

वार्षिक प्रतिवेदन

Annual Report

2010 - 11



राष्ट्रीय आर्किड् अनुसंधान केन्द्र

(भारतीय कृषि अनुसंधान परिषद्)

पाक्योङ - ७३७ १०६, सिक्किम

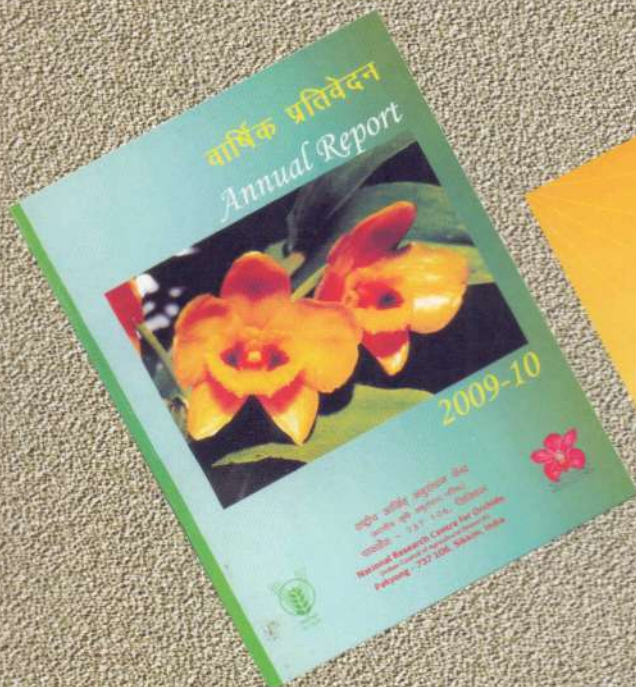
National Research Centre for Orchids

(Indian Council of Agricultural Research)

Pakyong - 737 106, Sikkim, India



Glimpses of Last 5 Years Institute Annual Report



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Cover photographs

Front : *Phalaenopsis* hybrid 'Rousserole'

Back (inside) : Glimpses from the National Conference on Production & Utilization of Orchids

Back (outside) : *Coelogyne cristata* Lindl., a gorgeous orchid in its natural habitat (Sikkim)

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Preface

This is my proud privilege to place this valuable document of Annual Report of National Research Centre for Orchids, Sikkim for the year 2010 – 2011. During the year Centre organized a National Conference on National Consultation on Production and Utilisation of Orchids, from which several useful recommendations were emerged. The recommendations would be helpful in formulating research programmes of the Centre. The centre also made several significant achievements in the fields of research on orchids. Through this document an



attempt has been made to highlight various achievements of this Centre. The information generated in the Centre could be used in conservation and commercialization of orchids in the country.

The Centre has been designated as national active germplasm site for orchids and entrusted with prime responsibility of conservation, characterization and evaluation of indigenous and exotic germplasm. During the year 110 accessions of different species were collected from Darjeeling in which 4 species are new record to West Bengal. The two endangered species namely *Paphiopedilum fairrieanum* and *P. villosum* were collected and conserved. Molecular characterization of 17 *Cymbidium*, 38 *Dendrobium* and 10 *Vanda* species was carried out.

The protocol for five commercially important hybrids has been standardized and is being used for mass multiplication. Using the developed protocol 25,000 plantlets of *Cymbidium* orchids were produced and distributed to the farmers.

Several experiments were conducted to standardized potting media and nutritional doses for growth and flowering of commercially important orchids. Valuable information has been generated which could be useful in commercialization of orchids. The role of macro and micro nutrients in growth and flowering of *Cymbidium* orchids were identified and electrical conductivity of fertilizer solution were found determining factors for flowering of *Cymbidium* orchids. The centre has also realized the importance of organic cultivation and several organic formulations were tested and found suitable for enhancing quality, yield and protection of orchids.

The sensitive diagnostics, ELISA & RT – PCR have been standardized and are in place for the detection of viruses in the planting materials. CymMV and ORSV are most serious pathogens of orchids. Indexing survey conducted in major orchid growing areas has shown that most of the commercial

hybrids are infected by viruses. There is a need to apply the strict quarantine measures for the orchids being imported in India.

The Centre has formulated National Test Guidelines for *Cymbidium*, *Dendrobium* and *Vanda* to facilitate the registration of new orchid cultivars developed in the country.

The staff of the Centre was encouraged to participate in different programmes for honing their skill. The findings of the institute were also disseminated through training and demonstrations to extension workers and farmers.

In order to review, monitor and evaluate the research programmes and developmental activities of the Centre, RAC and IRC meetings were conducted and the reports were submitted to the Council.

I hope the information provided in the report will be useful and of interest to the orchid growers, scientists, technologists and the students working in the field of Orchidology.

The growth of this Centre would not have been possible without the blessings, support and constant help from Dr. S. Ayyappan, Director General (ICAR) and Secretary (DARE) Govt. of India, Dr. H. P. Singh, Deputy Director General (Hort.) and Dr. U. Srivastava, Assistant Director General (Hort. II). I want to offer my gratitude and sincere thanks to all of them. I am also grateful to all the members of QRT, RAC and IRC for their guidance in carrying out the programme of the institute successfully.

I also thankfully acknowledge the contribution made by all the scientists, technicals, administrative and supporting staff of this Centre.

Place: Pakyong, East Sikkim.
Dated: 30th June, 2011



(R. P. Medhi)
Director

नूराह एल्सागोफ रेड और फातिमाह ऐल्सकोफ ब्लू, मोकरा के दो शंकरों हेपी ब्यूटी और मैडम पानी तथा आनसीडियम के ७ शंकरों वाइल्ड केट कारमेरा, पिक्वि रुथ, टाकायेलो, पोपकी रेड, जे.आर. पिंक स्पोट, जे.आर. आरेन्जरेड, जे.आर. येलो ब्राउन सिक्किम की मध्य पहाड़ियों में उगाने के लिए उचित पाये गये है।

- सिम्बीडियम शंकर पी सी एम वी में जी ए-३ (५० पीपीएम) + वी ए २०० पी पी एम प्रयोग करने पर सबसे लम्बे स्पाइक (३० से०मी) और अधिकतम स्पाइक/पौधा (४) पाये गये और अधिकतम आयुकाल (११५) दिन पाया गया।
- कैटेलिया के ५ पोटिंग मिश्रणों में कोकोचिप + पेड़ की छाल + कोकोपीट + ईट के टुकड़े ४:२:२:२ के अनुपात में मिलाने से सबसे अधिक फूल प्रति पौधे प्राप्त किये गये। कैटेलिया के नौ शंकरों में 'वैल्क चाई लिन न्यू सिटी' में अधिकतम पुष्पक प्रति स्पाइक पाये गये।
- सिम्बीडियम आर्किड में चार सस्यकर्तन अवस्थाओं में पात्र में जीवनकाल ७५ प्रतिशत खुले पुष्पों में 'पाइनक्लेस मूनवेनस' में ५६ दिन, 'बैली लीजेन्ड स्टेफी' ४८.८३ दिन एवं 'प्योर इनका गोल्ड' में ५३ दिन पाया गया।
- सिम्बीडियम शंकर पी० सी० एम० वी० में २ प्रतिशत केन सुगर को होल्डिंग मिश्रण में मिलाने पर प्रथम पुष्पन का जीवन काल ५४ दिन, पुष्प गिरने का प्रतिशत शून्य, मिश्रण अपटेक २४ मिली० तथा पात्र में अधिकतम जीवन काल ६१.२ दिन पाया गया।
- डेन्ड्रोवियम शंकर 'थोंगचाई गोल्ड' में ४ प्रतिशत सुक्रोज + १ प्रतिशत केलिसियम नाईट्रेट देने पर ६६ प्रतिशत कलियां खिली जबकि ४ प्रतिशत सुक्रोज + ऐसिटाइल एसिटिक अम्ल १०० पी पी एम देने पर ६० प्रतिशत कलियां खिली। सबसे अधिक पात्र में जीवनकाल ३६ दिन, ४ प्रतिशत सुक्रोज एवं १०० पी पी एम एलुमिनियम सल्फेट से साथ प्राप्त हुआ तथा ४ प्रतिशत सुक्रोज एवं १०० पी पी एम ऐसिटिक अम्ल के साथ ३३ दिन प्राप्त हुआ।
- सिम्बीडियम शंकर पी सी एम वी में ४ प्रतिशत सुगर एवं २०० पी पी एम सेलेसलिक एसिड देने से ७५ प्रतिशत पुष्प

खिले एवं उनका पात्र में जीवनकाल ४५ दिन पाया गया।

- सिम्बीडियम की १६ जातियों एवं ४१ शंकरों, डेन्ड्रोवियम की ३० जातियों एवं १४ शंकरों तथा वन्डा की १२ जातियों एवं ६ शंकरों का डस टेस्टिंग निर्देशक रेखा पूरी कर ली गयी है।
- सिम्बीडियम शंकर में एन पी के १५:३०:२० का ०.१ प्रतिशत अनुप्रयोग मई के महिने में कलियों के निर्गमन से पूर्व करने पर पुष्प उत्पादन सर्वाधिक पाया गया।
- सिम्बीडियम शंकर में उर्वरक मिश्रण ई सी का १ एम एस/सेमी० पुष्पन के लिए सबसे अच्छा पाया गया है। तथा पत्तियों में एन पी के की मात्रा १.६, ०.२४ एवं १.२३ प्रतिशत क्रमशः अनुकूलतम दर्ज की गयी। एनपीके की विभिन्नता कृमिका मात्रा में डालने पर एनपीके १२:३०:१० का अनुपात पुष्पन के लिए अनुकूलतम पाया गया तथा एन पी के की मात्रा पत्तियों में क्रमशः १.७५, ०.५४ और १.२६ दर्ज की गयी।
- सिम्बीडियम शंकर में पुष्पन के लिए पोरथ्रूलीचेट का इ सी ०.८०-१.० एम एस/सेमी० पाया गया।
- जब वर्धन माध्यम में पोषक तत्वों की मात्रा २८ पी पी एम से कम हो तो नाइट्रोजन का आभाव प्रदर्शित करता है। सिम्बीडियम शंकर को बालू में उगाये जाने पर नाइट्रोजन की क्रान्तिक सीमा २८-५६ पी पी एम पायी गयी।
- कैटेलिया एवं डेन्ड्रोवियम के शंकर, जो थाईलेन्ड से आयात किये गये थे, का विषाणु सूचीकरण किया गया। विषाणुसूचीकरण के परिणाम यह दर्शाते हैं कि ये शंकर सिम्बीडियम मोजेक वाइरस एवं ओडेन्टोग्लोसम रिंगस्पोट वाइरस से ग्रसित पाये गये जबकि वन्डा के शंकर विषाणुरहित पाये गये। सिक्किम एवं दार्जीलिंग क्षेत्रों में आर्किड के वाणिज्यिक शंकरों का एलिसा टेस्ट करने से ज्ञात हुआ है कि ज्यादातर शंकर सिम्बीडियम मोजेक एवं ओडेन्टोग्लोसम रिंगस्पोट विषाणुओं से ग्रसित पाये गये हैं।
- आर्किड की विभिन्न जातियां जो कर्नाटक एवं महाराष्ट्र से एकत्रित की गयी थी वे सिम्बीडियम मोजेक एवं ओडेन्टोग्लोसम रिंगस्पोट विषाणुओं से ग्रसित पाये गये हैं।

- आर्किड की एन्थ्रकनोज बिमारी, जो कलिटोट्राईकम ग्लेइयोस्परिआयडिस के द्वारा होती है उसको नियंत्रित करके लिए ट्राईकोडरमा विरिडी पात्र के परिक्षण में सबसे अच्छा विरोधी पाया गया है।
- सिम्बीडियम को पोलीहाउस अवस्था में नौ कीटनाशक एवं जीवकीटनाशकों को 'टूस्पोटेड रेडस्पाइडर माईट' के विरुद्ध परीक्षण किया गया जिसमें ०.०३ ईसी० नीम आयल सबसे प्रभावकारी पाया गया।
- इपिडेन्ड्रम का शूटवोरर, पेरीडेडाला एसपी का बी. टी. (डाईपेल) ०.०१ प्रतिशत और नीम आयल ०.०३ प्रतिशत ई सी ५ मिली०/ली० से प्रभावकारी ढंग से प्रबन्धन किया गया।
- आई पी एम के ७ प्रतिरूपक (माड्यूल) में से एम-५ (तंबाकू निचोड़ ५ प्रतिशत, नीम आयल ०.०३ प्रतिशत ई सी ५ मिली०/ली० और बाईफेनथ्रिन १० ई सी ०.२५ प्रतिशत सिम्बीडियम में माईट के विरुद्ध सबसे प्रभावकारी पाया गया।
- सिम्बीडियम फूलों में एफिड का प्रभावकारी ढंग से प्रबन्धन करने के लिए ईकोनीम (३००० पी पी एम) २ मिली०/ली० और नीम आयल ०.०३१ ई सी ५ मिली०/ली० का प्रयोग किया गया है।

Executive Summary

- Molecular variation and fingerprinting of ten species of genus *Vanda* of North Eastern Himalayan region were done using ISSR markers to determine the relationships among the species. All species are grouped in 04 distinct clusters showing their genetic relatedness.
- 17 *Cymbidium* species were analysed for PCR amplifications using three nuclear (ITS) and ten plastid loci (microsatellite markers). Significant variability observed in the species under study. Sequencing of the samples will help to generate molecular data for species identification.
- A set of 28 STM (microsatellite primers) were used for PCR amplifications of 38 *Dendrobium* species. The result of PCR amplifications of all the primers indicated a high potential to study the genetic variability of the *Dendrobium* species.
- Forty different species of orchids were collected from Meghalaya, Manipur, Karnataka and were inducted to germplasm collection.
- NRCO-Coll-77 of Red Vanda (INGR 10113) and NRCO-42 (No. 09131/IC 574581) has been registered with Plant Germplasm Registration Committee (PGRC).
- The 16 species of orchids and progenies of two crosses namely PBX-05-29 (*Cymbidium* 'Golden Elf' x *Cymbidium* 'Red Beauty') and *Arachnanthe cathcartii* x *Vanda coerulea* were characterized morphologically using common descriptor on orchids.
- Protocol of *Cymbidium* 'Baltic Glacier Mint Ice' is developed.
- Foliar application of 0.2% 19:19:19 (NPK) at 15 days interval increased the plant height (74.48 cm) of *Cymbidium* hybrid 'Sleeping Nymph' when compared with 7 days interval (69.86 cm).
- *Dendrobium* hybrid 'Emma White', treated with NPK (20:20:20) with Ca, Mg and Mn along with BA 50 ppm and GA₃ 100 ppm gave maximum number of spikes / plant (2).
- Among the two modes of application, drenching with 0.05 % NPK (30: 10:10) increased the number of leaves (10.77) , plant height (36.31 cm) and leaf length (34.22 cm) in *Cymbidium* hybrid Levis Duke 'Bella Vista' as compared to spraying.
- Foliar application of NPK (20:10:20) at 0.2 % increased the number of leaves (6.33), number of spikes (1.25) and number of flowers (7.0) while 10:20:10 NPK at 0.2 % increased plant height (9.37cm) in *Phalaenopsis* hybrid 'Brother and Sister'
- Six hybrids of *Aranda*, namely 'Propin Spot', 'Anne Khoo x V. Kasems Delight', 'Sayan x Ascda Bangkhuntian Gold', 'Prapine White', 'Noorah Alsagoff Red' and

'Fatimah Alsakoff Blue', two hybrids of Mokara namely 'Happy Beauty' and 'Madam Pani' and seven hybrids of *Oncidium* namely 'Wild Cat Carmera', 'Pixie Ruth', 'Taka Yellow', 'Popki Red', 'J.R. Pink Spot', 'J.R. Orange Red' 'J.R. Yellow Brown' were found suitable for mid hills of Sikkim.

- In *Cymbidium* hybrid 'PCMV', longest spike (60 cm), rachis length (30cm), the highest number of spikes /plant (4) and highest longevity (115 days) of flower spikes was observed with GA₃ (50 ppm) + BA(200 ppm).
- In *Cattleya*, out of five potting mixtures, cocochips + tree bark + cocopeat + brick pieces (4:2:2:2) had shown maximum number of flowers /plant and out of nine hybrids, Blc Chai lin New City had highest number of florets /spike(6).
- Among the four harvesting stages, the highest vase life was noticed in 75 % open stage. It was 59 days in 'Pine Clash Moon Venus', 48.83 days in 'Valley Legend Stefi' and 53 days in 'Pure Inca Gold'.
- Use of cane sugar (2%) in holding solution showed maximum first floret longevity (54 days), zero per cent flower dropping, maximum solution uptake (24ml) and highest vase life (61.2 days) in *Cymbidium* 'Pine Clash 'Moon Venus'.
- In *Dendrobium* hybrid 'Thongchai Gold', per cent of fully opened buds (66%) was recorded maximum with sucrose (4%) + Ca(NO₃)₂(1%) followed by sucrose (4%) + acetyl acetic acid (100 ppm) (60%). Longest vase life (36 days) was found with sucrose (4%) + Al₂(SO₄) (100 ppm) followed by sucrose (4%) + acetyl acetic acid (100 ppm) (33 days).
- In opening of tight bud of *Cymbidium* Pine Clash 'Moon Venus', treatment with 4% sugar + 200 ppm salicylic acid gave highest per cent (75%) of fully opened flowers with maximum vase life (45 days).
- DUS testing guidelines were finalized for 16 species and 41 hybrids of *Cymbidium*, 30 species and 14 hybrids of *Dendrobium* and 12 species and 9 hybrids of *Vanda* based on common descriptors.
- Application of NPK 15:30:20 @ 0.1% in the month of May, before the flower bud emergence is suitable and standardized to get maximum flower production in *Cymbidium* hybrid.
- The fertilizer solution having EC of 1 mS/cm was found best for flowering of *Cymbidium* hybrid and recorded optimum N, P and K content in the leaf, 1.6, 0.24 and 1.23%, respectively. Among the different graded doses of NPK, 12:30:10 NPK recorded best flowering in *Cymbidium* hybrid and having optimum N, P and K content in the leaf, 1.75, 0.54 and 1.29 %, respectively
- The optimum EC of the pour-thru leachate for best flowering of *Cymbidium* hybrid was found to be 0.80-1.0 mS/cm
- When the nutrient content of the growing media is below 28 ppm, plant shows N-deficiency. The critical limit of N for *Cymbidium* hybrid grown in sand was found to be 28-56 ppm.
- Virus indexing results revealed that

imported commercial hybrids of *Cattleya* and *Dendrobium* had mixed infections of CymMV and ORSV while hybrids like *Vanda* were found free from viruses. ELISA results have shown that majority of the commercial *Cymbidium* hybrids grown in Sikkim and Darjeeling hills are infected with CymMV and ORSV.

