

वार्षिक प्रतिवेदन
Annual Report
2008-09



राष्ट्रीय आर्किड्स अनुसंधान केन्द्र
(भारतीय कृषि अनुसंधान परिषद्)
पाक्योंग - 737 106, सिक्किम
National Research Centre for Orchids
(Indian Council of Agricultural Research)
Pakyong - 737 106, Sikkim, India



वार्षिक प्रतिवेदन
Annual Report

2008 - 2009



राष्ट्रीय आर्किड्स अनुसंधान केन्द्र
(भारतीय कृषि अनुसंधान परिषद्)
पाक्योंग - 737 106, सिक्किम
National Research Centre for Orchids
(Indian Council of Agricultural Research)
Pakyong - 737 106, Sikkim, India





National Research Centre for Orchids, Pakyong - 737 106, Sikkim , India

Phone : 03592-257954, 257703,257289
Fax : 03592-257289, 257282
Email : nrcorchids@rediffmail.com
Website : www.sikkim.nic.in/nrco

Correct citation

NRCO, 2009, National Research Centre for Orchids, Annual Report 2008 - 09, Pakyong, Sikkim

August, 2009

Published by

R. P. Medhi, Director
National Research Centre for Orchids, Pakyong, Sikkim

Editorial board

R. P. Medhi
L. C. De
Ram Pal
R. P. Pant

Compiled by

L. C. De and N. G. Debnath

Hindi translation

R. P. Pant

Cover photographs

Front : (From Top to Bottom) *Vanda Robert's Delight*, *Paphiopedilum spicerianum* Pfitz.,
Cym. Milton Carpenter Evergrades Gold, *Cym. Red Princes*, *Cym. eburnum* Lindl.

Back : *Cym. Showgirl 'Cooksbridge'*

Printed at

M/S. Hindusthan Printers,
Ground Floor, Gupta Market,
Raja Rammohan Roy Road,
Siliguri - 734 001
Phone No. : 0353-2432776, Cell : 96790 09688

Preface

It gives me an immense pleasure to place before you the Annual Report of National Research Centre, Pakyong for the year 2008-09. The centre is engaged in conservation and management and utilization of orchid genetic resources, development of protocols for propagation and cultivation of species and commercial cultivars. The centre aims at commercialization of orchid cultivation in the country. The centre has made significant progress in basic, applied research and extension activities during the reported period. Through this document, an attempt has been made to highlight the achievements in a comprehensive way. At Pakyong, a total of 3130 accession of orchids are conserved and maintained. A significant progress was made in the development of protocols for *in vitro* propagation, characterization of orchid genetic resources using molecular techniques, production technologies, disease pest management and post-harvest management. At Darjeeling campus, a total of 162 species of temperate species of orchids have been conserved. Some interesting genotypes of *Coelogyne nitida*, *Calanthe puberula*, *Eria spicata*, *Liparis bootanensis* were identified. A significant progress has been made in the production of quality planting materials of *Cymbidiums* through meristem culture under institute and externally funded projects. Approximately, 25,000 plantlets of *Cymbidium* hybrids were made and distributed to the farmers at subsidized rate. For the production of plantlets *in vivo*, a method for propagation of *Cymbidium* through backbulb has been developed. Linkages with the farmers and NGOs were strengthened by setting demonstration units and providing trainings to the farmers. A notable progress was made in organizing of training programme for the farmers in collaboration with state agricultural department, department of forest and horticultural societies.



A number of research papers, technical bulletins, and extension leaflets were also published. The scientists of this centre participated in various conferences, meetings and workshops. The liaison with the growers and entrepreneurs was improved through on campus and off campus trainings.

I must express my sincere thanks and gratitude to Dr. Mangala Rai, Director General, ICAR and Secretary DARE, Govt. of India, Dr. H. P. Singh, Deputy Director General (Horticulture) and Dr. U. Srivastava, Assistant Director General (Hort. II) for their constant encouragement, guidance and support in executing the mandate of the Centre. We are also grateful to the members of QRT, RAC and IRC for their guidance in carrying out the programmes of the institute successfully.

I also thankfully acknowledge the contributions made by all the scientists, technical, administrative and supporting staff of this centre.

Pakyong
Date : 17th August 2009

(R. P. Medhi)
Director

Executive Summary

- Diversity analysis and DNA profiling of 10 *Cymbidium* species were done using RAPD markers. Out of 20 decamer primers 10 arbitrary primers produced a total of 180 distinct major bands of which 98 % were polymorphic.
- RAPD analysis of 15 vandaceous orchids indicated 98 % polymorphism.
- The morphological traits of eight *Dendrobium* orchids, were analysed using RAPD analysis and the genetic distance was measured by using Squared Euclidean Distance ranged from 5 - 23 %.
- 3130 germplasm accessions were maintained at the centre. The characterization of 89 endangered and rare orchid species was done.
- Two *in vitro* clones of *Paphiopedilum venustum* and two crosses of *Cymbidium lowianum* X *Cym.* 'Showgirl', one clone of *Cymbidium lowianum* X *Cym.* 'Showgirl', one intervarietal cross of *Dendrobium nobile* and one *ex vitro* clonal variant of *Cattleya maxima* were identified.
- In *Cymbidium* hybrid 'Soul Hunt-1', P1b proliferation was found best on MS media supplemented with AC, IBA (0.5 mg/l) and GA₃ (1 mg/l).
- Light intensity of 1000 - 1500 lux was found to be ideal for hardening of *Cymbidium* hybrids.
- *Cymbidium* hybrid 'H. C. Aurora' showed maximum vegetative growth and backbulbs formation under 30 % shade with 50 % water regime.
- Total chlorophyll content was maximum in without shade condition with 25 % water regime.
- Foliar application of 0.3 % N P K (19:19:19) at 7 days intervals boosted the vegetative growth of six month old tissue cultured plants under hardening.
- Twelve hybrids of *Cymbidium* and four species of orchids were evaluated for their vase life. Out of four stages, 75 % opened flower stage recorded highest vase life with 8 HQS (200 ppm) in *Cym.* 'Red Princess'.
- Nutrient analysis showed that fully opened flowers contain higher amounts of N (0.95 %) and Potassium (0.54 %) as compared to bud stage.
- In *Cym.* 'Spring King' the pH of leachate of growing media was decreased with the progress of crop growth irrespective of treatments.
- Anthracnose disease caused by *Colletotrichum gloeosporioides* was also found to seriously infect *Phalaenopsis* and *Cattleya* hybrids.

- Application of Mancozeb (200 – 500 ppm) + Carbendazim (200 – 500 ppm) reduced the infection of anthracnose.
- A black spot disease caused by *Aternaria alternata* was observed on the leaves of *Coelogyne* and *Thunia* sp.
- Biological indexing of CymMV and ORSV was done through mechanical inoculation on different herbaceous host plants. Virus indexing of 30 *Cymbidium* hybrids and three *Dendrobium* hybrids was done by ELISA technique.
- Based on survey of 175 orchid species, mites, scale insects, aphids, shoot borer, mealy bug, weevil, thrips, slugs, snails and lepidopteran caterpillar were found to infest orchids. Among them, the incidence of mite was reported highest in May and mealy bugs during May – September.
- A new species of the thrips *Dichromothrips nakahari* is reported on *Cymbidium*.
- Among pesticides, Imidacloprid 17.8 SL (2ml⁻¹) was found most effective followed by bifenthrin and propagite (0.05%) for control of mites in *Cymbidium*.
- 162 orchid species are conserved at Darjeeling Campus.
- Three variants of *Coelogyne nitida*, one variant each of *Calanthe puberula*, *Eria spicata* and *Liparis bootanensis* were identified.
- The externally funded projects like MM-I, DUS project and Mega Seed Project work continued with accomplishment to support the core projects.
- 7,294 plantlets of orchids were produced under MM-I.
- 6,000 plantlets of orchids , 10,000 corms of gladiolus , 4,000 corms of freesia and 3,000 bulbs of lilies were produced under Mega Seed Project.
- 25,000 plantlets of *Cymbidium* were produced under DBT's Mission for North-East for Quality Planting Material and Utilization for the North East and institute programmes.
- Technology has been developed to produce the planting materials from the backbulbs of *Cymbidiums in vivo*.

कार्यकारी सारांश

- सिम्बीडियम की 10 प्रजातियों में आर० ए० पी० डी० मार्कर द्वारा विविधता विश्लेषण एवं डी० एन० ए० प्रोफाइलिंग किया गया। 20 डिसेम्बर प्राइमरों में से 10 प्राइमरों द्वारा कुल 180 प्रतिबंधित खंडों की प्राप्ति हुई जिनमें से 98 प्रतिशत बहुरूपी थे।
- वन्डा प्रजाति के आर्किड में आर० ए० पी० डी० विश्लेषण करने पर 98 प्रतिशत बहुरूपी पाये गये।
- आठ डेन्ड्रोवियम आर्किड प्रजातियों में आर० ए० पी० डी० विश्लेषण किया गया जिन्हें स्क्वार्ड यूक्लिडियन दूरी से मापने पर आनुवांशिक दूरी 5 से 23 प्रतिशत पाई गयी।
- केन्द्र में कुल 3130 जननद्रव्य क्रमांक संरक्षित है। 89 लुप्तप्रायः एवं दुर्लभ आर्किड प्रजातियों का अभिलक्षणन किया गया।
- पेफियोपेडिलम वेनुस्टम के 2 इनविट्रो क्लोन, सिम्बीडियम लोवियानम x सिम्बीडियम 'शोगर्ल' के दो क्रोस, एक क्लोन सिम्बीडियम लोवियानम x सिम्बीडियम 'शोगर्ल', डेन्ड्रोवियम नोविली का एक अर्न्तजातीय क्रोस तथा कैटलिया मैक्सिमा का एक्सविट्रो क्लोन को चिन्हित किया गया।
- सिम्बीडियम वर्णसंकर 'सोलहन्ट' के पी० एल० वी० को एम० एस० माध्यम में एक्टीवेटेड चारकोल तथा आई० बी० ए० (0.5 मिग्रा०/ली०) और जी० ए० 3 (1 मिग्रा०/ली०) मिलाकर प्रयोग करने से उनके पी० एल० बी० में अत्याधिक बढ़ोत्तरी पायी गयी।
- सिम्बीडियम वर्णसंकरों के लिए 1000-1500 लक्स प्रकाश तीव्रता प्रदान करने वाली शेडनेट आर्दश पायी गयी।
- सिम्बीडियम वर्णसंकर 'एच० सी० अरोरा' में 30 प्रतिशत छाया और 50 प्रतिशत पानी की व्यावस्था होने पर पौधों में कायिक वृद्धि एवं कन्द (वल्च) का विकास सर्वाधिक पाया गया।
- बिना छाया एवं 25 प्रतिशत पानी की व्यवस्था होने पर कुल हरितपर्ण लवक सर्वाधिक मात्रा में पाये गये।
- छह मास के ऊतक संवर्धित पौधों की पत्तियों में 0.3 प्रतिशत एन० पी० के० (19:19:19) का छिड़काव 7 दिन के अन्तराल में करने पर कायिक वृद्धि उत्तम पायी गयी।
- सिम्बीडियम के 12 वर्णसंकरों एवं आर्किड की चार अन्य प्रजातियों में फूलदान में जीवनकाल (वास लाईफ) का अध्ययन किया गया। सिम्बीडियम वर्ण संकर 'रेड प्रिंसेज' में 8 एच० क्यू० एस० (200 पी पी एम) मिलाने पर फूलदान में जीवनकाल सर्वाधिक पाया गया।

- कली के सापेक्ष पूर्णविकसित फूलों में पोषक तत्वों का विश्लेषण करने पर नाइट्रोजन (0.95 प्रतिशत) एवं पोटेशियम (0.54 प्रतिशत) अधिक मात्रा में पाया गया।
- सिम्बीडियम वर्णसंकर 'स्प्रिंग किंग' में मीडिया से छना हुआ घोल (लीचेट) का pH मान पौधों की वृद्धि के साथ साथ कम होता है।
- फेलिनोपसिस एवं केटलिया वर्णसंकरों में एन्थ्रेकनोज, कालिटो ट्राईकम ग्लाइयोस्पोरोयाडिस बीमारी की रोक थाम के लिए मेनकोजेव (200-500 पी पी एम) + कार्वनडाजिम (200-500 पी पी एम) का मिश्रण उक्त बीमारी के निदान के लिए उपयुक्त पाया गया।
- सिलोगाइनी एवं थूनिया प्रजातियों में अल्टरनेरिया अल्टरनाटा द्वारा जनित पत्तियों में काले धब्बे वाली बीमारी का प्रकोप पाया गया।
- सिम्बीडियम मोजेक एवं ओडेन्टोग्लोसम रिगस्पोट विषाणुओं का दूसरे शाकीय पौधों में संक्रमण कराया गया। इसके अलावा एलाइजा विधि द्वारा 30 सिम्बीडियम एवं 3 डेन्ड्रोवियम वर्णसंकरों का सफल परीक्षण किया गया।
- सर्वेक्षण के आधार पर आर्किड की 175 प्रजातियों में सामान्यतया स्केल, एफिड, सूटवोरर, मीलीबग, वीविल, थ्रिप्स, स्लग, स्नेल एवं लेपिडोप्टेरीय कैटरपिलर पाये गये।
- माईट का प्रकोप मई के महीने में तथा मिलीबग का प्रकोप मई से सितम्बर के बीच सबसे अधिक पाया गया।
- सिम्बीडियम में थ्रिप्स की एक नई प्रजाति, डेक्रोमोथ्रिप्स नाकाहारी, को रिपोर्ट किया गया।
- इमिडाक्लोप्रिड 17.8 एस एल (2 मिली०/ली०) तथा बाईफेनथ्रिन (0.05 प्रतिशत) माईट के निदान के लिए सबसे अच्छा पाया गया।
- राष्ट्रीय आर्किड अनुसंधान केन्द्र दार्जीलिंग परिसर में आर्किड की 162 प्रजातियों विभिन्न परीक्षण के लिए संरक्षित है।
- सिलोगाइनी निटिडा की 3, लिपारिस बूटानेन्सिस, कैलान्थी प्यूबरुला एवं एरिया स्पीकेटा की एक - एक भिन्नता वाली प्रजातियों को चिन्हित किया गया।
- केन्द्र में अनुसंधान को सफलतापूर्वक चलाने के लिए बाह्य श्रोतों से स्वीकृत परियोजनाएं जैसे एम० एम०-1, इस परियोजना तथा मेगासीड परियोजनाएं सुचारु रूप से चलाई जा रही है।
- एम० एम०-1 परियोजना के अर्न्तगत कुल गुणवत्ता रोपण पदार्थ का उत्पादन आर्किड में 7,294, मेगासीड परियोजना में 6,000 आर्किड एवं 10,000 ग्लैडियोलस के कार्म, 4,000 फ्रीजिया के कार्म तथा 3,000 लिली के बल्ब का सफलता पूर्वक उत्पादन किया गया।

Contents

Preface	
Executive Summary	
Introduction	01
Research Achievements	06
Technology Assessed and Transferred	41
Linkages and Collaboration	43
List of Publications	44
List of Ongoing Projects	48
RAC and IRC Meetings with Recommendations	50
Participation of Scientists in Conferences, Meetings, Workshops Training, Symposia, Seminars etc. in India and Abroad	58
Distinguished Visitors	60
Personnel	61
Other Information	63

Introduction

The National Research Centre for Orchids was established on 5th October 1996 by the Indian Council of Agricultural Research (ICAR), New Delhi to organize research programme for improvement in productivity, quality and utility of orchids and bulbous flowering crops. The Sikkim state authorities handed over 22.19 acres of land belonging to Regional Agricultural Centre, Pakyong along with all other assets to ICAR for the establishment of the centre. In October 1997, the centre also took over the Darjeeling campus from C.P.R.I. and established a campus for research on temperate orchids and other bulbous flowering crops. In the initial years of the establishment the major focus of research was on collection, evaluation, characterization and utilization of available germplasm in the north eastern 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/hybrids, molecular characterization, standardization of agro-techniques, post harvest management, production of quality planting materials through tissue culture and creation of repository of information related to all aspects of 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.

Mandate

- To collect, characterize, evaluate and conserve germplasm of orchids and other ornamental bulbous crops
- Molecular characterization to check biopiracy of orchids
- Development of protocol for mass multiplication
- Production of quality planting materials for large scale cultivation
- To develop hybrids/ varieties suitable for domestic and export market
- To develop production, protection, and post-harvest technologies for orchids and flowering bulbous crops
- 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 10 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 (MM-1), Network Projects on Distinctiveness, Uniformity and Stability (DUS), Mega Seed Project - Seed production in Agricultural crops and Fisheries, DBT's Mission for North-East for Quality Planting Material and

Utilization for the North East and NAIP's Value Added Chain of Selected Aromatic Plants of North East India.

Organisation

The Director is the administrative head of the institute. The Institute Management Committee, Research Advisory Committee and Institute Research Council assist the Director in matters

relating to management and research activities of the institute (Fig.1). Research on various aspects of mandate crops is conducted in three divisions/sections namely Crop Improvement, Crop Production and Crop Protection. The supporting sections include Administration & Accounts, ARIS Cell, Library, Documentation and Consultancy Cell.

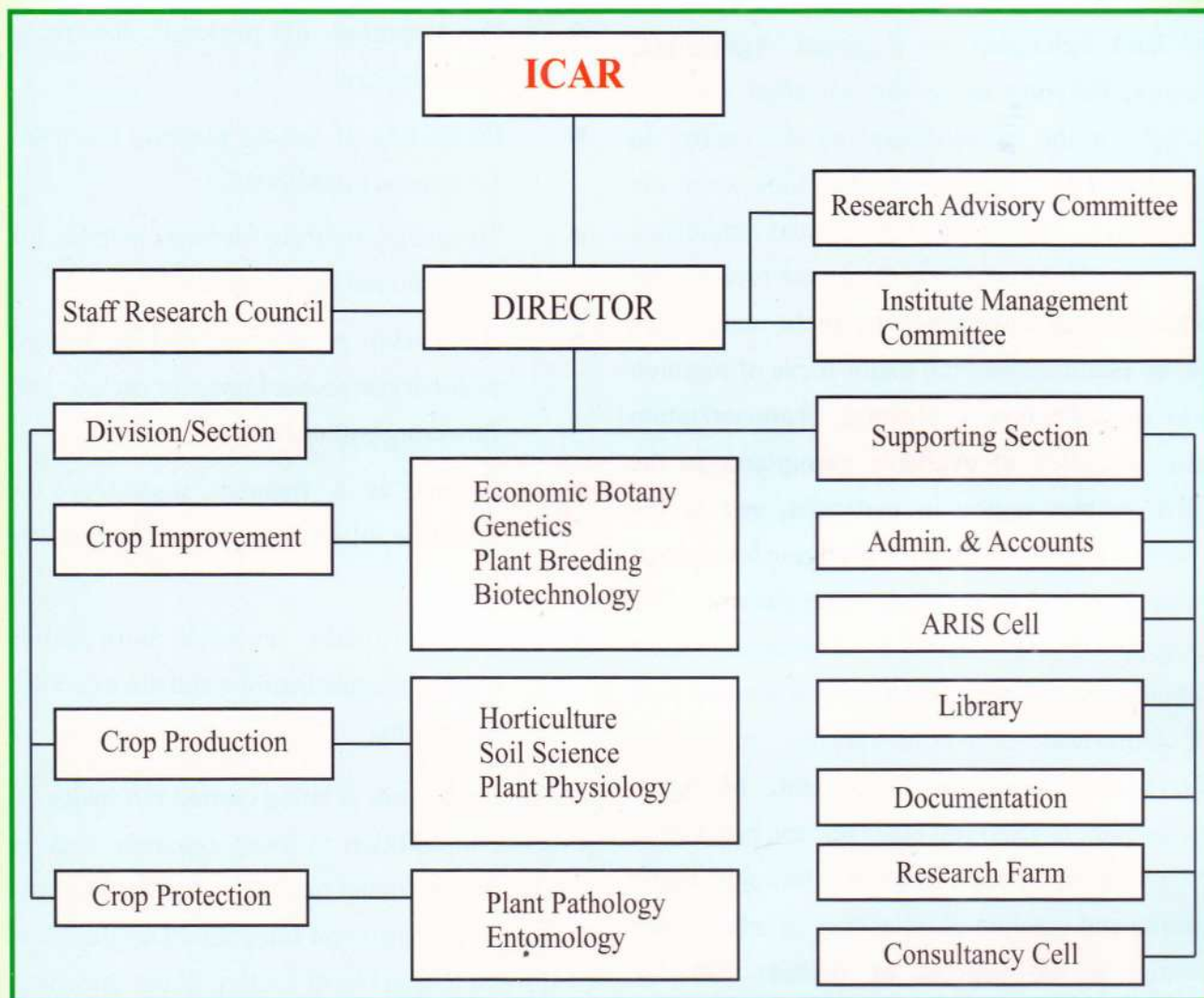


Fig. 1. Organisation of NRCO

Table 1. Financial statement (2008-09)

Head of Account	(Figure in Rupees)			
	Non-Plan		Plan	
	Sanctioned	Utilized	Sanctioned	Utilized
Establishment charges	1,05,05,000.00	1,04,66,384.00		
Labour wages	-	-	-	-
Traveling allowances	1,05,000.00	1,02,727.00	6,84,534.00	6,84,534.00
Other charges	8,90,000.00	5,57,243.00	1,41,61,602.00	1,41,61,602.00
Works	1,00,000.00	-	76,32,364.00	76,32,364.00
HRD	-	-	21,500.00	21,500.00
Total	1,16,00,000.00	1,11,26,354.00	2,25,00,000.00	2,25,00,000.00

Table 2. Revenue generation of the institute

Revenue generation	
Particulars	(Figure in Rupees)
Sale of farm produce	1,92,930.00
Sale of tender form	600.00
Training	63,000.00
Others	1,56,470.00
Total	4,13,000.00

Table 3. Staff position of the institute (as on 31.03.2009)

Sl. No.	Category	Sanctioned strength	In position	Vacant
1.	Director	1	1	-
2.	Scientific Post			
	Scientist	9	5	4
	Sr. Scientist	5	3	2
	Principal Scientist	1	1	-
Total		15	9	6
3.	Technical Staff			
	Category - I	5	4	1
	Category - II	2	2	-
	Category - III	-	-	-
Total		7	6	1
4.	Administrative Post			
	Asstt. Admn. Officer	1	1	-
	Asstt. Fin. & Account Officer	1	-	1
	Assistant	1	1	-
	U.D.C/Sr. Clerk	1	1	-
	L.D.C/Jr. Clerk	3	3	-
Total		7	6	1
5.	Supporting Staff(SSG-I, II, III, IV)			
		7	7	-

Past Achievements

Surveys were conducted for collection of orchid germplasm to various parts of the country. The collected accessions were conserved in conservatories. The accessions of tropical and sub tropical species were conserved at Pakyong (altitude, 1300 m) while the accessions of temperate species were conserved at Darjeeling

campus (altitude, 2150 m). The germplasm was characterised for various useful traits. The molecular characterisation of germplasm is also in progress. Virus indexing studies on orchids has also been initiated.

