontonal 0.5 mg/l was the best for quality plantlets production.

Influence of BAP, Coconut water and banana pulp on protocorm proliferation, differentiation and plantlet growth of *Cymbidium* hybrid

Nitsch as a basal media was found to be superior compared to MS media for all the characters recorded, while the response was poor in B5 media. The BAP 0.5 mg/l, 100 gm/l banana pulp and 100 ml coconut water was most effective for Plbs proliferation. The Plbs cultured on MS media supplemented 100 gm/l banana pulp showed mass multiplication with bigger size of protocorm. The maximum shoot length, leaf number, and increased leaf size were observed in MS media with 100 ml/l coconut water. The root development of plantlets was best, when cultured in BAP 0.5 mg/l in association with NAA 0.10 ml/l.

Ex vitro hardening

Ex vitro hardening of *in vitro* regenerated plantlets of Cym. 'Lunavian atlas'

Coco peat in combination with white moss with different proportion was used for *ex vitro* hardening Cym. 'Lunavian Atlas'. The most suitable proportion of coco peat and white moss for *ex vitro* hardening was 1 : 1 as it showed highest percentage of survivability. It also produced maximum shoot length with more and wider leaves, followed by moss alone.

Influence of potting mixture on *ex vitro* survival of *Cattleya* hybrid

The *Cattleya* hybrid (*Cattlya labiata* × *Cattlya aurantiaca*) plantlets, which were developed *in vitro*, were transferred to hardening house for *ex vitro* hardening. They were cultured in a variety of media using bricks, stone chips, white moss, leaf mould, perlite and coco peat in equal proportion and possible combinations with an objective to find out *ex vitro* survival percentage. The plantlets establishment in most of the potting mixture was below 80%. However, potting mixture comprising brick + white moss, followed by brick + perlite recorded 100% survival ability.

Effect of potting mixture on *in vitro* developed plantlets of *Zygopetalum intermedium*

In vitro developed plants of *Zygopetalum intermedium* were cultured in ten different potting mixtures, viz. white moss + brick, white moss + charcoal, white moss + tree fern, tree fern + coconut husk + charcoal, brick + tree fern, brick + coconut husk, charcoal + tree fern, charcoal + coconut husk, tree fern + coconut husk.

The seedlings from conical flask with well developed root got established within one month after transferred to community pot. However, the growth performance differs with potting mixture. The influence of potting mixture on plant growth showed that increased in shoot length was significant up to five months and there was no significant difference thereafter. The plantlet grown in potting mixture comprising white moss + charcoal showed maximum increased shoot length. The significant influence of potting mixture for increase in root number and root diameter was not observed in all the treatments. The plantlets grown in tree fern + coconut husk showed the maximum increase in root number after eleven month. The influence of potting mixture on root length was significant in all treatments. The maximum increase in root length was observed in pot comprising tree fern + coconut husk. The experiment result revealed that, the combination of white moss + charcoal proved the best media to its efficiency and white moss and charcoal holds enough water and food to enhance the plant growth in the initial stage.

Activity 2. Production of planting material under low cost poly house

Effect of bio-fertilizers on production of *Gladiolus*

An experiment was conducted with the objective to produce quality planting materials of *Gladiolus* cv. Candyman on commercial scale. The treatments consisted of control, NPK, FYM, VAM, NPK + FYM, NPK + VAM, FYM + VAM and NPK + FYM + VAM replicated three times in randomized block design.

The results showed that basal application of VAM along with NPK produced greatest length (40.9 cm) and number (8.2) of leaves/plant. Maximum spike length (95.9 cm), rachis length (54 cm) and number of flowers/plant (15.3) was recorded from the application of FYM

Production of quality planting materials of ornamentals on large scale

Orchids

Orchid Hybrids	Plant growth stages			(Number)
	Protocorms	Differentiation stage	Pre- hardening stage	Hardened plants
Cym. 'Soul Hunt I'	10,000	500	185	58
Cym. 'Golden Girl'	150	85	53	342
Cym. Showgirl "Cooksbridge",	500	423	98	20
Cym. 'Lunavian Atlas'	600	110	55	332
Cym. Jungfrau 'Dos Peblous'				55
Cym. Star Gold 'McAngel'	75	198	218	263
Cym. 'Sleeping Nymph'	3,300	709	498	582
Cym. 'Pine Clash'	1,650	315	156	378
Dendrobium- 5	356	48	120	63
Total	16,631	2,390	1,378	2,093

Other flowers

Orchid Hybrids	Type of planting material			(Number)
	Seedlings	Seeds	Corms	Cormels
Marigold	6,000	4 kg		
Chrysanthemum	10,000			
Gladiolus			10,000	100,000
Freesia			2,000	
Seasonal flowers		8 kg		

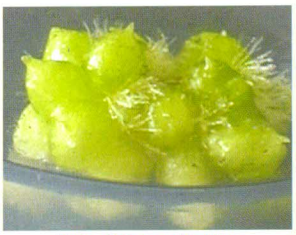
+ VAM. It was interesting to note that two numbers of corms of almost equal diameter were found with the application of NPK + VAM. Number of cormels/plant (68) and cormel weight (0.22 g) were highest with application of FYM + VAM.

AP Cess fund Project: 'Standardization of protocol for raising progeny from immature crossed embryo of Cymbidium orchids *in vitro*.'

In vitro morphogenetic response of embryos of *Cymbidium* crosses

The protocorm regenerated from five *Cymbidium* crosses were cultured on different media using MS, Nitsch, B5 and Knudson C media with or without activated charcoal, supplemented by plant growth substances (BAP, NAA, triacontanol and paclobutrazol) and growth adjuvant (yeast extract, malt extract, peptone, and coconut water) and response of protocorms in different media till date is mentioned in Table 8. The data revealed that embryo cultured on MS and Nitsch media supplemented with 0.5 mg/l BAP, as well as 100 ml/l coconut water showed early germination.

Plb multiplication and differentiation of *Cymbidium* elegans



Plb differentiation

Plb multiplication and differentiation of *Cymbidium* elegans

Table 8. Morphogenetic response *in- vitro* of embryos of cymbidium crosses

Cross number	Crosses	Media	Days taken for			
			Swelling	Greening	Germination	Plbs
PBX-05–67	*C.* 'Ammesbury' × *C.* 'Red Beauty'	B5	87	105	112	127
		Nitsch + 0.5BAP	82	102	107	115
		MS + 100 ml CW	86	109	110	120
PBX-05–55	*C.* 'Golden Elf' × *C.* 'Red Star'	MS + 100 ml CW	40	48	62	86
		Nitsch + 0.5 BAP	53	70	69	95
		B5 + 200 mg/l Malt	57	69	74	89
		MS + 0.5 BAP	51	65	81	98
PBX-05–29	*C.* 'Golden Elf" × *C.* 'Red Beauty'	Nitsch + 100 ml CW	31	55	62	76
		MS + 200 mg Peptone	30	53	69	84
		Nitsch + 50 ml CW	33	48	52	68
PBX-05–34	*C.* 'Red Star' × *C.* 'Fancy free'	MS	54	65	80	91
		MS + 100 ml CW	34	41	58	74
		MS + 0.5 mg/l Tri	50	61	84	78
PBX-05–46	*C.* 'Red Star' × *C.* 'Ammesbury'	Nitsch + 0.5 mg/l BAP	38	64	74	149
		B5 + 200 mg/l Y. Ext	45	91	89	181
		MS + 0.5 mg/l BAP	75	107	117	164