- Orchid species collected from Karnataka and Maharashtra also showed presence of CymMV and ORSV.
 - *Trichoderma viridae* was found highly antagonistic *in vitro* against orchid anthracnose caused by *Colletotrichum gloeosporioides*.
 - Neem oil 0.03 EC was found most effective
- among nine insecticides and bio pesticides tested against two spotted red spider mite on *Cymbidium* under polyhouse conditions.
 - Shoot borer, *Peridaedala* sp. on *Epidendrum* has been managed efficiently by using B.t. (Dipel) 0.012% and neem oil 0.03% EC 5 ml/lit.
 - IPM modules, M-5 (tobacco extract 5%, neem oil 0.03% EC 5 ml/lit and bifenthrin 10EC 0.25%) was most effective against mite on *Cymbidium*.
 - Econeem (3000 ppm) 2ml/litre and neem oil 0.03% EC 5ml/lit found most effective for control of Aphid on *Cymbidium* flowers.

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 on improvement in productivity, quality and commercialization of orchids and bulbous flowering crops. The Sikkim state authorities handed over 22.19 acres of land belonging to Regional Agricultural Centre along with all other assets to ICAR for establishment of the Centre. In October 1997, the Centre also took over the CPRS, Darjeeling from CPRI and established a campus for research on temperate orchids and other bulbous flowering crops.

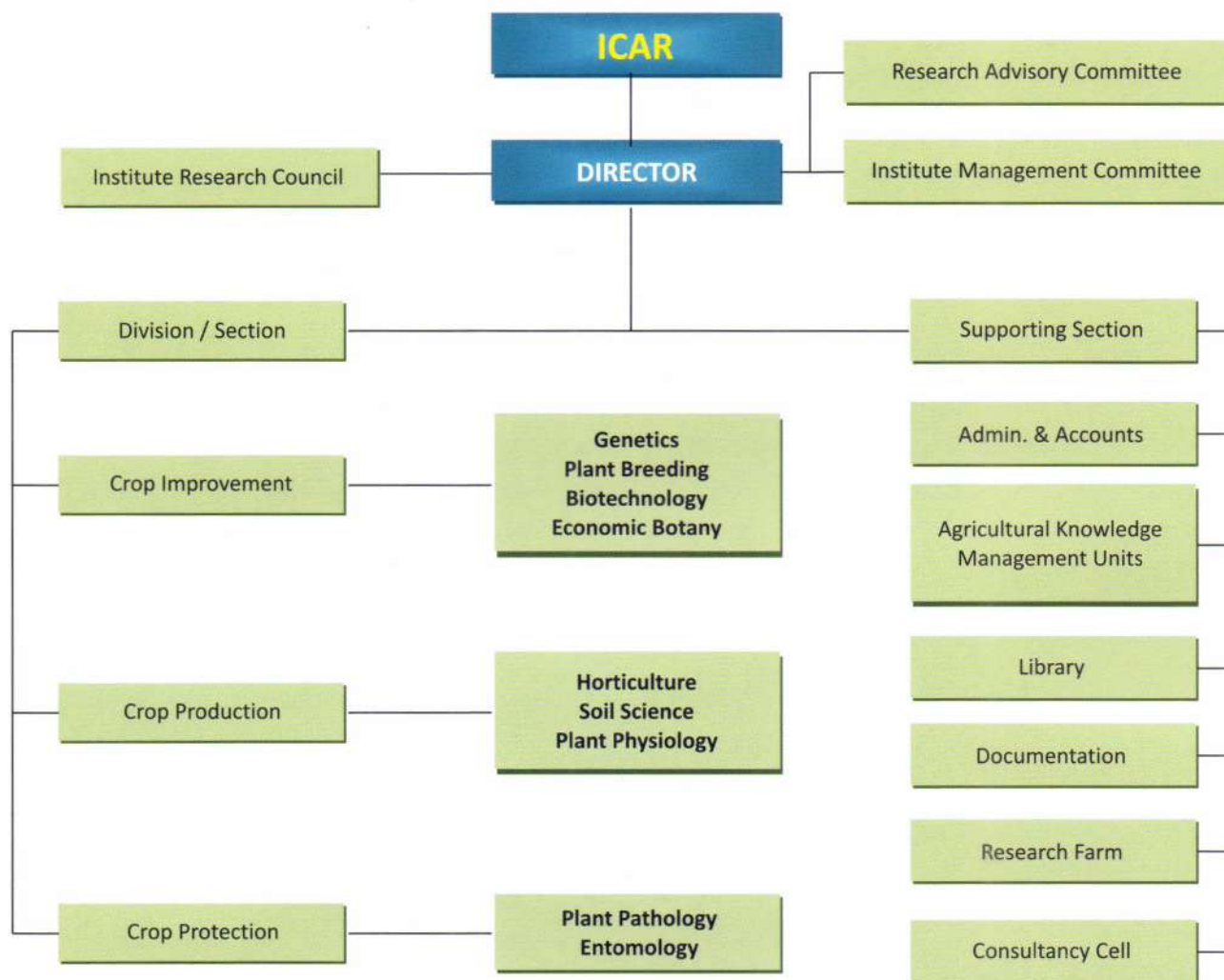
In the initial years of establishment the major focus of research was on collection, conservation evaluation, characterization and utilisation of available germplasm in the country in general and north eastern region in particular. With the changing scenario of floriculture in the country, the Centre 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 basis of recommendations of RACs the research programmes have been modified on the mission oriented research projects 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 ornamental bulbous crops
- To act as a national repository of scientific information on mandate crops
- To coordinate research with other scientific organizations and act as a centre for training

The research work is being carried out under 13 projects. In addition to these, research work is also being carried out under 4 externally funded projects viz. Horticulture Mission for Northeast and Himalayan States (HMNEH), Network Projects on Distinctiveness, Uniformity and Stability on Orchids (DUS), DBT's Mission for North-East for Quality Planting Material and Utilisation for the North East and NAIP's A Value Chain on Selected Aromatic Plants of North East India.

Organizational setup



Organogram of NRC Orchids

Organization

The Director is the administrative head of the Institute. The Institute Management Committee, Research Advisory Committee and Institute Research Council assist the Director in the matters relating to management and research activities of the Institute. 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, Agricultural Knowledge Management Units (earlier known to be ARIS Cell), Library, Documentation and Consultancy Cell.

Financial statement

Amount (Rupees)				
Head of Account	Non-Plan		Plan	
	Sanctioned	Utilized	Sanctioned	Utilized
Establishment charges	1,63,00,000.00	1,43,41,520.00	-	-
Labour wages	-	-	-	-
Traveling allowances	1,50,000.00	1,46,947.00	8,31,000.00	8,31,129.00
Other charges	22,50,000.00	20,63,533.00	1,75,63,000.00	1,75,66,633.00
Works	-	-	1,15,00,000.00	1,14,26,203.00
HRD	-	-	1,06,000.00	1,06,000.00
Total	1,87,00,000.00	1,65,52,000.00	3,00,00,000.00	2,99,99,965.00

Revenue generation

Amount (Rupees)			
Particulars	Institute	Project	Total Amount
Sale of farm produce	1,20,365.00	3,00,000.00	4,20,365.00
Sale of tender form	6,000.00	-	6,000.00
Training	64,800.00	-	64,800.00
Others	57,996.00	-	57,996.00
Total	2,43,161.00	3,00,000.00	5,49,161.00

Table 3. Staff position of the institute (as on 31.03.2011)

Sl. No.	Category	Sanctioned strength	In position	Vacant
1.	Director	01	01	-
2.	Scientific Post			
	Scientist	09	03	06
	Sr. Scientist	05	02	02
	Principal Scientist	01	02*	-
	Total	16	08	08
3.	Technical Staff			
	Category - I	05	05	-
	Category - II	02	01	01
	Category - III	-	-	-
	Total	07	06	01
4.	Administrative Post			
	Asstt. Admn. Officer	01	01	-
	Asstt. Fin. & Account Officer	01	01	-
	Assistant	03	01	02
	U.D.C/Sr. Clerk	01	01	-
	L.D.C/Jr. Clerk	02	02	-
	Stenographer	01	-	01
	Total	09	06	03
5.	Supporting Staff (SSG-I, II, III, IV)	06	06	-

* One Sr. Scientist promoted to Principal Scientist through CAS

Past achievements

Surveys were conducted for collection of orchid germplasm at 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 msl) while the accessions of temperate species were conserved at Darjeeling campus (altitude, 2150 msl). The germplasm was

characterized for various useful traits. The molecular characterization of *Dendrobium*, *Coelogyne* and *Vandaceous* orchids was carried out, and virus indexing technique, RT-PCR of ORSV has been standardized and being used for the detection of ORSV.

8 hybrids and 2 species of *Vanda*, 12 hybrids and 3 species of *Cymbidium* and 2 hybrids and 13

species of *Dendrobium* were studied to develop the DUS testing guidelines for *Vanda*, *Dendrobium* and *Cymbidium*.

Protocols for micropropagation of orchid species and hybrids were standardized. The improved vegetative propagation methods were developed for rapid multiplication of *Cymbidium* planting stock. The optimum requirement for nutrients, media, water, light, shade etc. were standardized for the *Cymbidium* cut flower production.

The surveys were conducted for the diseases and insect-pests causing damage in the farmer's field as well as in the orchid germplasm at the Centre. The causal organisms were identified, epidemiology was studied and control measures were suggested. Similarly, insect-pests causing damage to crops were studied and the management practices were suggested.

The Centre has regularly organized training programmes for extension workers and farmers. The quality planting material of orchids 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 179 reference books related to different subjects were purchased for strengthening the library facilities for scientists, technical staff and research scholars. Currently, the Centre is subscribing for 36 journals including 12 foreign journals and 14 scientific magazines. The institute's publications were made available to more than 200 different organizations in the country.

The Centre has established linkages with DAC, Ministry of Agriculture, DBT, Ministry of S&T, New Delhi, IIHR, Bangalore, CITH, Srinagar, NBPGR New Delhi, IARI New Delhi, VPKAS, Almora, ICAR Research Complex for NEH Region, Barapani, HPKV, Palampur, CPCRI, Regional Centre, Kahikuchi, UHF, Solan, CPRI Regional Station Shillong, SKUAST(J) & (K), Srinagar, CAU, Imphal & Gangtok and AAU, Assam.



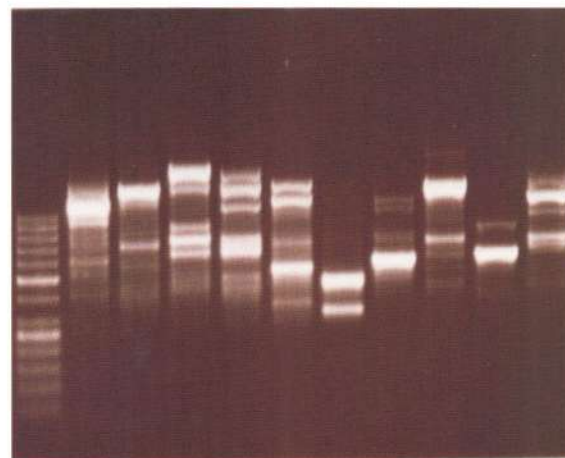
2 Research Achievements

CROP IMPROVEMENT

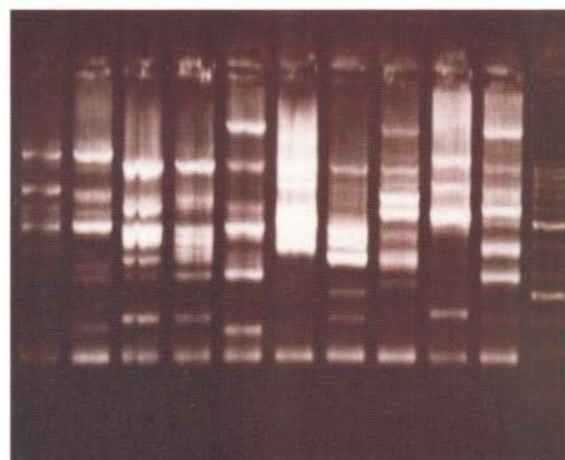
Molecular Characterization of Orchids

Molecular variation and fingerprinting of some species of genus *Vanda* Jones of North Eastern Himalayan region using ISSR markers

The relationships among ten species of genus *Vanda* Jones were studied using ISSR markers. All the ten species of *Vanda* were collected from different locations of North Eastern Himalayan region. Orchid species used in this study were *Vanda alpina*, *V. amesiana*, *V. coerulea*, *V. coerulescens*, *V. cristata*, *V. parishii*, *V. parviflora*, *V. stangeana*, *V.teres*, and *V. tessellata*. PCR amplifications using 19 selected UBC ISSR primers showed multiple banding patterns (Fig.1). UPGMA cluster analysis based on genetic similarity values for ISSR marker bands from all the *Vanda* species was construct a distinct dendrogram (Fig.2). Results from this analysis showed four cluster groups. The cluster analysis showed significant genetic variation among the species studied with a similarity coefficient varying between 0.12 and 0.56. The group I clustered with 04 species which consists of *Vanda alpina*, *Vanda amesiana*, *Vanda cristata* and *Vanda stangeana*. The group II includes three species namely *Vanda coerulea*, *Vanda coerulescens* and *Vanda tessellata*. The third group clustered only 02 species *Vanda parviflora* and *Vanda teres*. The cluster IV consist of only single species i.e. *Vanda parishii*. The results indicated that ISSR profiling as a powerful method for assessment of molecular diversity in orchids



UBC-872



UBC-848

Fig. 1. ISSR Banding pattern of *Vanda* species using primer UBC 872 and 848

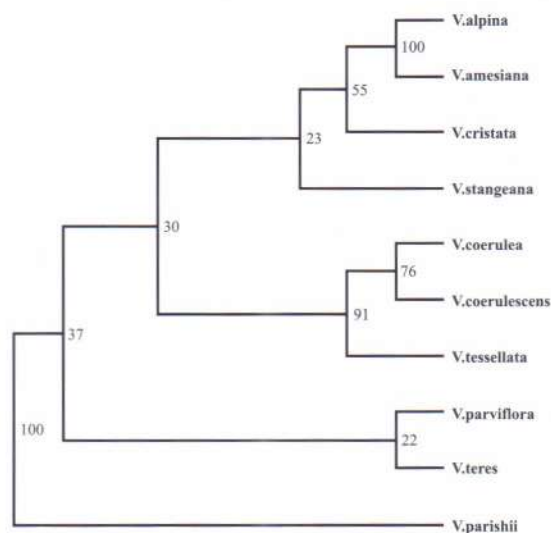


Fig. 2. Dendrogram of ten *Vanda* species based on cluster analysis of genetic similarity from ISSR data

Molecular analysis of *Cymbidium* Sw orchids

85 accessions of 17 *Cymbidium* species were collected from various locations viz. Darjeeling, Kalimpong, Meghalaya and Sikkim. PCR amplifications of these 17 *Cymbidium* species were done using three nuclear (ITS) and ten plastid loci (microsatellite markers). Significant variability was observed in the species under study (Fig. 3). The samples will be sequenced for molecular data.

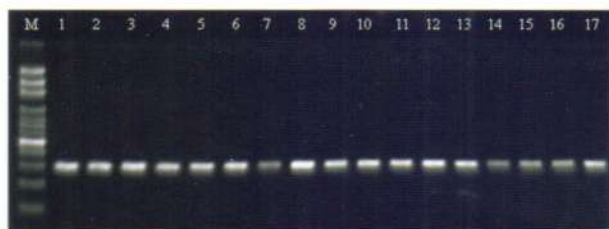


Fig. 3. Banding pattern of *Cymbidium* species using forward and reverse primer accD1f5A and accD4rR

Molecular analysis of *Dendrobium* Sw orchids

In this study 38 species of *Dendrobium* Sw orchids which were collected from Darjeeling, Kalimpong, Sikkim and Western Ghats are taken into consideration, a set of 28 STM primers which were already optimized for two important parameters of PCR i.e. annealing temperature of primers and $MgCl_2$ conc. were used for PCR amplifications. The result of PCR amplifications of all the primers indicated a high potential to study the genetic variability of the *Dendrobium* species.