Protocols for micropropagation orchid species and hybrids were standardized. The improved vegetative propagation methods were developed

in *Cymbidium*, *Lilium* and gladiolus for rapid multiplication of planting stock. The optimum requirement for nutrient, media, water, light, shade etc were standardized for the *Cymbidium* orchids standardized.

The surveys were conducted for disease and insect – pests causing damage in the farmer's field as well as in the orchid conservatories at the centre. The diseases causing damage to the orchids were identified, epidemiology was studied, casual organisms were isolated and their control measures were suggested. Similarly, insects-pests causing damage to the orchids were also identified and their nature of damage studied and the control measures were suggested. Several first time reports of pathogens and insect-pests damage to the crop has been recorded.

The centre organized training programmes for extension workers and farmers regularly. The quality planting material of orchids and other floriculture crops was produced and distributed to the farmers to promote orchid cultivation in the region. The demonstrations were conducted at the farmer's field to encourage farmers for adopting

orchid cultivation as a vocation.

The centre has developed a library that plays an important role in serving scientific information in the area of horticulture specially orchids and other ornamental crops. During the year near about 100 books related to different subjects and 13 Hindi books were purchased for the library. Thirty eight journals including ten foreign journals were procured through subscriptions. Institute's publications were provided to more than 200 different organizations.

The center established linkages with DAC, Ministry of Agriculture, New Delhi; IHR, 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.

Research Achievements

2



CROP IMPROVEMENT

Molecular Characterisation of Orchids

RAPD analysis of *Cymbidium* orchids

Diversity analyses and DNA profiling was done in *Cymbidium* orchids using RAPD markers. 20 randomly selected primers viz - OPA11, OPB20, OPC05, OPE06, OPE11, OPE12, OPF15, OPI20, OPK10, OPM12, OPQ20, OPS11, OPT06, OPT13, OPU17, OPV09, OPW11, OPX07, OPY18, OPZ06 were used to study the genetic relatedness of 10 *Cymbidium* species. Out of 20 decamer primers 10 arbitrary primers produced a total of 180 distinct major bands of which 98% were polymorphic (Fig.1).

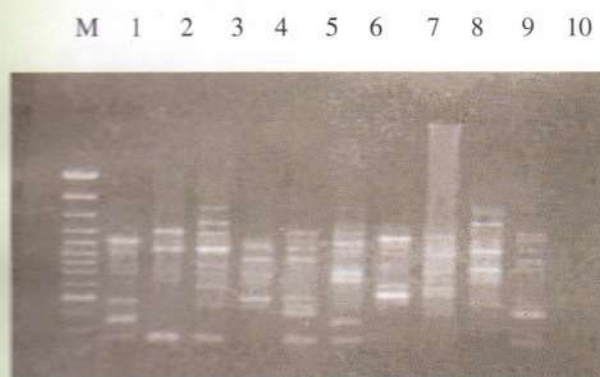


Fig. 1: RAPD banding pattern generated by primer OPM-12

RAPD analysis of Vandaceous orchids

15 vandaceous orchid species were selected from five genera of orchids on the basis of morphological data for diversity analysis using 20 random primers. Out of 20 decamer primers 12 arbitrary primers produced a total of 210 distinct major bands of which 98% were polymorphic (Fig. 2).

M 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 M

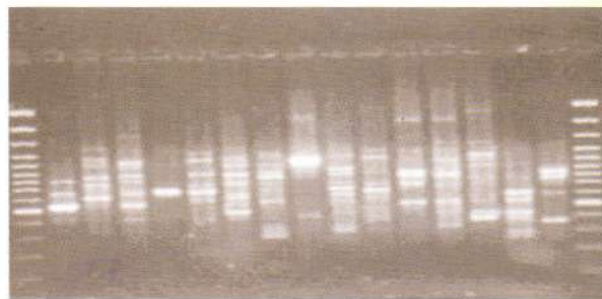


Fig. 2: RAPD banding pattern generated by primer OPK-10

RAPD analysis of some rare and endangered *Dendrobium* orchids

Eight rare and endangered species of *Dendrobium* orchids namely *D. chrysanthum*, *D. chrysotoxum*, *D. crepidatum*, *D. devonianum*, *D. falconeri*, *D. fimbriatum*, *D. hookerianum*, *D. lituiflorum* were selected for the study on the basis of morphological traits. 10 randomly selected decamer primers produced 90 amplified fragments among which 80% were polymorphic. The genetic distance was measured based on Squared Euclidean Distance ranged from 5 - 23% (Fig. 3).

M 1 2 3 4 5 6 7 8

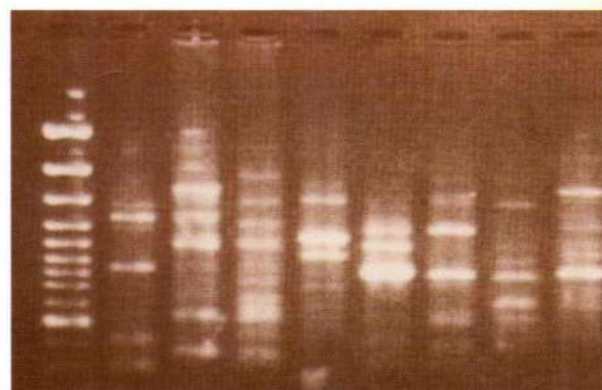


Fig. 3: RAPD banding pattern generated by primer OPR-1

Improvement of Orchids

Germplasm collection

Germplasm accessions (3,130) are maintained at the center. Registration proposal for *Renanthera imschootiana* Rolfe., has been submitted to NBPGR. Indian Collection identity was given as IC 566525. During this year 68 different species were procured from Nursery International, Kalimpong, West Bengal and were inducted to germplasm collection.

Characterization and evaluation

Characterization of 89 orchid species was done as per common descriptor's on orchids. The characterised orchid species include *Ascocentrum ampullaceum*, *Ascocentrum aurantiacum*, *Aerides multiflorum*, *A. odoratum*, *Arachnis rubra*, *Ascda* 'Kultana Gold Spot' x *Ascda* 'Karbafah' 4n, *Ascda* 'Fuchs Gold' x *Ascda* 'Kultana Gold', *Acampe papillosa*, *Ascocentrum ampullaceum*, *Paphiopedilum spicernum*, *P. insigne*, *P. villosum*, *P. venustum*, *Dendrobium anceps*, *D. aphyllum*, *D. williamsoni*, *D. primulinum*, *D. nobile* var. *alba*, *D. lituiflorum*, *Cattleya maxima*, *Dendrobium secundum*, *Hygrochilus parishii*, *Cymbidium* Hybrid (unknown), *Phalaenopsis lobbi*, *Luisia* sp, *P. hirsutissimum*, *Renanthera imschootiana*, *Vanda cristata*, *Papilionanthe teres*, *Oncidium spacealatum*, *Lycaste crueata*, *Cymbidium lancifolium*, *Phalaenopsis hybrid* (unknown), *Dendrobium bensonii*, *D. formosum*, *Eria amica*, *Micropera manni*, *Calanthe masuca*, *Cleisoscentrum trichronum*, *Dendrobium* 'A. Abraham', *D. farmeri*, Mokara hybrid (unknown), *Palatanthera insectifera*, *Vanda coerulea*,

Zygopetalum intermedium, *Vanda Mamo* x *V. Thongchai*, *D. "Thongchai Gold"*, *Paphiopedilum spicerianum*, *P. insigne*, *Coelogyne nitida*, *Coelogyne* sp, *Cymbidium* Sp. (from Shillong), *C. 'Big Don Herman'*, *Oncidium 'Colm. Wildeat Rainbow'*, *Paphiopedilum villosum*, *Cattleya 'Den. EB'*, *Vanda* (purple color-gerbera house), *V. 'Adisak'* x *V. 'Dr. Anek FCC' 4n*, *Ione cirrhata*, *Cymbidium 'Sant Mary Gold'*, *C. 'Fantassia Delmer'*, *C. 'Karnuladakhan'*, *C. 'Caphobolate'*, *C. 'December Gold'*, *C. 'A 340'*, *C. 'White Panni'*, *C. 'Chujen'*, *C. 'Florence'*, *Oncidium 'Sweet Fragrance'*, *C. 'Venustenine'*, *Coelogyne graminifolia*, *Papilionanthe vandarum*, *D. williamsoni*, *Coelogyne flaccida*, *Eria pubescence*, *Tainia minor*, *Coelogyne elata*, *Phaius tankervilleae*, *Phaius flavus*, *Tainia hookeriana*, *Calanthe* sp and *Lycaste crueata*. The new identifications were done for *Dendrobium ruckeri*, variant of *Papilionanthe* species and phylogenic studies were done for among the species of *Dendrobium*, *Cymbidium* and *Vanda*.

Crossing Program

Selective crossings for species & hybrids having flowering synchrony were done between species and hybrids, based on the summary of the earlier three years.

New hybrid lines identified from F₁/clone progeny

Color variants from *P. venustum*

The plants developed through *in-vitro* culture of *P. venustum* species flowered during October,

2008 with marked differences. The characters of the identified clone were recorded and designated as NRCO - *P. venustum* / 2008 - Clone 01 (Fig. 4). Medium size plant having sepals, petals and lip similar to mother plant. But the color of petals and lip was found to be greyed orange (RHS 177A) which is generally not seen in species of *Pahioepidulum*. The leaf shape is narrow elliptic with obtuse apex. This variation may be the result of somaclonal mutations caused in culture media. The variations observed may serve as new germplasm stock.



Fig. 4 : NRCO-*P. venustum*/2008-clone 01

The 2nd variant was observed from the same stock and identified and designated as 'NRCO-*P. venustum*/2008-Clone 02' (Fig. 5). Petal and lip deep purple (RHS N79A), smooth (non-ciliated). Leaves narrow, elliptic with acute tip like mother species.



Fig. 5 : NRCO-*P. venustum*/2008-clone 02

In case of mother species (*P. venustum*), the dorsal sepal color is white with yellow green (RHS 146 A) stripes, petal green with shades of red purple (RHS 59A) and spotted purple (RHS N79 A), ciliated. But, the lip is in light yellow and leaves are narrow elliptic with acute tip (Fig. 6). The comparative details of the variants are given in table 1.



Fig. 6 : Flower of *P. venustum*

'NRCO-H x B/2008' (*Cymbidium lowianum* x *Cym. 'Showgirl'*)

Hybrid reported last year was also evaluated for the expressivity of the color pattern and variation among progeny. *Cymbidium lowianum* inflorescence generally bears more than 20 flowers and flowers measuring, 4 cm x 9.92 cm. Sepal and petal are yellow to green in color with light maroon stripes and lip having color of yellow, white and maroon. In case of *C. 'Showgirl'*, inflorescence raceme bears 6 - 8 flowers with color of whitish maroon with maroon spots and white margin and lip has maroon pinkish spots on anterior lobe.

Description on H X B/2008 clone-01

Plant height moderate (65 cm), with spread area of 55 cm. Pseudo bulb circular 3.5 cm length with 2.9 cm in diameter. Leaves - 13, linear, 58 cm x 1.8

Table 1. Comparison of clonal variants of *P. venustum* with mother plant of *P. venustum*

Characteristics	NRCO-P venustum/2008-clone 01	NRCO-P venustum/2008- clone 02
Plant height	24.5 cm	17 cm
Plant spread	14.5 cm	28 cm
Leaf shape	Narrow elliptic, obtuse	Narrow elliptic, narrow acute
Leaf colour variegation	Dark green	Dark purple
Flower size	10.2 cm x 10.0 cm	9.5 cm x 11.0 cm
Dorsal sepal size	5.6 cm x 5.5 cm	5.6 cm x 4.9 cm
Lateral sepal size	4 cm x 2.1 cm	4.3 cm x 1.7 cm
Petal size	5.5 cm x 1.7 cm	5.9 cm x 1.4 cm
Lip size	4.9 cm x 2.0 cm	4.5 cm x 1.8 cm
Column size	1.1 cm x 0.9 cm	1.5 cm x 0.5 cm
Dorsal sepal shape	Obovate (broad)	Obovate
Lateral sepal shape	Narrow ovate	Narrow ovate
Petal shape	Lanceolate	Lanceolate
Lip shape	Slipper shaped (pouch shaped)	Slipper shaped (Pouch shaped)
Dorsal sepal colour	Purple (RSH N79 C)	Purple (RHS N79 C)
Lateral sepal colour	Off white with yellow green colour stripes (RSH 146 C)	Off white with yellow green colour stripes (RHS 146 C)
Petal color	Grayed orange (RHS 177 A)	Purple (RHS N 79 C)
Lip color	Grayed orange (RHS 177 A)	Purple (RHS N79 C)
Flower longevity	24 days	24 days

cm in size with narrow acute tip and symmetric. Inflorescence - racemose, spike emerges from the base of pseudo bulb with 8 flowers (Fig 7). Peduncle - erect to semi erect, 38 cm long and 0.7 cm in thickness. Flowers - 5.6 cm x 8 cm, sepals and petals are narrow elliptic and yellow green (RHS 146D) in color having a color shading of gray orange (RHS 177C) unlike last year with

darker pigmentation in same color group, dorsal sepal (6.2 x 2.3 cm), lateral sepal (5.5 x 2.2 cm) & petals (5.3 x 2.2 cm). Lip - yellow (RHS 11C) with gray purple (RHS 187B) apical lobe, broad trapezoid with size 4 cm x 2.5 cm, apical lobe is pointed at tip and rhombic with white edged. Column - Yellow (RHS 11C) with color spot grayed orange (RHS 177C), size 3.1 x 1 cm, 2nd

year flowering observed during 1st week of January 2009.



Fig. 7 : Inflorescence of 'NRCO-Cymbidium hybrid-HxB/2008' - 01

'NRCO-H x B/2008 clone-02'

Plant height 62 cm and spread area 65 cm. Peduncle is comparatively larger (40 cm), with less number of flowers. Leaves - 27, linear 59.4 x 2 cm. Inflorescence - racemose, spike emerges from the base of pseudo bulb with 3 flowers. Flowers - larger, 6.6 x 10 cm size, sepals and petals are elliptic and yellow (RHS 8C) with light shading in middle (RHS 177D), dorsal sepal (4.9 x 2.7 cm), lateral sepal (5 cm x 2.8 cm) & petals (5 x 2.2 cm). Lip - yellow (RHS 8C) with grayed purple (RHS 187B/C) apical lobe, broad trapezoid (3.1 x 2.5 cm.) Column yellow (RHS 8C) with color spots grayed purple (RHS 187C). Clone - 2 of the cross flowered during 2nd week of January 2009 (Fig. 8).

'NRCO-B x H/2009-01' (*Cym* 'Showgirl' x *C. lowianum*)

Reciprocal cross of direct cross of H x B flowered during January 2009 having maximum features of the mother plant. Lip with spotted dark gray

orange (RHS 174 A). Plant height 52 cm, spread area 60 cm bearing 8 leaves. Leaves linear, tip acute. Inflorescence erect, 5 flowered. Flowers 6.2 x 8.1 cm, sepals and petals elliptic, grayed orange (RHS 174A). Dorsal sepal 5.5 x 2 cm, lateral sepal 5.5 x 2.2 cm and petals 5.4 x 2 cm. Lip apex triangular, strongly reflexed, inverted back at tip, apical 4 x 2.8 cm, yellow (RHS 12C) spotted grayed purple (RHS 187B). Column yellow (RHS 12C) spotted grayed purple (RHS-187B). Flowered 1st time during first week of January 2009 (Fig 9 & 10).



Fig. 8 : Inflorescence of 'NRCO-Cymbidium hybrid-HxB/2008'-02



Fig. 9 : Flower of 'NRCO-Cymbidium hybrid-BxH/2009'-01



Fig 10 : Plant of 'NRCO - *Cymbidium* hybrid-BxH/2009'-01

'NRCO-D. nobile x D. nobile var. alba cross/2009'

Plant size medium having a height of length 32.2 cm and spread area of 45 cm and pseudo stems clustered. Leaves 25, oblong - elliptic, asymmetric, emarginate measuring approx. 11 x 2.5 cm (top 5th leaf). Flower arises from the node of pseudo-stem. Pedicellate ovary 5.5 cm long. Flowers 6.1 x 7.3 cm, bigger than common *Dendrobium nobile* found in Sikkim. Sepals linear, dorsal sepal 4.6 x 1.5 cm, lateral sepal 4.5 x 1.3 cm, white with purple (RHS-N78 B) tips. Petals ovate, 4.5 x 2.3 cm, white with purple (RHS N78B) tips. Lip yellow (RHS 4D), purple at middle (RHS N79B) and purple colored (RHS N78 B) edged, ovate shaped apex. Column green (RHS-143 A) and anther cap purple (RHS- N78 A). The 1st flowering was recorded in March - April, 2009.

Clonal variation among *ex-vitro* hardened plants of *Cattleya maxima*

The *Cattleya maxima* plantlets raised through in-vitro culture 1st flower in 2008. They flowered

with common features of *Cattleya maxima* except a few characters in the color of lip. In previous year (2008) color of lip was light purple having white edge and a yellow band in the middle but in 2nd year clonal variants were observed with purple color lip and yellow color band in middle with smaller in size.



Fig. 11 : Flower of 'NRCO-D.n x D.n var Alba cross/2009'



Fig. 12



Fig. 12 & 13 : Clonal variation among *ex-vitro* *Cattleya maxima* plants

Embryo culture and status of F₁ hybrids under *in vitro* and *ex vitro* conditions

The F₁ progenies of forty different crosses developed earlier years are under evaluation. These crosses are - {3 x 6 (15), F x H (3), PRTF (5), BxH (30), Ri x Vanda (5), NRCO-42 (5), PI x Pw (37), H x B (29), 4710 A (1), 'NRCO-Epi-Cross/2008' (85), PBX-05-10 (52), -34 (40), -11 (13), -29 (160), -07 (11), -55 (39), -751 (12), -884 (30), -41 (20), -178 (200), -826 (43), -897 (25), -39 (131), -56 (17), -771 (72), -10 (24), -21 (128), -772 (296), -884 (15), -57 (65), -01 (20), -34 (178), -490 (12), -24 (2), -46 (5), SS x PB (2), 6 x 11 (1), Cym A (109) and AB x SG (131)}.