Standardization of media for *Cymbidium elegans*

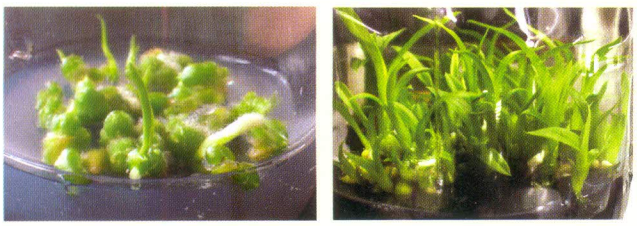
Protocorms regenerated from *Cymbidium elegans* were cultured in six different media, viz. MS, Nitsch, Gamborg, Knudson, Streat and White with and without activated charcoal (AC). *Cymbidium elegans* responded to different morphological characters with different media. Addition of AC in the media improved plantlet growth and established better. Protocorm responded better for multiplication in KC with 1.5 mg activated charcoal but Plb multiplication was slow in White and Streat media. However protocorm differentiation was early in Knudson with 1 g/l activated charcoal.

Influence of peptone on *in vitro* Plb multiplication of *Cymbidium whitae*

The efficacy of different concentration of peptone on *in vitro* media for multiplication of *Cymbidium whitae* was carried out. The protocorm like bodies (Plb) were cultured in Murashige and Skoog media incorporated with various concentration of peptone (0, 25, 50 and 100 mg/l). The results showed that the media supplemented with 100 mg/l of peptone found optimum for Plb, whereas the shoot initiation and further growth was fastest on the MS media with 25 mg/l of peptone. Media supplemented with 50 mg/l of peptone found optimum for leaf initiation. The longest shoot length was recorded in MS media supplemented with 100 mg/l of peptone in the media. Among the different concentration of peptone, 25 mg/l mediated early root initiation and the longest root length was observed in the media incorporated with 100 mg/l of peptone.

Influence of growth hormones on Plb multiplication of *Cymbidium* hybrid

Protocorm regenerated *in vitro* from embryo of *Cym.* 'Amesbury' × *Cym.* Showgirl 'Cooksbridge' and *Cym.*



Plb proliferation | Plantlet stage

Plb proliferation and plantlet stage of *Cymbidium* hybrids

'Oriental Legend' × *Cym.* Showgirl 'Cooksbridge' were subcultured on various media having different concentrations of growth hormones for further multiplication and differentiation. The results showed that Plb proliferation was best on MS with 0.5 mg/l of BAP and 0.50 mg/l of triacontonal. The multiplication and differentiation into shoots were better on MS containing 0.5 mg/l of BAP + 0.10 mg/l NAA and 0.75 mg/l of triacontonal, as it produced maximum number of shoots of well developed leaf and further growth.

Network project: Distinctness, Uniformity and Stability of Seed

Development of NTG (National Test Guidelines) for *Cymbidium*, *Dendrobium* and *Vanda* species and hybrids

Species and hybrids of *Cymbidium*, *Dendrobium* and *Vanda* species and hybrids have been selected and set for DUS testing to develop NTG. Plant number was from 3–10 in each aged between 2.5 to 4 years.

Cymbidium species

Cymbidium lowianum: Luxurious growth with a plant height of about 61.5–75 cm. Number of spike varied from 9–12. Each flower measured about 8–10.5 cm across.

Cymbidium gammeanum: Medium sized plant, which grows up to a height of 72–75.2 cm with ovate shaped pseudobulb. Peduncle emerges from the base of pseudobulb and pendulous in attitude and measures 53–56.3 cm of length. The general appearance of sepal and petals are incurved with reflexed apex, which are yellow in color with brown stripes.

Cymbidium devonianum: Peduncle attitude is pendulous with raceme type inflorescence. The number of flowers in a spike varies from 22–34. Flower type is single with shades of maroon and greenish yellow.

Cymbidium elegans: The plant grows upto a height of 64.2–68.2 cm having ovate shaped pseudobulb. Peduncle is semi-erect in attitude having 12–16 flowers, which are incurved and spreaded in appearance. Color of sepals and petals are greenish yellow.

Cymbidium pendulum: It is a miniature Orchid with an average plant height of 35–45 cm. Flowers are small measuring 2.3 and 3.6 cm length and width respectively.

Cymbidium tracyanum: Large sized plant having oblong shaped pseudobulb. Peduncle is semi-erect in attitude with strong rigidity. Sepal and petal appearance are incurved and spreaded type, possessing green color with brown stripes on middle part of it. Maroon spots present on lip.

Cymbidium tigrinum: Possesses showy and large flower with a length of 5.15 cm and width of 5.45 cm. Petal contains maroon spots. Apical lobe of lip is white to creamy yellow striped with distinct brownish-red bands akin to the stripes on a tiger stripes.

Cymbidium iridioides: The plant height is 76.2–78.4 cm with oblong shaped pseudobulb, semi-erect peduncle attitude. Incurved and spreaded type sepal and petal with yellow margin and dark maroon spots. The shape of lateral lobe of lip is trapezium.

Cymbidium aloifolium: Spike is pendulous and weak in nature with the presence of anthocyanin coloration. Flower has a strong fragrance.

Cymbidium erythreum: Oblong shaped pseudobulb with a plant height of 89.5–92.2 cm with lanceolate leaves shape having acute apex. Peduncle is semi-erect in nature with racemose type inflorescence. Sepals and petals are incurved and spreaded in appearance with greenish yellow color and white margin. Column is greenish yellow with white tip. Blooms in winter season.

Cymbidium Hybrids

Cym. "Luna Pink Champion": Plant height is 75.4–77.3 cm. Peduncle is pendulous in attitude with a length of 39.8–41.2 cm. Inflorescence is racemose type bearing 8–10 flowers. Incurved and spreaded type sepals and petals which are greenish brown in color. Maroon spots on petals. White margin with maroon spots on lip. Blooms in winter season.

Cym. "Nonina Paleface": Ovate shaped pseudobulb

with 60–63.2 cm plant height. Semi-erect peduncle with racemose type inflorescence bears 10–12 flowers. The general appearance of sepals and petals are incurved and spreaded type. Maroon color sepals and petals with green color margin in sepals and maroon stripes on petals. Lip is white to yellow color with trapezoid lateral lobe in shape. It blooms in the month of November.

Cym. "Red Beauty": The plant grows upto 69.4–72.2 cm with oblong shaped pseudobulb. Leaves are linear in shape with acute apex. Peduncle is semi-erect in nature with anthocyanin pigmentation. The sepals and petals general appearance are incurved and spreaded type with racemose type inflorescence. Maroon margin with brown stripes in sepals and petals. Winter season is flowering time.

Cym. "Soul Hunt": The plant height 80–85 cm with semi-erect peduncle attitude and anthocyanin pigmentation. Racemose inflorescence and general appearance of sepals and petals are incurved and spreaded type. Red spots on sepals and petal are with red stripes. Lip shape is with narrow triangular with dark maroon spots. Blooming period is winter.

Cym. "Red Star": Large sized plant with erect peduncle attitude possessing anthocyanin pigmentation. Racemose type inflorescence having 15–20 flowers. Incurved and reflexed sepals and petals in appearance. Red spots on sepals and yellow margin in petals. Lip is with narrow triangular in shape. Winter season blooming.