Improvement of Orchids

Germplasm collection

The two germplasm lines, NRCO-Coll-77 of red *vanda* (INGR 10113) and NRCO-42 of *Dendrobium* (No. 09131/IC 574581) has been registered by Plant Germplasm Registration

Committee (PGRC).

During the year 31 different species of orchids were collected from different places. *Dendrobium*, *Vanda*, *Otochilus*, *Eria*, *Oberonia* and *Bulbophyllum* species were collected from Senapati district, Manipur; *Dendrobium*, *Coelogyne*, *Oberonia*, *Rhynchostylis*, *Cleisostoma*, *Pholidota*, *Bulbophyllum* and *Aerides* species were collected from Karnataka; *Pleione*, *Pholidota*, *Anoectochilus*, *Dendrobium*, *Eria*, *Calanthe*, *Otochilus*, *Cymbidium*, *Thunia*, *Liparis*, *Bulbophyllum*, *Cryptochilus*, *Malaxis*, *Coelogyne*, *Vanda* and *Rhynchostylis* species were collected from Shillong and were inducted to germplasm collection.

Characterization and evaluation

Characterization of 14 orchid species and 2 crosses were done as per common descriptors. The characterized orchid species include *Coelogyne fuscescens*, *Paphiopedilum villosum*, *Paphiopedilum spicerianum*, *Paphiopedilum insigne*, *Coelogyne (occulatacae) barbata*, *Epidendrum xanthinum*, *Acampe papillosa*, PL x PW, *Arachnanthe cathcartii* X *Vanda coerulea*, *Eria vitata*, *Coelogyne elata*, *Calanthe plantaginea*, *Coelogyne cristata*, *Eria pubescens*, *Paphiopedilum hirsutissimum* and *Eria amica*.

New hybrid lines identified from F₁ progeny

PBX-05-29

The progenies of PBX-05-29 (*Cymbidium* 'Golden elf' x *Cymbidium* Red 'Beauty') which flowered in the year 2010 had yellow lip with grayed purple (RHS184A) color spots. But the progenies flowered during the current year (2011) have two distinct variation in flower colors and

forms. The flower colour of one progeny was found pale white with red purple (RHS59A) color in the apical lobe (PBX- 05-29 I pink) and other is yellow (RHS8C) with red purple (RHS60B) in apical lobe (PBX-05-29 II yellow) (Fig. 4a, 4b, 4c).

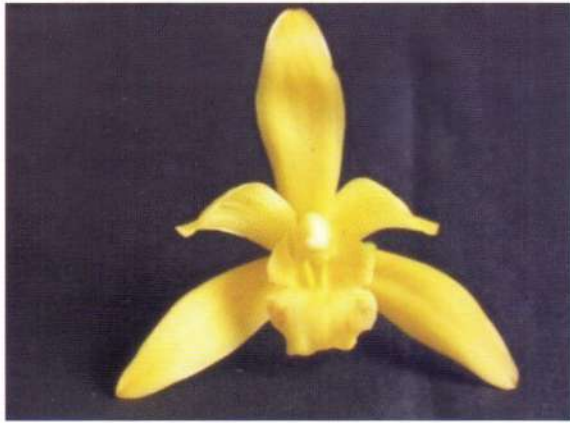


Fig. 4a. *Cymbidium* 'Golden Elf'



Fig. 4b. *Cymbidium* Red Beauty



Fig. 4c. Hybrid

Variation of two progenies

PBX- 05-29 I Pink (Fig. 5a)

- Flower color –pale white with red purple shading (RHSN66C),
- Lip –pale white with red purple (RHS59A) color in the apical lobe.
- Column – pale white with red purple (RHS59A) spots.

PBX-05-29 II Yellow (Fig. 5b)

- Flower color –yellow (RHS 8C)
- Lip- yellow (RHS8C) with red purple (RHS60B)in apical lobe
- Column- yellow with red purple (RHS60B) spots.



Fig. 5a. PBX-05-29 (Pink)



Fig. 5b. PBX - 05-29 II (Yellow)

Arachnanthe cathcartii X *Vanda coerulea*

The crosses between *Arachnanthe cathcartii* and *Vanda coerulea* flowered during Jan – Feb, 2011. It was observed that the appearance and flower color of the progeny is different from its parents. The sepals and petals of *V. coerulea* are white color & violet blue shaded and tessellated (RHS-92A, shaded & RHS-91A, tessellated) color pattern whereas in a new hybrid, the color of the sepals' petals are purple violet (RHS N80B). Plant height of progeny is 53.5cm with leaf shape symmetric emarginated. Inflorescence bears 05 flowers and size of flower is approximately 7.7 cm X 7.9 cm. (Fig. 6a, 6b, 6c).



Fig. 6a. *Arachnanthe cathcartii*



Fig. 6b. *Vanda coerulea*



Fig. 6c. Hybrid

***In Vitro* Propagation of Orchids**

Seed culture

Seed culture was done for different crosses and selfed are in different *in-vitro* and *ex-vitro* stages. *Vanda stangeana* X *Vanda cristata* crossing was done successfully for developing new hybrids (Fig. 7a, 7b).



Fig. 7a. *Vanda stangeana*



Fig. 7b. *Vanda cristata*

Influence of growth hormones on Plbs proliferation of *Cymbidium* 'Pine Clash Moon Venus'

Protocorms of *Cymbidium* hybrid Pine Clash 'Moon Venus' were cultured on MS media incorporated with different levels of BAP, Kinetin, NAA and IBA. The results revealed that MS + BAP (0.5 mg/l) resulted for faster Plb proliferation (22 days for 5th Plb stage) (Fig. 8) while combined effect of both hormones BAP (0.5mg/l) + NAA (0.2mg/l) was best for Plb differentiation.

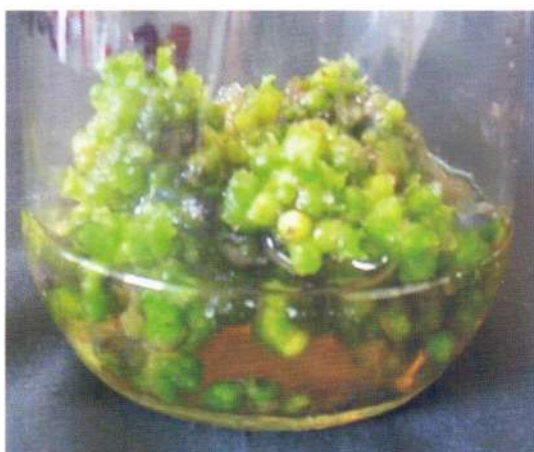


Fig. 8. Plbs of *Cymbidium* 'Pine Clash Moon Venus'

Effect of different media and hormone levels on germination of embryos of different species and crosses

A total of 10 selfed as well as crossed capsules of different orchids like *Cymbidium*, *Dendrobium*, *Vanda*, *Zygopetalum* and *Cattleya* were harvested at 6-7 months after pollination. The harvested capsules were cultured in different media, viz. MS (Murashige and Skoog), Gamborg (G5), Knudson, and Nistch (Na) media supplemented with activated charcoal, sucrose and without activated charcoal. The different parameters like swelling, greening, globule formation and germination were observed. Germinated seeds were further sub-cultured into

different media for their proliferation and differentiation.

Among 10 crossed/selfed species, embryos of 6 crossed/selfed responded and formed plbs, while others did not respond to any media.

The protocorms were sub-cultured on different media using MS with activated charcoal and supplemented by plant growth substances viz. BAP, Kinetin, NAA and IBA at the rate of 0.2 mg/l each. The presence of BAP, NAA and kinetin, in the media resulted in early swelling, globular formation and shoot initiation. The addition of activated charcoal in the media improved plantlet growth and established better when cultured on MS media with 1.0 mg/l activated charcoal recorded the fastest multiplication of Plb (Fig.9).



Fig. 9. Germinated crosses and species

Effect of different media on germination of PBS-10-28 (*Cattleya maxima*)

Among the five basal media tested for the seed germination of PBS-10-28, Gamborg's B5 medium was found best for seed germination which took least number of days for greening (18days), globule formation (28days) and first PLB's formation (40 days) as compared to other media like MS, Knudson, Nitsch and White's media (Fig.10).

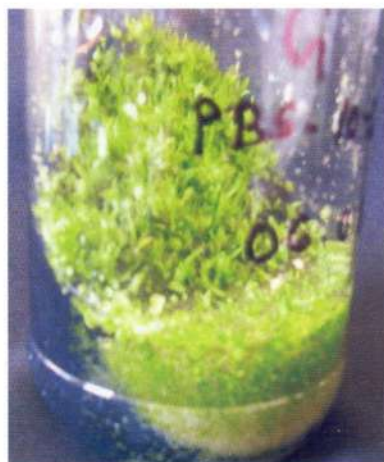


Fig. 10. Seed germination in Gamborg's B5 media

Protocol development for mass multiplication of *Cymbidium* 'Baltic Glacier Mint Ice'

To develop a protocol for the mass propagation of *Cymbidium* 'Baltic Glacier Mint Ice' hybrid through meristem culture, the shoot tips were cultured on MS media supplemented with various

concentrations of plant growth hormones BAP, NAA, Kinetin and IBA at different concentrations. MS media supplemented with 1.0 g/l of activated charcoal, 0.2mg/l of NAA and 0.2 mg/l BAP gave better results for regeneration of plb from shoot tips. Further culturing of this *in-vitro* regenerated protocorms showed maximum number of plbs (12/explant) in shortest period (28 days for 1st plbs stage) and protocorms developed within 90 days. Maximum number of shoot (10/explant) using basal media supplemented with activated charcoal at the rate of 1.0g/l.

But the study on influence of growth hormones for plbs multiplication showed that rate of plbs multiplication was rapid in MS incorporated with 0.2mg/l BAP alone. MS media supplemented with 0.4mg/l each of BAP, IBA and Kinetin produced plantlets of well developed leaves and roots, which is a pre requisite for *ex-vitro* survival of plants. The plantlets were maintained for three months in the same media for *in-vitro* hardening and then transferred to community pots filled up with potting mixture of coco chips and Leaf mould (1:1) resulted in 70% survival after 2 months of *ex-vitro* hardening (Fig. 11a, 11b, 11c).



Fig.11a. Plb proliferation of *Cymbidium* 'Baltic Glacier Mint Ice'



Fig. 11b. *In vitro* hardening of plantlets of *Cymbidium* 'Baltic Glacier Mint Ice'



Fig.11c. Plantlet ready for *ex-vitro* hardening *Cymbidium* 'Baltic Glacier Mint Ice')

CROP PRODUCTION

Development of Agro-Techniques for Commercial Production of Orchids under Protected Condition

Optimization of nutrient requirement for *Cymbidium* plants under hardening

The experiment consisted of four concentrations of N, P, K @ 19:19:19 (0%, 0.1%, 0.2% and 0.3%) and two spray intervals (7 days and 15 days). Nutrient solution was given as foliar applications. It was recorded that foliar application of 0.2% 19:19:19 of N, P, K at 15 days interval increased the plant height (74.48cm) of *Cymbidium* hybrid 'Sleeping Nymph' when

compared to 7 days interval (69.86). (Fig.1a, 1b) However, in both intervals the plant height was lesser in control (65.83 cm). Number of leaves (26.6) was highest in 0.2% 19:19:19 of N, P, K at 15 days interval when compared to 7 days interval (25.4) and lowest in control (22.25). Leaf length was observed maximum in 0.2% 19:19:19 of N, P, K at 15 days interval (71.6 cm) and pseudo bulb girth was found maximum (3.70) in 0.1% 19:19:19 of N, P, K at 15 days interval.



Fig. 1a. 15 days interval



Fig. 1b. 7 days interval

Effect of inorganic nutrients and growth regulators in reducing pre-blooming of *Cymbidium* 'Black Magic'

Inorganic nutrients (N:P:K) 10:10:10, 20:10:10 and 30:10:10 were given at two different concentrations at 0.1% and 0.2% and growth

regulators, BA and GA₃ in two concentrations 100 ppm, 200 ppm each and combination of GA₃ 100 ppm + BA 100 ppm and GA₃ 100 ppm + BA 200 ppm were applied as foliar spray. The nutrient spray was given weekly once while the growth regulators were given at monthly interval. The result reveals that foliar application of inorganic nutrient 0.1% of 10:10:10 NPK and BA 200 ppm increased the plant height (80 cm) and foliar application of inorganic nutrient 0.1% of 30:10:10 NPK and GA₃ 100 ppm and BA 100 ppm induced flowering.

Influence of frequency and mode of application of different growth regulators on *Dendrobium* 'Thongchai Gold'

Growth regulators like GA₃ (50,100,200 ppm) and BA (50, 100 ppm) were applied in two frequencies (morning and evening spray) and in two different modes, foliar spraying and drenching. BA 50 ppm in evening spray showed maximum number of pseudobulbs (3.87) while number of flowers (14.6) were recorded maximum in drenching. Number of spikes (1.55) were maximum in plants drenched with BA 100 ppm followed by evening spray (1.83) (Fig. 2a and 2b).



Fig. 2a. Showing less flowering in spraying



Fig. 2b. Showing more flowering in drenching

Effect of BA and GA₃ injection on growth and flowering of *Dendrobium* 'Thongchai Gold'

Different treatment combination consisting of growth regulators like GA₃ (0, 2500, 5000 ppm) and BA (0, 5000, 10000 ppm) were applied to induce winter flowering. A combination of GA₃ 2500 ppm and BA 5000 ppm showed maximum number of leaves (14.11) and number of pseudobulbs (4.22). whereas the maximum number of spikes (1.8) was observed in plants injected with BA 5000 ppm.

Influence of plant growth regulators and inorganic nutrients on flower regulation of *Dendrobium* 'Emma White'

Treatments consisting of inorganic nutrients (NPK 20:20:20 and 30:30:30 along with Ca, Mg and Mn) and growth regulators (BA 10, 25, 50 ppm and GA₃ 50, 100, 200 ppm) and distilled water as control were experimented. Among these NPK 20:20:20 with Ca, Mg and Mn along with BA 10 ppm and GA₃ 100 ppm increased number of leaves (20.06), pseudobulbs (2.73) and pseudobulb girth (1.94 cm). The plant height was highest (59.79 cm) in treatment NPK 30:30:30 with Ca, Mg and Mn along with BA 25 ppm and

GA₃ 50 ppm. NPK 20:20:20 with Ca, Mg and Mn along with BA 50 ppm and GA₃ 100 ppm gave maximum number of spikes (2) / plant as compared to other treatments.

Influence of drenching and spraying of inorganic nutrients in *Cymbidium Levis Duke 'Bella Vista'*

Experiment on Drenching and Spraying of inorganic nutrients in *Cymbidium* hybrid has been carried out with three inorganic nutrients like 30:10:10, 20:20:20, and 15:30:30 NPK at two different concentrations viz, 0.05% and 0.1%. Among the two modes of application, drenching with 0.05% of 30: 10:10 NPK increased the number of leaves (10.77), plant height (36.31 cm) and leaf length (34.22 cm) as compared to spraying.

Effect of NPK on growth and flowering of *Phalaenopsis 'Brother and Sister'*

Phalaenopsis hybrid Brother and Sister was treated with 10:20:10, 20:10:20 and 10:20:30 NPK at two different concentrations 0.1% and 0.2%. Among the treatments, foliar application of 20:10:20 NPK at 0.2% increased the number of leaves (6.33), number of spikes (1.25) and number of flowers (7.0) while 10:20:10 NPK at 0.2% increased plant height (9.37cm) (Fig.3).

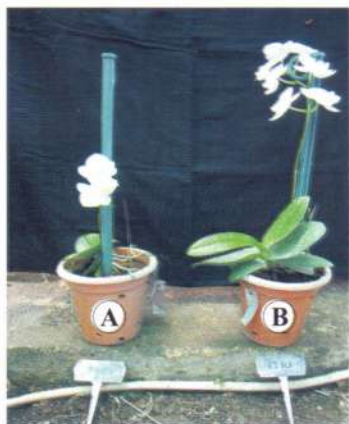


Fig. 3. (A) - Control (B) - 20:10:20 NPK at 0.2%

Development of Integrated Floriculture Enterprise

Five *Cymbidium* hybrids (Pine Clash Moon Venus, Soul Hunt, Ensikhan, Valley Legend Stefi and No.39), four varieties of *Alstroemeria* (Pink Surprise, Venus, Golden Eye and Passion) and potted plants of Azalea, Christmas plant, Cycas, Fern, Thuja, Asparagus are the part of study under this project. Among *Cymbidium* hybrids Pine Clash Moon Venus produced more number of flower spikes per pot (2.20) and 'Ensikhan' produced maximum number of florets per spike (12.10) where as 'Valley Legend Stefi' had maximum plant height (111.3 cm) and length of flower spike (76.2 cm). Among *Alstroemeria* varieties, 'Golden Eye' performed very well and recorded maximum plant height (187.5 cm), maximum number of shoot per plant (43.5), maximum number of flower spike per clump (26.5). However, variety 'Venus' produced the maximum number of flowers per spike (15.5) under Pakyong conditions. The potted plants were multiplied for additional resource generation.