Seed culture of PBX-05-11, 21, 41, 178, 772, 57, 897, 898, 593, 24, 393, 449, 467, 148, 438, 448, -868, -374, -407, -767, -841, -954, PBX-06-0495, -0318, -0301, -0291, -0153, -0193, -0223, -0200, -0201, -0257, -258, -0197, -0451, -0312, -0320, -0205, -0527, -0169, -0275, -0309, -0303, -0293, -42, -36, -4, PBX-09-13, PBS-05-03, -593, -0419, -248, -984, -382, PBS-06-0111, -0129, -0130, -0420, -0225, -396, -0462, -0492, 01 and D. *crepidatum* are under incubation stage for germination.

NRCO-Er x Ex-cross/2005 (*Epidendrum radiacans* and *E. xanthinum*)

The F₁ progeny of the above cross was evaluated for 4th year. The variety is suitable for potted plant and landscaping. Flower size of selected line is bigger than both parents. The progeny has bright saffron-orange color (RHS 44A) which is a preferential attribute for potted flowering plants.

The dorsal sepal 1.8 x 0.6 cm, lateral sepal 1.9 x 0.7 cm, petal 1.8 x 0.6 cm, lip 2.3 x 2 cm and column 1.1 x 0.2 cm are relatively bigger than parents. Side lobes of lip fimbriated with deep cleft at anterior margins which similar to male parent (*E. xanthinum*). The F₁ progeny of 'NRCO-Epidendrum cross/2005' flowered with different shades of red-orange to yellow and categorized into three groups viz. red-orange, orange-yellow and yellow. The ease in multiplication, long flowering period and 2-3 flowering in a year are additional characters of this progeny.

NRCO - PI x Pw - cross/2006 (*P. lawrenceanum* x *P. 'Winston Churchill'*)

Variation among the F₁ progeny of the cross was recorded. The bigger size flower like *P. insigne* with same expressivity like in 2006 - 07 was observed.

Description of clone - 30 : Plant height 17.5 cm and spread area of 33.0 cm. Stem stout and erect. Leaves elliptic, tip emarginated. Inflorescence solitary, single flowered. Flowers 9.0 x 9.5 cm, dorsal sepal 4.8 x 6.4 cm, lateral sepals 4.2 x 3.6 cm, ovate, white with yellow green shades (RHS-N144B) (white 40%, green 60%), spotted grayed purple (RHS-187A). Lateral sepals yellow green (RHS-145B) spotted grayed purple (RHS-187A). Petals 6.0 x 3.1 cm, spatulate, yellow green (RHS N144A) spotted grayed purple (RHS-187A). Lip 5.0 x 3.5 cm, pouch shaped and yellow green in color (RHS-154C) with grayed purple (RHS 187A) shading (Fig. 14).

NRCO - 42 (Den. 'Emma White' x Den. 'Pompadour')

A double hybrid flowered with the features of moth type *Dendrobium* (*D. phalaenopsis* - cane type) with bigger, overlapping petals and sepals (unlike *D. nobile* - cane types) purple colored (RHS N78A) having whitish shade at base. Colour enrichment over the male parent may be due to the parentage of the hybrids used in crossing program and their pedigree record. The color of lip throat and column are whitish pink and white respectively in NRCO - 42. Side lobes of lip semi - arching over column, unlike broadly open in male parent and semi open in female parent.



Fig. 14 : 'NRCO - P1 x Pw-cross/2006 - 30'

Evaluation and bulking of selected crosses

NRCO - Freesia hybrid - 01/2000

A new hybrid line of freesia was identified in 2003. This was multiplied for bulking breeder's stock during last year (3rd) and used for regional multi-location trails at 6 locations (on station, Gangtok, Ranipul, Mohitnagar, Guwahati & Umiam) during this year. Parental lines were also bulked for selection and purification. The F₁ exhibited double colored scented flowers with

maroon - yellow color and having 08 days flowering period. Propagation coefficient was recorded 165.3 and 143.7 for two different years from plot basis. Flowering from cormels was also observed in the population which may not be desirable for commercial cultivation and planting material production but flowering was allowed to confirm the hybridity. The third order inflorescence and two additional side shoots that emerged from mother plants also gave single stem first order inflorescence making its complete flowering period of 18 days under field conditions.

In Vitro Propagation of Orchids

Influence of growth hormones on Plbs proliferation of *Cym.* 'Soul Hunt-1'

Protocorms of *Cym.* 'Soul Hunt-1' were cultured on MS media incorporated with different levels of IBA & GA₃. The results revealed that MS + AC + GA₃ (0.5 mg⁻¹) resulted faster Plb proliferation (18 days for 5th Plb stage) while combined effect of both hormones IBA (0.5 mg⁻¹) + GA₃ (1 mg⁻¹) was best for Plb proliferation.

Study on Plbs multiplication and differentiation of *Cym.* Showgirl 'Cooksbridge' using media and hormones

Morphogenic response of Plbs of *Cym.* Showgirl 'Cooksbridge' were studied with MS, AC, GA₃ and kinetin revealed that the 0.25 mg⁻¹ kinetin alone showed early Plb proliferation (88 days for 5th Plb) and early differentiation was found with 0.25 mg⁻¹ GA₃.

Influence at IBA vs Sucrose on the root induction

using Plb's of *Cym.* 'Soul Hunt-I'

MS media incorporated with IBA and sucrose were used as treatments for the study of the root induction from plb's of *Cymbidium* 'Soul Hunt-I'. The study revealed that MS + IBA (1mg^{-1}) + sucrose (30g^{-1}) showed the faster Plb proliferation i.e. 28 days for 1st plb stage & 99 days for 5th Plb stage.

Influence light, media & temperature on hardening of *Cymbidium* hybrids under *ex vitro* conditions

Shade nets with 1000 - 1500 lux were found suitable for hardening of tissue culture plants in the nursery.

CROP PRODUCTION

Development of Agro-Techniques for Commercial Scale Production of Orchids in Protected Condition

Standardization of shade requirement and moisture regime for growth and flowering of *Cymbidium* hybrid 'H. C. Arora'

The experiment consisted of four shade levels (0%, 30%, 50% and 75%) and four moisture regimes (25%, 50%, 75% and 100%). The moisture level of the media was calculated on the basis of water holding capacity and the water was applied at 10 - 15 days interval depending on the weather and moisture content. The experimental results showed that growing of *Cym.* 'H. C. Aurora' under 30% shade with 50% water produced maximum number of shoots (4.0) and number of leaves (6.9) and more backbulbs (3.4)

in 30% shade with 100% water. Plant height (92.7 cm) and leaf length (87.9 cm) was maximum in 75% shade with 100% water. Total chlorophyll content was maximum in 0% shade with 25% water followed by 50% shade with 100% water. Chlorophyll 'a' content was highest in 30% shade with 75% water and lowest in 75% shade with 50% water. Chlorophyll 'b' content was maximum in 0% shade with 25% water and minimum in 75% shade with 100% water (Fig. 1).

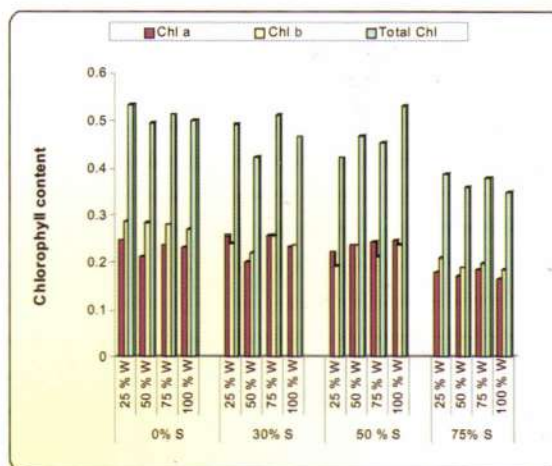


Fig. 1 : Chlorophyll content in the leaves of *Cym.* H. C. 'Aurora' grown under different shade levels and moisture regimes

Optimization of nutrient requirement for *Cymbidium* plantlets under hardening

The experiment consists of four concentrations of N P K @ 19:19:19 (0%, 0.1%, 0.2% and 0.3%) and two spray intervals (7 and 15 days). Nutrient solution was given as foliar applications. It was recorded that foliar application of 0.3% of N P K at 7 days interval increased the plant height (56.27cm) of *Cym.* 'Sleeping Nymph' when compared with 15 days interval (55.34 cm). However, in both intervals the plant height was lesser in control (47.56 cm). Number of leaves

(17.60) were maximum in 15 days interval when compared to 7 days interval (16.19). The least number of leaves (15.90) were recorded from the control (Fig. 2).

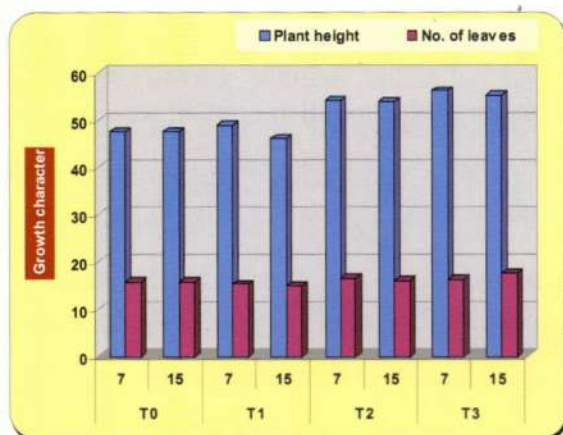


Fig. 2 : Effects of NPK (19:19:19) concentration and spray intervals on plant height and Leaf numbers of *Cym. H. C. 'Aurora'*

Development of Integrated Floriculture Enterprise

In this study, five cultivars of *Cymbidium* namely Pineclash 'Moon Venus', Soul Hunt, Ensikhan, Valley Legand 'Steff' and No. 39 were cultivated as main components. Among these cultivars 'Ensikhan' produced 1 - 2 flower spikes / plant from September to October and during the winters no flower production was observed. Again flower production was recorded 1-6 spikes/ plant during March to June. It was found that this is a summer season flowering variety and can be cultivated at lower elevations. Apart from orchids, four varieties of *Alstroemeria* and eight varieties of *Lilium* and potted plants showed promising as other components under integrated floriculture enterprise (Fig. 3 & 4).



Fig. 3 & 4 : (Top to bottom) *Cymbidium*, *Lilium*, *Alstroemeria* & other ornamentals grown under integrated floriculture enterprise

Post Harvest Technology of Orchids

Evaluation of *Cymbidium* hybrids for their vase life

Cymbidium hybrid cut flowers namely Pineclash 'Moon Venus', Red Princess, White Beauty, H. C. 'Aurora', Sun Gold, Simpeda, Red Beauty, Red Tower, Ensikhan, Florance, Valley Legand and Platinum Gold were evaluated for their vase life. It was found that *Cymbidium* hybrid Florance is having the highest vase life of 53.66 days followed by White Beauty 53.05 days. The lowest vase life was noticed in Platinum Gold (22.44 days).

Evaluation of different orchid species for their post harvest life

Orchids species namely *Cymbidium iridioides*, *Zygopetalum intermedium*, *Phaius tankervillae* and *Lycaste* species were evaluated for their vase life and found that *Cymbidium iridioides* is having the vase life of 29.50 days and *Zygopetalum intermedium* is having the vase life of 18.10 days. *Phaius tankervillae* is having 24.20 days and *Lycaste* sp having 9 days of vase life (Fig. 5).

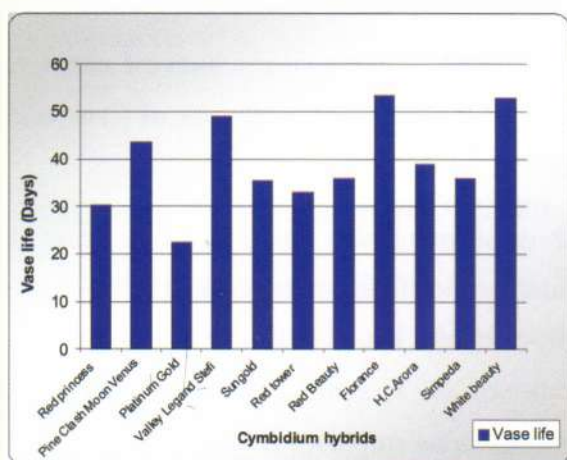


Fig. 5 : Variation in the vase life of different *Cymbidium* hybrids

Standardization of stage of harvesting in *Cym. 'Red Princess'*

Experiment on standardization of stage of harvesting was carried out in *Cym. 'Red Princess'* with four harvesting stages (100 %, 75 %, 50 % and 25 % opened flowers). Four harvesting stages of cut spikes were subjected to eight different holding solutions. Among the four stages, 75 % opened flowers recorded the highest vase life of 38.33 days with 8 - HQS 200 ppm as a holding solution. The lowest vase life (16.75 days) was noticed in 50 % opened flowers kept in 0.5Mm STS solution. In all the stages cent per cent

opening of florets was noticed. Fig.6. indicates the effect of harvesting stage and different holding solutions on vase life of *Cym. 'Red Princess'*.

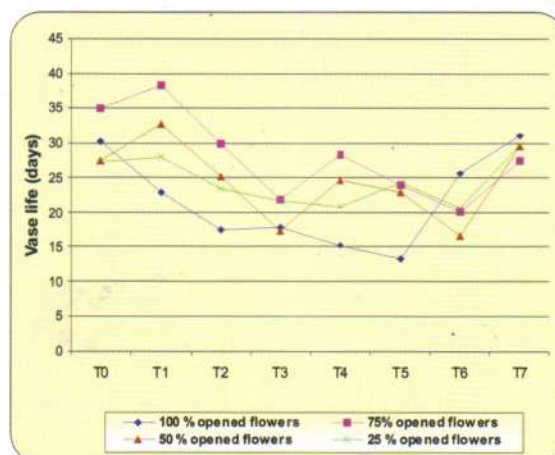


Fig. 6 : Effects of harvesting stage and different holding solution on vase life of *Cym. 'Red Princess'*

Standardization of pulsing solution for *Cym. Pineclash 'Moon Venus'*

An experiment was carried out to standardize the pulsing solutions for *Cym. Pineclash 'Moon Venus'*. The pulsing was given for 2 hours and 4 hours with 8 different chemicals. Among the different pulsing solutions used 2 hours pulsing with sucrose at 5 % increased the vase life of flower (56 days) followed by sucrose @ 8 % (54.78 days) (Fig.7). Water uptake was highest in sucrose 8 % (31.99g) followed by sucrose 5 % (30.05g) and water loss was highest in sucrose 8 % (40.00g).



Fig. 7 : *Cym. Pineclash 'Moon Venus'* showing the effects of different pulsing solutions on vase life

Nutrient composition of bud and fully opened flowers of *Cymbidium* hybrids

The experiment was undertaken to study the nutrient composition of *Cymbidium* hybrids. The healthy flowering plant was selected and the floral spike was cut from the base of the pseudobulb. The flowers were divided into two categories, one fully opened and other bud condition. The flower samples were washed with distilled water, blotted dry and placed separately in paper bags. The samples were dried at 70°C and ground to powder form. The ground samples were subjected to mineral nutrient analysis.

The result (Fig. 8) showed that the N content of fully opened flowers had higher value as compared to flower buds of different *Cymbidium* hybrid. The N content was highest of 0.95% in *Cym.* Pineclash 'Moon Venus' in fully open flowers. It was followed by *Cym.* 'White Beauty' (0.79%) and *Cym.* 'Red Princes' (0.76%). The P content was found higher in flower buds as compared to fully opened flowers. The highest (0.41 %) P content was observed in the flower buds of *Cym.* Pineclash 'Moon Venus'. It was followed by *Cym.* 'Red Princes' (0.36%) and *Cym.* 'White Beauty' (0.22%). The K content of fully opened flowers had higher value as compared to flower buds of different *Cymbidium* hybrids. The K content was highest of 0.54 % in the flowers of *Cym.* 'White Beauty'. It was followed by *Cym.* 'Red Princes' (0.53 %) and *Cym.* Pineclash 'Moon Venus' (0.42%).

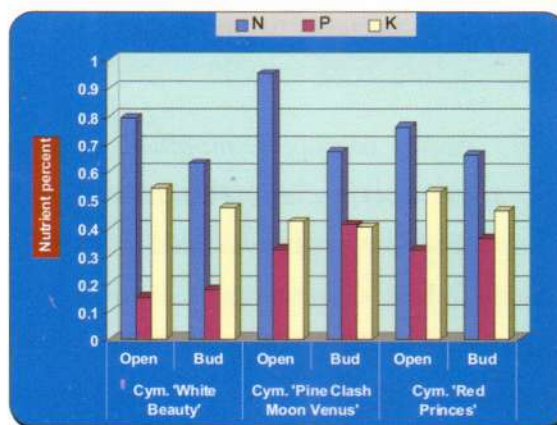


Fig. 8 : Distributions of N, P and K on flower of *Cymbidium* hybrids

Influence of different post harvest chemicals on the N P K content of flower of *Cymbidium* 'Red Princes'

The experiment was undertaken to study the influence of different chemicals on N P K content of flowers of *Cym.* 'Red Princes'. The treatments comprised of T₀ - distilled water; T₁ - 8HQS (hydroquinone sulphate) 200 ppm; T₂ - citric acid 0.05%; T₃ - STS (silver thiosulphate) 0.5mM; T₄ - sucrose 10 %; T₅ - STS 1 mM + sucrose 10 %; T₆ - AgNO₃ 50 ppm; T₇ - 8HQS 200 ppm + sucrose 5 %; T₈ - Al₂(SO₄)₃ 100 ppm. The flower samples were collected at the end of the post harvest treatment. Fully opened flowers in the spike were divided into three regions namely upper, middle and lower. The flower samples from the respective regions were collected and placed separately in paper bags. The samples were dried at 70°C and ground to powder form. The ground samples were subjected to mineral nutrient analysis.

The N-content of flower was more in upper portion of the flower spike compared to lower portion. The N content was more (0.99 %) in the

treatments receiving sucrose (flower spike kept in 10 % sucrose) followed by 8 - HQS 200 ppm. It has been observed that P content of flower was more in upper portion of flower compared to lower portion of the spike. The P content was more (0.42 %) in the treatment receiving citric acid (Flower spike kept in 0.05 % citric acid) followed by 8 - HQS (200 ppm). The K-content was more in the middle portion of flower and lowest in the flowers from lower portion of the spike. The K content was more (4.18 %) in the treatment receiving citric acid (flower spike kept in 0.05 % citric acid) followed by 8 - HQS (200 ppm).

Nutrient Management in Orchids

Effect of graded doses of N P K to *Cym. 'Spring King'* on the changes in pH of the leachate of growing media

The investigation was undertaken to study the effect of graded doses of N P K for *Cym. 'Spring King'* on the changes in pH of the leachate of growing media. The different graded doses of N P K fertilizers were prepared by mixing the appropriate quantities of ammonium nitrate, ammonium dihydrogen phosphate and potassium nitrate. The treatments comprised of T₀ (Control); T₁ (N₂₀ : P₁₀ : K₁₀); T₂ (N₂₀ : P₂₀ : K₂₀); T₃ (N₂₀ : P₃₀ : K₃₀); T₄ (N₃₀ : P₁₀ : K₁₀); T₅ (N₃₀ : P₂₀ : K₂₀); T₆ (N₃₀ : P₃₀ : K₃₀); T₇ (N₄₀ : P₁₀ : K₁₀); T₈ (N₄₀ : P₂₀ : K₂₀); T₉ (N₄₀ : P₃₀ : K₃₀). The fertilizer solutions were applied at 0.1 % at fortnightly intervals. During winter season (November to February) application of fertilizers were restricted to monthly once. Intercultural operations were carried out as and

when required.

The leachate was collected by pour thru technique described by Wright. Three representative pots were labeled for each replication and water was added to saturate the pot without leaching. The pots were placed in clean saucer and 100 ml of fresh water was poured over the surface of the media in each pot and the resulting leachate (approx. 70 ml) was collected. Water was applied slowly and evenly to prevent channeling of water through the mix or down the sides of the container so as to prevent dilution of leachate. The leachate was poured from three saucers into a clean jar and swirled to make evenly mixed. Then it was subjected to routine analysis of pH and EC. The pH of the leachate gradually decreased with the progress of crop growth (Fig. 9), irrespective of different treatments and the lowest pH was recorded in the treatment supplied with N₄₀ : P₃₀ : K₃₀, irrespective of sampling date. However, higher pH was observed in control compared to other treatments throughout the sampling date and gradually decreased with the progress of crop growth.