Cym. "Ammesbury": Plant height is 75–80 cm. Semi-erect peduncle with racemose type inflorescence bearing 12–18 flowers. The general appearance sepals and petals are incurved and spreaded. Green color sepals and petals with maroon shades. Oblate shape lip with maroon spots and yellow callus. Blooms in winter season.

Cym. "Yankililla": 90–100 cm of plant height with semi-erect peduncle. Sepals and petals are incurved and spreaded in appearance with green shades. Narrow triangular shape lip which is yellow in color. Winter season blooming.

Dendrobium species

***Dendrobium nobile*:** General appearance of sepal and petal are incurving and spreading. Flowers are highly ornamental and have a good mass effect. The lip is ovate-oblong, shortly hairy, with a very dark purple central blotch.

***Dendrobium parishii*:** Inflorescence emerges directly from pseudostem. Flowers are purplish- white in color. Edge of the petal is finely fringed.

***Dendrobium aphyllum*:** Peduncle is semi-erect in nature which bears 20–30 flowers. Flower arise bunches in 1–3 from the nodes of short stalks and covers the entire mature Pseudostem giving it a magnificent appearance at the flowering time.

***Dendrobium pierardi*:** Elliptical and white colored sepals whereas petals are obovate in shape. Lip is elliptical shaped with moss green colored eye. It flowers during last week of May to first week of June.

***Dendrobium densiflorum*:** The densely and drooping flowered inflorescence from the bud eye located between the leaves. Flowers are golden-yellow, 2.5–3.5 cm. across and last for about a week.

***Dendrobium candidum*:** Plant height 32.2–34.4 cm, semi-erect pseudostem. General appearance of sepals and petals are reflexed with netted and pale white in color. Lip callus is present. Rainy season is the flowering time.

***Dendrobium primulinum*:** The sepals and petal are pale rose-purple with deeper coloured veins, while the nearly orbicular lip is pale primrose color run by purple streaks.

***Dendrobium bulboflorum*:** Plant grows upto 20.2–24.4 cm height, semi-erect pseudostem, narrow elliptic leaves. Inflorescence emerged from top of pseudostem. 10–14 flowers per inflorescence. Incurved type sepals and petals in appearance which are green in color with brown spots on petals. Rhombic shape apical lobe with triangular lateral lobe. Flowers in rainy season.

***Dendrobium fimbriatum*:** Each spike bears 6–12 flowers, 5–7.5 cm across, and pure orange-yellow in color. The lip is also orange and beautifully fringed at edges.

***Dendrobium bensonae*:** Plant height is 28–30 cm with pseudostem drooping in attitude. General appearance of sepals and petals are incurved. White color sepals and petals with orangish-yellow lip. Blooms in rainy season.

***Dendrobium thrysiflorum*:** Flowers contain floral bracts. The inflorescence is produced in graceful arches with off- white color sepal and petal and orange colored lip which make the whole bunch very attractive.

***Dendrobium aduncum*:** Medium sized plant with erect peduncle. Inflorescence is racemose with reflexed type sepals and petals which are netted and violate in

color. Rainy season flowering time.

Dendrobium moschatum: Pendulous flower spike 15–20 cm long develops from near the apex of leafy or leafless stem carrying 10–20, 6–8 cm across flowers. They are uniformly orange-yellow tinged with purple-pink and reddish veins. The flowers are musk-scented. The lip is slipper shape bearing two dark maroon blotches at the base.

***Dendrobium chrysanthum*:** Plant height is 70–72.6 cm with pseudostem horizontal in attitude. Flowers emerged from the node of pseudostem. General appearance of sepals and petals are incurved and spreaded type. Flower color yellow to orange. Lip shape transverse elliptic which is yellow in color. Eye is purple in color. Blooms in rainy season.

Dendrobium devonianum: Sepals and petal are velvety to white and purple in color. Lip is very attractive with two orange blotches on white base.

Dendrobium chrysotoxum: Number of flowers borne in spike varies from 10–20. Sepal and petal are yellow in color. Lip is colored in shades of yellow and orange.

***Dendrobium transparens*:** Flower occurs from the apex of inflorescence. Sepals and petal are violet colored. Lip is circular in shape and eye is yellowish orange in color.

***Dendrobium kingeanum*:** Small sized plant with dark green, narrow ovate leaves. Inflorescence arises from top part of pseudostem bears 10 flowers per inflorescence. Appearance of sepals and petals are incurved and spreaded type. Sepals are in purple color and petals with white shading. Purple color lip with angular shape apical lobe and broad trapezoid lateral lobe. Flowering time is spring.

***Dendrobium crumenatum*:** Flowers are seen on the top part of inflorescence. Sepals and petal are spreading and reflexed type and white colored. Lateral lobe of the lip is ovate in shape. This species flowers during the June.

***Dendrobium longicornu*:** Semi-erect pseudostem with narrow ovate shaped leaves. Inflorescence emerged from top part of pseudostem. Sepals and petals are spreaded in general appearance and white in color. Yellow color is present in middle part of lip. Blooms in the month of September to October.

***Dendrobium hookerianum*:** Plant height 71.2–74.3 cm with pseudostem semi-drooping in nature. Inflorescence emerged from top part of pseudostem. Sepals and petal incurved and spreading type. Yellow color sepals and petals. Maroon color eye. Fine fringing in lip margin with strong pubescence. Season of flowering is winter.

***Dendrobium acinaciformae*:** Small sized plant with drooping pseudostem. Inflorescence emerged from top part of pseudostem bearing 6–8 flowers. Pale white color petal and sepals with incurved in appearance. Lip callus is present. Flower in rainy season.

Dendrobium hybrids

***Dendrobium* "A. Abraham":** Hybrid with flowers in bright purple color. Flower spike semi-erect, 25–30 cm long and 5–8 flowered. Flower remains fresh for 20–25 days after opening of first flower.

***Dendrobium* "Burana stripe":** Erect pseudostem with narrow ovate leaves. Inflorescences emerged from top part of pseudostem. General appearance of sepals and petals is spreaded. Sepals and petals are purple to violet in color. Apical lobe is transverse elliptic and lateral lobe narrow trapezoid. Flowering time September to October.

***Dendrobium* "Pompador":** The plant height usually ranges from 53–55 cm, erect pseudostem, and semi-erect peduncle in attitude. Inflorescence emerged from top part of pseudostem bearing 10–14 flowers. General appearance of petals and sepals are spreading type, purple color with white shades. Shape of petal is spatulate. Purple color lip with elliptic shape apical lobe and broad trapezoidal lateral lobe. Flowering time November to December.

Vanda species

Vanda coerulea: Also known as blue Vanda .The erect spike carries 7–10 large, very showy, vibrant blue color flower. Petals are completely twisted and lip is dark green-blue in color.

***Vanda cristata*:** Flowers are borne along the peduncle in 3–5 numbers. The most distinct part of the flower is the shape of lobules.

***Vanda alpinae*:** General appearance of the sepals and petal are incurving. Peduncle attitude is erect. Sepals and petal are greenish yellow in color whereas lip is magenta.

***Vanda parviflora*:** Flowers are small and 8–12 numbers in a spike. Sepals are creamy in color. Lip possesses spots.

***Vanda stangeana*:** Flower spike semi-erect in nature with flower measuring 6 cm across. Flowers are green – tessellated with dark purplish-brown spots. Lip is contrasting white with yellow spots.