Production Management of Tropical and Sub-tropical Orchids

Evaluation of tropical and subtropical hybrids of commercially grown orchids

Out of seventeen hybrids of *Aranda* only six hybrids like 'Propin Spot', 'Anne Khoo x V. Kasems Delight', 'Sayan x Ascda Bangkhuntian Gold', 'Prapine White', 'Noorah Alsagoff Red' and 'Fatimah Alsakoff Blue' came into flowering. Maximum number of florets /spike was recorded in 'Noorah Alsagoff Red' (12) followed by 'Sayan x Ascda Bangkhuntian Gold' (9) and 'Fatimah

Alsakoff Blue' (9). The Aranda hybrid 'Anne Khoo x V. Kasems Delight' had maximum flower diameter (9.5cm), highest spike length (35cm) and rachis length (15cm). The longest flower longevity was recorded in 'Sayan x Asda Bangkhuntian Gold'(47 days). Among nine hybrids of *Mokara*, 'Happy Beauty' had maximum flower diameter (9cm), spike length (47cm) and rachis length (20cm). The highest longevity of flower spike on plants was recorded with 'Madame Pani'(60 days). Out of thirteen hybrids of *Oncidium*, only 'Wild Cat Carmera', 'Pixie Ruth', 'Taka Yellow', 'Popki Red', 'J. R. Pink Spot', 'J. R. Orange Red' and 'J. R. Yellow Brown' had flowering. Amongst them, 'Taka Yellow' showed maximum number of flower (35), spike length (40cm) and flower spike longevity (60days).

Growth, flowering and post-harvest life of *Cymbidium* hybrid Pine Clash MoonVenus as influenced by pre-harvest treatments

Treatments consisted of T₀: Control (Distilled water), T₁: 0.3% N: P: K (19:19:19/10: 20:30), T₂: Cow urine (1: 20), T₃: Coconut water (1:10), T₄: Calcium nitrate (1%), T₅: Micronutrient mixture (0.05%), T₆: Glucose (0.1%), T₇: Mustard cake (1kg/50 litre), T₈: GA₃ (50 ppm), T₉: BA (200 ppm), T₁₀: GA₃ (50 ppm) +BA (200 ppm) were applied at regular interval. Good quality cut flowers with longer spike and rachis length were observed with the pre-harvest foliar treatments of GA₃ (50 ppm) + BA (200 ppm), Glucose (0.1%), Micronutrient mixture (0.05%) and Coconut water (1:10). The longest flower spike (60 cm), rachis (30cm) and highest number of spikes /plant (4) were found with GA₃ (50 ppm)

+ BA (200 ppm). Number of florets per spike varied significantly with all the treatments. Maximum number of florets per spike (15) was recorded with GA₃ (50 ppm) + BA (200 ppm) followed by Glucose (0.1%) (14). Foliar application with all the three growth regulators enhanced flower longevity more than 100 days and highest longevity (115 days) of flower spikes was observed with GA₃ (50 ppm) + BA (200 ppm).

Changes in carbohydrate content of pseudobulb, leaf and flower had shown significant variable response for the treatments. The highest carbohydrate content of pseudobulb (242 mg/g) and flower (164mg/g) were recorded with cow urine (1:20). Carbohydrate content in leaf was estimated maximum with BA (200 ppm) (182mg/g) followed by GA₃ (50 ppm) + BA (200 ppm) (170mg/g). Total carbohydrate content was estimated maximum with cow urine (1:20) (552 mg/g) followed by 0.3% NPK (19:19:19) (484mg/g) and micronutrient mixture (460mg/g).

Effect of different potting mixture on growth, flowering and longevity of *Cattleya* hybrids

In *Cattleya*, out of five potting mixtures P1: Cocochips + Cocopeat + Tree barks + Brick pieces (4:2:2:2), P2: Cocochips + Tree Barks + Leaf mould + Brick pieces (4: 2: 2: 2), P3: Cocochips + Tree Barks + Brick pieces (4: 4: 2), P4: Cocochips + Cocopeat + Brick pieces (4: 4: 2) and P5: Cocochips + Leaf mould + Brick pieces (4: 4: 2), Cocochips + Tree bark + Cocopeat + Brick pieces (4:2:2:2) had shown maximum number of flowers /plant and out of nine hybrids,(H1: B/c Guanmiau City, H2: B/c Chinese Beauty Orchid Queen, H3: L/c Purple

Cascade Fragrant Beauty, H4: B/c Pamela x L/c Raiwan, H5: C. Queen Sirikhit, H6: B/c Chalin New City, H7: L/c Ahmod Sheikhi, H8: B/c Hsingin and H9: Blc 'Mem Ann Balmores Convess), Blc Chai lin New City had highest number of florets /spike(6) followed by C. 'Purple Cascade Fragrant B'(4). Blc 'Mem Ann Balmores Convess' had maximum flower diameter (11.5cm).

Effect of different potting mixture on growth, flowering post-harvest life of *Dendrobium* hybrids

- Out of fourteen hybrids of *Dendrobium*, Den. 'Big White Jumbo' and Den. 'Emma White' had maximum length of pseudobulbs and internode at flowering stage. Among potting mixtures, T₁: Cocochips + Cocopeat + Leaf mould + Cowdung + Brick pieces (4: 2: 1: 1: 2), T₂: Cocochips + Leaf mould + Cowdung (5:4:1) and T₃: Cocochips + Leaf mould + Cow dung + Brick pieces (4:1:2:3) were found effective. Length of longest internode (6.25cm) with Den. 'Madam Pompadour' with the potting mixture with Cocochips + Leaf mould + Cow dung (5:4:1).
- Longest spike length (47.7 cm) and rachis length (32.7cm) was found in Den. 'Madam Pink' with Cocochips + Leaf mould + Cowdung (5:4:1).
- Den. 'Madam Pink' had highest number of flowers/spike (15) followed by Den. 'Bangkok Blue' (11) and Den. 'Erika' showed maximum flower diameter (15cm).
- Highest longevity of flowers on the plants was recorded in Den. 'Ear Sakul'(71 days) followed by Den. 'Triple Pink' (70 days) and

Den. 'Thongchai Gold' (69 days). Among potting mixtures, T₅: Cocochips + Cocopeat + Leaf mould + Brick pieces (4: 1: 2: 3) was found beneficial to improve this character.

- In flowers, maximum carbohydrate content (260mg/g) was recorded with Den. 'Kating Dang' followed by Den. 'Erika' (259.0 mg/g) and Den. 'Madam Pink' (218 mg/g).
- In pseudobulbs, Den. 'Erika'(279 mg/g) had the maximum amount of carbohydrate followed by Den. 'Madam Pink'(259 mg/g) and Den. 'Kating Dang'(248 mg/g).
- Out of fourteen hybrids, Den. 'Big White Jumbo' had highest vase life (37.5 days) followed by Den. 'Madam Pompadour' (37 days), Den. 'Erika'(34.8 days) and Den. 'Ear Sakul' (33.5 days).

Post-harvest Technology of Orchids

Evaluation of different hybrids of orchids

- Standardization of stage of harvesting was carried out in *Cymbidium* Red Princess with four harvesting stages (100%, 75%, 50% and 25% opened flower spikes). Four harvesting stages of cut spikes were subjected to 8 different holding solutions. Among the four stages, 75% opened flower stage recorded the highest vase life of 38.33 days with 8 – HQS 200 ppm as a vase solution. In all harvesting stages 100% opening of florets was noticed.

The flower spikes of three *Cymbidium* hybrids namely 'Pine Clash Moon Venus', 'Valley Legend Stefi', 'Pure Inca Gold' were harvested at four stages viz. Fully open, 75% open, 50% open and 25% open to standardize

the stage of harvesting. The highest vase life was noticed in the flower spikes harvested at 75 % open stage. It was recorded 59 days in 'Pine Clash Moon Venus', 48.83 days in 'Valley Legend Stefi' and 53 days in 'Pure Inca Gold'.

Effect of chemical preservatives on vase life of *Cymbidium* Pine Clash 'Moon Venus'

- Effect of cane sugar in holding solution on the vase life of *Cym.* 'PCMV' was studied., Out of three concentrations (0%, 2% cane sugar, 4% cane sugar and 8% cane sugar), 2% cane sugar had shown maximum depletion of stored carbohydrates, maximum longevity of first floret (54 days), zero per cent of flower dropping, maximum solution uptake (24ml) and highest vase life (61.2 days) followed by 4% cane sugar. The solution containing 8% cane sugar had least longevity of first floret (27.2 days) and vase life (36.2 days).
- To study the vase life of *Cym.* 'PCMV', 8 different chemicals including control were tested. The maximum first floret longevity was recorded with BA (25 ppm) (49.2 days) followed by $Al_2(SO_4)_3$ (100 ppm) (45.2 days). The maximum vase life (54.8 days) was found with $Ca(NO_3)_2$ (100 ppm) followed by $Al_2(SO_4)_3$ (100 ppm) (53.4 days). Solution uptake (33 ml) was observed maximum with $Al_2(SO_4)_3$ (100 ppm) and 8-HQS(200 ppm).

Standardization of bud opening chemicals for *Cymbidium* and *Dendrobium* orchids

- Reducing sugar analysis was carried out in *Dendrobium* Thongchai Gold. Three stages of flowers like opened flowers, half opened

flowers and bud were taken for analysis. It was found out that opened flower contains 29 %, half opened flower contains 28.25 % and buds contain 16.17 % of reducing sugars.

- In *Dendrobium* 'Thongchai Gold', per cent of fully opened buds (66%) was recorded maximum with sucrose (4%) + $Ca(NO_3)_2$ (1%) followed by sucrose (4%) + acetyl acetic acid (100 ppm) (60%). Longest vase life (36 days) was found with sucrose (4%) + $Al_2(SO_4)_3$ (100 ppm) followed by sucrose (4%) + acetyl acetic acid (100 ppm) (33 days).
- Opening of tight buds of cut flowers of *Cymbidium* orchids was improved with all chemical treatments except control. Minimum duration (18 days) for opening of first floret was observed with Sugar 4% + 8-HQS (200 ppm). The treatment combination of Sugar 4% + Salicylic acid 200 ppm had first floret with maximum diameter (6.6cm) Per cent of half opened buds was recorded maximum (30.7%) with Sugar 4% + 8-HQS (200 ppm) whereas per cent of fully opened buds was highest (75%) in Sugar 4% + Salicylic acid 200 ppm. In control, all flower buds dropped on 27th days. Vase life of cut spikes was found maximum (45days) with Sugar 4% + Salicylic acid (200 ppm) followed by Sugar 4% + $Al_2(SO_4)_3$ (100 ppm) and Sugar 4% + 8-HQS (200 ppm) (44 days).
- Changes in carbohydrate content of cut flowers at senescence stage had shown significant variations starting from flower bud to flower opening stage. Highest content

of carbohydrate (140mg/g) was estimated at bud stage in fresh condition followed by at bud stage (131mg/g) at senescence in control. Minimum carbohydrate content (60mg/g) was observed with Sugar 4% + 8-HQS (200 ppm) followed by Sugar 4% + Salicylic acid 200 ppm (64mg/g).

Macronutrient Management in Orchids

Effect of electrical conductivity of nutrient solution and fertilization regime on growth of *Cymbidium* 'Sleeping Nymph'.

- The experiment was undertaken to study the effect of electrical conductivity of fertilizer solution on growth of *Cymbidium* 'Sleeping Nymph'. The growing media comprised of Leaf mould + Coconut husk + Bricks pieces + Vermiculite (8:4:2:1). The treatments comprised of, T₁=Control; T₂=20:20:20 NPK at 1mS/cm; T₃=15:5:25 NPK at 1mS/cm; T₄=12:30:10NPK at 1mS/cm; T₅=20:20:20 NPK at 1.5 mS/cm; T₆=15:5:25 NPK at 1.5 mS/cm; T₇=12:30:10NPK at 1.5 mS/cm; T₈=20:20:20 N PK at 2.0 mS/cm; T₉=15:5:25 NPK at 2.0 mS/cm; T₁₀=12:30:10NPK at 2.0 mS/cm. All the treatments are subjected to CRD.
- The highest N, P and K content of leaf at flowering stage was 2.21, 0.66 and 1.98 % in the treatment T₈, T₁₀ and T₉, respectively. However, for best flowering was observed in the treatment T₄. The NPK content of growing media was recorded highest of 0.55, 0.37 and 1.28%, respectively in the treatment T₈, T₁₀ and T₉, respectively.
- The best flowering was recorded in the treatment T₄ containing NPK of 0.91, 0.37 and 1.97 %, respectively in the flower sample.
- The fertilizer solution having EC of 1 mS/cm was found best for flowering of *Cymbidium* hybrid and recorded optimum N, P and K content in the leaf, 1.6, 0.24 and 1.23%, respectively. Among the different graded doses of NPK, 12:30:10 NPK recorded best flowering in *Cymbidium* hybrid and having optimum N, P and K content in the leaf, 1.75, 0.54 and 1.29 %, respectively (Fig.4)
- With increasing doses of EC of the fertilizer solution up to 1.5mS/cm, the N, P and K content of the flower gradually increased and found 1.26, 0.29 and 2.21 %, respectively. Beyond 1.5mS/cm of fertilizer solution, there was no flowering. Similarly, the fertilizer dose of 20:20:20 NPK recorded highest N and K content of 0.91 and 1.40 %, respectively, while the fertilizer dose 12:30:10NPK recorded highest P content of 0.26% (Fig. 5).
- The optimum EC of the pour-thru leachate for best flowering was found to be 0.80-1.0 mS/cm (Fig.6). Further increase of EC above 1.0 mS/cm, the quality of the flower was found to be deteriorated. No flowering was noticed when the EC of the leachate exceeds 1.2 mS/cm.

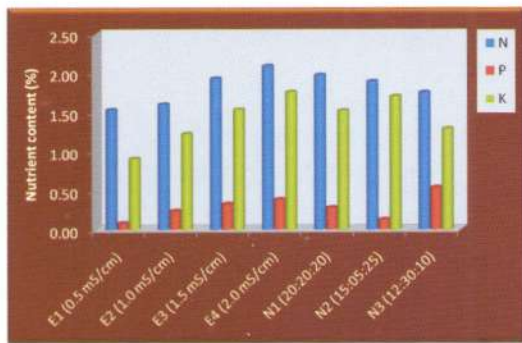


Fig.4. Effect of electrical conductivity of fertilizer solution on the nutrient content of leaf of *Cym.* "Sleeping Nymph" at flowering stage

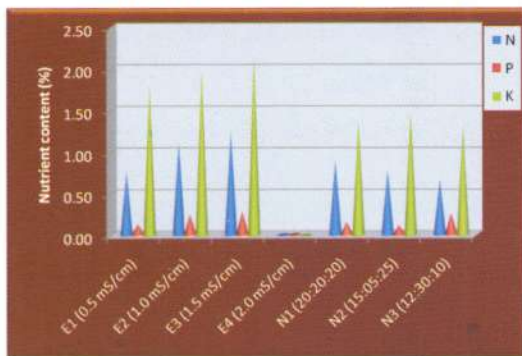


Fig.5. Effect of electrical conductivity of fertilizer solution on the nutrient content of the flower of *Cym.* "Sleeping Nymph"

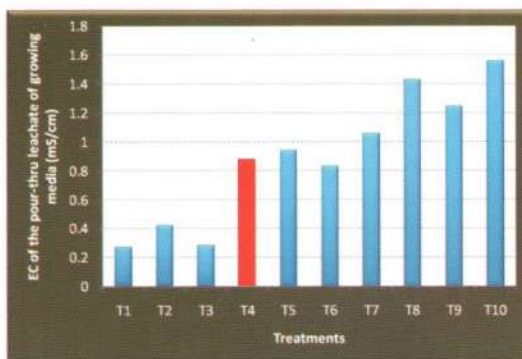


Fig. 6. Electrical conductivity of the pour-thru leachate of the growing media at flowering stage

Standardization of primary nutrient requirement by *Cymbidium* hybrid at reproductive stage

The experiment was undertaken to standardize the NPK requirement for reproductive stage of *Cymbidium* hybrid. The treatments comprised of T_1 =Farmer's practice (Control); T_2 = N_{10} : P_{20} : K_{10} ; T_3 = N_{10} : P_{20} : K_{20} ; T_4 = N_{10} : P_{20} : K_{30} ; T_5 = N_{10} : P_{10} : K_{20} ; T_6 = N_{10} : P_{10} : K_{30} ; T_7 = N_{15} : P_{30} : K_{10} ; T_8 = N_{15} : P_{30} : K_{20} ;

T_9 = N_{15} : P_{30} : K_{30} . The growing media used for the experiment was Leaf mould + Cocochips + Brickpieces (4 :2 :1). During the growth phase the NPK dose of 30 :10 :10 was applied for the period February to April while NPK dose of 20 :20 :20 for the period May to June. From June to January, the reproductive stage dose (T_2 to T_9) were applied to all the treatments. The fertilizer was applied at 15days interval at 0.1% from February to October, while during winter months from November to January, fertilizer was applied at monthly interval.

The result shows that the application of different graded doses of NPK for flowering significantly influenced the growth parameters (Fig.7). The plant height and leaf length were recorded highest of 71.93 and 46.07 cm, respectively in the treatment T_8 and was closely followed by T_7 . The pseudobulb length and girth were highest of 3.44 and 2.29 cm, respectively in the treatment T_7 , and was closely followed by T_8 . Highest number of pseudobulbs/ plant of 4.33 was recorded at T_4 . The flowering parameter like number of spikes/clump, number of floret/spike, spike length and rachis length recorded highest of 1.93, 6.88, 36.53cm and 13.65cm, respectively in the treatment T_8 (Fig. 8) and was closely followed by the treatment T_4 .