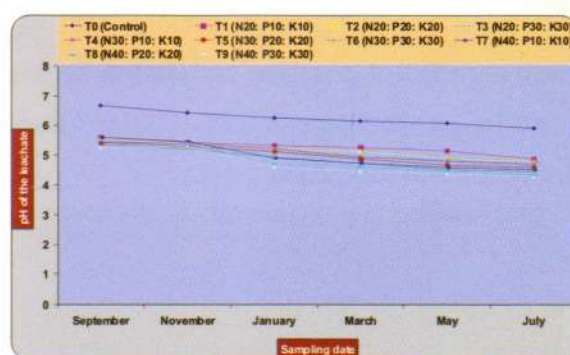


Fig. 9 : Changes in pH of the leachate as affected by graded doses of NPK to *Cym. 'Spring King'*

Effect of graded doses of N P K to *Cym. 'Spring King'* on the changes in E C of the leachate of

growing media

The leachate was collected by pour thru technique and subjected to electrical conductivity analysis in EC Bridge (Fig. 10). The EC of the leachate gradually increased with the application of graded doses of NPK [T₀ (Control); T₁ (N₂₀: P₁₀: K₁₀); T₂ (N₂₀: P₂₀: K₂₀); T₃ (N₂₀: P₃₀: K₃₀); T₄ (N₃₀: P₁₀: K₁₀); T₅ (N₃₀: P₂₀: K₂₀); T₆ (N₃₀: P₃₀: K₃₀); T₇ (N₄₀: P₁₀: K₁₀); T₈ (N₄₀: P₂₀: K₂₀); T₉ (N₄₀: P₃₀: K₃₀)], irrespective of sampling dates. Higher fertilizer concentration caused higher EC of the leachate. During winter season (November to February), the EC of the leachate was recorded more compared to summer season irrespective of treatments. The higher EC during winter months may have been the result of slower growth due to reduced photosynthetic photon flux and lower air temperatures.

A linear negative correlation was found between pH and EC of the leachate throughout the sampling dates under study (Fig. 11). Due to application of graded dose of NPK having acidic nature reduces the pH of the media and leachate. In contrast, the EC of the media and leachate increased with increasing doses of NPK due to increased concentrations of soluble salts. The highest significant negative correlation between pH and EC of the leachate was - 0.993** during March 2008 and July, 2008.

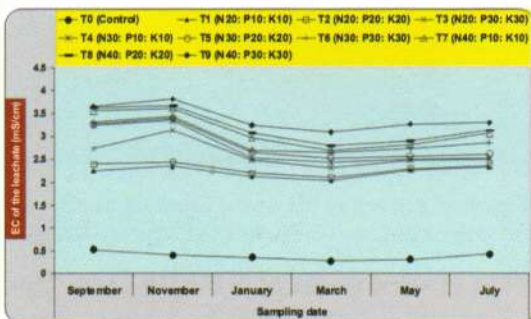


Fig. 10 : Changes in pH of the leachate as affected by graded doses of N P K to *Cym*. 'Spring King'

Effect of EC of nutrient solution and fertilization regime on growth of *Cymbidium* 'Sleeping Nymph'

The experiments comprised of three nutrition doses and four EC of the fertilizer solution. All the experiments were subjected to C R D with factorial concept. The growing media comprised of leaf mould + coconut husk + bricks pieces + vermiculite (8:4:2:1). The nutrition doses are N₁ - 20 : 20 : 20 (N P K), N₂ - 15 : 5 : 25 and N₃ - 12 : 30 : 10. The EC doses were E₁ - 0.5 mScm⁻¹, E₂ - 1.0 mScm⁻¹, E₃ - 1.5 mScm⁻¹ and E₄ - 2.0 mScm⁻¹. The desired EC of the fertilizer solution was prepared by dissolving the desired quantity of N P K fertilizer. During winter season (November to February) application of fertilizers were restricted to monthly once. Intercultural operations were carried out as and when required (Fig. 12).



Fig. 12 : Effect of E C of nutrient solution and fertilization regime on growth of *Cym*. 'Sleeping Nymph'

The results pertaining to growth were observed at two months interval. The leaf growth like leaf length, leaf width and leaf number varied significantly among the different treatments (Fig. 12). The leaf length was highest of 49.33 cm in the treatment E₃N₁ (EC 1.5 mScm⁻¹ and NPK (20 : 20 :

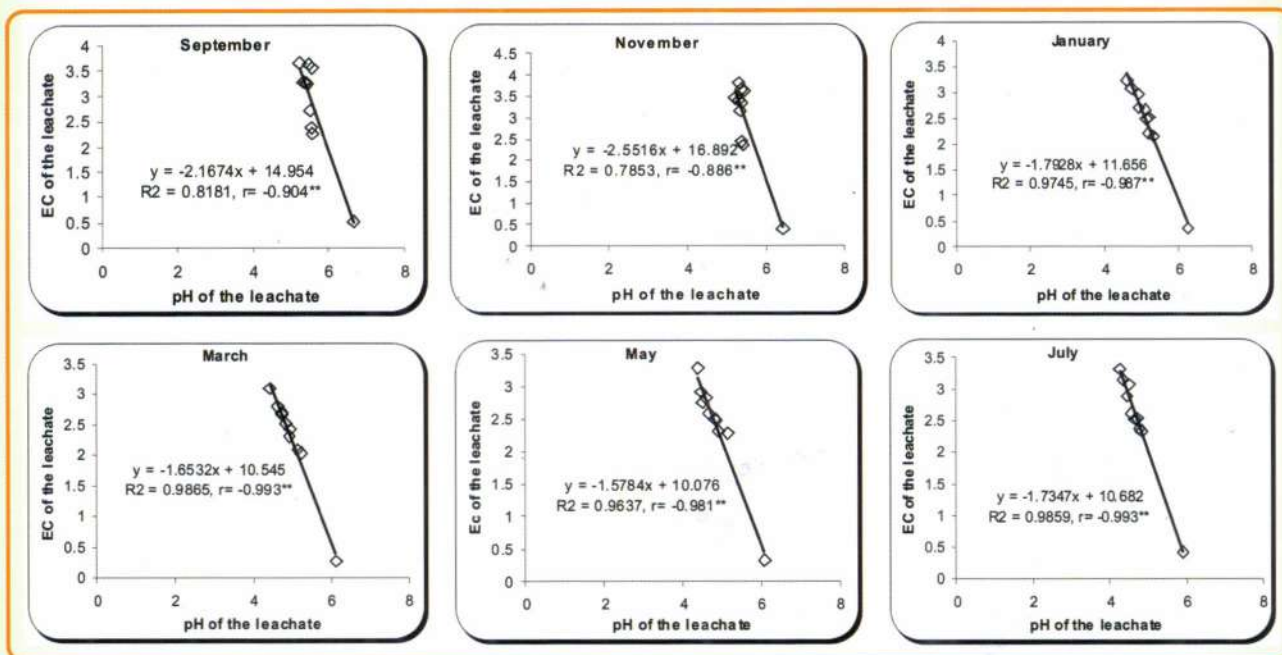


Fig. 11 : Correlation and regression analysis between pH and EC of the leachate of growing media

20). The number of leaf per plant was highest of 18.17 in the treatment E_3N_3 (EC 1.5 mScm^{-1} and NPK 12 : 30 : 10). There is no much different in leaf width throughout the treatments under study. The pseudobulb growth like length, girth and pseudobulb numbers was varied among the treatments (Fig. 13). The pseudobulb length registered maximum of 5.28 cm in the treatment E_4N_1 (EC 2.0 mScm^{-1} and NPK 20 : 20 : 20). The pseudobulb girth recorded highest of 2.93 cm in the treatment E_1N_1 (EC 0.5 mScm^{-1} and NPK 20 : 20 : 20) and was followed by the treatment E_3N_1 (EC 1.5 mScm^{-1} and NPK 20 : 20 : 20). Similarly the number of pseudobulb per plant was highest (6.0) in the treatment E_4N_3 (EC 2.0 mScm^{-1} and NPK 12 : 30 : 10). Plant height was highest (72.58 cm) in E_3N_1 (EC 1.5 mScm^{-1} and NPK 20 : 20 : 20) followed by 71.17 cm in E_2N_1 (Fig. 14).

The pH of the leachate gradually decreased with the progress of crop growth, irrespective of

different treatments. The highest EC was recorded in the treatment E_4N_1 (EC 2.0 mScm^{-1} and NPK 20 : 20 : 20) followed by E_4N_2 (EC 2.0 mScm^{-1} and NPK 15 : 5 : 25) and E_4N_3 (EC 2.0 mScm^{-1} and NPK 12 : 30 : 10). However, the EC gradually increased from September to February and then decreased from March onwards irrespective of different treatments. The nitrogen content of the pour-thru leachate gradually increased with the progress of the growth irrespective of treatments. The N-content was recorded highest of 25.5 mg^{-1} in March 2009 in the treatment E_4N_1 (EC 2.0 mScm^{-1} and NPK 20:20:20). The phosphorus content of the pour-thru leachate was more during November to February and recorded less from March onwards. The potassium content of the pour-thru leachate gradually increased with the progress of the Cymbidium growth irrespective of treatments. The K-content was recorded highest of 217 mg^{-1} in March 2009 in the treatment E_4N_2 (EC 2.0 mScm^{-1} and NPK 15 : 5 : 25).

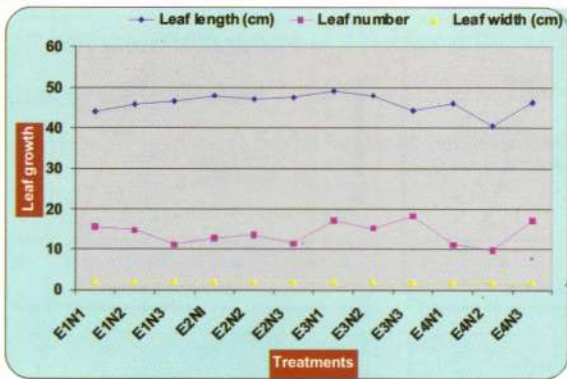


Fig. 13 : Effect of EC and nutrition regime on leaf growth characteristics of *Cym.* 'Sleeping Nymph'

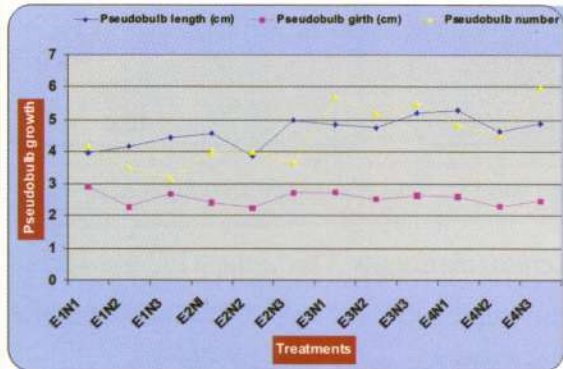


Fig. 14 : Effect of EC and nutrition regime on pseudobulb growth characteristics of *Cym.* 'Sleeping Nymph'

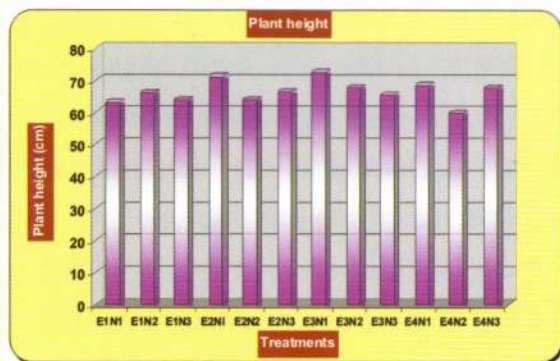


Fig. 15 : Effect of EC and nutrition regime on plant height of *Cym.* 'Sleeping Nymph'

Identification of nutrient deficiency symptoms in orchids

Iron deficiency symptoms

Iron deficiency localized on new leaves, leaves chlorotic between veins, necrotic spots usually

absent, in extreme cases necrosis of margins and tip of leaf, sometimes extending inward, developing large areas.



Fig. 16a : Fe deficiency in *Cymbidium* 'Pineclash Moon Venus'

Management of Fe - deficiency

Foliar application of 100 ppm Fe (0.05 % $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) for adult plants and 50 ppm Fe (0.025 % $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) for small plant at 15 days interval can recover from Fe-deficiency.

Application of 50 ppm Fe (0.025% $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) recover Fe-deficiency



Fig. 16b : Application of 50 ppm Fe (0.025% $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) recover Fe-deficiency

Nitrogen deficiency symptoms

Nitrogen deficiency localized on older leaves, foliage light green, growth stunted, leaves small, lower ones lighter yellow than upper. The yellowing of leaves is followed by drying to a light brown colour, usually little drooping. Gradually affects whole plant (Fig. 17).



Fig. 17 : N deficiency in *Dendrobium gibsonii*

Management

Foliar application of 300 ppm N ($0.88\text{g NH}_4\text{NO}_3^{-1}$) at 15 days interval and media application at monthly interval can recover the N - deficiency.

Potassium deficiency symptoms

Potassium deficiency symptoms localized on older leaves; lower leaves mottled, usually with dead areas near tip and margins; yellowing begins at margin and continuing towards the centre; margins later turn brown and older leaves drooping.

Management

Foliar application at 200 ppm K (0.55g KNO_3^{-1}) at 15 days interval and media application at monthly interval can recover the K - deficiency.



Fig. 18 : K-deficiency in *Coelogyne elata* Symptoms

CROPPROTECTION

Integrated Management of Diseases of Orchids

Diseases caused by various fungal pathogens and their incidence on different orchid species and hybrids were monitored regularly at NRC for Orchids for the year 2008 - 09. Anthracnose disease caused by *Colletotrichum gloeosporioides* was noticed most serious disease in orchids during the year.

Monitoring the incidence of anthracnose on

Phalaenopsis hybrid and *Cattleya* hybrids

Anthracnose produces dark coloured spots on leaves with slightly raised rim. The fungus affects all the aerial parts of the plants but most commonly it infects leaves. Initially small oblong to circular, oval, sunken and reddish brown to dark brown and grey coloured spots appears at the tip or middle of the leaf lamina which gradually enlarges and covers large area of the leaf surface. It produces dieback symptoms which starts from the tip and goes downward. It produces conidia within black acervuli. It also affects leaf sheaths and floral spikes. It is found in nature mostly in conidial stage and can over winter as mycelium or conidia.

Symptom development

Initially water soaked lesions appeared on the surface of the leaf which gradually enlarged and became whitish in colour. Finally it turned black and covered entire leaf resulting defoliation or death of the leaf (Fig. 1 A - D).

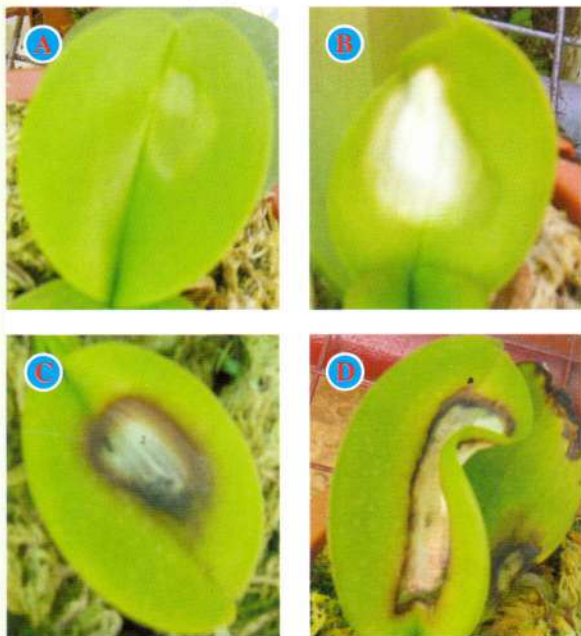


Fig. 1A-D : Development of anthracnose symptoms on *Phalaenopsis* hybrid

It is clear from the above table that the incidence of anthracnose disease was quite high and ranged from 27 to 83 % on *Phalaenopsis* sp.

Isolation and characterization of the fungus

Anthracnose affected *Phalaenopsis* and *Cattleya* samples were collected from the polyhouse of the NRCO. The infected leaf tissue was surface sterilized in 0.1% mercuric chloride (HgCl_2) and subsequently washed with distilled water and placed on oat meal agar (OMA) and incubated at 28°C and observed for growth. The white mycelial growth of fungus appeared after 72 h of incubation which gradually turned grayish in colour. Brown colored septate mycelium and oval shaped conidia were observed under microscope (Fig. 2).

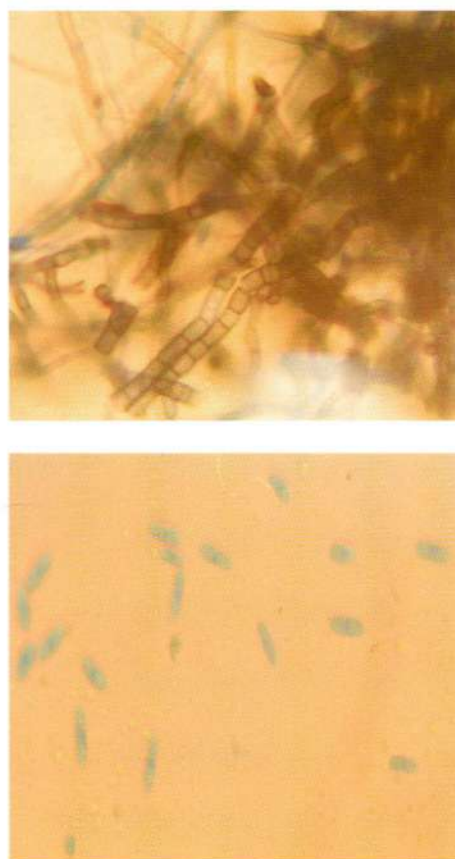


Fig. 2 : Mycelium and conidia of *Colletotrichum gloeosporioides* from *Phalaenopsis* hybrid.

Table 1. Percent incidence of anthracnose disease on *Phalaenopsis* hybrids

Sl No.	Name of hybrid	Total no. of plants	Infected plants	% incidence
1.	Phal. Brother & sister	114	32	28
2.	Phal. Tiasuco Pixerot	39	11	28
3.	Phal Raman Holiday	100	47	47
4.	Phal Taisuco Kochdian	101	83	82
5.	Phal. Rousserole	100	35	35
6.	Phal Amberdelite X Princes Kaiulami	36	10	27
7.	Phal Thaida show	120	100	83

Isolation of fungal pathogens from other orchid species

Black spots on the leaves of *Coelogyne* and *Thunia* species were noticed throughout the year at NRCO germplasm collection. *Dendrobium* sp. showing black lesions were also observed as minor disease. *Oncidium* species showing large number of black spots on leaves was reported during the year. All the pathogens associated with the disease were isolated and cultured. The cultures and live specimens were sent to Indian Type Culture Collection, Division of Plant Pathology, Indian Agricultural Research Institute, New Delhi-110012 for identification. The identification results with accession number are given in table 2.

Table 2. : Fungus samples identified from ITCC, New Delhi

Accession No.	Name of the species	Fungus identified as
7218.08	<i>Coelogyne</i> sp.	<i>Alternaria alternata</i>
7219.08	<i>Dendrobium</i> sp.	Sterile
7220.08	<i>Thunia</i> sp	<i>Alternaria alternata</i>
6832.08	<i>Oncidium</i> sp.	<i>Claadosporium sphaerospermum</i>

In vitro chemical control of anthracnose disease on *Phalaenopsis*

An experiment was conducted to control anthracnose disease caused by *Colletotrichum gloeosporioides in-vitro* using different fungicides like Mancozeb 75% WP, Carbendazim 50% WP, Copper oxychloride (Blitox) and Carbendazim + Mancozeb by poisoned food technique at different dilutions like 100 ppm, 200 ppm and 500 ppm. It was found that Mancozeb + Carbendazim @ of 200 ppm and 500 ppm each inhibited the growth of the fungus remarkably.

Use of bio - control agent

Application of biocontrol agent Max-Tricho (*Trichoderma harzianum*) 2% WP commercially available was used against *Colletotrichum* sp. on *Phalaenopsis* hybrids, *Phaius tankervilleae* and *Cymbidium* hybrids 250 gm of Max-Tricho powder (Marketed by Maxeema Biotech Pvt. Ltd. Ahmedabad) thoroughly mixed with 50 Kg. of FYM and covered with polythene and kept for 2 weeks in sunlight. When the growth of the fungus (bio control agent) spreads uniformly it was applied to the test plants. Preliminary observation

showed that the biocontrol agent effectively works against the fungus.

Monitoring and management of virus diseases of orchids

Germplasm collections at NRCO and nearby farmer's field were regularly observed for virus incidence. Samples were collected from different parts of the state and checked against CymMV and ORSV by ELISA using commercial antibodies. Out of 100 samples tested 42 samples were found positive with mixed infection of CymMV and ORSV. 28 samples were found positive with ORSV and 17 samples were found positive with CymMV. Only, 13 samples were found free from these viruses.