***Vanda tessellata*:** Plant height 30–35 cm with semi-erect peduncle attitude. Racemose type inflorescence bearing 8–10 flowers. Inflorescence emerged from nodal part of pseudostem. Sepals and petals are reflexed in appearance. Petal shape spatulate. Main color of the flower is purple with white edging. Winter season flowering.

Vanda hybrid

***Vanda* "Pakchong Blue":** Plants grows upto a height of 15.2–17 cm. Leaves are elliptic in shape. Spike emerges from plant base. Cymose type inflorescence. General appearance of sepals and petals incurved and spreaded type. Color of sepals and petals are navy blue. Lip is violet in color with presence of lateral lobe. Blooms in autumn season.

Vanda mamo* × *Vanda thongchai (Hybrid from Thailand): Height of the plant is 19.4–20.6 cm with elliptic shape leaves. Peduncle semi-erect in attitude with racemose type inflorescence bearing 4–6 flowers. General appearance of sepal and petals are reflexed and spatulate in shape. Color of flower is purple. Apical lobe of lip is elliptic and lateral lobe broad trapezoid. Blooms in winter season.

Digitalization

Digitalization of following species and hybrids has been done.

***Dendrobium*:** *Dendrobium candidum*, *D. aphyllum*, *D. chrysotoxum*, *D. densiflorum*, *D. nobile*, *D. primulinum*, *D. fimbriatum*, *D. thrysiflorum*, *D. moschatum*, *D. devonianum*, *D. transparens*, *D. crumenatum*, *D. parishii*, *D. pieriardii* and *Dendrobium* A. Abraham.

***Cymbidium*:** *Cymbidium lowianum*, *C. devonianum*, *C. pendulum*, *C. tigrinum*,*C. aloifolium*, *Cym.* "Nonina Paleface", and *Cym.* "Red Beauty", Cym. "Concerto"

***Vanda*:** *Vanda cristata*, *V. parviflora*, *V. corulea*, *V. alpinea* and *V. stangeana*.

Network Project: Utilization of wild species in crop improvement

Breeding orchids for potted and extended blooming period using wild species of Orchids

The emphasis was given for minor orchids, miniature orchids, EDV, *Cymbidium* species, *Vanda*, Mokara *etc*. in crossing program. The crosses developed (15) and their present status is given in Table 9.

Table 9. Crosses done under Net work project during 2005–06

Cross	Parentage	Stage
PBX-05–404	*Vanda* 'Pakchong Blue' × *Vanda coerulescence*	Plbs
PBX-05–407	*Arachnis rubra* × *Acampe rigida*	
PBX-05–458	*Dendrobium* 'Emma White' × *D. chrysanthum*	
PBX-05–423	*Vanda coerulescence* × *Vanda* 'Pakchong Blue'	
PBX-05-101	*Hygrochilus parishii* × *Vanda stangeana*	
PBX-05-103	*Hygrochilus parishii* × *Vanda stangeana*	Greening
PBX-05-401	*Eria javanica* × *Cymbidium* "Golden elf"	Cultured
PBX-05–470	*Arachnis rubra* × *Cleisoscentron triconum*	
PBX-05–527	*Mokara* hybrid × *Acampe rigida*	
PBX-05–862	*Vanda coerulea* × *V. tessellata*	
PBX-05–196	*Dendrobium moschatum* × *D. densiflorum*	
PBX-05-861	*Vanda coerulea* × *V. tessellata*	Swelling
PBX-05–82	*Vanda cristata* × *Aerides* sp.	Germination
PBX-05–178	*Epidendrum xanthium* × *Renanthera imschootiana*	Plantlets
PBX-05–01	*Zygopetalum intermedium* × *Peristeries elata*	

3 Transfer of Technology

The major transfer of technologies taken up by the centre were

- Frontline extension through training programmes.
- Technology transfer through demonstrations, trials and linkage programmes.
- Promotion of technologies through print media, extension literature.

Training programmes

The centre organized six tailor made training programmes on various topics and trained 20 trainers from state Department of Horticulture/Agriculture and 71 farmers to cater the specific needs and demand. The details are given below.

Trainees from Meghalaya

Trainees from Sikkim

Training programmes for the Trainers and farmers

Title of the programme	Date	No. of participants
Production technology of orchids	April 28–30, 2005	8 horticulture officers and 27 farmers from Meghalaya
Awareness-cum training on commercial floriculture	June 23–25, 2005	24 farmers from Hee Birmiok, West Sikkim
Production technology of tropical orchids	September 26–28, 2005	3 Assistant Directors, 1 Agriculture Development Officer, 3 Agricultural Officers, 3 progressive growers from Tripura
Production technology of tropical orchids	November 07–09, 2005	2 Agricultural Officers, 10 progressive growers from Nagaland and Mizoram
Production technology of tropical orchids	November 29–December 01, 2005	1 Horticulture Officer and 4 progressive growers from Assam
Production technology of orchids	January 24–27, 2006	1 Agricultural Officer and 4 farmers from Nagaland

Technology transfer

Demonstrations

One group of 58 farmers of self help group from Kalimpong and another group of 36 progressive farmers from Bilaspur district of Himachal Pradesh have visited the centre and orchid farm on 4.6.2005 and 6.6.2005, respectively.

A group of progressive farmers from Bilaspur (Himachal Pradesh)

Technology transfer through mass media

Exhibitions

Name and place	Date
Flower show of orchids at White hall, Gangtok, Sikkim	April 2, 2005
North East Agri Expo-2006 at Dimapur, Nagaland	March 27–31, 2006