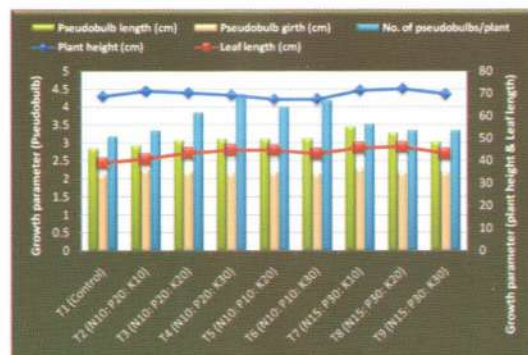


Fig.7. Influence of graded doses of NPK on the growth parameter of *Cymbidium* "Pine clash moon venus"

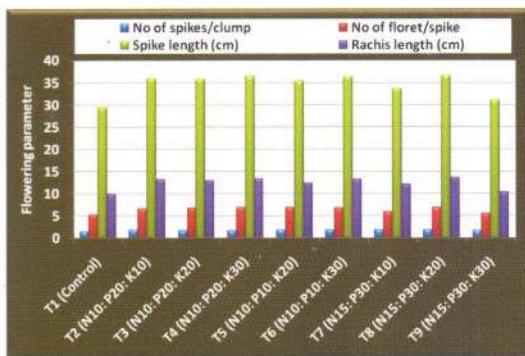


Fig. 8. Influence of graded doses of NPK on the flowering parameter of *Cymbidium Pine Clash 'Moon Venus'*

Micronutrient Management in Orchids

Effect of calcium and magnesium on growth of *Cymbidium 'Levis Duke Bella Vista'*

- The treatments comprised of T₁: Control; T₂: Ca₁₀₀; T₃: Mg₁₀₀; T₄: Ca₁₀₀ + Mg₁₀₀; T₅: Ca₁₀₀ + Mg₅₀; T₆: Ca₅₀ + Mg₁₀₀; T₇: Ca₅₀ + Mg₅₀.
- The recommended doses of NPK were applied to all the treatments. The *Cymbidium* hybrid was grown in poly bag containing substrates of Leaf mould+Coconut husk +Brick pieces (4:2:1).
- The highest plant height (59.63 cm), leaf length (32.76cm), leaf number (20.7), pseudobulb length (2.60 cm) and girth (1.68 cm) were recorded in the treatment receiving Ca at 100ppm + Mg at 100 ppm (T₄). However, the number of pseudobulbs/plant was highest in T₆ (Fig. 9).

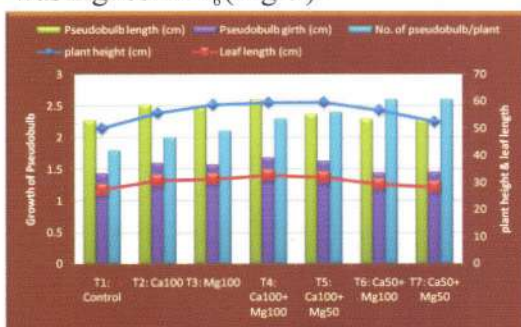


Fig. 9. Effect of Ca and Mg on growth parameter of *Cym. Levis Duke 'Bella Vista'*

Effect of different concentrations of Calcium and growing media on growth of *Cymbidium Levis Duke 'Bella Vista'*

- The treatments comprised of four different concentrations of Ca, T₁: Control; T₂: Ca 100ppm, T₃: Ca 200ppm, T₄: Ca 300ppm and four different growing media, M₁: Leafmould + Coconut husk + brick piece (4:2:1), M₂: Coconut husk + Cocopeat + brick piece (4:2:1), M₃: Leafmould + Cocopeat + brick piece (4:1:1), M₄: Coconut husk + Vermicompost + brick piece (4:2:1).
- The media M₁ recorded highest plant height, number of pseudobulbs/plant, pseudobulb length and pseudobulb girth of 57.12cm, 2.17, 2.25cm and 1.70cm, respectively. Among the nutrition dose, Ca at 200 ppm was best in terms of different growth parameter and recorded highest plant height, number of pseudobulbs/plant, pseudobulb length and pseudobulb girth of 55.07cm, 2.04, 2.27cm and 1.65cm, respectively throughout the growth season (Fig. 10).

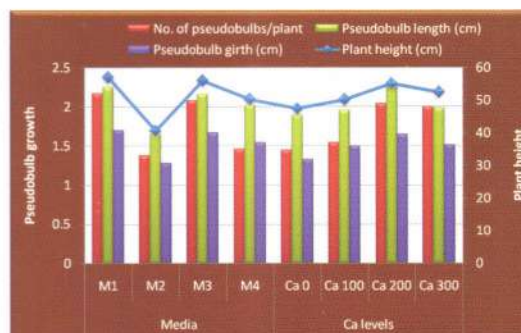


Fig. 10. Influence of growing media and calcium on *Cym. Levis Duke 'Bella Vista'*

Influence of Panchgavya on growth of *Cymbidium 'Sleeping Nymph'*

- The experiment was conducted to study the different concentration of panchgavya on

growth of *Cymbidium* 'Sleeping Nymph'. The treatments comprised of T₁: Control, T₂: 1 :50 (Panchgavya : water) foliar application, T₃: 1 :30 foliar application, T₄: 1 :20 foliar application, T₅: 1 :50 media application, T₆: 1 :30 media application, T₇: 1 :20 media application.

- Application of Panchgavya in substrate influenced profoundly on growth as compared to foliar spraying.
- Among the media application, the treatment T₇ recorded highest plant height of 61.8 cm. However, pseudobulb length, pseudobulb girth of 4.06 and 2.66 cm, respectively were the highest in the treatment T₆. Further, the number of pseudobulbs/plant was highest in the foliar application of panchgavya in the treatment of T₂, T₃ and T₄ (Fig. 11).

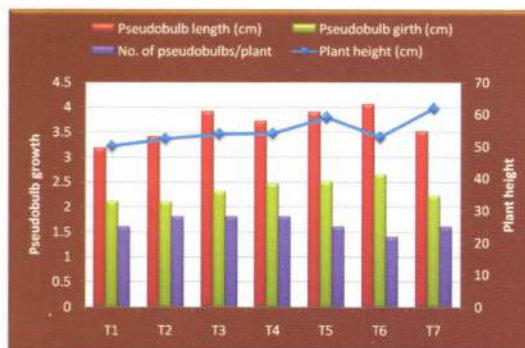


Fig. 11. Effect of difference concentration of panchgavya on growth of *Cymbidium* 'Sleeping Nymph'.

Evaluation of nutrient deficiency in *Cymbidium* "Sleeping Nymph"

- The experiment was conducted to study the deficiency symptoms in *Cymbidium* "Sleeping Nymph" grown in sand. The treatments comprised of T₁= No NPK (Control) ; T₂= NPK (300 :100 :100 ppm) ;

T₃= PK (100 :100 ppm) ; T₄= NK (300 :100 ppm) ; T₅= NP (300 :100 ppm) ; T₆= N (300 ppm) ; T₇= P (100 ppm) ; T₈= K (100 ppm).

- The highest N, P and K content of 70, 1.38 and 48 ppm, respectively were recorded in the treatment T₂.
- The critical limit of N for *Cymbidium* hybrid grown in sand was found to be 28-56 ppm.
- The nutrient analysis of different plant parts indicated that the N and K content followed the order, Pseudobulb > Leaf > Root, while P content followed the order, Root > Pseudobulb > Leaf.
- The treatments T₁, T₃, T₇ and T₈ showed N-deficiency (Fig. 12). Further the visual appearance was best in the treatment of T₂, T₄, T₅ and T₆.

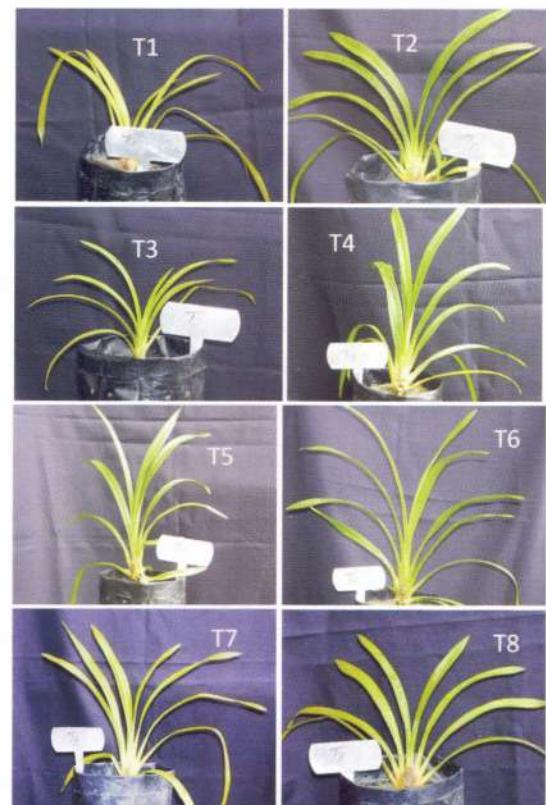


Fig. 12. Sand culture techniques for identification nutrient deficiency symptom in *Cym.* "Sleeping Nymph".

CROP PROTECTION

Disease Management of Orchids

Characterization, detection and management of viruses infecting orchids

A. Virus indexing of *Cattleya*, *Dendrobium* and *Vanda* hybrids

Nine *Cattleya*, fifteen *Dendrobium* and twenty-seven *Vanda* hybrids were tested against Cymbidium mosaic virus (CymMV), Cymbidium ringspot virus (CyRSV) and Odontoglossum ringspot virus (ORSV) in DAS-ELISA. The results showed that all the hybrids of *Cattleya* were having dual infection of CymMV and ORSV (Fig.1.). However, in *Dendrobium* hybrids a mixed infection of CymMV and ORSV was found in Kating Dang, Madam Pink and Dentruple Pink. *Dendrobium* hybrids Emma White and Earsakul were found positive with ORSV while Lervia and Big White 4N were found positive with CymMV (Fig. 2). ELISA results revealed that all the *Vanda* hybrids were found free from all the three viruses (Fig. 3).



Fig. 1. *Cattleya* hybrids



Fig. 2. *Dendrobium* hybrids



Fig. 3. *Vanda* hybrids



Fig. 4. *Cymbidium* hybrids

B. Virus Indexing of hybrids/species collected from local growers

Cymbidium hybrids from Namchi (South Sikkim)

Twenty seven *Cymbidium* hybrids were tested against viruses of which 26 hybrids were found positive with ORSV, and 9 hybrids were found positive with Cymbidium ringspot virus (CyRSV)(Fig. 4).

***Cymbidium* hybrids from Kartok (East Sikkim)**

Five commercial *Cymbidium* hybrids grown widely in Kartok Village, were showing mosaic and black necrotic spots. Leaf samples of such plants were collected and tested against CymMV, CyRSV and ORSV in ELISA. Four hybrids were found positive with ORSV while one hybrid was having mixed infection of CymMV and ORSV.

***Cymbidium* hybrids from Assam Lingzey (East Sikkim)**

Sikkim Himalayan Orchids Pvt. Ltd., is a joint venture between Natsyn Flora Ltd., Chennai and Govt. of Sikkim having around 30,000 plants of different *Cymbidium* hybrids acquired from Australia. 59 hybrids were tested against CymMV, ORSV and CyRSV. ELISA results showed that 9 hybrids were found positive with ORSV and one hybrid was found positive with CymMV.

Orchid species from Kalimpong

Twenty seven species namely *Aerides multiflorum*, *A. fieldingii*, *A. odoratum*, *A. longicorn*, *A. recemiformis*, *Bulbophyllum sp.*, *Bulbophyllum rubra*, *Calanthe masuca (a)*, *C. masuca (a-1)*, *C. masuca (a-2)*, *C. masuca (b)*, *C. masuca (b-1)*, *Cattleya*, *Cymbidium eburneum*, *C. devonianum-1*, *C. devonianum-2*, *C. tigrinum*, *C. mastersii*, *C. lancifolium*, *C. lowianum*, *Dendrobium sp.*, *Phaius tankervillae*, *P. wallichii*, *Sarchanthus sp.*, *Papilionanthe vandarum* and *Pleione praecox* were collected from International Nursery, Kalimpong and screened against CymMV, CyRSV and ORSV in ELISA. Mixed infection of ORSV and CyRSV was reported on *Cymbidium eburneum* while

Calanthe masuca and *Phaius tankervillae* were found positive with CyRSV. *Pleione praecox* and *Calanthe masuca* were found positive with ORSV and CymMV respectively.

Etiology of fungal and other diseases affecting orchids and their management

Monitoring of anthracnose on different orchids

Anthracnose is one of the important fungal disease of orchids and commonly found in various orchid species/hybrids in the germplasm house as well as farmers field. The following orchid species were found seriously affected by anthracnose during the year namely *Calanthe masuca*, *Pholidota articulata*, *Bulbophyllum guttulatum*, *Coelogyne sp.*, *Phaius tankervillae*, *Eria bamboosifolia*, *Cymbidium gammeanum*, *Vanda Ratch Blue Stars*, *Phaius flavus*, *Liparis longipes* and *Tainia hookeriana*

Pathogenicity test of *Colletotrichum gloeosporioides*

The anthracnose disease caused by *Colletotrichum gloeosporioides* was isolated from *Phaius tankervillae*. The culture was purified and further multiplied on PDA. Spore suspension was prepared from seven days old culture and spore concentration was adjusted with the help of haemocytometer to a concentration of 2.4×10^6 spores/ml in sterile water. The potted *Cymbidium* hybrids of around one year old were sprayed with spore suspension. After spraying spore suspension with atomizer the plants were covered with moist plastic bags to increase relative humidity which is required for disease development. After about 21 days of inoculation small black dots appeared at the tip of

the leaves which subsequently enlarged and finally the whole leaf gets blighted. In majority of cases the inoculated plants developed dieback symptoms. On isolation from the inoculated leaves same pathogen was isolated thus proving the pathogenicity of the pathogen.

Biological control of anthracnose (*Colletotrichum gloeosporioides*) of orchids

Biological control of anthracnose (*Colletotrichum gloeosporioides*) of orchids was done by dual culture technique, periphery technique and opposite periphery technique *in vitro* using *Trichoderma viridae*, *T. harzianum*, *Gleocladium virens*, *Pseudomonas fluorescens*, *Bacillus megaterium* and *B. subtilis* as biocontrol organism. The results showed that *Trichoderma viridae* was found highly antagonistic against *C. gloeosporioides* followed by *T. harzianum* (Fig.5).

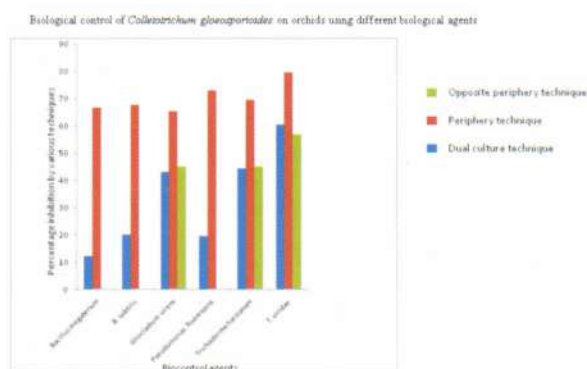


Fig. 5. Bar diagram showing performance of different biocontrol agents against *C. gloeosporioides*

Isolation of *Alternaria sp.* from *Zygopetalum intermedium*

A large population of *Zygopetalum intermedium* was showing black spots with dark patches on the adaxial surface of the leaves at NRCO collection. The infected leaf samples were surface sterilized and inoculated on PDA. After 48 h, brownish growth of the fungus was observed which later

turned blackish. Microscopic observation revealed the presence of large number of conidia resembling with *Alternaria sp.* (Fig.6a,6b). The culture has been sent to Indian Type Culture Collection, Division of Plant Pathology, IARI, New Delhi and identified as *Alternaria alternata* with ID No. 8207.11.



Fig. 6a. Black spots on leaves of *Zygopetalum intermedium*

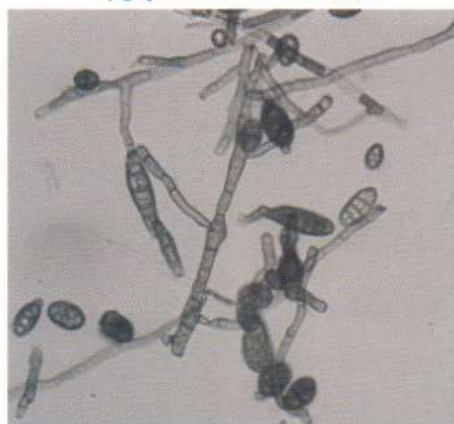


Fig. 6b. *Alternaria alternata* isolated from black spot affected *Zygopetalum intermedium*

Integrated Pest Management in Orchids

Insect-orchid host preference studies in orchids

Survey on pests associated with orchids- host range

The qualitative surveys for occurrence of insect pest and their host range were conducted in orchid growing areas viz. Mirik, Darjeeling (WB),

Assamlinzey, Rumtek (HCCD Department), Kartok village, Raigoan, Dikling (Sikkim) and Shillong (Meghalaya). It was observed that two spotted spider mite, *Tetranychus urticae*, aphid species, *Macrosiphum luteum* and *Toxoptera aurantii*, scale insects, shoot borer, *Peridaedala* sp., thrips, slugs and snails cause damage to most of the orchids grown in these areas.