Biological indexing

Mechanical inoculations

Mechanical inoculations were made from symptomatic leaves of the virus affected samples by standard methods. Seedlings of *Datura stramonium*, *Chenopodium amaranticolor*, *Nicotiana glutinosa*, *N. rustica*, *Physalis floridana*, *Phaseolus vulgaris* var. *alapatri*, *P. vulgaris* var. *mungo*, *P. vulgaris* var. *gheusemi* were inoculated with mixed infection of CymMV and ORSV. Mechanical inoculations were done by extracting sap from infected orchid samples (*C. aloifolium*) in 0.1 M phosphate buffer (pH - 7.2) containing 2-mercaptoethanol (0.1 %).

CymMV was successfully transmitted by mechanical inoculations from infected orchid samples (*C. aloifolium*) to *Chenopodium amaranticolor* and *Datura stramonium* but not

to *Nicotiana glutinosa*, *N. rustica*, *Physalis floridana*, *Phaseolus vulgaris* var. *alapatri*, *P. vulgaris* var. *mungo*. Leaves of *D. stramonium* developed small pointed lesions on young leaves which turned large necrotic lesion on inoculated leaves (Fig. 3) while *C. amaranticolor* developed blotchy local lesions developing slowly but not systemic (Fig. 4a). ORSV was transmitted to only *Nicotiana benthamiana* producing mild chlorotic lesions and systemic mosaic symptoms (Fig. 4b).

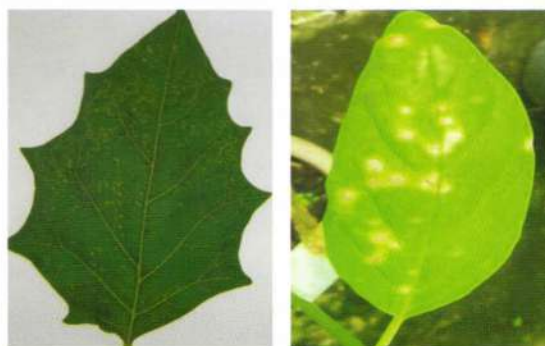


Fig. 3 : *Datura stramonium* showing small necrotic lesions and large necrotic lesions on inoculation with CymMV



Fig. 4a : *Chenopodium amaranticolor* showing blotchy local lesions on inoculation with CymMV

Fig. 4b : *Nicotiana benthamiana* showing mild chlorotic lesions on inoculation with ORSV

Virus indexing of Commercial hybrids by ELISA

Virus indexing of 30 *Cymbidium* hybrids and three *Dendrobium* hybrids : Virus indexing of 30 *Cymbidium* and three *Dendrobium* hybrids

Table 3 : Indexing of *Cymbidium* and *Dendrobium* hybrids against CymMV and ORSV

	Name of the orchid species	OD value at 405 nm	
		CymMV	ORSV
	Buffer Control	0.21	
	Healthy control	0.25	
1	<i>Cym. Koren -108</i>	3.03	1.68
2	<i>Cym. Takaragaika</i>	2.90	1.79
3	<i>Cym. Howtescence</i>	2.46	1.99
4	<i>Cym. Norella Jennifer Gail</i>	2.91	1.87
5	<i>Cym. Solex Beyre</i>	0.35	0.78
6	<i>Cym. Koren - 96</i>	0.41	0.97
7	<i>Cym. Show Girl Milimilar</i>	0.70	1.98
8	<i>Cym. Menecar Showgirl</i>	0.31	1.75
9	<i>Cym. Dospueblos</i>	0.50	1.29
10	<i>Cym. Revelex Chanity</i>	0.45	1.34
11	<i>Cym. Sayunara Gold</i>	0.49	1.49
12	<i>Cym. Koren 104</i>	0.39	-ve
13	<i>Cym. Nonina "Pale Face"</i>	2.55	1.16
14	<i>Cym. Jensh Lotley</i>	0.94	1.29
15	<i>Cym. Jungfran "Snow Queen"</i>	0.46	1.19
16	<i>Cym. Soul Hunt - 6</i>	1.22	1.66
17	<i>Cym. Havix</i>	0.49	1.01
18	<i>Cym. Redgrass</i>	0.89	0.74
19	<i>Cym. Ann Green</i>	0.31	1.25
20	<i>Cym. Koren - 93</i>	0.46	1.05
21	<i>Cym. Red Beauty Carmen</i>	0.36	1.13
22	<i>Cym. Koren - 96</i>	0.51	0.88
23	<i>Cym. Platinum Gold</i>	0.42	0.90
24	<i>Cym. "Penneshaw Interflush"</i>	0.52	0.56
25	<i>Cym. Yellow Jet</i>	0.41	0.51
26	<i>Cym. Howtescence</i>	0.51	1.09
27	<i>Cym. Bolokam</i>	0.53	0.83
28	<i>Cym. Matvat Kranesa</i>	0.46	1.55
29	<i>Cym. Show Girl - capsule(Outer Coat)</i>	0.40	1.43
30	<i>Cattleya</i> hybrid - Flower(Color Breaking)	1.68	0.93
31	<i>Den. Eb</i> (Newly imported)	0.46	0.83
32	<i>Den. Cb</i> (Newly imported)	0.49	0.41
33	<i>Den. Bd</i> (Newly imported)	0.31	0.38

purchased from Mainam Garden, Namchi and Sheel Biotech, New Delhi are given in the table 3.

Results : CymMV and ORSV was found positive in *Cymbidium* Koren -108, *Cym* Takaragaika, *Cym* Howtescence, *Cym* Narella Jennifer Gail, *Cym* Nonina "Pale Face", *Cym* Jensh Lotley, *Cym*

Soul Hunt – 6, *Cym. Redgrass*, *Cym. Show Girl Milimilar* and *Cattleya* hybrid flower while ORSV was found positive in *Cym* Ann Green, *Cym. Koren - 93*, *Cym* Red Beauty Carmen, *Cym* Koren - 96, *Cym* Platinum Gold, *Cym* "Penneshaw Interflush", *Cym* Yellow Jet, *Cym* Howtescence, *Cym* Bolokam, *Cym* Matvat

,Kranesa, *Cym* Havix, Jungfran "Snow Queen", Show Girl Milimular, *Cym*. Menecar Showgirl, *Cym*. Dospueblos, *Cym*. Revelex Chanity, *Cym*. Sayunara Gold, *Cym*. Sayunara Gold, *Cym*. Solex Beyre, *Cym*. Koren - 96. However, newly imported species of *Dendrobium* Eb, *Dendrobium* Cb, *Dendrobium* Bd, *Cym*. Koren 104 were found free from both the viruses.

(ii) Indexing of Cymbidium hybrids from Mirik (Darjeeling)

Results : Cymbidium mosaic virus (CymMV) was found positive in Burgandy Sydney, Revolux Cooks Bridge, Lal Cherry, Vampire and Odontoglossum ringspot virus (ORSV) was found positive in Sanfransisco Mona Lisa, Burgandy Sydney, Revolux Cooks Bridge, Lal Cherry, Karnu Lal Khan, Vampire, Cold Stream inferno, Red Vampire, RBS, Forest King, Angilika, Unknown, Ganslatory Code No. 107 (Table 4).

(iii) Virus indexing of NRCO tissue culture material

Tissue cultured plants of different hybrids were indexed against viruses and the results are given in table 5.

(iv) Virus indexing of infected capsule of Cymbidium species and hybrids

Capsules of following *Cymbidium* hybrids and species were tested for CymMV and ORSV and results are given in table 6.

Results : Capsules of *Cym*. Showgirl, *C. aloifolium*, *C. pendulum*, *C. dayanum*, *C. devonianum* were also tested in ELISA for the presence of CymMV and ORSV. It was interesting to note that both the viruses were found positive in outer coat, inner coat and undifferentiated seed mass of the *Cym*. Showgirl, *C. pendulum*, *C. dayanum* and *C. aloifolium*. However *C. devonianum* was found free from

Table 4 : Indexing of Cymbidium hybrids collected from Darjeeling

Sl.No.	Name of species/hybrid	OD value at 405 nm	
		CymMV	ORSV
	Healthy control	0.38	
	Buffer control	0.28	
1.	Black farm star birds	0.34	0.84
2.	Sanfransisco Mona Lisa	0.34	1.17
3.	Burgandy Sydney	3.08	1.44
4.	Revolux Cooks Bridge	2.66	1.17
5.	Lal Cherry	1.31	1.74
6.	Karnu Lal Khan	0.81	1.49
7.	Vampire	0.95	1.44
8.	Cold Stream inferno	0.47	1.34
9.	Red Vampire	0.39	1.26
10.	RBS	0.36	1.29
11.	Forest King	0.74	1.78
12.	Angilika	0.63	1.82
13.	Unknown	0.52	1.39
14.	Ganslatory Code No. 107	0.42	1.74

Table 5 : Virus indexing of NRCO tissue cultured materials

Sl. No	Name of the orchid species	OD value at 405 nm	
		CymMV	ORSV
	Healthy control	0.23	
	Buffer control	0.34	
1.	<i>Cymbidium</i> soul Hunt I-A	0.19	0.78
2.	C. Golden Girl-B	0.29	0.26
3.	C. Lunavian Atlas -D	0.16	0.30
4.	C. Sleeping nymph-H	0.06	0.06
5.	C. Pine Clash- J	0.38	0.40
6.	C. Star Guard Mc Angel-G	0.40	0.00
7.	C. Show girl Cooks bridge	0.09	0.10
8.	CVA-1	0.63	0.26
9.	CGA2	0.43	0.16
10.	CDA3	0.16	0.75
11.	CGA4	0.76	0.52
12.	CCA5	0.85	0.39
13.	CVA6	0.25	0.23
14.	CPA7	0.72	0.59
15.	CA 340	0.44	0.89
16.	CKA 9	0.52	0.55

Results : Odontoglossum ringspot virus (ORSV) was found positive in *Cym.* Soul Hunt I-A, CDA3, CPA7, CA 340 and *Cymbidium* mosaic virus (CymMV) was found positive in CVA-1, CGA4, CCA5 and CPA7.

Table 6 : Virus indexing infected capsules of *Cymbidium* species and hybrids :

Sl. No	Name of the orchid species	OD value at 405 nm	
		CymMV	ORSV
	Buffer Control	0.21	
1	<i>Cym.</i> Show Girl – capsule, OC	1.50	1.43
2	<i>Cym.</i> Show Girl – capsule, IC	1.44	1.33
3	<i>Cym.</i> Show Girl - SM	2.24	1.33
4	<i>Cym. pendulum</i> – capsule, OC	1.71	0.83
5	<i>Cym. pendulum</i> – capsule IC	1.57	1.40
6	<i>Cym. pendulum</i> - SM	2.32	1.44
7	<i>Cym. dayanum</i> – capsule, OC	1.47	0.66
8	<i>Cym. dayanum</i> – capsule, IC	2.01	1.21
9	<i>Cym. dayanum</i> - SM	1.30	1.00
10	<i>Cym. aloifolium</i> –capsule, OC	2.16	0.39
11	<i>Cym. aloifolium</i> – capsule, IC	0.82	0.58
12	<i>Cym. aloifolium</i> – SM	0.97	2.75
13	<i>Cym. devonianum</i> – OC	0.45	0.39
14	<i>Cym. devonianum</i> -IC	0.46	0.41
15	<i>Cym. devonianum</i> – SM	0.35	0.29

these viruses. These results suggest the possibility of seed transmission of these two viruses.

Detection by RT-PCR of Cymbidium mosaic virus : PCR is highly sensitive technique and commonly used for the detection of viruses. Specific primers have been designed based on available sequences of CymMV CP gene from GenBank. Following primers were used:

Forward primer, 5' TTGGATCCATGGGAGAGCCCACT 3'
reverse primer, 5' TTTCTAGATTATTCAGTAGGGGG 3'

Using RT-PCR, a 700 bp product achieved (Fig. 5). This product was cloned in pGEMT cloning vector and sequenced and coat protein gene submitted in GenBank. The cp gene was then cloned in pMAL protein expression vector and 700 bp product achieved (Fig. 6). Protein expression is being confirmed by SDS-PAGE and Western blotting.

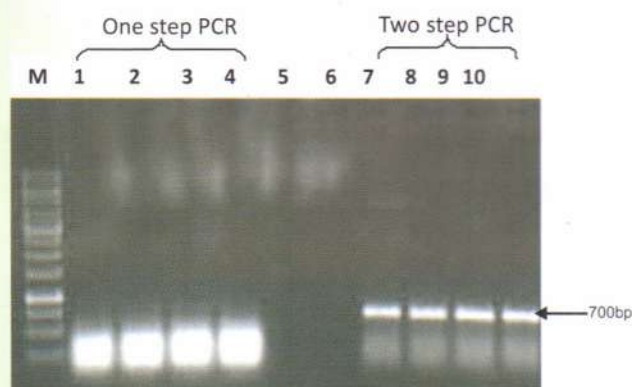


Fig. 5 : RT-PCR of CymMV cp gene. M-marker , lane 1-4 one step PCR, Lane 5&6 healthy samples, Lane 7-10 two step PCR of *C. aloifolium*, *C. eburnum*, *C. erythrum*, *C. iridioides*

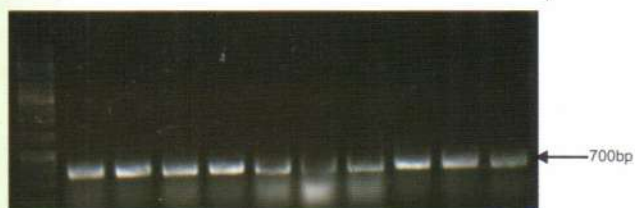


Fig. 6 : Positive clones in pGEMT cloning vector

Integrated Pest Management in Orchids

Insect - orchid host preference studies in orchid germplasm

Studies on the host range of pests of orchids under polyhouse conditions

The visual observations were made to study the host range of pests of orchids under polyhouse conditions. The observations were recorded from the germplasm and hybrids collected and conserved at the centre. A total of 175 species belonging to 44 genera were studied. The mite species, *Tetranychus urticae* observed round the year on *Cym.* hybrids (*Cym.* -Winter Beach Sea Green, *Cym.* -SN Glacier, *Cym.* - Pineclash Moon Venus, *Cym.* -Valley Legent, *Cym.* - HC Aurora, *Cym.* - Soul Hunt, *Cym.* - Sleeping Nymph) and *Cym.* species (*Cym.* Ensikhan, *C. lowianum*, *C. aloifolium*, *C. longifolium* and *C. devonianum*), *Coelogyne*, *Eria*, *Epidendrum*, *Oncidium*, *Thunia* and *Zygopetalum* round the year.

Scale insects like *Pinnaaspis buxi*, *Diaspis boisduvali*, *Coccus hesperidum*, *Lecanium* sp. and *Chrysomphalus aonidum* infest *Cymbidium*, *Aerides*, *Cleisostoma*, *Coelogyne*, *Dendrobium*, *Liparis*, *Eria*, *Paphiopedilum*, *Papilionanthe*, *Epidendrum*, *Phaius*, *Pholidota*, *Oncidium*, *Vanda*, *Cattleya*, *Calanthe*, *Phalaenopsis* and *Zygopetalum* orchids throughout the year.

Aphids, *Macrosiphum luteum* and *Toxoptera aurantii* suck the juice from new shoots, flower buds and flowers of *Acampe*, *Anthogonium*, *Calanthe*, *Coelogyne*, *Cymbidium*, *Dendrobium*, *Epidendrum* and *Oncidium*, while, shoot borer, *Peridaedala* sp. infest to *Acampe*, *Aerides*,

Arachnanthe, *Ascocentrum*, *Chrysochilus*, *Dendrobium*, *Eria*, *Gastrochilus*, *Oncidium*, *Rhynchostylis* and *Vanda*.

Mealybug, *Pseudococcus maritimus* feed on leaves, stem, leaf sheath, pseudobulbs, flower buds and flowers of *Acampe*, *Cattleya*, *Calanthe*, *Cymbidium*, *Coelogyne*, *Bulbophyllum*, *Phaius*, *Luisia*, *Dendrobium*, *Epidendrum* and *Rhynchostylis*,

Black weevil reported to cause damage on pseudobulbs, leaves and stem of *Dendrobium*, *Epidendrum*, *Storopsis*, *Pholidata*, *Renanthera*, *Ascocentrum*, *Aerides*, *Coelogyne*, *Cymbidium* and *Phaius*.

Thrips were observed to infest on *Cymbidium* hybrid, *Dendrobium*, *Coelogyne* and *Epigeneium* and slugs and snails were found to cause damage to Pseudobulbs, leaves, flower buds and flowers of *Dendrobium*, *Cymbidium*, *Calanthe*, *Eria*, *Cattleya*, *Phalaenopsis* and *Zygopetalum* during rainy season. Grass hopper, yellow beetle and lepidopteran caterpillars feed on many species of orchids.

Insect- pests of orchids - A survey

A Regular survey was made at institute's farm, adjoining area of Sikkim, Kalimpong and Darjeeling district of West Bengal for insect/ pests occurring on orchids and other ornamentals and found mites, *Tetranychus urticae*, thrips, *Dichromothrips nakahari*, scale insects (*Pinnaspis buxi*, *Diaspis boisduvali*, *Coccus hesperidum*, *Lecanium* sp. and *Chrysomphalus aonidum*), shoot borer, *Peridaedala* sp. aphid (*Toxoptera aurantii* and *Macrosiphum luteum*),

mealy bugs, *Pseudococcus maritimus*, slugs and snails, black weevil, *Siphalinus* sp., lepidopteran caterpillar and grass hopper were mainly infested to the orchids. Leaf hoppers, whitefly, tobacco caterpillar, Bud borer, *Helicoverpa armigera*, aphids and leaf minor were also found on other ornamentals like Gerbera, Carnation, Gladiolus, Liliium.

Monitoring the pests on orchids

Seasonal abundance of mealy bug, *Pseudococcus maritimus* on *Dendrobium gibsonii*

Both the nymph and adults of mealy bug, *Pseudococcus maritimus* feed on leaves stem, pseudobulbs and petioles by sucking the cell sap from succulent tissue. They have soft filamentous yellowish to pink coloured body which is covered with white powdery wax like cottony growth in irregular shape. The affected leaves get weakened and exhibited severe mottling and wilting resulting stunting of plant. Insects also secrete honeydew that attracts ants. In case of severe infestation sooty mould fungus also developed and whole plant looked like wilted. Observations were recorded during April to October and found that the maximum infestation was noticed when the humidity, temperature was high and with cloudy weather (Fig. 7).



Fig. 7 : *D. gibsonii* showing infestation of mealy bug

Arachnanthe, Ascocentrum, Chrysochilus, Dendrobium, Eria, Gastrochilus, Oncidium, Rhynchostylis and *Vanda*.

Mealybug, *Pseudococcus maritimus* feed on leaves, stem, leaf sheath, pseudobulbs, flower buds and flowers of *Acampe, Cattleya, Calanthe, Cymbidium, Coelogyne, Bulbophyllum, Phaius, Luisia, Dendrobium, Epidendrum* and *Rhynchostylis*,

Black weevil reported to cause damage on pseudobulbs, leaves and stem of *Dendrobium, Epidendrum, Storopsis, Pholidata, Renanthera, Ascocentrum, Aerides, Coelogyne, Cymbidium* and *Phaius*.

Thrips were observed to infest on *Cymbidium* hybrid, *Dendrobium, Coelogyne* and *Epigonium* and slugs and snails were found to cause damage to Pseudobulbs, leaves, flower buds and flowers of *Dendrobium, Cymbidium, Calanthe, Eria, Cattleya, Phalaenopsis* and *Zygopetalum* during rainy season. Grass hopper, yellow beetle and lepidopteran caterpillars feed on many species of orchids.

Insect- pests of orchids - A survey

A Regular survey was made at institute's farm, adjoining area of Sikkim, Kalimpong and Darjeeling district of West Bengal for insect/ pests occurring on orchids and other ornamentals and found mites, *Tetranychus urticae*, thrips, *Dichromothrips nakahari*, scale insects (*Pinnaspis buxi, Diaspis boisduvali, Coccus hesperidum, Lecanium* sp. and *Chrysomphalus aonidum*), shoot borer, *Peridaedala* sp. aphid (*Toxoptera aurantii* and *Macrosiphum luteum*),

mealy bugs, *Pseudococcus maritimus*, slugs and snails, black weevil, *Siphalinus* sp., lepidopteran caterpillar and grass hopper were mainly infested to the orchids. Leaf hoppers, whitefly, tobacco caterpillar, Bud borer, *Helicoverpa armigera*, aphids and leaf minor were also found on other ornamentals like Gerbera, Carnation, Gladiolus, Liliium.