Technical bulletins

- Pests of orchids and their management
- Orchids in North Eastern States

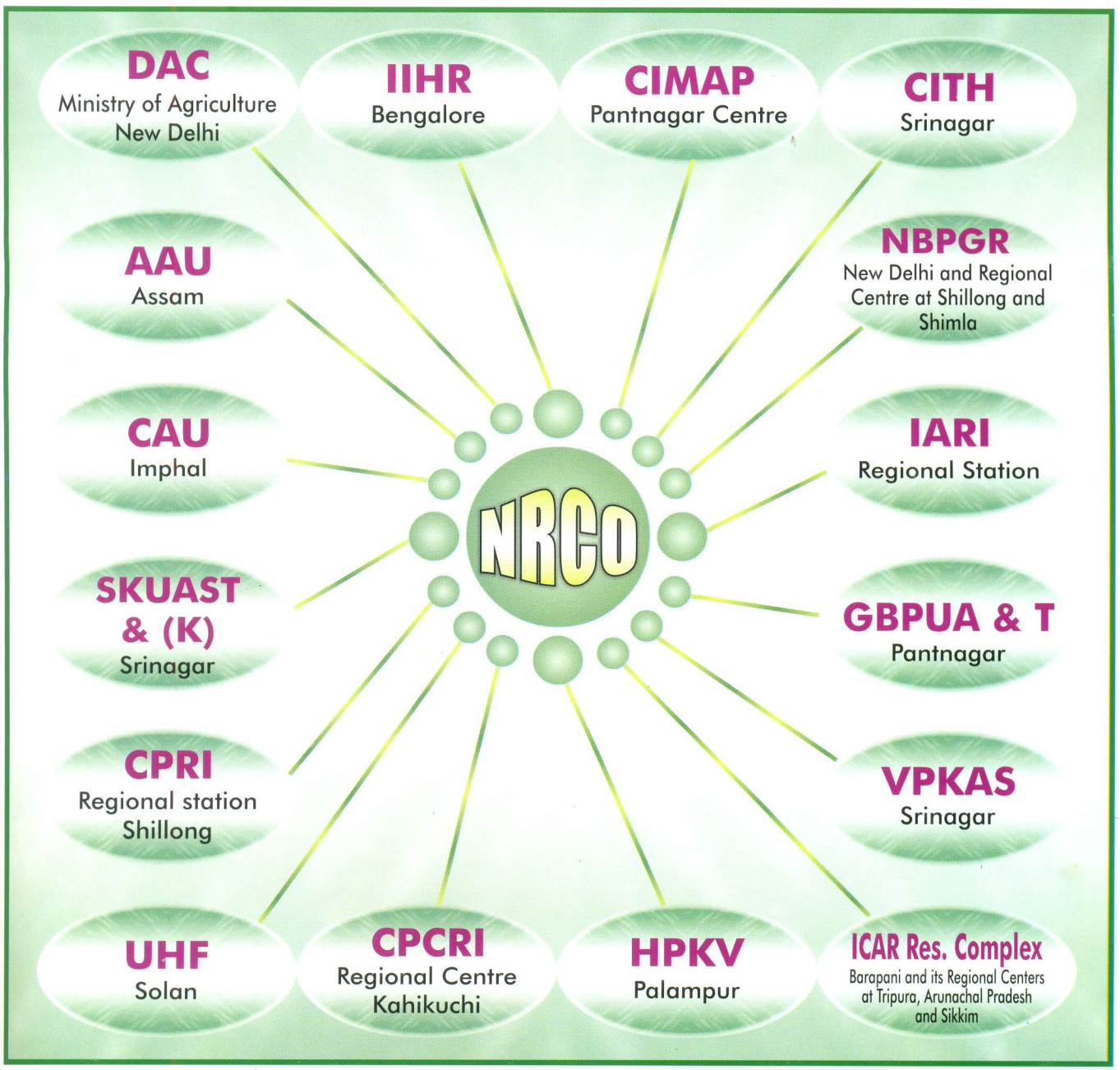
4 Education and Training

Training

The following scientists attended training programmes during the year under report.

Name of Scientist	Title of the programme and place	Duration
S Chakrabarti	Training programme on Intellectual Property Rights and World Trade Organization Related Issues sponsored by DST at Administrative Staff College of India, Bella Vista, Raj Bhavan Road, Hyderabad	January 23–27, 2006
V S Nagrare	Training programme on Intellectual Property Rights and World Trade Organization Related Issues sponsored by DST at Administrative Staff College of India, Bella Vista, Raj Bhavan Road, Hyderabad	December 5–9, 2005
Ramgopal Devdas	Training on DUS testing of Plant Varieties organized under the Central Sector Scheme for implementation of PVP legislation at the Division of Seed Science and Technology, IARI, New Delhi	September 12–17, 2005
	Winter school on Implication of WTO Agreements on Indian Agriculture at National Academy of Agricultural Research Management, Rajendranagar, Hyderabad	October 4–24, 2005

5 Linkage and Collaborations



6 List of Publications

Research articles

1. Bag T K. 2005. A new seedling blight disease of *Swertia Chirayita* (Roxb. ex Flem.) Karst. incited by *Rhizoctonia Solani* Kuhn. *Sci. & Cult.* **71**(1–2): 33.
2. Bag T K. 2005. Aerial blight of dahlia incited by *Rhizoctonia Solani* Kuhn-A new disease. *J. Hill Res.*, **18**(1) 35–36.
3. Barman D, Rajni K, Naik S K and Upadhyaya R C, 2004. Effect of nitrogen, phosphorus, potassium on growth and flowering of *Cymbidium*. *J. Ornam. Hort.*, **7** (3 & 4): 235–238.
4. Sherpa A R, Bag T K, Hallan V and Zaidi A A. 2006. Detection of Odontoglossun Ring spot virus in Orchid from Sikkim, India. *Australasian Plant Pathology*, **35**: 69–71.

Popular articles

1. Bag T K. 2005. *Cymbidium* ka virusharu, tiniharuko phelabat/sacharan transmission. *Himalaya Darpan*,12th August, 2005 (Nepali).
2. Bag T K 2005. *Cymbidium* sunakhari ma lagne black rot rhog r samayko rhoktham. *Himalaya Darpan*, 9th June, 2005 (Nepali).
3. Devadas R and Upadhaya R C. 2005. Patenting Plants? Now (News Daily), Sikkim, November 15, 2005.
4. Naik S K. 2005. Media for growing Orchid. *Agrobios Newsletter*, **11**: 44–45.
5. Ram Pal and Nagrare V S. 2005. Adbhut rup Cymbidium ka. *Falful*, April–June, 2005, pp. 19–21 (Hindi).

Paper presented in Seminar/Symposia

1. Bag T K. 2005. Present status of orchid diseases in the Sikkim Himalayas and their management under protected cultivation (*Abstract*). Global Conference II on Plant Health-Global Wealth, November 25–29, 2005, MPUAT, Udaipur.
2. Bag T K. 2006. Sclerotinia rot of two 'Jewel Orchids'—A new report (*Abstract*). National Symposium on Emerging Plant Diseases, their Diagnosis and Management, January 31–February 3, 2006, University of North Bengal, Siliguri (West Bengal) p. 18.
3. Bag T K. 2006. PseudoBulb Rot: A threatening disease of *Cymbidium* orchid in the Hills of Sikkim Himalaya (*Abstract*). International Symposium on Agriculturally Important Microorganisms: Conservation, Utilization, Bioremediation and Ecological significance, February 23–25, 2006, University of Calcutta, Kolkata, pp. 114–15.
4. Barman D, Rajni K and Upadhyaya R C. 2005. Sustainable production of *Cymbidium* hybrid Soul Hunt-6 under partially modified condition in the mid hill of Sikkim (*Abstract*). National Symposium on Current Scenario in Temperate Horticulture July 6–7, 2005, IARI, Regional station, Amartara Cottage, Shimla, Himachal Pradesh.
5. Barman D, Rajni K and Upadhyaya R C, 2005. Floriculture Model for unemployed youth under mid hill conditions of Sikkim. *Abstract* National Symposium on Sustainable Production of and Export of Horticultural Crops, December 2–4, 2005, BCKV, Kalyani, West Bengal.
6. Barman D, Rajni K, Naik S K and Upadhyaya R C. 2005. Year round production of cut roses in partially modified green house under mid hill conditions of Sikkim (*Abstract*). National Symposium on Sustainable Production of and Export of Horticultural Crops, December 2–4, 2005, BCKV, Kalyani, West Bengal.
7. Nagrare V S. 2005. Record of new pests in orchid cultivation (*Abstract*). National Conference on Applied Entomology: Current status, Challenges and Opportunities, September 26–28, 2005, MPUAT, Udaipur.

Technical publications

1. Nagrare V S. 2005. Pests of orchids and their management. National Research Centre for Orchids, Pakyong, Sikkim.
2. Nagaraju V, Upadhyaya R C, Barman D, Nagrare V S, Bag T K and Sarkar J. 2006. Orchids in North Eastern States. National Research Centre for Orchids, Pakyong, Sikkim.