Screening of orchids for their resistance against two spotted spider mite (TSSM)

The 150 plants of *Cymbidium* "Winter Beach Sea Green" were evaluated for natural infestation of two spotted spider mite, *Tetranychus urticae* during the year. No plant protection measures were adopted against TSSM. It was observed that all plants were found infested (100 % infestation) by the pest in different level. The other orchids like *Dendrobium*, *Epidendrum*, *Phalaenopsis*, *Vanda*, *Coelogyne*, *Acampe*, *Aerides*, *Cattleya*, *Zygopetalum* etc. maintained at the centre were also evaluated for pest resistance. The maximum numbers of pests were noticed on *Dendrobium* whereas, minimum numbers of pests were observed on *Zygopetalum*.

Pest management

Evaluation of bio-pesticides against mite, *Tetranychus urticae* on *Cymbidium*

To evaluate the bio efficacy of botanicals and bio pesticides against two spotted spider mite, *Tetranychus urticae* on *Cymbidium* under polyhouse conditions, the nine treatments (including control) viz., Neem oil 0.03% EC @ 5 ml/lit., garlic extract 5%, chilaune leaf extract (*Schima wallichii*) 10%, dhatura leaf extract 10%, B.t. (Dipel) 0.012%, titapat extract

(*Artimissia*) 10%, tobacco extract 5%, and mycomite 3g/lit were applied on three-year old potted plants. The data on average percent reduction in mite population in *Cymbidium* showed that, all the treatments were highly significant over control. The maximum percent reduction (76.52 %) in mite population was recorded in the treatment of neem oil 0.03 EC followed by mycomite 3g/lit. Treatment B.t. (0.012%) was found least effective followed by titapat extract (*Artimissia*).

Evaluation of bio-pesticides against ti scale, *Pinnaspis buxi* on *Cymbidium*

Ten treatments (including control) viz., Neem oil 0.03% EC @ 5 ml/lit., garlic extract 5%, chilaune leaf extract (*Schima wallichii*) 10%, dhatura leaf extract 10%, ahook 1500 ppm (NSKE) 5 ml/lit, tita pat extract (*Artimissia*) 10%, tobacco extract 5%, B.t. (Dipel) 0.012% and cow urine 50% were evaluated to test the bio-efficacy against ti scale, *Pinnaspis buxi* on 2 year-old plants of *Cymbidium* under protected conditions. The treatments were applied on plants when sufficient crawler's emergence was buildup. The results showed that all the treatments were found significantly superior over control in reducing insect population. The maximum percent reduction (98.72%) in scale's crawler population was reported in neem oil 0.03% EC (5ml/lit.) followed by ahook 1500 ppm (5 ml/lit.). The next effective treatments were garlic extract 5% (89.12%), dhatura leaf extract 10% (88.55%) and tobacco extract 5% (77.26%), whereas, minimum percent reduction in scale population was recorded in the treatment of B.t. (Dipel).

Evaluation of IPM Modules against mite infesting *Cymbidium*

A field experiment was conducted under polyhouse condition to investigate the efficacy of seven IPM modules against mite, *Tetranychus urticae* in *Cymbidium*. The seven IPM modules consisting of botanical products, biopesticides and chemical insecticides were applied at ten days interval from the emergence of pest. Results showed that all the modules were significantly superior over control. Among the seven modules, M-5 (tobacco extract 5%, neem oil 0.03% EC 5 ml/lit and bifenthrin 10EC 0.25%) was found superior to rest of the modules which reduced 99.0 percent population.

Relative efficacy of bio-pesticides against aphids on flowers of *Cymbidium*

An experiment was conducted to test the efficacy of botanicals and bio-pesticides against aphids on the flowers of *Cymbidium* H C Aurora under polyhouse conditions. The nine treatments (including control) viz., neem oil 0.03% EC (5 ml/lit.), garlic extract 5%, chilaune leaves extract (*Schima wallichii*) 10%, dhatura leaf extract 10%, B.t. (Dipel) 0.012%, tita pat extract (*Artemissia*) 10%, tobacco extract 5%, and NPV 0.10% were tested. The spray treatments were made on emergence of aphids on the flowers. The results showed that all the treatments were significantly superior over control. The maximum percent reduction (76.93%) in aphid population was recorded in the treatment of Econeem 2ml/litre followed by neem oil 0.03% EC (5ml/lit.), whereas, minimum percent reduction was noticed on the plants treated with titapat (*Artemissia*) extract.

Evaluation of bio-pesticides for their efficacy against mite on *Dendrobium nobile*

To test the efficacy of botanicals and bio pesticides against mite on *Dendrobium nobile*, nine treatments (including control) viz., neem oil 0.03% EC @ 5 ml/lit., garlic extract 5%, chilaune leaf extract (*Schima wallichii*) 10%, dhatura leaf extract 10%, B.t. (Dipel) 0.012%, titapat extract (*Artemissia*) 10%, tobacco extract 5%, and mycomite 3g/lit were applied on three years old potted plants having 10-15 shoots per pot. The results shows that maximum percent reduction in mite population in the treatment of neem oil 0.03 EC which was followed by mycomite 3g/lit. Treatment B.t. (0.012%) was found least effective followed by chilaune leaf extract 10% and titapat (*Artemissia*) extract 10%.

Efficacy of bio-pesticides against shoot borer, *Peridaedala* sp. on *Epidendrum*

To test the efficacy of biopesticides against shoot borer on *Epidendrum*, nine treatments viz., neem oil 0.03% EC (5 ml/lit.), garlic extract 5%, chilaune leaves extract (*Schima wallichii*) 10%, dhatura leaf extract 10%, B.t. (Dipel) 0.012%, tita pat extract (*Artemissia*) 10%, tobacco extract 5%, and NPV 0.10% were applied on plants at fortnight interval. The minimum shoot borer infestation was recorded on the plants treated with B.t. (Dipel) @ 0.012% followed by neem oil 0.03% EC @ 5 ml/lit and NPV @ 0.10% at 7 days after second treatments.

Darjeeling Campus

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

Germplasm collection

Explorations were conducted to various parts of Darjeeling district of West Bengal. The area surveyed include Sanchel Wild Life Sanctuary, Chatakpur, Maldiram, Sibong, Aloobari Forest, Maney Bhanjang, Barbate etc. 110 accessions of various orchid species belonging to *Achrochaene punctata*, *Bulbophyllum reptans*, *B. leopardianum*, *Bulbophyllum* sp. *Calanthe mannii*, *Calanthe plantaginea*, *C. yucksomnensis*, *C. trulliformis*, *Coelogyne fuscescens*, *C. corymbosa*, *C. nitida*, *Cymbidium elegans*, *C. cyperifolium*, *C. devonianum*, *C. lowianum*, *Dendrobium* sp., *D. eriaflorum*, *Epigeneum rotundatum*, *Eria graminifolia*, *E. spicata*, *Goodyera schlectendaliana*, *G. secundifolia*, *Liparis cordifolia*, *L. resupinata*, *Odotochilus lanceolatus* and *Satyrium nepalensis* were collected and conserved in orchidaria with suitable potting mixture. The collection includes 4 new records to West Bengal. Apart from the above wild collections *Paphiopedium insigne* (2 accessions), *Paphiopedium villosum* (01 accession) and *Paphiopedilum farrieanum* (01) accessions were also collected.

Characterization

The collected accessions were morphologically characterized. The orchid species namely *Anthogonium gracile*, *Bulbophyllum rigidum*, *B. eublepharum*, *Calanthe brevicornu*, *C. chloroleuca*, *C. herbacea*, *C. plantaginea*, *C.*

puberula, *C. trulliformis*, *C. yucksomnensis*, *C. whiteana*, *Coelogyne corymbosa*, *C. cristata*, *C. longipes*, *C. elata*, *C. occultata*, *Cremastera appendiculata*, *Cryptochilus leutea*, *Cymbidium eburneum*, *C. elegans*, *C. erythraeum*, *C. devonianum*, *C. gammieanum*, *C. lancifolium*, *C. lowianum*, *C. tracyanum*, *D. kingianum*, *Dendrobium longicornu*, *Epigeneum rotundatum*, *Eria coronaria*, *Eria graminifolia*, *Eria spicata*, *Liparis bootanensis*, *L. cordifolia*, *L. viriflorum*, *Pleione humilis*, *Pleione praecox*, *Phais ludicrous*, *Satyrium nepalensis*, *Spiranthes sinensis*, *Sunipia palacea* were characterized during the year. During characterization of collected accessions two new distinct genotypes of *Pleione humilis* were identified.

Evaluation

The accessions of *Cymbidium erythreum*, *C. hookerianum*, *C. lowianum* were evaluated for various morphological characters. The four distinct genotypes of *Cymbidium lowianum* and one genotype of *C. hookerianum* were identified. The *C. hookerianum* genotype was large flowered and *C. lowianum* genotypes were distinctly differed in having number of flowers, flower colour and nature of spikes.

Value addition

The two endangered species viz. *Cymbidium hookerianum* and *Cymbidium tigrinum* were selfed for multiplication and induction of polyploidy. Apart from selfing 4 new crosses of *Cymbidium* involving *Cymbidium* species and hybrids were made and the crosses made during 2009-10 were cultured. The plantlets from five crosses made during 2008 -09 were hardened off.

Massmultiplication of *Cymbidium*

Standardization of basal media for multiplication of protocorm like bodies (PLBs) of four *Cymbidium* hybrids cultured *in vitro*

The protocorm like bodies (PLBs) of four *Cymbidium* cultivars viz., Levis Duke 'Bella Vista', Vivacious 'Super White', Pine Clash 'Moon Venus' and Margaret Thatcher 'Perfection' were cultured on eight different basal media viz. MS, KC, Thomale GD medium, VW, SH, White's medium B5, and NC in order to optimize the basal media requirement for multiplication of protocorm like bodies (PLBs) (Fig.1). The cultivar Levis Duke 'Bella Vista' produced maximum number of PLBs on MS (9.0), followed by on KC (8.3) and SH medium (8.0) which were statistically on par on with MS medium. The Vivacious 'Super White' recorded maximum number of PLBs on NC (8.8) followed by MS (8.3) and B5 medium (5.6). The Variety Pine Clash 'Moon Venus' produced maximum number of PLBs on NC (10.8) medium followed by MS (7.8) B5 (6.0) medium which was statistically at par with KC and SH medium. The variety Margaret Thatcher 'Perfection' recorded maximum number of PLBs on MS (7.87) medium followed by B5 (7.1) and SH medium (5.98). The other medium recorded significantly lower number of PLBs. In all the cultivars, PLBs produced on B5 or SH medium produced larger diameter. The maximum diameter was observed in Vivacious 'Super White' on B5 medium followed by Margaret Thatcher 'perfection' on SH medium which were significantly at par. The maximum fresh weight (357 mg) of PLBs was recorded in Levis Duke 'Bella Vista' on MS

medium followed by Margaret Thatcher on MS (193.7 mg) medium. The cultivar Pine Clash 'Moon Venus' and Vivacious 'Super White' recorded maximum fresh weight on SH and B5 medium respectively. The dry matter content was found maximum in Vivacious Super White on NC medium followed by in Margaret Thatcher 'Perfection' on MS medium.



(A) PLBs of *Cym* Levis Duke 'Bella Vista' produced after 40 days of *in vitro* culture on different basal media



(B) PLBs of *Cym* Vivacious 'Super White' produced after 40 days of *in vitro* culture on different basal media



(C) PLBs of *Cym* Pineclash 'Moon Venus' produced after 40 days of *in vitro* culture on different basal media



(D) PLBs of *Cym Margaret Thatcher 'Perfection'* produced after 40 days of *in vitro* culture on different basal media

Fig.1. Effect of basal media on proliferation of PLB of four cultivars of *Cymbidium*

Effects of 6- Bezyaminopurine (BAP) on multiplication of protocorm like bodies (PLBs) of four *Cymbidium* hybrids cultured *in vitro*

The protocorm like bodies (PLBs) of four *Cymbidium* cultivars viz., Levis Duke 'Bella Vista', Vivacious 'Super White', Pine Clash 'Moon Venus' and Margaret Thatcher 'Perfection' were cultured on MS media supplemented with 0.1 mg l^{-1} NAA and various concentrations of BAP (6 – benzylaminopurine) in order to optimize the BAP requirement for the proliferation of PLBs. The PLBs number, PLB diameter and fresh and dry weight of PLBs were influenced by genotypes and concentration of BAP. The BAP concentration 2.0 mg l^{-1} for Levis duke 'Bella Vista', 1.5 mg l^{-1} for Margaret Thatcher 'Perfection' and 0.5 mg l^{-1} to 0.1 mg l^{-1} Pine Clash "Moon Venus' and for Vivacious 'Super White' were found optimum for proliferation of PLBs. The BAP concentration beyond optimal level inhibited the proliferation of PLBs (Fig 2).

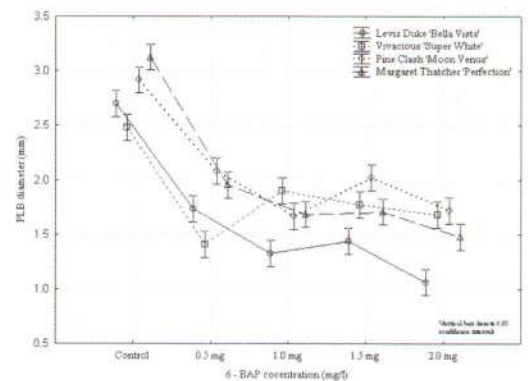
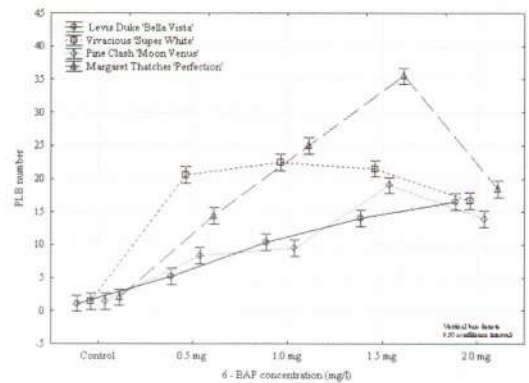
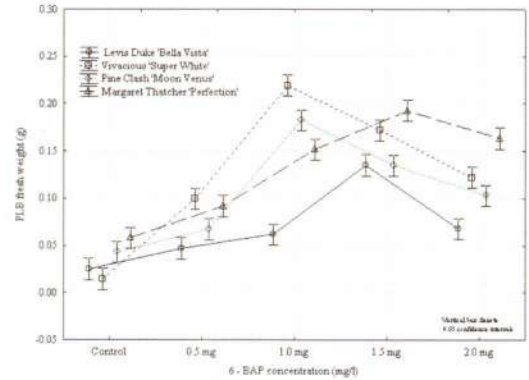
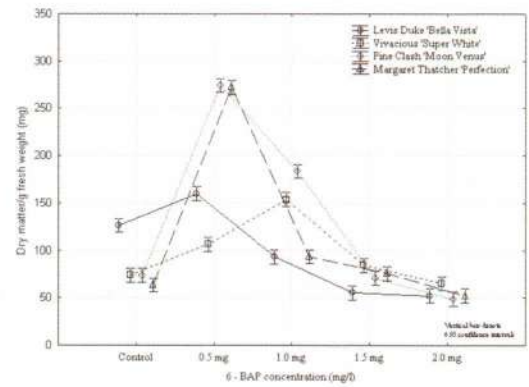


Fig.2. Effect of various concentrations of BAP (6-Benzylaminopurine) on PLB number, diameter, fresh weight and dry weights of four cultivars of *Cymbidium*

Comparison of different culture media for plantlet growth of four *Cymbidium* hybrids cultured *in vitro*

The shoot apices of four *Cymbidium* cultivars viz., Levis Duke 'Bella Vista', Vivacious 'Super White', Pine Clash 'Moon Venus' and Margaret Thatcher 'Perfection' were cultured on eight different basal media viz. MS, KC, Thomale GD medium, VW, SH, White's medium, B5 and NC in order to optimize the basal media requirement for growth of shoot apices *in vitro*. The cultivar and basal media both were found to affect the growth of shoot apices *in vitro* (Fig. 3). The cultivar Levis Duke 'Bella Vista' recorded maximum plant height, plant spread, leaf length and root number on NC medium whereas plant

base diameter, root length, plant fresh weight were found maximum on SH medium. The cultivar Vivacious 'Super White' recorded maximum plant height, leaf length, root length and plant fresh weight on NC medium. Whereas plant spread, leaf number, plant base diameter, root number and root diameter was maximum on SH medium. The cultivar Pine Clash 'Moon Venus' recorded maximum plant height, leaf length, leaf width, root diameter and root length on NC medium however, plant spread and leaf length were found maximum on MS medium. The cultivar Margaret Thatcher 'Perfection' recorded maximum plant height, plant spread, leaf number, leaf width, on MS media.



(A) Effect of basal media on growth of micro shoots of *Cym.* Levis Duke 'Bella Vista'



(B) PLBs of *Cym* Vivacious 'Super White' produced after 40 days of *in vitro* culture on different basal media



(C) Effect of basal media on growth of micro shoots of *Cym.* Pine Clash 'Moon Venus'



(D) PLBs of *Cym* Margaret Thatcher 'Perfection' produced after 40 days of *in vitro* culture on different basal media

Fig 3. Growths of *Cymbidium* shoot apices on different media after 90 days of *in vitro* culture

Effects of Complex organic substances on growth of microshoots of *Cymbidium*

The shoot apices of four *Cymbidium* cultivars viz., Levis Duke 'Bella Vista', Vivacious 'Super White', Pine Clash 'Moon Venus' and Margaret Thatcher 'Perfection' were cultured on NC medium supplemented with three organic supplements namely banana pulp (0, 50, 100, 200 g/l), coconut water (0, 50, 100, 200 ml/l) and Aloe vera pulp (0, 10, 50, 100 g/l) for three months. The addition of organic supplements increased the growth parameters except Aloe vera pulp. All the growth parameters were recorded highest when the medium was supplemented with banana pulp 200 g/l followed by coconut water 200 ml/l. Among four cultivars cultivar Levis Duke 'Bella Vista' recorded maximum plant height, leaf width, root number, plant fresh weight and shoot fresh weight. However, the plant base diameter, leaf length and root length were maximum in Vivacious 'Super White'. The cultivar Margaret Thatcher 'Perfection' performed very poorly.