Monitoring the pests on orchids

Seasonal abundance of mealy bug, *Pseudococcus maritimus* on *Dendrobium gibsonii*

Both the nymph and adults of mealy bug, *Pseudococcus maritimus* feed on leaves stem, pseudobulbs and petioles by sucking the cell sap from succulent tissue. They have soft filamentous yellowish to pink coloured body which is covered with white powdery wax like cottony growth in irregular shape. The affected leaves get weakened and exhibited severe mottling and wilting resulting stunting of plant. Insects also secrete honeydew that attracts ants. In case of severe infestation sooty mould fungus also developed and whole plant looked like wilted. Observations were recorded during April to October and found that the maximum infestation was noticed when the humidity, temperature was high and with cloudy weather (Fig. 7).



Fig. 7 : *D. gibsonii* showing infestation of mealy bug

Seasonal incidence of mite, *Tetranychus urticae*

An investigation was carried out on the seasonal incidence of mite, *Tetranychus urticae* on orchids under polyhouse conditions and found that the infestation of mite was throughout the year. The population reached at maximum in third week of May when 29°C temp., 69 % RH and 318.3 mm rainfall was there. The abiotic stress like maximum temperature and relative humidity had positive correlation and minimum temperature and rainfall had negative correlation with mite population fig 8.

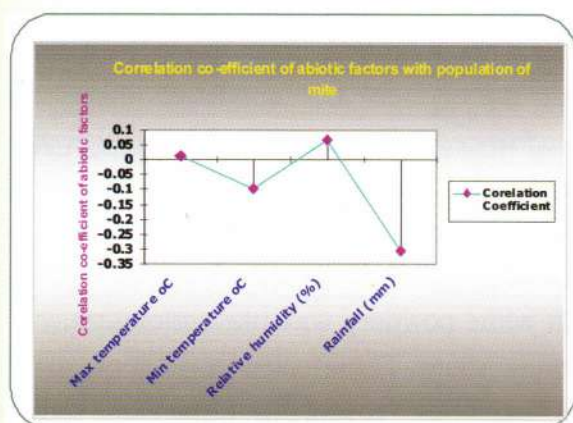


Figure 8 : Correlation co-efficient of abiotic factors with population of mites

A new record of the thrips, *Dichromothrips nakahari* (Thysanoptera : Thripidae) infesting the cymbidium hybrid

Cymbidium hybrid were severely infested by the thrips, *Dichromothrips nakahari* (Fig. 9). Out of 60 plants of *Cymbidium* observed for the infestation of thrips, 51 plants were infested (85%). The insect produced big irregular patches on leaves which later on collapse and made the leaves discoloured and looks like dead leaves. Plant growth was deteriorated and flower quality and quantity drastically affected. The small yellow colour nymph crawl on new leaves and adults suck the sap of the leaves.



Fig. 9 : Severe infestation of *D. nakahari* on *Cymbidium* hybrids

Thrips multiplied round the year on different species of orchids excluding *Cymbidium*. Thrips infestation was also noticed on *Dendrobium nobile*, *Dendrobium moschatum* during flowering stage. Thrips infestation started on *Dendrobium nobile*, *D. moschatum* with the initiation of flower buds. The affected flower buds showed improper opening. The white transparent spots were observed on the petals of fully opened flowers which reduces the market value of the flowers. The adult secrete honeydew on the attacked portion which supports the growth of black sooty mould, an unsightly fungus that mars the beauty of flower and these secretions also invite the black ants. The occurrence of thrips, *Dichromothrips nakahari* on orchid (*Cymbidium* hybrid) from India is the first report.

Pest management in *Cymbidium*

Evaluation of bio - pesticides and insecticides against mite on *Cymbidium*

An experiment was conducted to evaluate the bio efficacy of insecticides and bio pesticides against mite, *Tetranychus urticae* on *Cymbidium* under polyhouse conditions. The nine treatments viz.,

propagite 57 EC (0.05%), imidacloprid 17.8 SL (2ml⁻¹), Dicofol 18.5 EC (0.05%), Bifenthrin (0.05%), Ethion 50 EC (0.05%), Achook (NSKE) 5ml⁻¹, Neem oil 0.03 EC 5ml⁻¹ and Tobacco leaf extract 5% including control. The experiment was conducted following Randomized block design (RBD) and each treatment was replicated thrice. All the treatments were highly significant over control indicating that all were effective (Fig. 10). Imidacloprid 17.8 SL (2ml⁻¹) was found most effective followed by bifenthrin and propagite in reducing the mite population 96.33, 94.87 and 93%, respectively. The treatment of tobacco leaf extract 10% was found least effective followed by Achook (NSKE) 1500 ppm and Neem oil 0.03 EC (5 ml⁻¹)

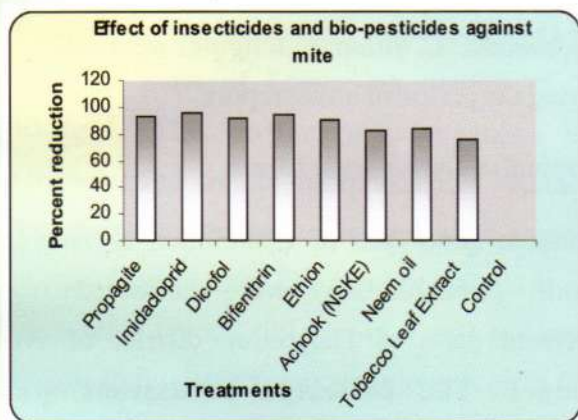


Fig. 10 : Effect of insecticides and bio-pesticides against mite

Management of pests complex of Dendrobium

Response of botanicals against thrips on Dendrobium nobile

Eight botanicals viz., dhatura leaf extract 10%, titapat extract 10%, Achook (NSKE) 1500 ppm, garlic extract 5%, tobacco leaf extract 5%, neem oil 0.03% EC (5ml⁻¹) and chilaune leaf extract 10% were evaluated for the control of thrips, *Dichromothrips nakahari*. The result showed that all the botanicals

were found to control the thrips significantly. The maximum percent reduction (76%) of thrips population was achieved when neem oil 0.03% EC followed by Achook (NSKE) 1500 ppm and tobacco leaf extract 5% was applied. Chilaune leaf extract 10% was found least effective. The remaining treatments (dhatura leaf extract, garlic extract and tita pat extract) were found moderately effective against this pest.

Phytotoxicity of botanicals and insecticides on flowers of Cym. H. C. 'Aurora'

An experiment was conducted to evaluate the phytotoxicity of six botanicals (*Azadirachta indica*, *Allium sativum*, *Sehima walchii*, *Artimesia*, *Nicotiana tabacum* and *Datura stramonium*) and three insecticides (dicofol, dimethoate and imidacloprid) on *Cym. H. C. Aurora*. It was found that there was no phytotoxicity due to botanicals. However, small patches were observed on flowers treated with insecticide (dimethoate 30 EC @ 2ml⁻¹)

Identification of new insects and bio-control agent

Two insect species namely *Dichromothrips nakahari* (thrips), and *Aulacorthum* sp. (aphid) were reported on orchids from Sikkim. Apart from these two new records, a bio-agent coccinellid, *Oenopia sexareata* (Mulsant) of aphids, mites and coccids has also been reported from Sikkim.

DARJEELING CAMPUS

Collection, Conservation, Characterization, Evaluation and Maintenance of High Altitude Orchid Germplasm Collection of Orchid Germplasm

Germplasm collection

Explorations for collection of orchids were conducted to various parts of Darjeeling district of West Bengal. Sanchel Wild Life Sanctuary, Mungpoo Kurseong forest, Jalapahar Cantonment, Takdah etc. were surveyed. The collected accessions belonged to *Coelogyne nitida*, *Satyrium nepalensis*, *Coelogyne cristata*, *Calanthe puberula*, *Calanthe trulliformis*. The cultivars of *Cymbidium* namely Kiwi Magic 'Sue', Kiwi Mint Celebration 'Iorna', Magic Kiwi 'Winner', Valley Zenith 'Concorde', Ruby Anniversary 'Pink Surprise', Valley Zenith 'Top Spot', Valley Inga 'Pink Towers', Valley Zenith 'Discus', Pure Jungle 'Green', Valley Champion 'Georgeous', Margaret Thatcher 'Diplomat', Valley Chianti 'Wine', Valley Red 'Vampire' were introduced at Darjeeling campus.

Conservation of wild species and cultivars

The collected species of orchids were grown in pots as well as 'artificial natural habitat'. Orchids in pots required more attention than those tied on trees (artificial natural habitat). The loss of germplasm in artificial natural habitat were almost nil. The artificial natural habitat aims at providing almost similar conditions as that of nature in which epiphytes were tied on the tree

trunks while terrestrial were grown on grounds under the shady locations. The artificial natural habitat method for conservation of orchids reduced the cost on maintenance.

Characterization and evaluation of orchid species

The orchids collected at Darjeeling Campus of NRC (O) were evaluated for their horticultural traits. The information on the species *Cymbidium gammieanum*, *C. erythraeum*, *C. lowianum*, *C. traceyanum*, *Pleione praecox*, *Eria spicata*, *E. gramminifolia*, *Paphiopedilum insigne*, *P. villosum*, *Calanthe brevicornu*, *Coelogyne corymbosa*, *C. nitida*, *C. longipes* were collected during the period of under report.

Cymbidium erythraeum Lindl.

Fourteen genotypes of *Cymbidium erythraeum* Lindl. (Orchidaceae) were collected from different parts of Darjeeling district of West Bengal. The collected accessions were characterized for 23 morphological characters. The data showed wide variation with respect to morphological traits like plant height (20.8 – 40.9 cm), plant spread (29.5 – 55.9 cm) pseudobulb length (3.8 – 8.7 cm), pseudobulb girth (5.9 – 13.2 cm), inflorescence length (28.7 – 56.3 cm) and inflorescence diameter at base (0.32 – 0.48 cm). The flower height was found to vary between 1.8 to 3.8 cm and the flower size varied between 8.2 – 9.6 cm. The dendrogram revealed 3 clusters (Fig. 1). The cluster 1 and 2 had 5 members and while cluster 2 had 4 members.

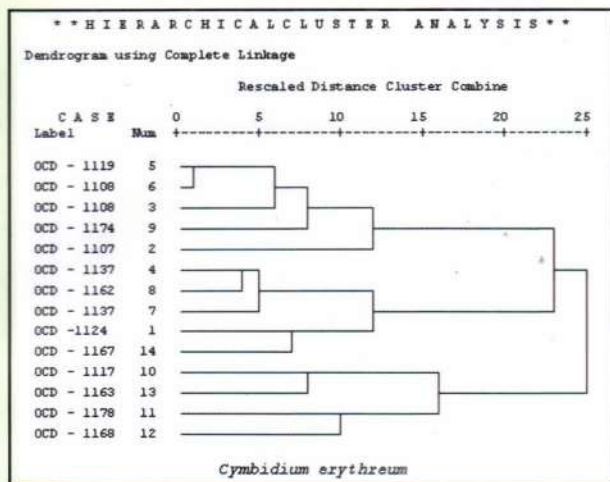


Fig. 1 : Dendrogram illustrating dissimilarity among 14 genotypes of *Cymbidium erythraeum*

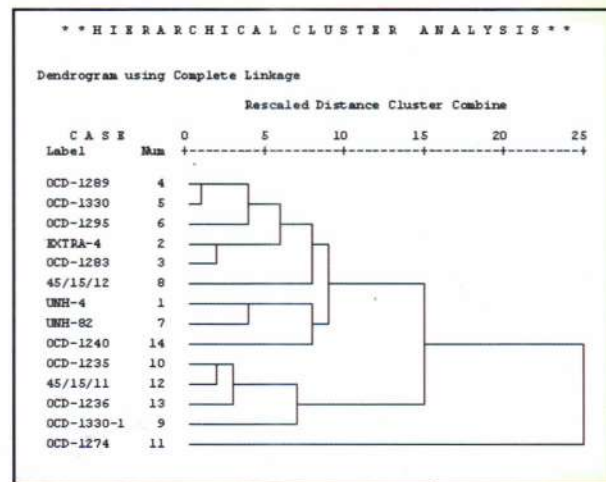


Fig. 2 : Dendrogram illustrating dissimilarity among 14 genotypes of *Cymbidium lowianum* Reichb. f.

Cymbidium lowianum Reichb. f.

Fourteen genotypes of *Cymbidium lowianum* Reichb. f. (Orchidaceae) were collected from different parts of Darjeeling district of West Bengal. The collected accessions were characterized for 23 morphological characters. The data showed wide variation with respect to morphological traits like plant height (24.8 – 46.6 cm), plant spread (29.5 – 44.6 cm) pseudobulb length (6.6 – 10.85 cm) pseudobulb girth (8.3 – 12.5 cm) inflorescence length (48.3 – 67.3 cm), inflorescence diameter at base (0.41 – 0.60 cm) and flower count 7.5 – 13.5. The flower height was found to vary between 3.15 to 5.45 cm and the flower size varied between 8.27 – 16.35 cm. The dendrogram revealed 3 clusters (Fig. 2). The cluster 1 had largest membership (5) and cluster 2 had smallest membership (3). The genotype OCD – 1274 did not join any cluster.

In vivo multiplication

The multiplication of *Cymbidium* cultivars through conventional methods was studied. This

activity aimed at increasing plant population in the conservatory. The old and mature pseudobulbs of sympodial orchids are generally not detached from the plant. These backbulbs dry and wither on the plant itself. When the pseudobulbs of different orchids are removed and planted in sand / sphagnum moss they produce one or none plantlets. Thus the orchids can also be multiplied by old unused bulbs. *In vivo* multiplication technique for *Cymbidium* was standardized. The technique involves treating of detached backbulbs with 100 ppm 6-BAP for overnight and then planting in moist sawdust. The shoot buds were initiated during the season of active growth. When these shoot buds attain fully expanded leaves and 3 or more roots these are detached from the pseudobulb and planted separately. The pseudobulbs can be replanted in saw dust. Thus same pseudobulb can be utilized 3-4 times for production of plantlets. The major steps involved in propagation of cymbidium through backbulbs are depicted in fig. 3.



Fig. 3 : Step in propagation of *Cymbidium* through backbulbs

In vitro multiplication

Effect of basal media on germination and growth of *Coelogyne nitida*

The seeds from mature green pods of *Coelogyne nitida* were cultured on 6 different basal media namely modified MS, Vacin Went, Themole GD, Gamborg's B5, & Knudson C medium. The highest germination was recorded on Themole

GD medium while the lowest from the MS medium (Fig. 4a - 4b). The plants were large and fully differentiated on Themole GD medium. It was concluded that Themole GD is the best medium for the propagation of *Coelogyne nitida* through seeds. The developed plantlets were hardened on medium containing sawdust, perlite and peatmoss (1:1:1) ratio.

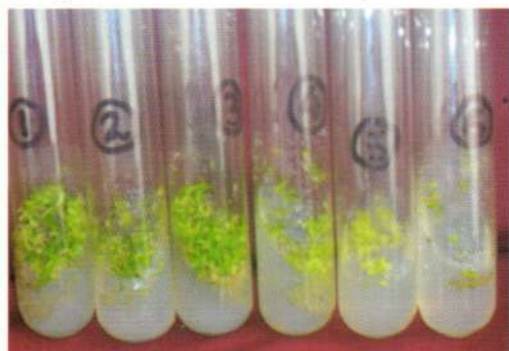


Fig. 4a : Seeds of *Coelogyne nitida* growing on different basal medium



Fig. 4b : Seeds grown on Themole G D medium

Promising genotypes

Coelogyne nitida Lindl.

A new color variant of *C. nitida* was collected from Sukhia – Pokhari, Darjeeling district of West Bengal. The variant has been described as new variety. The variety is closely related to *Coelogyne nitida* which is characterized by having 7 – 10 cm long pseudobulbs, proteranthous or sometime synanthous scape, 6 – 8 flowered racemes and 4 large, yellow eyes marking on the disc of the lip. The variety distinctly differs from *C. nitida* by absence of eye shaped yellow spots on lip and marking on the column.



Coelogyne nitida Lindl.

A variant of *Coelogyne nitida* was collected from Takdah forest area of Darjeeling district of West Bengal. The common form of *C. nitida* bears 5 – 7 flowers on its inflorescence. This variant found to have 8 – 10 flowers on its flower spike. The flowers are smaller than common form and having upright flower spikes.



Coelogyne nitida

An another variant of *C. nitida* was collected from the Sanchel Wild Life Sanctuary. This variant has been found to have a different blotching pattern on its lip than the common form. This variant may be useful in developing cultivars having different types of blotch on lips.



Calanthe puberula

A variant of *Calanthe puberula* Lindl. was collected from Darjeeling district of West Bengal. *C. puberula* Lindl is characterized by having 5-7 unequal leaves, spurless flowers and orbicular to ovate apical lobe. This variant found to have linear apical lobe rather than ovate or ovate or orbicular apical lobe.



Liparis bootanensis

A late flowering genotype of *Liparis bootanensis* was identified. This genotype flowers nearly one month later than the commonly occurring species.



Eria spicata D. Don

A variant of *Eria spicata* was collected from Jalapahar area of Darjeeling district of West Bengal. This genotype has been found to have pendulous flower spikes. The common species have upright to arching flower spikes. The genotype may be useful in potted plants having pendulous flower spikes.



EXTERNALLY FUNDED PROJECTS

Technology Mission on integrated Development of horticulture in North Eastern States including Sikkim. (Mini Mission-I)

Production of quality planting material

The quality planting material of *Cymbidium* and *Dendrobium* under the project is mentioned in table 1.

DUS Testing on Orchids: Preparation for Plant Varieties Protection and DUS Testing through ICAR-SAU system

Characterization done during the period (2008-09) to fulfill DUS guidelines for the

Table 1 : Production of quality planting materials under MM-I

Variety	Type	Achievements	Shortfall	Income generated through sale of planting materials/ free distribution
<i>Cym.</i> 'Soul Hunt -1' (A)	Tissue cultured plantlet	7,294	2,706	Rs. 1,51,500 From the sale of tissue cultured plants Distribution to different sections of NRCO. Soil Science - 312 nos. Plant Pathology - 09 nos. Plant Breeding - 300 nos. Genetics - 07 nos. (TC bottles)
<i>Cym.</i> 'Goldengirl' (B)				
<i>Cym.</i> 'Showgirl' 'Cooksbridge' (SG)				
<i>Cym.</i> 'Lunavian Atlas' (D)				
<i>Cym.</i> 'Pineclash 'Moon Venus' (J)				
<i>Cym.</i> 'Star Guard Mc Angel' (G)				
<i>Cym.</i> 'Miss Sandose'				
<i>Cym.</i> 'Orkeny Pink Heather'				
<i>Cym.</i> 'Christmas Beauty'				
' <i>Cattleya labiata</i> x <i>C. aurantiaca</i> '				
HBD-V-19.5-10-SPT) MM-2				
(<i>Dendrobium</i> brought from Shillong)				

following species and hybrids

***Dendrobium* species**

D. fimbriatum, *D. thrysiflorum*, *D. jenkinsi*, *D. densiflorum*, *D. nobile*, *D. chrysotoxum*, *D. devonianum*, *D. parishii*, *D. moschatum*, *D. primulinum*, *D. gibsonii*, *D. chrysentum*, *D. aduncum*

***Dendrobium* hybrids**

Dendrobium "Pompador", *D.* "Emma White", *D.* "Burana Stripe".

***Vanda* species**

Vanda cristata, *V. parviflora*, *V. coerulescence*, *V. coerulea*

***Cymbidium* species**

Cymbidium tigrinum, *C. lowianum*, *C. pendulum*, *C. aloifolium*, *C. dayanum*, *C. elegans*, *C. irridioides*, **C. Erythraeum*

***Cymbidium* hybrids**

Cym. "Arabean Night", *Cym.* "Takarajoke", *Cym.* "Yankillilla"

Mega Seed Project: “Seed Production in Agricultural Crops and Fishries”

Targeted production achieved during the year is furnished below for the year 2008-09:

S. no	Particulars	Achievements	Revenue generation
1	Commercial hybrids/Cymbidium etc plantlet through tissue culture & other techniques	6,000	Rs. 1,39,634/-
2	Gladiolus corms	>10,000	
3	Freesia corms	4,000	
4	Lilium (scales planting done 20,000 no.)	3,000	

DBT's Mission for North-East for Quality Planting Material and Utilization for the North East

The five cultivars namely Levis Duke 'Bellavista', Pineclash 'Moon Venus', Margaret Thatcher "Diplomat", Vivacious "Super white" and Soul Hunt - 6 were selected for

multiplication. These cultivars were multiplied through meristem culture. The targeted plantlets, 20, 000 were produced for the demonstration of *Cymbidium* cultivation in Sikkim. The project is aimed at expansion of orchid cultivation through the supply of quality planting material to the farmers (Fig. 1 & 2).