Book chapter

1. Nagrare V S. 2003. Pests of bulbous ornamentals and their management. *In*: Bulbous Ornamentals. (Ed. Rajeevan P K, Singh K P, Valsalakumari P K and Geetha C K). Published by Indian Society of Ornamental Horticulture, Division of Floriculture and Landscaping, IARI, New Delhi, pp. 161–176. ❑

7 List of Ongoing Projects

Institute projects

Project title	PI	CoPI
Development of agro – techniques for commercial scale production of orchids in open and protected condition	D Barman	S K Naik & R C Upadhyaya
In vitro propagation of orchid: *Cymbidium* and important, rare and endangered species	V Nagaraju	S Chakrabarti & Ramgopal Devdas
Cytogenetical research on orchids	S Chakrabarti	
Breeding superior hybrids in *Cymbidium* and other important orchids	Ramgopal Devdas	V Nagaraju & S Chakrabarti
Collection, conservation, characterization, evaluation and maintenance high altitude orchid germplasm	Ram Pal	
Collection, conservation, evaluation and multiplication of bulbous ornamental crops	Ram pal	
Studies on bulb production of *Lilium*	Ram Pal	
Pest management in orchids and bulbous flowering plants Investigations on fungal diseases of orchids	V S Nagrare T K Bag	

Technology Mission on Integrated Development of Horticulture in North Eastern States including Sikkim, Uttaranchal, Himachal Pradesh and Jammu & Kashmir (Mini-Mission I)

Activity	Associates
Development of conventional and micro-propagation techniques	V Nagaraju and D Barman
Production of planting material under low cost polyhouses	D Barman, T K Bag and V S Nagrare
Refinement and transfer of production technologies for commercial production of ornamentals through training	R C Upadhyaya, V Nagaraju, S Chakrabarti, D Barman, T K Bag, Ram Pal and V S Nagrare

PI : R. C. Upadhyaya, CCPI : D. Barman

DUS Project

Project title	CCPI	CoCCPI
Preparation for Plant Variety Protection and Conducting test for Distinctness, Uniformity and Stability for Orchids	V Nagaraju	Ramgopal Devdas

Network Project: Utilization of wild species in crop improvement

Project title	CCPI	CoCCPI
Breeding orchids for potted and extended blooming period using wild species of orchids	V Nagaraju	Ramgopal Devdas

AP Cess Fund Project

Project title	CCPI
Standardization of protocol for raising progeny from immature crossed embryo of *Cymbidium* orchids *in vitro*	V Nagaraju

8 RAC and SRC Meetings with Recommendations

RAC

The Sixth Research Advisory Committee (RAC) meeting of the Centre was held under the Chairmanship of Dr G L Kaul, Ex-Vice Chancellor, Assam Agricultural University, Jorhat, Assam on 10th May 2005. The following participated in the meeting.

1. Dr P K Hazra — Member
   Former Director, BSI,
   29–6, Inder Road,
   Dehradun 248 001
2. Dr A A Zaidi — Member
   Head, Division of Floriculture,
   Institute of Himalayan Bioresource Technology,
   CSIR, Palampur 176 061
   (Himachal Pradesh)
3. Shri G K Gurung — Member
   Secretary (Hort & Agriculture),
   Government of Sikkim, Krishi Bhawan,
   Tadong, Sikkim
4. Dr Amor Roy — Member
   Professor (Horticulture),
   Incharge RRS, Hill Zone,
   Uttar Banga Krishi Viswavidyalaya,
   Kalimpong, West Bengal

RAC Meeting

5. Dr R C Upadhyaya — Member
   Director,
   NRC for Orchids, Pakyong, East Sikkim
6. Shri Gyen Ong Rup Lepcha — Farmer representative
   North Sikkim, Sikkim
7. Shri Prem Dorjee Leptcha, — Farmer representative
   North Sikkim, Sikkim
8. Dr T K Bag — Member Secretary
   Scientist Senior Scale
   (Plant Pathology)
   NRC for Orchids, Pakyong,
   East Sikkim

Dr K C Garg, ADG (VC), ICAR, New Delhi, Dr S N Hedge, Director, Forest Research Institute, Vana Bihar, Itanagar, Dr Man Mohan Attwar, Indo American Hybrid Seeds, Bangalore, Dr B N Choudhary, New Delhi could not attend the meeting due to some unavoidable circumstances.

Major recommendations

A. Project/work specific

1. Rare orchids like *Habaenaria* and *Anoetochillus*, which are in the category of near extinct and endangered species, are difficult to survive under Pakyong conditions, hence they may be preserved at Darjeeling centre.
2. Orchid species that have been already evaluated for taxonomical characters and also may be evaluated for horticultural characters. Further, species taxonomy, which have been evaluated and described in the literature, need not to be evaluated.
3. Phenological data cards for lady's slipper (*Paphiopedilum* sp) orchids developed by BSI, Shillong should be procured for preparation of the data card for other species.

4. NRC for Orchids should take lead in developing a standard descriptor for orchids, after due consultation with other leading orchid scientists and NBPGR, and publish the same for use by others.
5. Work on tissue culture multiplication should be concentrated on species and hybrids of *Cymbidium*. Available protocol of *Dendrobium* may be tested on a small scale and if found better, the technology may be given to the growers.
6. Protocol for the Centre should be given to the growers after re-testing. Further work on modifying the protocol should attempt at improving the available protocol. Use of coconut water and banana pulp in the growing media should be replaced by hormones.
7. Biochemical analysis of orchid species, which are not done, should be done in this year. Basic laboratory facilities for molecular works should be created immediately to do RAPD work. Identification of molecular markers from orchid species may be worked out later in collaboration with other institutions which already have required facilities.
8. The new project proposal "Isozyme analysis of Orchids" should be merged with the subproject Biochemical analysis of orchids.
9. Breeding programme should be concentrated on *Cymbidium* hybridization for cut flowers, potted plants and earliness. The objective of the project (1.3) "Initiate hybridization programme in tropical orchids" should be deleted.
10. In the new project "*Cymbidium* based floriculture model for entrepreneurship development in Sikkim", long term objective may be given 'to provide guideline for self employment and entrepreneurship development', Short term objective may be mention as:
    (a) Utilization of locally available resources.
    (b) To promote effective utilization of human resources.
    (c) To maximize returns per unit area.
11. In model floriculture project, cropping sequence may be revised so as to provide revised recurring income to the growers from the beginning. Further, 'potted plants' may be restricted to only few suitable ornamentals. The entire 500 m^2 area be put under cover. Other recommendations given and recorded may be followed. The second model of open and cover may be deleted.
12. Effect of standard dose of nitrogen should be tested first and then the effect of P & K may be tested on lily bulblets produced through scales. Besides this, only three doses of NPK should be tested instead of testing many doses.
13. Evaluation of new hybrids of lilium should be done first, followed by effect of depth of planting and finally NPK requirements. Best two treatments should be tested next year along with control in large plots.
14. Minimum plot size for fungicidal trial for control of black rot should be standardized. The best two treatments of fungicides should be tested in a larger plot then in farmers' field later.
15. The new projects on pest control, as presented, lacked basic details, which should be provided before approving the same.
16. Instead of evaluation of entire orchid germplasm for resistance to pests, the concerned scientist should focus only on *Cymbidium* for the time being. Control measures against most serious *Cymbidium* pest should be developed as an immediate priority.