Effect of potting substrate and nutrient solutions on hardening of tissue cultured plants of four cultivars of *Cymbidium*

In order to optimize the potting substrate and nutrient solutions the tissue cultured plantlets of four *Cymbidium* cultivars viz., Levis Duke 'Bella Vista', Vivacious 'Super White', Pine Clash 'Moon Venus' and Margaret Thatcher 'Perfection' were planted in four different potting substrates, namely {(a) potting mix containing saw dust, cocopeat and vermiculite (1:1:1) (b) white moss, (c) sphagnum peat moss and (d) bleached sphagnum moss} and sprayed weekly with and six nutrient solutions {NPK (10:10:10), Sach's

solution, B5 salts, NC salts, KC salts, and Knop's solution}. There was significant interaction between variety, nutrient and potting substrate for all the character studied except plant spread, leaf width, leaf thickness and root diameter. In cultivar, Levis Duke 'Bella Vista' plant height, leaf length, root number, were higher when the plants were grown on sphagnum moss and sprayed with Sach's solution. However, the root number and root diameter were maximum in plants grown on pot mix and sprayed with NPK (10:10:10) solution@1 g/l. The cultivar Vivacious 'Super White' recorded maximum plant height, plant base diameter, leaf number, leaf length in the plants grown on bleached sphagnum moss and sprayed with NC salts. However, the root numbers and root diameter were found maximum when the plants were grown in pot mix and sprayed with NPK (10:10:10) solution. In cultivar, Pine Clash 'Moon Venus' the maximum plant height, root number and root diameter were maximum when the plants were grown in pot mix and sprayed with NPK (10:10:10) solution. The plant base diameter, leaf number, leaf length were found maximum when the plants were grown in white moss and irrigated with Sach's solution. The cultivar Margaret Thatcher 'Perfection' recorded maximum leaf length, root number and root diameter when the plants were grown in white moss and sprayed with NPK (10:10:10) solution. However, the plant base diameter and leaf numbers were maximum when potted on bleached sphagnum moss. The height of the plants was found maximum when grown on white moss and sprayed with NC salt solution. Thus, out of six nutrient solutions, NC salts, NPK (10:10:10) and Sach's solution were found

effective for growth of tissue cultured *Cymbidium* plants.

EXTERNALLY FUNDED PROJECTS

Horticulture Mission for North East and Himalayan States (Mini Mission– I)

Programme I: Production of nucleus/basic seed and planting materials

Seven *Cymbidium* hybrids and one *Cattleya* hybrids were taken for mass multiplication. The protocorms, plantlets were in different stages of growth. Approximately 23,000 plants were generated and one thousand hardened plants were distributed to 10 farmers of Sikkim.

Programme II: Standardization of production and protection technologies

Evaluation of organic fertilizer for *Cymbidium*

Eight different slow organic sources viz, Aishwarya (20:20:20), Biophos (20P), Biopotash (20P), Megacal (Ca, Mg + other micro nutrients), Pushkal (20N), EM Compost, Vermicompost and Bone meal at different concentration were applied. Plants treated with Pushkal (20N) + Biophos + Biopotash + Megacal (20g:10g:10g:1ml) at quarter interval improved vegetative character like plant height (49.35 cm) and leaf length (47.72 cm) as compared to other treatment.

Programme III: Technology refinement and imparting training

Two training programmes on 'Commercial Cultivation of Orchids', one Kissan Mela and six field demonstrations in relation to media preparation, repotting of orchids and disease and

pest management of orchids were organised for the farmers of Sikkim.

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

In the present study, 16 species and 41 hybrids of *Cymbidium*, 30 species and 14 hybrids of *Dendrobium* and 12 species and 9 hybrids of *Vanda* were included for development of DUS test guidelines using common descriptors. In *Cymbidium*, out of 66 characteristics, pseudobulb size, inflorescence length, number of flowers, flower width, flower duration, flower predominant color, lip ornamentation, blooming time; in *Dendrobium*, out of 62 characteristics, plant height, internode length and number, inflorescence length, flower width, lip colour, and ornamentation and flowering time and in *Vanda*, out of 66 characteristics, plant type, internode length, leaf type, spike length, flower number, inflorescence colour, sepal and petal ornamentation, lip shape, colour and ornamentation, spur length and flowering time were used for grouping of species and hybrids.

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

Production of planting material and demonstration of package of practices for cultivation of *Cymbidiums*

Five demonstration units for cultivation of *Cymbidium* orchids were set up at 5 different locations of Sikkim. There are 55 beneficiaries under the demonstration project in five different locations. The farmers were given a hardening house and 33,000 plantlet of *Cymbidium* orchids

Technology Assessed and Transferred

3

Details of extension/technologies developed or extension methods perfected/ technologies transferred /commercialized etc.

Date	Topic	Number of Participants	Category of Participants	Venue
05 th May, 2010	Commercial Cultivation of <i>Cymbidium</i>	21	Trainees and Farmer of JICA RHP Project, Kalimpong	NRC (O), Pakyong
17-19 th May, 2010	Commercial Cultivation of <i>Cymbidium</i>	40	Farmers of Assam Lingzey and Naitam, East Sikkim	NRC (O), Pakyong
01-30 th June, 2010	DNA finger printing	01	B. Tech (Biotech) student of Amity Institute of biotechnology, Sector-125, Nooda-2013021, Uttar Pradesh	NRC (O), Pakyong
03-05 th June, 2010	Commercial Cultivation of <i>Cymbidium</i>	70	Farmers of Pakyong, East Sikkim.	NRC (O), Pakyong
28 th June - 28 th July, 2010	DNA finger printing	04	Students of Haldia Institute of Technology, W.B. -	NRC (O), Pakyong
12-14 th Aug., 2010 16-18 th Aug., 2010	Techniques in cultivation & multiplication of Asiatic and Oriental Lilies.	30	Farmers of Forest protection Committee, W.B.	NRC (O) Darjeeling Campus
19 th Sept., 2010	Commercial Cultivation of <i>Cymbidium</i>	27	Farmers of Sikkim	NRC (O), Pakyong
25-29 th Sept., 2010	Commercial Cultivation of <i>Cymbidium</i>	07	Officials and Farmers of BAIF, Pune	NRC (O), Pakyong



Training Programme on 'Production Technology of *Cymbidium*'



Training Programme on 'Commercial Cultivation of *Cymbidium* Orchids'

Demonstrations

Sl. No.	Topic	Target (2010-11)	Achievement	No. of Participants
1.	Farmer's field demonstration on media preparation and repotting/disease and pest management of Orchids and group discussions about problems related to Orchids cultivation.	06	06	210
2.	Demonstration of package of practices for commercial cultivation of <i>Cymbidium</i> orchid.	05	05	55
3.	package of practice for cultivation of <i>Cymbidium</i> and <i>Lilium</i> for farmers of Rambong and Millihng Hatta of Darjeeling District of West Bengal.	02	02	35



Officials and Farmers of BAIF, Pune



Members of Smriti Sang (SHG) on demonstration unit

Scientist

Training programme on production of tropical orchids at KAU, Vellanikara, Kerala from 4 – 8 Aug., 2010.

D. Barman & Ram Pal

Training programme on PCR based Advanced DNA Fingerprinting at Department of Biotechnology, Assam University, Silchar from 21st Apr. – 5th May, 2010.

S. Chakrabarti

Training cum awareness programme on PPV& FRA at ICAR Research Complex for NEH Region, Sikkim Centre, Tadong on 22nd Sept., 2010.

S. Chakrabarti

One day Sensitization cum Training Workshop on PIMS-ICAR at Directorate of Water Management, Bhubaneswar (Orissa) on 30th Oct., 2010.

N. K. Meena

Technical

Training programme on 'Programming using SAS' at ICAR Research Complex for NEH Region, Barapani from 7 – 12 Mar., 2011.

N. G. Debnath

Supporting staff

Integrated Training & Policy Research-Technical Workshop for Group 'D' Employee from 25-27 August, 2010 at New Delhi.

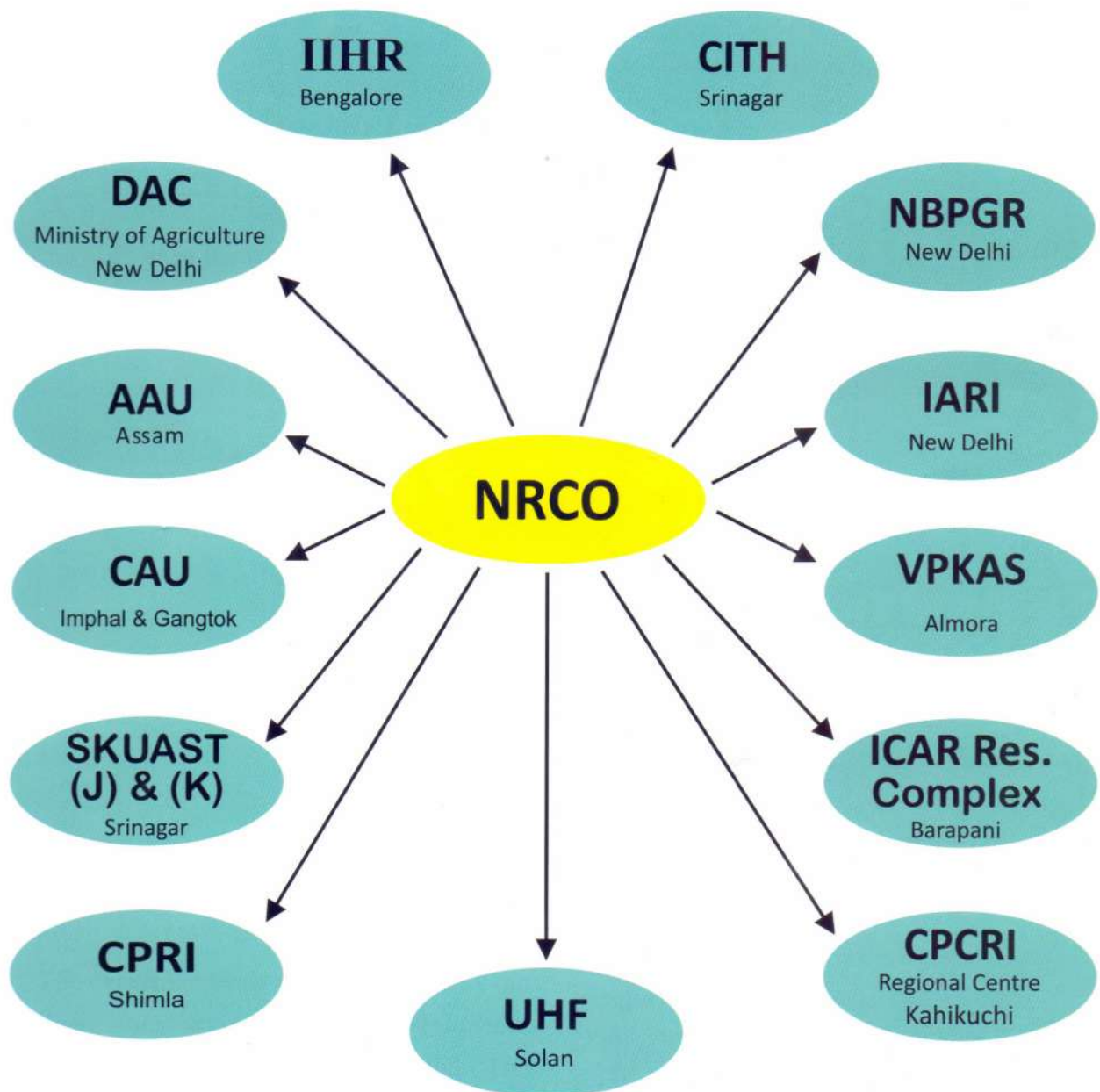
Tularam Dulal & Dawa Bhutia

Linkages and Collaboration

5

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

activities in orchids and other mandate floriculture crops.



Research papers

1. Devdas., R., R. P. Medhi and S. P. Das. 2010. Interspecific hybrid in Epidendrum Orchid from *E. radicans* Pav. Ex. Lindl. x. *E. xanthinum* Lindl. *J. of Horticultural Sciences*, **5(2)**:144-147.
2. Meena., N. K. and R. P. Medhi. 2010. Evaluation of botanical products for management of thrips, *Dichromothrips nakahari* on orchid (*Dendrobium nobile*). *Pestology*, **XXXIV(9)**: 17–22.
3. Pant., R. P., Mrinal Das., K. B. Pun., P. Ramachandran and R. P. Medhi 2010. Occurrence of Cymbidium mosaic and Odontoglossum ringspot viruses in orchid germplasm of Sikkim and Darjeeling hills, their identification and diagnosis. *Indian Phytopath.* **63**: 326 – 332.
4. Ram Pal and R. P. Medhi. 2010. A colour variant of *Liparis bootanensis* Griff, from Darjeeling Hills. *Indian J. of forestry.* **33**: 125–126.
5. Rani., P., R. P. Pant., and R. K. Jain 2010. Serological detection of Cymbidium mosaic and Odontoglossum ringspot viruses in orchids with polyclonal antibodies produced against their recombinant coat proteins. *J. Phytopathology.* **158**: 542–545.

Popular articles

1. Chakrabarti., S. 2010. Cultivation of *Epidendrum* Orchids. *Rastriya Krishi.* **4(2)**: 78–80.
2. Chakrabarti., S. 2010. Pollination mechanisms in orchids. *Rastriya Krishi.* **4(2)**:127–129.
3. Chakrabarti., S. 2010. Conservation of Orchids by the people of North Eastern India. *NE Bio: a Journal of Environment and Biodiversity.* April I: 48–52.
4. Chakrabarti., S. 2011. Cultivation of *Cymbidium* Orchids. *Rastriya Krishi.* **5(1)**: 8–9.
5. Chakrabarti., S. 2011. Vanilla- the highly priced spice orchid. *Rastriya Krishi.* **5(1)**: 72–75.
6. Chakrabarti., S. 2011. *Cymbidium* Orchids. *Agro India.* March: 20–23.

Bulletin

1. Meena., N. K., R. P. Medhi., R. P. Pant., Rampal and D. Barman. 2010. *Pest Management in Orchids*, National Research Center for Orchids, Pakyong, Sikkim, *Mini Mission – I, Technical Bulletin–6*.
2. Meena, N. K., R. P. Pant., Rampal and R. P. Medhi. 2011. *Orchids Ke Hanikarak*

- Keet avam Unka Prabandhan*, National Research Center for Orchids, Pakyong, Sikkim, *Mini Mission – I, Technical Bulletin–8*.
3. Naik., S.K., T. Usha Bharathi., D. Barman., Rampal., L.C. De and R.P. Medhi. 2010. *Basics of Orchid Nutrition*, National Research Center for Orchids, Pakyong, Sikkim, *Mini Mission – I, Technical Bulletin–5*.
 4. Rampal and R. P. Medhi. 2011 *Technoguide for Propagation of Cymbidiums through Backbulbs*, National Research Center for Orchids, Pakyong, Sikkim, *Mini Mission – I, Technical Bulletin–7*.
 4. Barman., D., H. Pokhrel and R.P. Medhi. 2011. Water management in Orchids In: *National Conference on cent Trends and Future Prospect in Floriculture*” from 6–8 March, 2011 at Meerat, U.P.
 5. Barman., D., R. P. Medhi., Utapala Parthasarathy., K. Jayaranjan and V.A. Parthasarathy. 2011. A GIS interpretation of diversity of *Cymbidium swartz*. P. 67. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19-21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 6. Barman., D., 2011, Impact of climate change on orchid population and probable solutions. P. 143. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19 – 21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.