Fig. 1 & 2 : Hardened plants of *Cymbidiums* ready for distribution to the farmers

Technology assessed and transferred

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.

Demonstration of package of practices for cultivation of *Cymbidium* and *Lilium*

The two demonstration projects which were carried at Milling Hatta and Rambong Busty, Darjeeling completed 2 years. The projects were monitored regularly. The plants are expected to flower in next year. The farmers of the village shown interest in growing of *Cymbidium* orchids. 2,500 tissue culture plantlets of Levis Duke 'Bellavista' and Pineclash 'Moon Venus' were given to the farmers. The farmers were charged

Rs. 15/- per plant as the cost of multiplication. The 26 farmers of Rambong village were also given 13,000 *Lilium* bulblets along with technical know how to grow these bulblets. Krishak Kalyan Sangthan (KKS), Kalimpong was given 2,500 hardened tissue cultured plants of *Cymbidium* orchids (Levis Duke 'Bellavista') for its members. The planting material was given to the farmers along with technical know how. The farmers were charged nominal cost Rs. 15/- per plant as the cost of multiplication.

Technology transfer through mass media Exhibitions/Participations

Training Programmes

The centre organized 5 (five) tailor made training programmes on various topics and trained government officials from different states department of Horticulture / Agriculture and farmers to cater the needs and demands.

The details of training programmes are given below.

Date	Topic	Category of participants	Venue
27 - 28 th June, 2008	Production technology for commercial production of ornamentals.	Farmer of Pakyong	NRCO, Pakyong
22 nd - 23 rd July, 2008	<i>Cymbidium</i> cultivation practices.	Farmer of Pakyong	NRCO, Pakyong
24 th September, 2008	Orchid propagation	Farmer of Pakyong	NRCO, Pakyong
11 - 13 th November, 2008	Commercial cultivation of flowers.	Farmer of Tura, Meghalaya	NRCO, Tura, Meghalaya
29 - 31 Jan., 2009	Commercial cultivation of orchid.	Officers & Farmers of Uttrakhand	NRCO, Pakyong

Sl. No.	Name and place	Date
1.	Kharif Kisan Mela, Samsa Garden Ranipool, Sikkim	12 - 14 th June, 2008
2.	Regional Agricultural Fair, Samsa Garden Ranipool, Sikkim	1 st - 3 rd December, 2008



NRCO at Regional Agricultural Fair



Demonstration of *Cymbidium* Cultivation



Farmer's participation in R&D programme



Farmer's learn about propagation of *Lilium*



Farmer's training at NRCO

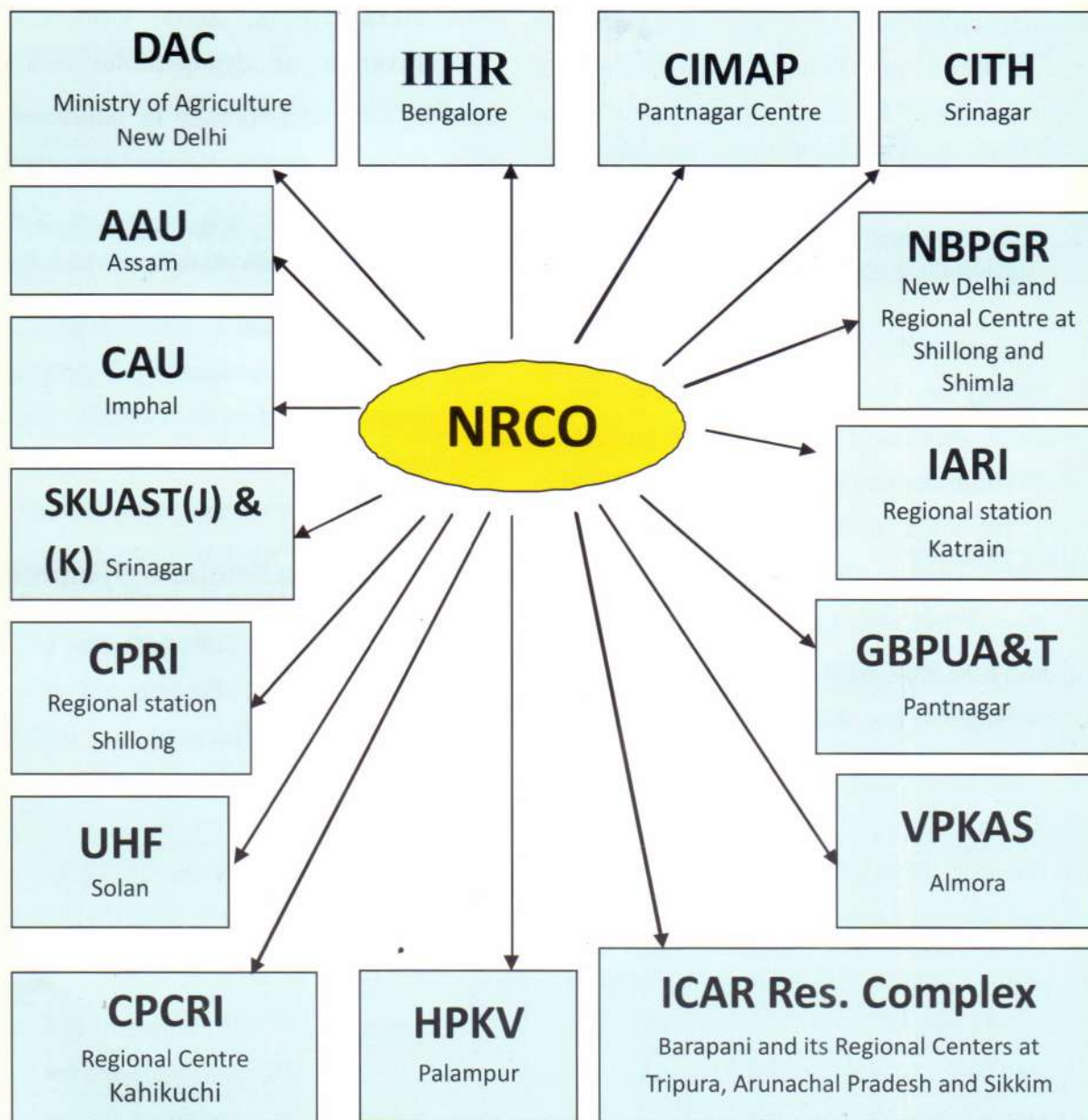


Farmer's learning about planting of *Cymbidium*

Linkages and collaboration

The centre has linkages with several universities, research institutes and developmental agencies for collaborative research and developmental

activities in orchids and other mandated floriculture crops (Fig. 1).



Research papers

1. Barman, D., J. Basak, B. Rai, R. Devadas, V. Nagrare and R. P. Medhi. 2007. Performance of *Cymbidium* hybrids in mid hill situation of Sikkim. *J. Ornament Hort.* **10**: 30-33.
2. Barman, D., B. Rai, T. U. Bharathi, V. Nagarare and R. P. Medhi. 2008. Influence of chemicals on vase life of *Cymbidium* hybrid variety Halley's Cornet Aurora. *J. Ornament Hort.* **10**: 240-244.
3. Nagrare, V. S., Ram Pal and D. Barman 2009. Pests Associated with *Dendrobium nobile* under Mid Altitude of Sikkim *Environment and Ecology* **27**: 560-562.

Popular articles

1. Kumar, Rajiv, L. C. De, Pankaj Baiswar and A.R. Roy. 2008. Saving Siroy lily: an endangered and beautiful flower. *Indian Horticulture.* **53**: 24.
2. Kumar, Rajiv, L.C. De and Pankaj Baiswar (2009). Montbretia for flowers and foliage. *Indian Horticulture.* **54**: 19
3. Barman, D., R. P. Medhi, B. Rai and T. Usha Bharathi. 2009. Fragrant orchids are treasure trove of Sikkim. *Indian Horticulture.* March-April: 27-32.
4. Chakrabarti, S. 2008. Orchids used as

herbal medicine. *Farmer's Digest* **41**:16-19.

5. Chakrabarti, S. 2008. *Dendrobium nobile* - its medicinal properties for herbal medicine. *AGROBIOS.* **7**: 40.
6. Chakrabarti, S. 2008. Commercial cultivation of *Zygopetalum* orchids. *Rastriya Krishi.* **3**: 4-6.
7. Chakrabarti, S. 2008. Growing Phalaenopsis orchids as indoor plants. *Rastriya Krishi.* **3**: 41-43.
8. Medhi R. P. and S. Chakrabarti 2009. Traditional Knowledge of NE people on conservation of wild orchids. *Indian Journal of Traditional Knowledge.* **8** : 11-16.

Paper presented in Seminar/ Symposia

1. Kumar, Rajiv, L. C. De, A. R. Roy and M. R. Verma 2009. Post-harvest life of gladiolus as influenced by different holding solution. In: *Proceeding of National Seminar on 'Sustainable Hill Agriculture'* held from 28th Feb - 2nd March, 2009 at ICAR RC NEH Region, Imphal, Manipur.
2. Barman, D., T. Usha Bharathi and R. P. Medhi 2008. Effect of shade and moisture requirement on growth and flowering of *Cymbidium*. Third Horticulture Congress on New R and D Initiatives in Horticulture

- for accelerated growth and prosperity 6 - 9th Nov. 2008.
3. Barman, D., T. Usha Bharathi, S. K. Naik and R. P. Medhi. 2009. Genetic Diversity of Orchids in Northeastern India. *National Conference on Floriculture for Livelihood and Profitability* organized by ISOH at IARI, Pusa, New Delhi on 16th - 19th March 2009 p.p.4.19.
 4. Naik, S. K., D. Barman, T. Usha Bharathi, and R. P. Medhi. 2009. Influence of NPK on changes in pH and EC of leachate of Cymbidium Spring King at vegetative stage. *The National Conference on Floriculture for Livelihood and Profitability*, 16-19th March 2009, IARI, New Delhi.p.15.
 5. Usha Bharathi. T., D. Barman, N. Buragohain, S. K. Naik and R. P. Medhi. 2009. Effect of Different Chemicals and growth regulators on Vase life of Oriental and Asiatic Lilies. *National Conference on Floriculture for Livelihood and Profitability*, 16-19th March 2009, IARI, New Delhi.p25.
 6. Barman, D., B. Rai, T. U. Bharathi, V. Nagraire and R. P. Medhi. 2008. Influence of chemicals on vase life of Cymbidium hybrid. *National Conference on Orchids: Science and Society*. organized by The Orchid Society of India (TOSI), Held at Bangalore, 10th - 12th April, 2008.
 7. Barman, D., T. U. Bharathi, and R. P. Medhi. 2008. Effect of Shade and Moisture Requirement on Growth and Flowering of Cymbidium. *Focus: New R & D Initiatives in Horticulture for Accelerated Growth and Prosperity* Organized by the Horticultural Society of India, New Delhi, at Bhubaneswar, 6th - 9th Nov., 2008.
 8. Usha Bharathi, T., D. Barman, S. K. Naik and R. P. Medhi. 2009. Post harvest Management of Cymbidium. *National Conference on Floriculture for Livelihood and Profitability*, 16 - 19th March, 2009, IARI, New Delhi.
 9. Usha Bharathi, T. and R. P. Medhi. 2009. Orchids – Post harvest Handling and Value addition. *National Seminar on sustainable hill Agriculture*. p.27.
 10. Medhi, R. P. and Usha Bharathi, T. 2009. Genetic Diversity of Orchids in Northeastern India. *National Seminar on Sustainable Hill Agriculture*. p.27.
 11. Pant, R. P., Mrinal Das and R. P. Medhi. 2009. Occurrence of Black Rot Disease on Cymbidium hybrids in Sikkim. Presented at *National Workshop cum Seminar on Status and Future Strategies of Horticulture Development in Andaman and Nicobar Islands* from 23rd -25th, January, 2009.
 12. Meena, N. K. 2008. Pest incidence in orchid's cultivation. In: *3rd Indian Horticultural Congress* held at Orissa University of Agriculture and Technology, Bhubaneshwar, Orissa, 6-9th

Nov., 2008.

13. Meena, N.K. and R.P. Pant, 2008. Effectiveness of Bio-pesticides against shoot borer in Orchids (*Dendrobium nobile*). In : 3rd Indian Horticultural Congress held at Orissa University of Agriculture and Technology, Bhubaneswar, Orissa, 6-9 November, 2008 .p.317.
14. Meena, N. K. 2008. Evaluation of some insecticides and botanicals against mite, *Tetranychus urticae* on orchids, In: *National Symposium held at NRC for Agroforestry*, Jhansi, 15-17 Dec., 2008.p.205.
15. Meena, N. K., R. P. Pant and R. P. Medhi, 2009. Seasonal incidence of aphid, *Macrosiphum luteum* infesting Orchid (*Epidendrum radicans*) under mid hill conditions of Sikkim, In: *National Conference on Applied Entomology*, organized by Entomological Research Association, Udaipur, Rajasthan from 5-7th March, 2009. p. 39.
16. Pant, R. P., Mrinal Das, N. K. Meena and R. P. Medhi 2009. Orchid viruses - a serious threat to production of orchid flowers in Sikkim and Darjeeling hills of West Bengal. In: *National Conference on Floriculture for Livelihood and Profitability*, Organized by Indian Society of Ornamental Horticulture, New Delhi 16-19th March, 2009.p.224 -225.
17. Devadas, R., S. P. Das, P. Khatiwara and R. P. Medhi. 2008. Characterization of new *Dendrobium* hybrid developed: NRCO - 42 (*D. Emma White* x *D. Pompadour*). In: *Book of Abstracts, National Conference on Floriculture for Livelihood and Profitability* organized by ISOH at IARI, Pusa on 16-19th March 2009. p. 39 (awarded best poster)
18. Devadas, R., S. Baruah, R. C. Upadhyaya and R. P. Medhi 2008. First hand protocol for micropropagation of *Cymbidium Golden Girl* hybrid. In : *National Conference on Floriculture for Livelihood and Profitability* organized by ISOH at IARI, Pusa on 16-19th March 2009. p 203.
19. Medhi, R. P., and Usha Bharathi. T. 2009. Genetic Diversity of Orchids in Northeastern India. *National Seminar on Sustainable Hill Agriculture*. p.27.
20. Chakrabarti, S. 2008. Estimating the genetic diversity of some *Dendrobium* orchids using RAPD markers” In: 3rd Indian Horticulture Congress 2007 organized by the Horticultural Society of India, New Delhi, held at OUAT Bhubaneswar, Orissa 6-9th Nov, 2008.
21. Chakrabarti, S. and R. P. Medhi. 2008. Orchids used in human health and nutrition In: 3rd Indian Horticulture Congress 2007 organized by the Horticultural Society of India, New Delhi, held at OUAT Bhubaneswar, Orissa 6-9th Nov., 2008.

22. Chakrabarti, S. and R. P. Medhi. 2008. Ethno-botanical uses of orchids in India In abstract and souvenir, *National Conference on Traditional Knowledge Systems, Intellectual Property Rights and Their Relevance for Sustainable Development*, organized by National Institute of Science Communication and Information Resources (NISCAIR), CSIR, New Delhi, held at NASC Complex, ICAR, and New Delhi 24-26th Nov., 2008.
23. Chakrabarti, S. and R. P. Medhi. 2008. *Dendrobium* orchids in Science and Art *National Symposium of Orchids, Science and Art*, organised by the Orchid Society of India TOSI. held at Panjab University, Chandigarh 16-17th Dec., 2008.
24. Chakrabarti, S. and R. P. Medhi. 2008. Water management through hydroponic culture of orchids *National Symposium on Constraints and Mitigations in Indian Agriculture*, organised by The Agricultural Society of India, Kolkata held at Science City Centre, Kolkata 29-30th Dec., 2008.
25. Chakrabarti, S. and R. P. Medhi. 2008. Orchid Industry-a new vista in floriculture Trade In: *National Symposium on Constraints and Mitigations in Indian Agriculture*, organised by The Agricultural Society of India, Kolkata held at Science City Centre, Kolkata 29-30th Dec., 2008.
26. Chakrabarti, S. and R. P. Medhi. 2009. Orchids in Traditional Knowledge In : 96th *Indian Science Congress*, organised by Indian science Congress Association, Kolkata. held at NEHU, Shillong, Meghalaya 3rd-7th Jan., 2009.
27. Chakrabarti, S. and R. P. Medhi. 2009. Cluster analysis to assess genetic variability of *Coelogyne* orchids. In: *National Conference on Floriculture for Livelihood and Profitability*, organised by Indian Society of Ornamental Horticulture (ISOH) held at IARI, New Delhi 16-19th Jan., 2009.
28. Chakrabarti, S. 2009. Genetic diversity assessment of Indian Ladies Slipper orchids using RAPD markers. In : *National Conference on Floriculture for Livelihood and Profitability*, organised by Indian Society of Ornamental Horticulture (ISOH) held at IARI, New Delhi 16-19th Jan., 2009.
29. Chakrabarti, S. and R. P. Medhi. 2009. Cluster analysis to assess genetic variability of *Coelogyne* orchids In : *National Conference on Floriculture for Livelihood and Profitability* organised by Indian Society of Ornamental Horticulture (ISOH) held at IARI, New Delhi 16-19th March, 2009.

List of Ongoing Projects

6

Institute Projects

Project title	Principal Investigator	Co-PI
<i>In vitro</i> propagation of orchid: <i>Cymbidium</i> and important, rare and endangered species	R. P. Medhi	Ramgopal Devadas
Cytogenetical research on orchids	S. Chakrabarti	
Breeding superior hybrids in <i>Cymbidium</i> and other important orchids	Ramgopal Devadas	
Nutrient management in orchids	S. K. Naik	D. Barman
Development of agro – techniques for commercial scale production of orchids in open and protected condition.	D. Barman	L.C De, T. Usha Bharathi & S. K Naik
Post harvest technology of orchids	L. C. De	T. Usha Bharati & D. Barman
Diseases management in orchids	R. P. Pant	
Pest management in orchids and bulbous flowering plants	N. K. Meena	
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 <i>Lilium</i>	Ram Pal	

RAC and IRC Meetings with Recommendations

7

The 9th Research Advisory Committee (RAC) meeting of this centre was held under the Chairmanship of Prof. P. Tandon, Vice-Chancellor, North Eastern Hill University, Shillong, Meghalaya on 19th September 2008 at the conference hall of NRC for Orchids. The Member Secretary Dr. Ramgopal Devadas, Scientist (Plant Breeding) invited all the esteemed members of the RAC, during the inaugural session and also briefed on the significance of the 8th RAC impact. The Director, Dr. R. P. Medhi formally welcomed the Chairman and other members of RAC including the new Assistant Director General (Horticulture – II), ICAR, Dr. Umesh Srivastava who visited this institute and as well Sikkim for the first time. The participants of RAC Committee were as follows:

Prof. P. Tandon, Chairman
Vice-Chancellor
North Eastern Hill University,
Mawlai, Shillong, Meghalaya

Dr. U. Srivastava ICAR
Assistant Director General (H-II) Nominee
Krishi Anusabdhan Bhavan Member
New Delhi

Dr. Narendra Kumar Member
Outstanding Scientist &
Director (Personnel),
DRDO, DRDO Bhavan
New Delhi

Dr. S. K. Datta Member
CSIR- Emiratus Scientist,
Bose Institute, Madhyamgram,
Experimental Farm,
Jessor Road, 24 Paragana (N),
Kolkata – 700 129

Prof. P. Rajeevan Member
Associate Dean
Kerala Agricultural University
Trichi, Kerala

Dr. R. P. Medhi Member
Director,
NRC for Orchids, ICAR
Pakyong, East Sikkim



Dr. H. Rahman
Joint Director,
ICAR RC NEHR,
Sikkim Center
Tadong, Sikkim

IMC
Member/
Nominee

Shri. K. K. Singh
Shri. D. K. Bhandari
Director (Horticulture),
Govt. of Sikkim, Krishi Bhavan
Tadong, Sikkim

IMC
Member/
Nominee

Dr. Ramgopal Devadas
Scientist (Plant Breeding)
NRC for Orchids,
Pakyong, East Sikkim

RAC -
Member
Secretary

The following Scientists of the NRC for Orchids,
Sikkim attended the meeting:

Dr. Syamali Chakrabarti
Senior Scientist (Genetics)

Dr. D. Barman
Senior Scientist (Horticulture)

Dr. R. P. Pant
Sr. Scientist (Plant Pathology)

Mr. Rampal
Scientist Sr. Scale (Horticulture)
& Scientist In-charge
NRCO-Regional Center,
Darjeeling, W. B.