B. General recommendations

17. Develop linkages and collaboration with other ICAR institutes, SAUs and BSI etc for exchange of ideas and taking up collaborative projects.
18. The projects on micro-propagation be grouped under "Crop Production' instead of 'Crop Improvement'. The projects on genetics and plant breeding, economic botany etc will come under Crop Improvement.
19. Plant varieties/cultivars of private sector being promoted by them should also be included in evaluation trials as a part of private-public partnership in research programs.
20. Each project, sub project and experiments should be given a definite number, as is done in other ICAR Institutes, and that number maintained without any change while presenting the work in any forum including SRC, RAC or QRT.
21. More number of farmers/private entrepreneurs should be motivated to participate the RAC to get more feedbacks.

22. All the scientists should work as a team and focus on the priority problems facing commercial cultivation of *Cymbidium*, instead of taking too many species.

Staff Research Council

The Staff Research Council meeting was held under the chairmanship of Shri G K Gurung, Secretary Horticulture, Government of Sikkim on 19.4.2005. The following attended the meeting.

1. Mr K G Bhutia, Principal Director (Horticulture), Government of Sikkim, Gangtok.
2. Shri S Z Lucksom, Addl. Director (Environment & Forest), Government of Sikkim, Gangtok.
3. Dr R C Upadhyaya, Director, NRC for Orchids, Pakyong, Sikkim
4. Shri D K Bhandari, Floriculturist, Government of Sikkim, Gangtok.
5. Mrs T M Chamling, Progressive orchid grower, Namchi, South Sikkim
6. Shri N T Bhutia, Addl. Director (Floriculture), Government of Sikkim, Gangtok.
7. Shri Gyen Ongrup Lepcha, Farmer Representative, Lower Dzengu, North Sikkim
8. Shri Nirmal Yonjon, Orchid grower, Dikling, Sikkim
9. Dr V Nagaraju, Sr Scientist (Biotechnology), NRC for Orchids, Pakyong, Sikkim.
10. Dr S Chakrabarti, Sr Scientist (Genetics), NRC for Orchids, Pakyong, Sikkim.
11. Dr D Barman, Sr Scientist (Horticulture), NRC for Orchids, Pakyong, Sikkim.
12. Shri Ram Pal, Scientist (Horticulture) and Scientist in Charge, NRC for Orchids, Darjeeling Campus.
13. Dr T K Bag, Scientist Sr. Scale (Plant pathology), NRC for Orchids, Pakyong, Sikkim.
14. Dr V S Nagrare, Scientist (Entomology), NRC for Orchids, Pakyong, Sikkim.
15. Shri S K Naik, Scientist (Soil Science), NRC for Orchids, Pakyong, Sikkim.

Major Recommendations

1. The *Cymbidium* species may be characterized and species not used earlier may be used for breeding of unique hybrids to compete the international market in future.
2. Early, medium and late *Cymbidium* hybrids should be identified depending on the time of flowering for continuous supply of flowers for longer period.
3. In the project: "Orchid based model floriculture system for entrepreneurs", the cost of the electricity, transportation, labour and Deprecation should be included to evaluate cost benefit ratio.
4. Model floriculture project for below poverty line (BPL) farmers may be formulated with low cost planting materials and poly structures.
5. Lilium bulb production technology may be transferred to NGOs or private party for large scale multiplication.
6. A suitable technique for increasing storage life and recycling of old bulbs of *Lilium* to be worked out.
7. Bio-pesticides along with the fungicides may be tried in the management of the black rot of the *Cymbidium*.

9

Participation of Scientists in Conferences, Meetings, Workshops, Symposia, Seminar etc. in India and Abroad

Workshop on Large cardamom and Flowers for Northeastern States held on July 05, 2005 at Tadong, Sikkim

- T K Bag – Floriculture Scenario in India with reference to Northeastern states.

National Symposium on Current Scenario in Temperate Horticulture held on July 6–7, 2005 at IARI, Regional station, Amartara Cottage Shimla, Himachal Pradesh

- D Barman – Sustainable production of *Cymbidium* hybrid Soul Hunt-6 under partially modified condition in the mid hill of Sikkim.

International Flora Expo 2005 Exhibition and Conference held on July 13, 2005 at Bangalore.

- V Nagaraju

Seminar cum workshop on Cultivation of Gerbera, Lilium, Gladiolus, Anthurium and Disease and Pest Management of *Cymbidium* Orchids held on Sept. 19, 2005 at Phuguri, Mirik, Darjeeling

- T K Bag – Disease management in *Cymbidium*
- V S Nagrare – Pest management in *Cymbidium*

National Conference on Applied Entomology: Current status, Challenges and Opportunities held during September 26–28, 2005 at MPUAT, Udaipur

- V S Nagrare 2005. Record of new pests in orchid cultivation.

Meeting on Organic farming held during Nov. 09–10, 2005 at Hort. Department, Government of Meghalaya

- D Barman

International Conference on Plastic Culture and precision farming held on November 17–25, 2005 at New Delhi

- V Nagaraju

Global Conference II on Plant Health-Global Wealth, held during 25–29 November, 2005 at MPUAT, Udaipur

- T K Bag – Present status of orchid diseases in the Sikkim Himalayas and their management under protected cultivation.

National Symposium on Sustainable Production and Export of Horticultural crops held during December 02–04, 2005 at BCKV, Mohanpur, West Bengal

- D Barman – (i) Year round production of cut roses in partially modified green house under mid hill conditions of Sikkim., (ii) Floriculture Model for unemployed youth under mid hill conditions of Sikkim.

National Symposium on "Emerging Plant Diseases, their Diagnosis and Management" held during Jan 31–February 3, 2006 at Department of Botany, University of North Bengal, Siliguri

- T K Bag – Sclerotinia Rot of Two 'Jewel Orchids'— A new report.

Post Conference Satellite seminar on "Diseases of Horticultural Crops in Darjeeling Hills and their Management" held on February 3, 2006 at Mirik Tourist Lodge, Mirik, Darjeeling

- Bag T K – Diseases of orchids in the hills of Sikkim and Darjeeling and their management.

National Symposium on Biotechnological Intervention for Improvement of Horticultural Crop, held during January 10–12, 2005 at KAU, Thrissur

- S Chakrabarti - Application of RAPD technique to study the genetic relationship of orchids.

Meeting of Technology Mission on Integrated Development of Horticulture in N E States, Sikkim, Uttaranchal, Himachal Pradesh, Jammu and Kashmir. (Mini-Mission 1) held on February 24, 2006 at ICAR Research Complex for NEH Region, Barapani, Meghalaya

- D Barman

International Symposium on Agriculturally Important Microorganisms: Conservation, Utilization, Bioremediation and Ecological Significance" held during February 23–25, 2006 at Department of Botany, University of Calcutta, Kolkata

- T K Bag – Pseudobulb rot: A threatening disease of *Cymbidium* orchid in the Hills of Sikkim Himalaya.

North East Agri Expo-2006 held during March 27–31, 2006 at Dimapur, Nagaland .

- V Nagaraju – Exhibition
- D Barman – Exhibition
- T K Bag – Exhibition

Distinguished Visitors

- Mr David Parsons and his team from ADB Agri-buisiness, NCDC, New Delhi — 06.04. 2005
- Mrs T M Chamling, orchid grower and wife of Chief Minister of Sikkim — 19.04. 2005
- Dr Nawab Ali, DDG (Engg.), ICAR, KAB-II, New Delhi — 01.06. 2005
- Shri Nakul Das Rai, Member of Parliament (Lok Sabha), Gangtok, Sikkim — 16.07.2005
- Dr Hemant K Badala, Scientist Incharge, GBPIHED, Pangthang, Gangtok, Sikkim — 05.08.2005
- Dr P S Pathak, Director, IGFRI, Jhansi — 05.05.2005
- Dr S K Pradhan, Principal, Sikkim Govt. College, Gangtok, Sikkim — 02.09.2005
- Prof R K Sachdeva and group, IIPA, New Delhi — 28.09.2005
- Shri G M Gurung, Minister HRDD, Government of Sikkim, Gangtok, Sikkim — 05.10.2005
- Shri G K Gurung, Secretary Agri. and Horti., Government of Sikkim, Gangtok, Sikkim — 18.10.2005
- Brig R K Arora, Deputy GOC, HQ 170, Mountain Dursion, APO, Gangtok, Sikkim — 21.10.2005
- Shri S Pradhan, Director, State Institute of Rural Development, Gangtok, Sikkim — 30.12.2005
- Prof S P Vij, Orchidologist, Ex Head, Department of Botany, Panjab University Chandhigarh & Secretary, The Orchids society of India, Chandigarh — 13.01.2006
- Mrs Manita Manger, ML A, Lossing Pacheykhani, Sikkim — 28.02.2006

Shri Nakul Das Rai, MP (extreme left) observing orchid cultivation

Prof S P Vij (extreme left) Orchidologist visited orchid polyhouse

11 Personnel (as on 31 March 2006)

Scientific

R C Upadhyaya	Director (up to 11.12.2006)
V Nagaraju	Principal Scientist (Hort.) (w.e.f) 4.10.2005 and Acting Director (w.e.f. 12.11.2006)
Syamali Chakrabarti	Sr. Scientist (Genetics)
D. Barman	Sr. Scientist (Horticulture)
T. K Bag	Scientist Sr. Scale (Plant Pathology)
Ram Pal	Scientist Sr. Scale (Horticulture)
V S Nagrare	Scientist Sr. Scale (Entomology)
S K Naik	Scientist (Soil Science) (on study leave w.e.f. 01.10.2005)
Ramgopal Devdas	Scientist (Plant Breeding)

Administration

Shri Sunil Kumar Das	Assistant Finance and Accounts Officer
Miss Lakit Lepcha	Assistant
Shri Rajat Kumar Das	Sr. Clerk
Mrs Diki Bhutia	Jr. Clerk
Mrs Dil Maya Subba	Jr. Clerk (up to 7.11.2005)

Technical

Shri Sunil Kumar	Sr. Tech. Asst. (T-4)
Shri G B Mukhiya	Farm Tech. (T-2)
Shri R C Gurung	Technical Asst., Driver (T-2)

Supporting

Shri T B Singh	SSG – III
Shri Gopal Brahmin	SSG – III
Shri Phigu Tshering Bhutia	SSG – II
Ms. Meena Kumari Chettri	SSG – II
Shri Dawa Bhutia	SSG – I
Shri Tularam Dulal	SSG – I
Shri Trilok Singh Balmiki	SSG – I

Appointment

- Dr V Nagaraju, joined as a Principal Scientist (Hort.) on selection by ASRB on 4.10.2005. He has taken over charge of Acting Director w.e.f. 12.12.2005.
- Shri Janaki Mandi joined as Horticulture Assistant (T-3) w.e.f. 21.7. 2005.

Transfer

- Dr R C Upadhyaya, Director, transferred to Central Agricultural Research Institute, Port Blair, Andaman and Nicobar and joined there w.e.f. 12.12.2005.

Study leave

- Shri S K Naik, Scientist, Soil Science has been relieved for study leave w.e.f 01.10.2005 to join PhD programme at BCKV, Kalyani, West Bengal.

Resignation

- Mrs Dil Maya Subba, Jr. Clerk resigned from her post w.e.f. 8.11.2005.

Other Information

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Hindi Diwas

Hindi Diwas was celebrated on 14.9.2005 by organizing competitions on essay writing on '*Manav vikas prakritik sampada ka vinash*' among local school students (Class XI & XII), extempore, debate on '*Mahilaonko sansad me Aarakshan*', speech on' *Uttar Purvi Bharat me pushpotpadan*'. Winners were awarded with prize and certificate.

Raising day celebrated

Raising day of this centre was celebrated on 5.10.2005. On this occasion Shri G M Gurung, Honorable HRDD Minister, Government of Sikkim was invited as Chief Guest. Dr R C Upadhyaya presided over the function. On this day newly constructed "Entry Gate" of this centre was inaugurated by the auspicious hand of chief guest. Publications- Annual Report 2004-05, Orchids Newsletter (January–June 2005) and Technical bulletin on "Pests of orchids and their management" were released. For the whole day variety of indoor and outdoor sports and cultural events were organized for different group of participants of the family members of the employee of this centre. The winners were awarded with prize and certificates. Dr V S Nagrare coordinated the celebration along with other staff.

Shri G M Gurung releasing publications

Parliament committee on official language visited

Parliament committee on official language visited on 11.06.2005 and reviewed the progress made in the use of Hindi for official purpose at this Centre.

Meeting of Parliament committee on official language

Flower show

Shri Shivraj Patil, Hon'ble Union Home Minister inaugurated the flower show of orchids and others flowers on 2nd April 2005 at White hall, Gangtok in presence of Shri P K Chamling, Chief Minister of Sikkim, his cabinet ministers and senior officials from various State and Central Government Departments. The flower show

Shri Shivraj Patil, Hon'ble Union Home Minister observing flower show

was organized in collaboration with state forest department, horticulture and cash crop department, Government of Sikkim and National Research Centre for Orchids, Pakyong, Sikkim.

North East Agri Expo-2006

The center participated in the North East Agri Expo-2006 and installed an exhibition hall in Dimapur, Nagaland organized by the Government of Nagaland and ICAR held during March 27–31, 2006.

North East Agri Expo-2006 Dimapur, Nagaland

Library

Subscription of several National journals of Crop Improvement, Crop Production and Crop Protection of Horticultural importance, viz. India Journal of Agricultural Sciences, Indian Journal of Horticulture, Indian Journal of Ornamental Horticulture, Indian Journal of Plant Physiology, Indian Journal of Genetics and Plant Breeding, Indian Journal of Biotechnology, Indian Journal of Intellectual Property rights, Indian Phytopathology, Indian Horticulture, Indian Farming, Indian Journal of Mycology and Plant Pathology, Current Science; Foreign journals, viz. Orchids, the Orchid Review, The Australian Orchid Review, Hort Science, Journal of Genetics and Breeding, Journal of Economic Entomology, Journal of the American Horticulture Society, Horticultural Abstract and Plant Disease were continued for enrichment of library facilities.

A total of 49 new books were purchased for library from institute library funds. Besides important books on orchids biochemistry and biotechnology, Entomology, viz. (1) Sander's list of Orchid Hybrids, (2) HPLC of Biological Macromolecules, (3) Floriculture: Designing & Merchandising, (4) Mycorrhizal Biology, (5) Statistical Methods for Plant Variety Evaluation, (6) UK Pesticides Guides 2004, (7) Aphids of the World's Crops: An Identification and Information guide and (8) State of the Indian Farmers: A millennium Study (1–27 vol.) were also procured for library as reference books.

Works/Building/Infrastructure

Farm: 6 poly houses under institute fund and 2 under DUS project have been constructed. Transformer and generator have been ready for handing over from CPWD.

Other facilities -Completed construction of 4 no. Type IV quarters had been completed. Mini bus redeployed at this centre from CPCRI, Kasaragod and now being used for school duty.

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