Dr. Ramgopal Devadas
Scientist (Plant Breeding)

Sh. S. K. Naik
Scientist (Soil Science)

Dr. N. K. Meena
Scientist (Entomology)

Ms. Usha Bharathi
Scientist (Floriculture)

Summary of Recommendations

A. Project/Work specific

1. The Assistant Director General (H-II) suggested developing 'Common descriptors for Orchids' to fulfill the characterization work at the center under the status of NAGS. (Plant Breeding)
2. Dr. Narendra Kumar suggested developing hybrids with export values within a fixed time frame of minimum 4-6/6-8 years as fixed target. (Plant Breeding)
3. Dr. S. K. Datta recommended for *in vitro* mutagenesis using *in vitro* mutagens for development of new varieties. (Plant Breeding)
4. Prof. P. Tandon, Chairman suggested to submit a research project for external funding to overcome some gaps. (Plant Breeding)
5. It has been approved by the RAC for evaluation at tissue hardened plants of meristem culture & seed culture at CPCRI Regional Station, Jalpaiguri and ICAR RC NEHR, Umiam as per 1st QRT recommendations, as it was reminded by the former DDG (Horticulture), Dr. S. K. Ghosh during DBT meeting recently. (Plant Breeding)
6. The new hybrids identified during the 2007-08; NRCO-42 (*Dendrobium whitae* x *D. pompadour*) and H x B (*Cymbidium* 'Lunavian Atlas' x C. 'Golden Girl') has been recommended for multiplication and variety release proposals. (Plant Breeding)

7. The chairman suggested even to use simple sugars like sugar as one of the treatment with other sources in a view to cut down the cost for the growers point of view under the experiment, "Influences of carbon sources for in vitro multiplication" (Plant Breeding)
8. Modified method developed for *ex vitro* hardening was suggested for proposing for submission of patent within 06 months. (Plant Breeding)
9. The Chairman suggested for winding up project on "In vitro propagation of Orchids: *Cymbidium* and Important rare and endangered species" and asked to work on only 3-4 species/hybrids in a year for protocol development. (Plant Breeding)
10. To avoid the constraints in having an agreement with CDFD, Dr. U. Srivastava, ADG (H-II) suggested the proposed work on SSR's on Orchids to be collaborated with NBPGR, New Delhi immediately. (Genetics)
11. It is strongly recommended for submitting a project for external funding on molecular mapping and data base development. (Genetics)
12. The Chairman also suggested developing molecular markers for developed hybrid lines to assist plant breeding division for quicker confirmation. (Genetics)
13. Dr. N. Kumar suggested to use more number of primers (25-30) instead of working with 10 primers was also recommended by the RAC. (Genetics)
14. The Chairman suggested identifying the priority areas in molecular work, rather doing for the academic interest. (Genetics)
15. The chairman commenting on the new project proposal, "Identification, isolation and characterization of micro-satellite markers from *Cymbidium* and *Dendrobium* Orchids" suggested working on commercially important hybrids only. Director suggested for changes and requested to submit the RPF-I immediately. (Genetics)
16. The experiment on "Effect of inorganic material on reducing pre-blooming of *Cymbidium*" should be collaborated with Soil Science and Plant Breeding & Tissue Culture divisions. (Horticulture)
17. The work of "Effect of EC of nutrient solution and fertilization regime on spike production and quality of *Cymbidium*" will be done by the Soil Science division. The exact plan of work may be finalized in consultation with chairman quickly by e-mail. The ADG (H-II) suggested having more experiments to be taken up in a year. (Horticulture/Soil Science)
18. The project on "Development of integrated floriculture enterprise" was seriously questioned for the non-compliance of action, as per last year RAC (8th) recommendation for the external project submission. The chairman and other members suggested for good cultivation plan and submit to DBT/DST under Women and Rural Development within one or two months for external funding. (Horticulture)

19. The experiments on "Standardization of stage of harvest for orchids" (in collaboration with the state department) and "Standardization of pulsing solution of orchids" (with collaboration of the farmers/suppliers/growers) have been approved. (Horticulture-Post Harvest)
20. The experiments on "Standardization of packing materials for orchids" and "Standardization of packing boxes for orchids" has not been approved by the RAC and suggested for new innovations in these lines. (Horticulture-Post Harvest)
21. The Chairman and ADG (H-II) suggested proposing more experiments under post harvest projects. Commenting on the procurement of flowers for experimentation, the Chairman suggested that Director may arrange the flowers by purchasing for the research work. (Horticulture-Post Harvest)
22. The "Multiplication of orchid germplasm by conventional methods" through hormonal inducing has been recommended for patenting. (Horticulture-Darjeeling Campus)
23. It is propose for including Darjeeling and Kalimpong areas of DGHC of West Bengal to include under the DBT's mission with north-east. (Horticulture-Darjeeling Campus)
24. The project on Tulips is to be dropped as requested by the scientist due to space constraints. But, the Chairman and Dr. N. Kumar suggested for submitting external projects on research based on the requirement. (Horticulture-Darjeeling Campus)
25. "Standardization of major nutrient requirements by *Cymbidium* hybrid at reproductive stages" and "Effect of different concentration of vegetative stage dose and different media on growth of *Cymbidium* hybrids" has been approved with suggested changes. The Chairman suggested for analyzing the micro-nutrients of plants at different stages, apart from major nutrient analysis of plant and media. (Soil Science)
26. The Chairman also suggested, that the Plant Breeding & Tissue Culture and Horticulture division to be a part of the experiments of Soil Science. The ADG (H-II) suggested for 2- 3 experiments more for the current year after sending e-mail confirmation from the Chairman. (Soil Science)
27. It is suggested for analyzing the contents of plant and media from the other National Institutes on payment basis for completion of the task. (Soil Science)
28. The ADG (H-II) suggested for the record of fungal diseases and their controlling measures on existing hybrids rather than orchid germplasm as a whole. (Plant Pathology)
29. The ADG (H-II) suggested for surveying across India on the Anthracnose and come out with developing remedial measures after further studies. Chairman pointed out to evaluate the correlation studies with nutrient of the soil in relation to disease. (Plant Pathology)

30. The sub-project, "Management of anthracnose and black rot in *Cymbidium* with available bio-control agents" has been approved with isolation of local pathotypes of *Trichoderma*, *Pseudomonas* and *Bacillus* from the ecotype. (Plant Pathology)
31. The Chairman suggested for submission of DBT funding to work on virus indexing, apart from the approved ICAR networking projects on the "Diagnostic and molecular characterization of Virus". In this regard, Chairman suggested taking the lab facilities and collaborating from the Genetics division. (Plant Pathology)
32. As per last year (8th RAC) recommendation, the Chairman insisted again to take help from Dr. Thaper, Shillong and TERI (or) Prof. G. D. Sharma, Assam University, Silchar to work specially on fungal diseases to fulfill the project accomplishment on "Exploitation of Orchid Mycorrhiza (OM) in the Early Establishment (Hardening) and Growth Promotion of Tissue Cultured Plants of Important Orchids" with collaboration of Plant breeding division. (Plant Pathology)
33. All the possible traditional methods for controlling insect pests to be included as treatments in experimental designs and to popularize the same in the form of technologies with proven scientific data. (Entomology)
34. The Chairman appreciated the natural enemies identified against orchid pests like Coccinellid etc., and suggested to work more on this line for multiplication and include as an experiment. (Entomology)
35. The four projects, on "Insect-orchid host preference studies in Orchid germplasm", "Pest management in *Cymbidium*" (with two experiments), "Organic control of pest management in *Dendrobium*" and "Efficacy of bio-pesticides on *Oncidium*, *Vanda*" have been approved for the current year program. (Entomology)
36. On new project proposal, "Screening of orchid germplasm against insects", the Chairman suggested to come out with the advantages and relevance of the work in project mode, rather than experimental mode and suggested to submit the project to the DBT for external funding with changes in methodology presented on carbohydrates, chlorophyll and phenols. (Entomology)
37. The RAC Member Secretary suggested for inclusion of leaf glossiness, trichomes density, ligular hair, chemical on leaf for waxiness (benzaldehyde) and surface exudates like malic acid, formic acid, glucosides and flavonoids for precise correlation to insect resistance in Orchids. (Entomology)
38. The RAC Member Secretary suggested for limited destructive methodology, as germplasm collection has been a difficult job in view of recent National Bio-diversity Act, 2003. The chairman suggested for more review on the theme and suggested for collaboration with Plant Breeding. (Entomology)

B. General recommendations

39. The Director's presentation should include the past QRT recommendation apart from last three years RAC recommendation for proper evaluation.
40. The Director's presentation should also include the each infrastructural facility given to each division and other sections in every year.
41. The necessary measures to fulfill the recommendation of previous RAC recommendations, the RAC review may be taken up for at least weekly / monthly by Director and RAC member secretary.
42. The characterization of orchids on morphological and molecular studies should be mutually complemented.
43. A national seminar/symposium may be organized with in a time from of one year.
44. NRC for Orchids, ICAR, Sikkim has been requested to be a part of 'Bio-technological park' that is going to be established in North-east India at Shillong and Scientists are requested to share the experience and knowledge at NEHU and other universities in NE for guidance to students and also to get solutions to fundamental researchable issues with teaching professors.
45. The revenue generation or technology generation and adoption rates for the each individual projects may be kept as a criteria for evaluation and assessment.

46. The incentives for getting any external funding project like extra mural fund for the lead scientists from the project is strongly recommended from the RAC body to the council, as an encouraging phenomena for better output for the scientists.

Recommendations of the 7th "Institute Research Council" (IRC) meeting, National Research Centre for Orchids (ICAR) Pakyong, East Sikkim-737 106

The Institute Research Council meeting of NRC for orchids, Pakyong, Sikkim-737 106 was held on 22nd October, 2008 under the Chairmanship of Director, Dr. R. P. Medhi at the Conference Hall of the Institute. Following members were present in the meeting :

Dr. R. P. Medhi Director, NRC for Orchids Pakyong, Sikkim	Chairman
Dr. M. R. Sudharshan Deputy Director (Research) Spices Board Govt. of India, Gangtok	Member
Dr. H. K. Badola Scientist Incharge G. B. Pant Institute, Pangthang, Gangtok, Sikkim	Member
Dr. S. N. Yadav Associate Prof., College of Agriculture & Engineering & Post Harvest Technology Ranipool, Gangtok Sikkim	Member

Dr. Kundan Kishor Scientist Horticulture, ICR Research Complex for NEH Region, Tadong, Sikkim	Member	Mr. Rampal Scientist (SS) Horticulture NRC for Orchids, Darjeeling Campus Darjeeling
Mr. P. Subba Deputy Director, State Agriculture & Cash Crop Development Department, Govt. of Sikkim Gangtok, Sikkim	Member	Dr. R. Devadas Scientist (Plant Breeding) NRC for Orchids, Pakyong Sikkim
Mr. Nirmal Yonzong Farmer's Representative	Member	Dr. S. K. Naik Scientist (Soil Science) NRC for Orchids, Pakyong Sikkim
Mr. Vidya Subba Farmer's Representative	Member	Dr. N. K. Meena Scientist (Entomology) NRC for Orchids, Pakyong Sikkim
Mr. Benu Dhakal Farmer's Representative	Member	Ms. T. Usha Bharathi Scientist (Horticulture) NRC for Orchids, Pakyong Sikkim
Dr. S. Chakrabarti Senior Scientist (Genetics) NRC for Orchids, Pakyong Sikkim		
Dr. R. P. Pant Senior Scientist (Plant Pathology) NRC for Orchids, Pakyong Sikkim		

Major Recommendations

Sl. No.	Division	Recommendation	Action Taken
1	Plant Breeding	To register and release the variety at state level. No need of multilocational trials and identify virus free plant material for further multiplication.	Dr. Devadas, Scientist (Plant breeding) to initiate the work in this line.
		Developed varieties should meet the International standards and acceptability	Dr. Devadas, Scientist (Plant Breeding).
2	Genetics	All the hybrids/ varieties developed at NRCO have to be characterized at molecular level.	Dr. S. Chakraborty, Senior Scientist (Genetics) may initiate the work
3	Horticulture	Regarding the shade experiment IRC suggested to make separate shade compartment for each shade levels and suggested to co-relate shade with light intensity.	Dr. D. Barman and Ms. T. Usha Bharati may initiate to work on this aspect.
		The analysis of commercial fertilizers like Nitrophoska, Aishwariya etc. for actual nutrient content and come out with own formulations.	Dr. D. Barman and Ms. T. Usha Bharati have to work on this aspect
4	Darjeeling Centre	Regarding the project collection and conservation of Begonia germplasm it is suggested that Begonia is not a potential crop in this region instead <i>Alstroemeria</i> and <i>Zantedeschia</i> can be considered.	Mr. Rampal to work in this direction



7th IRC Meeting at Conference Hall



9th RAC Meeting at Conference Hall

Participation of Scientist in Meetings, Conferences, Workshops, Training, Symposia, Seminar etc. in India and abroad



Brain storming on management of germplasm of horticultural crops at NBPGR, New Delhi from 14 - 16th March, 2008.

Rampal

Meeting on bio-diversity and agriculture at GBPIHE, Pangthang, Gangtok on 22nd May, 2008.

R. Devadas

Review meeting on the monitoring committee for North East mission programme at DBT, Lodhi Road, New Delhi on 30th July, 2008.

R. Devadas

Fourth International Flori-Expo at New Okhala Industrial Area, New Delhi on 26 - 28th Sept., 2008.

R. P. Pant

3rd Indian horticulture congress organised by the Horticultural Society of India, New Delhi at OUAT, Bhubaneswar, Orrisa from 6 - 9th Nov. 2008.

S. Chakraborty

ICAR training cum workshop on IP and Technology management with the theme of

protection of IPR and micro-organisms at ICAR research complex for NHE Region, Barapani from 20 - 22nd Nov., 2008.

R. Devadas

National conference on traditional knowledge systems, Intellectual Property Rights an their Relevance for sustainable Development organised by National Institute of Science Communication and Information Resources (NISCAIR), CSIR, New Delhi at NESC Complex, ICAR, New Delhi on 24 - 26th Nov., 2008.

S. Chakraborty

Regional Agricultural Fair, organised by ICAR Research Complex, Barapani at Saramsa Garden, Ranipool, Gangtok, Sikkim on 1-3rd Dec., 2008.

D. Barman, R. P. Pant, R. Devadas, N. K. Meena & T. Usha Bharati

National Certificate System for Tissue Cultured Raised Plants (NCS-TP), organised by bio-tech consortium India Ltd. New Delhi at Hotel Brahmaputra, Ashok, Guwahati on 15th Dec. 2008.

Rampal

National Symposium on Agro forestry knowledge for sustainability, climate Moderation and Challenges Ahead at NRC for Agro forestry, Jhansi, U.P. from 15 - 17th Dec., 2008.

N. K. Meena

Annual Review Meeting of ICAR Seed Project Seed Production in Agricultural crops and Fisheries at NASC Complex, New Delhi from 5 - 6th Jan., 2009.

R. P. Pant

DUS Project's Meeting on 2nd Plant Genome Savior Community Recognition Function organised by Protection of Plant Varieties and Farmers Rights Authority, Ministry of Agriculture, Govt. of India at NASC Campus, DPS Marg, IARI, New Delhi on 12th Feb., 2009.

R. P. Pant

Short Course on Application of GIS in Plant Biodiversity and Horticulture at IISR, Calicut from 25th Feb - 6th March, 2009.

T. Usha Bharathi

National Seminar on Sustainable Hill Agriculture organised by ICAR, Regional Centre for NEH Region at ICAR, NEHR, Imphal, Manipur from 28th Feb. - 2nd March 2009.

L. C. De

MM-1 Workshop entitled 'Technology Mission-Livelihood Opportunities at ICAR Research Complex for NEH Region from 4 - 5th March 2009.

R. P. Pant

National Conference on Floriculture for Livelihood and Profitability organised by Indian Society of Ornamental Horticulture (ISOH) at IARI, New Delhi from 16 - 19th March, 2009.

S. Chakraborty, D. Barman, R. P. Pant & R. Devadas

Distinguished visitors

9

- Dr. Narendra Kumar, 19.09.2008
Director, (Personal)
DRDO, New Delhi
- Dr. S. K. Dutta 19.09.2008
CSIR- Emeritus Scientist,
Bose Institute,
Madhyamgram,
Experimental Farm,
Jessor Road, 24 Pgn. (N),
Kolkata
- Dr. Umesh Srivastava, 19.09.2008
ADG (Hort.II)
ICAR, KAB-II, Pusa
New Delhi
- Dr. C. K. George, 12.11.2008
UN Consultant,
International Trade Centre,
Geneva
- Mr. Tenzim Choeda, 12.11.2008
Bhutan
- Mr. P. Perinbam, 12.11.2008
Asstt. Director,
Spice Board,
Tadong, Sikkim
- Dr. B. S. Chundawat, 18.11.2008
Former V.C.
GAU & SDAU,
Pratapnagar, Udaipur,
Rajasthan
- Dr. K. N. Nag, 18.11.2008
Former V. C.,
MLS University,
Udaipur & Founder V.C.
Rajasthan Agril. University,
Bikaner
- Dr. Akali Sema, 1.12.2008
Director, CIH, Jharnapani
Nagaland
- Dr. N. P. Singh, 2.12.2008
Joint Director,
ICAR RC NEHR,
Tripura Centre,
Lembucherra
- Dr. V. S. Korikanthimath, 26.12.2008
Director,
ICAR Research
Complex for Goa

I. Scientific

Dr. R. P. Medhi,	Director
Dr. L. C. De,	Principal Scientist (Horticulture)
Dr. Syamali Chakrabarti,	Sr. Scientist (Genetics)
Dr. D. Barman,	Sr. Scientist (Horticulture)
Dr. R. P. Pant	Sr. Scientist (Plant Pathology)
Dr. Rampal,	Scientist Sr. Scale (Horticulture)
Shri. S. K. Naik,	Scientist (Soil Science)
Dr. Ramgopal Devadas,	Scientist (Plant Breeding)
Dr. N. K. Meena,	Scientist (Agril. Entomology)
Miss. T. Usha Bharathi,	Scientist (Hort./Floriculture)

II. Administration

Mrs. Lakit Lepcha	Assistant Admn. Officer (Upto 31st July, 08)
Shri Ajen Lama	Assistant Admn. Officer
Shri. Rajat Kumar Das	Assistant
Mrs. Diki Bhutia	Sr. Clerk

Shri. Phigu Tshering Bhutia Jr. Clerk

Mrs. Prema Nagaraju Jr. Clerk

Mrs. Sangeeta Lepcha Jr. Clerk

III. Technical

Shri. Janaki Mandi	Technical Asstt. (T-3)
Shri. Ram Chandra Gurung	Driver (T-3)
Shri Nonigopal Debnath	Computer Assistant (T-II-3)
Shri. G. B. Mukhia	Farm Technical (T-2)
Shri. Manoj Adhikari	Technical Asstt. (T-1)
Shri. Deepak Khattri	Driver (T-1)
Miss. Meena Kumari Chettri	Technical Asstt. (T-1)

IV. Supporting

Shri. Gopal Brahmin	SSG-IV
Shri. Dawa Bhutia	SSG-II
Shri. Tularam Dulal	SSG-II
Shri. Trilok Singh Balmiki	SSG-II
Shri. Arjun Gurung	SSG-I
Shri. N. K. Biswakarma	SSG-I*
Mrs. Rabin Kala Subba	SSG-I

*Terminated from service

Appointments

- Dr. L. C. De joined as Principal Scientist (Horticulture) on 24th November, 2008
- Mr. Ajen Lama joined as Asstt. Admn. Officer on 19th August, 2008
- Shri Noni Gopal Debnath joined as Computer Assistant on 2nd June, 2008
- Mrs. Sangeeta Lepcha joined as Junior Clerk on 23th February, 2009

Promotions

- Mrs. Diki Bhutia was promoted from Jr. Clerk to Sr. Clerk on 23.05. 2008

Retirements

- Mrs Lakit Lepcha, AAO retired on 31. 07. 2008
- Shri G. B. Mukhia, T2 retired on 31. 07.2008

Other Information

11

Independence Day

National Research Centre for Orchids celebrated Independence Day on 15.08.08. All the staff participated in the flag hoisting ceremony.



Hindi Diwas:

Hindi Diwas was celebrated on 14th September 2008 to promote the use of Rajbhasa. The staff of the Centre participated in various competitions. The participants who stood 1st, 2nd and 3rd were honoured prizes.



Raising Day

The centre celebrated raising day on 5.10.08 the celebration was marked by a number of activities in which the staff participated actively



Republic Day

Republic day was celebrated in the centre on 26.01.09





National Research Centre for Orchids, Pakyong- 737 106, Sikkim

Phone : 03592-257954, 257703, Fax: 03592-257289 / 257282

Website : www.sikkim.nic.in/nrco, Email : nrcorchids@rediffmail.com