Paper presented in Seminar/ Symposia

1. Barman., D., T. Usha Bharathi and R. P. Medhi. 2010. Landscaping with fragrant orchids In: *National Consultation on Landscape Gardening for aesthetic value and environmental services* from 29 – 30 April, 2010 at IIHR, Hesaraghatta, Bangalore.
2. Barman., D., Rampal and R.P. Medhi. 2010. Integrated approach for conservation of Orchids In: *North Eastern Region, Indian Horticulture Congress-2010* from 19-21 Nov, 2010
3. Barman., D., R.P. Pant., N. K. Meena and R.P. Medhi. 2010. Effect of climate change on Orchids In: *Indian Horticulture Congress-2010* from 19-21 Nov, 2010.
7. Chakrabarti., Syamali., Gaganjyot Singh., R. P. Medhi and Sunil Archak. 2011. Analysis of Diversity and Genetic relatedness of some *Coelogyne* species of North Eastern India using ISSR markers. P. 104. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19 – 21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
8. Chakrabarti., Syamali., N. G. Debnath and R. P. Medhi. 2011. Diversity

- Management in *Cymbidium* Orchids. P. 75. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19 – 21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
9. Chakrabarti., Syamali. 2011.Orchid Industry- A lucrative Business for women. P. 143. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19 – 21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 10. Chakrabarti., Syamali., Gaganjyot Singh and R. P. Medhi. 2010.Molecular Diversity and relationships among *Vandaceous* Orchids of North Eastern Himalayan Region based on Inter Simple Sequence Repeat (ISSR) markers. In: *15th Annual Convention of ADNAT (Association for Promotion of DNA Fingerprinting and other DNA Technologies)* from 23-25 February, 2011 at CCMB, Hyderabad.
 11. De., L.C., Rampal and R.P. Medhi. 2010. Biodiversity of Ornamental Plants in North Eastern Region. In: *National Conference on Horticultural Biodiversity for Livelihood, Economic Development and Health Care* from 29 -31 May, 2010 at UHS, Bangalore.
 12. De., L.C., and R.P. Medhi. 2010. Orchid – a diversified and value added flower crop. In: *4th Indian Horticulture Congress* from 18-21 November, 2010 at New Delhi.
 13. De., L.C., A.N. Rao., P.K Rajeevan., G.S. Rawat., S.K. Sood., M. Srivastava and Geetamani Chhetri. 2011. DUS testing on commercial orchids. P. 73. In: Souvenir cum Abstracts - *National Conference on National Consultation of Production and Utilisation of Orchids* from 19 -21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 14. De., L.C., S.K. Naik., S.K. Mitra and R.P. Medhi. 2011. Pre-harvest Management in *Cymbidium*. P. 116. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19 -21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 15. De., L.C., S.P. Vij and P. Deb. 2011. Post-harvest Management and Value Addition in *Cymbidium*.P. 126. In: Souvenir cum Abstracts - *National Conference on National Consultation for production and Utilisation of Orchids* from 19 – 21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 16. De., L. C., S.K. Naik., S. K. Mitra and R. P. Medhi. 2011. Pre-harvest management in *Cymbidium*. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19 – 21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 17. Deka., B.C., A. R. Roy and R. P. Medhi. 2011. Orchid as a source for livelihood security in North East India. P. 146. In:

- Souvenir cum Abstracts - *National Conference on National consultation for production and Utilisation of Orchids* from 19 – 21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
18. Gupta., Smita., R. P. Pant and R. P. Medhi. 2011. Detection of *Cymbidium* mosaic and *Odontoglossum* ringspot viruses by ELISA and RT-PCR from Sikkim and Darjeeling Hills. P. 136. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19 – 21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 19. Medhi., R.P., L.C. De and P. Deb. 2010. Orchid biodiversity in North East. In: 4th *Indian Horticulture Congress* from 18 - 21 November, 2010 at New Delhi.
 20. Medhi., R. P., Ram Pal., M. Dayamma and Parvati Khatiwara. 2011. Commercialization of *Cymbidiums*: NRCO Turning Dreams into Reality. P. 141. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19-21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 21. Medhi., R. P., Ram Pal, N. K. Meena. 2011. Sustainable Management of Indian Orchid Biodiversity. P. 92. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19-21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 22. Medhi., R. P. and Ram Pal. 2010. Orchid Biodiversity Based Microenterprise Development: An Approach for Conservation and Income Generation for Rural Youth of North Eastern India. In: *North Eastern Zone, Regional Agri-Fair, 2010 – 2011* from 28 February - 2 March, 2011 at ICAR Res. Complex for NEH Region, Barapani.
 23. Meena., N. K., R. P. Pant., D. Barman and R. P. Medhi. 2011. Evaluation of bio-pesticides for their effectiveness against shoot borer, *Peridaedala* sp. on *Epidendrum*. P. 133. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19-21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 24. Meena., N. K., R. P. Pant., D. Barman and R. P. Medhi. 2011. Field evaluation of bio-pesticides and insecticides effectiveness against two spotted spider mite, *Tetranychus urticae* KOCH on Orchid (*Cymbidium* 'H.C. Aurora'). P. 134. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids held at NRC for Orchids* from 19-21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 25. Naik., S. K., D. Barman and R. P. Medhi. 2011. Effect of electrical conductivity of fertilizer solution on flowering of *Cymbidium* hybrid. P 118. In: Souvenir

- cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19-21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
26. Naik., S. K., D. Barman and R. P. Medhi. 2011. Influence of Panchgavya on growth of *Cymbidium* hybrid. P. 119. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19-21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 27. Naik., S. K., D. Barman and R. P. Medhi. 2011. Evaluation of nutrient content of growth media and iron deficiency in *Cymbidium* hybrid. In: *National Conference on cent Trends and Future Prospect in Floriculture* from 6 – 8 March, 2011 at Meerat, U.P.
 28. Pattnayak., S.L., D. Barman and R. P. Medhi. 2011. *In-vitro* propagation of *Cymbidium* hybrids. P. 108. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19 – 21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 29. Pathak., N., D. Barman and S. K. Naik. 2011. Orchid cultivation: An approach for income generation in Sikkim. P. 144. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19-21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 30. Pant., R. P., Smita Gupta and R. P. Medhi. 2010. Incidence of *Cymbidium* mosaic *potexvirus* and *Odontoglossum* ringspot *tobamovirus* on cultivated *Cymbidium* hybrids from Sikkim Himalayas. In: *63rd Annual meeting of Indian Phytopathological Society National Symposium on Perspective in the Plant Health Management* from December, 14–16, 2010 at Department of Plant Pathology, AAU, Anand, Gujarat.
 31. Pant., R.P., Smita Gupta., N. K. Meena., D. Barman and R. P. Medhi. 2010. Emerging plant pathogens of orchids in North Eastern States of India. In: *National Symposium on Molecular approaches for Management of fungal diseases of crop plants* from 27-30 December, 2010 at IIHR, Bangalore.
 32. Pant., R. P., Smita Gupta., N. K. Meena and R. P. Medhi. 2011. Emerging diseases of orchids in North Eastern states of India and their management. P. 136. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19-21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 33. Pant., R. P., Smita Gupta., N. K. Meena and R. P. Medhi. 2011. Occurrence of *Cymbidium* mosaic (CymMV) and *odontoglossum* ringspot viruses (ORSV) on commercial hybrids and species in Sikkim and Darjeeling hills. P. 135. In: Souvenir cum Abstracts - *National Conference on National Consultation for*

- Production and Utilisation of Orchids* from 19-21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
34. Ram Pal., R. P. Medhi., R. B. Ram and R. C. Upadhyaya. 2011. Effect of 6-Benzyleamino purine (BAP) on Multiplication of Protocorm like bodies (PLBs) of four *Cymbidium* hybrids cultured *in vitro*. P. 105. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19-21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 35. Ram Pal., R. P. Medhi., R. B. Ram and R. C. Upadhyaya. 2011. Comparison of different culture media for pantlet growth of four *Cymbidium* hybrids cultured *in vitro*. P. 106. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19-21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 36. Ram Pal., M. Dayamma and R. P. Medhi. 2011. *In vitro* Asymbiotic germination and seedling growth of *Coelogyne nitida* (Orchidaceae) - A beautiful scented orchid. P. 107. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19-21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 37. Ram Pal., R. P. Medhi., R. B. Ram and R. C. Upadhyaya. 2011. Effect of complex organic substances on growth of microshoots of *Cymbidium*, Souvenir. P. 107. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19-21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 38. Usha Bharathi., T., S. K. Naik and D., Barman. 2011. Effect of harvesting stages and chemical preservatives on post harvest life of *Cymbidium* hybrid 'Red Princess'. P. 131. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19-21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.
 39. Usha Bharathi., T., D. Barman. 2011, Effect of different pulsing solutions on post harvest life of *Cymbidium* hybrid 'Pine Clash Moon Venus'. P. 128. In: Souvenir cum Abstracts - *National Conference on National Consultation for Production and Utilisation of Orchids* from 19 – 21 February, 2011 at NRC for Orchids, Pakyong, Sikkim.

List of Ongoing Projects

7

Institute Projects

Project title	PI
<i>In vitro</i> propagation of orchid: <i>Cymbidium</i> and important, rare and endangered species	R. P. Medhi
Cytogenetical research on orchids	S. Chakrabarti
Improvement of orchids	D. Barman
Development of agro-techniques for commercial production of orchids in open and protected conditions.	D. Barman
Production management of tropical and sub-tropical orchids	L. C. De
Development of Integrated floriculture enterprise	D. Barman
Macronutrient management in orchids	S. K. Naik
Secondary and micronutrient management in orchids	S. K. Naik
Post harvest technology of orchids	L.C. De
Collection, conservation, characterization, evaluation and maintenance of high alt. orchid germplasm	Ram Pal
<i>In vitro</i> conservation of orchids	Ram Pal
Disease management of orchids	R. P. Pant
Integrated pest management in orchids	N. K. Meena

Externally Funded Projects

Mini Mission – I

Project title: Horticulture Mission for North East and Himalayan States (HMNEH)

Principal Investigator: R. P. Medhi

Programmes of the Project	Associated Scientists
Programme I: Production of nucleus/basic seed and planting material of horticultural crops	R. P. Medhi , D. Barman, L. C. De
Programme II: Standardization of improved production technologies for horticultural crops	D. Barman, L. C. De, R. P. Pant & N. K. Meena
Programme III: Technology refinement and imparting of training to extension functionaries	L. C. De, R. P. Pant, D. Barman, Rampal, S . Chakrabarti, N. K. Meena & S. K. Naik

DUS Testing Project

Project title: DUS testing of orchid varieties /species for development of NTG

CCPI / Nodal Officer: L. C. De

DBT Project

Project title: DBT mission for quality planting material production and utilization for the North East

Principal Investigator : R. P. Medhi, Co-Principal Investigator : Rampal

NAIP Project

Project title: A value chain on selected aromatic plants of North East India

Co-Principal Investigator : R. P. Medhi, CCPI : D. Barman, Rampal

RAC and IRC Meetings with Recommendations



Recommendations of 11th Research Advisory Committee (RAC) Meeting of National Research Centre for Orchids, Pakyong- 737 106, East Sikkim, held on 11th October 2010



The 11th RAC meeting was held under the Chairmanship of Prof. D.P.Ray, Vice Chancellor, OUAT, Bhubaneswar, Orissa -751003 on 11th Oct 2010 at the conference hall of NRC for Orchids with the following members.

1. Prof. D.P. Ray, Chairman, Vice-Chancellor, OUAT, Bhubaneswar

2. Dr. Umesh Srivastava, Member, ADG (Hort.II), ICAR,N.Delhi
3. Prof. S. P. Vij, Member, Ex Head Deptt. of Botany, Punjab University
4. Dr. S. N. Sinha, Member, Ex Head, IARI Regional Station, Karnal
5. Dr. R. D. Rawal, Member, Ex Head, Div. of Plant Pathology,IIHR,
6. Prof. S. K. Mitra, Member, Faculty of Horticulture, BCKV,
7. Dr. R. C. Srivastava, Member, Joint Director, BSI, Kolkata
8. Dr. R. P. Medhi, Member, Director
9. Mr. D. K. Bhandari, Representative, IMC Nominee
10. Dr. D. Barman, Member Secretary

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

1. Dr. L. C. De, Principal Scientist (Horticulture)
2. Dr. S. Chakrabarti, Senior Scientist (Genetics)
3. Dr. R. P. Pant, Senior Scientist (Plant Pathology)
4. Shri. Rampal, Scientist SS (Horticulture), Scientist i/c Darjeeling Campus.

5. Dr. S. K. Naik, Scientist SS (Soil Scientist)
6. Dr. N.K. Meena, Scientist (Entomology)

Summary of Recommendation

General recommendation

- The experiments which could not be initiated as per 10th RAC recommendation should be initiated immediately without further delay.
- Before planning of experiment, thorough literature search should be made; rationale of the proposed studies should be clearly outlined.
- Experiment should be set up to address to the problems and the needs of local farmers with locally available materials and title of the experiments should be indicative of the work.
- Scientist should publish the results of the experiment in any format (research paper /bulletin /news letter etc.)
- IRC should consist of 3-4 specialist and 2-3 members of RAC and IRC should follow the recommendations of RAC.
- NRC should publish books on orchid flora and cultivation manual of orchids.
- Critical criticism is very important and thus scientists have to put much more energy to achieve the objectives of the experiments.
- Economically viable technologies need to be developed and thus cost benefit ratio in the experiments has to be calculated.
- NRCO should promote orchid culture in

different parts of the country.

- Registration of the elite materials should be done through NBPGR.

Crop Improvement

- Documentation of each accession is very important with the passport data and the institute has to develop a good descriptor for orchids.
- Scientists need to collect different species from the natural habitats through surveys instead of procuring the materials from nurseries.
- For conservation of orchid germplasm, The NRCO has to take a holistic approach: creation of proper micro climate, meeting of optimum nutritional requirements, ensuring mycorrhizal association and natural pollinators, should be looked into for better results for collection and conservation of orchid flora, the NRCO can play a major role in India and should work in collaboration with AICRP, Floriculture to take advantage of the ICAR network.
- A detail list of all species, hybrids and rare and endangered species need to be published as soon as possible.
- Variability within the species needs to be studied thoroughly.
- Collection and characterization of orchid flora collected from different parts of the country to prepare maps species wise need to be done with help of BSI and CCMB.
- NRCO should take proactive role to

conserve and protect endemic, rare & endangered orchid flora from to extinction.

- Breeding work should be done in close collaboration and scientists should make sincere efforts to achieve desired goals.

Crop Production

- All the experiments should have logical basis and the objectives should be directed to fulfill the need of farmers.
- Standardization of the package of practices should be done on the varieties having more commercial importance followed by other important variety
- Production technologies of orchids should be popularized in the country through AICRP centres on floriculture.
- Soil scientist may go for training on isolation and culture of root mycorrhizae and other beneficial fungi to help in better availability of nutrients by the hairless roots of orchids.
- The number of new experiments considered useful for farmers should be initiated

Crop Protection

- Documentation of all the micro flora associated with orchids from different ecological conditions should be done.
- Quarantine for diseases and pests should be done religiously as per standard procedures without giving much importance to the quarantine certificate given by the suppliers of the planting materials.
- Disease infestation at in Darjeeling centre is

rather thus rampant pathologist has to frequently visit the centre to suggest control measures.

- The beneficial micro flora from leaves of different plants used for making leaf –mould manure should be noted.
- Concentration of Azadirachtin should be mentioned while using Neem based products protect orchids from pest attack.
- In neem based products, NSKE may not be mentioned.

Recommendations of the 9th “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 18th December, 2010 under the Chairmanship of Director, Dr. R. P. Medhi at the Conference Hall of the Institute. Following members were presented in the meeting:

1. Dr. R. P. Medhi, Director and Chairman of 9th IRC meeting
2. Prof. S.K. Mitra, BCKV, Mohanpur, Nadia, West Bengal-741252
3. Shri K. K. Singh, Principal Director, HCCD Department, Govt. of Sikkim, Krishi Bhawan, Tadong, Gangtok
4. Prof. (Mrs.) Jauti Sharma, Head, Deptt. of Botany, St. Anthony College, Shillong
5. Dr. K.K. Singh, Scientist i/c, G.B. Pant Institute of Himalayan Environment & Development, Sikkim Unit, Post Box No-24,

Panhang, Gangtok

6. Dr. Kundan Kishor, Scientist, Horticulture, ICAR Research Complex for NEH Region, Tadong, Sikkim, Member
7. Nirmal Yonzong, Farmer,s Representatives , Member
8. Dr. L. C. De, Principal Scientist(Hort.) and Member Secretary

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

1. Dr. D. Barman, Senior Scientist (Horticulture)
2. Dr. S. Chakrabarti, Senior Scientist (Genetics)
3. Dr. R. P. Pant, Senior Scientist (Plant Pathology)
4. Shri. Rampal, Scientist SS (Horticulture), Scientist i/c Darjeeling Campus.
5. Dr. N.K. Meena, Scientist (Entomology)

Summary of Recommendation

Crop Improvement

□ Genetics

Collection of rare orchid species like *Cymbidium whiteae*. Molecular characterization of own crossed materials or specific species

□ Plant Breeding and Tissue Culture

Development of some orchid hybrids or varieties for domestic market. Potentialities of F1 materials of crossed products

Crop Production and Post Harvest Handling

□ Horticulture

A complete package of integrated Floriculture Development Project to be prepared and demonstrated in 2 to 3 farmers area. Emphasis on packaging and post-harvest life. Experiments on drying of orchids may be initiated. 2 to 3 demonstrations on tropical and subtropical orchids in collaboration with Govt. of Sikkim.

Darjeeling Centre

- Publication on a complete package of production and propagation of lilies. Use of phytamol media in place of isabgol gel media in multiplication. More emphasis on production of intermediate *Cymbidium* hybrids for pot plants. Registration of newly released varieties through NBPGR. Development of complete description of 1-2 genera of orchids
- **Soil Science** (*Project: Nutrient management in Orchids*)

Correlation studies between EC and N_1 . Formulation of experiments on variation of pH and EC with varying planting media. Continuation of Panchagavya experiment. Development of package of practices for a single variety only

Crop Protection

□ Pathology

Virus indexing followed by tissue culture separately in collaboration with IIHR.

Frequent visit to Darjeeling Centre. Collection of planting materials from Arunachal Pradesh or NBPGR for getting virus free stocks.

□ **Entomology**

Survey of insect pests and its remedial measures in a particular commercial species preferably *Cymbidium* and then followed by other species. Identification of best chemical sprays including other methods to make a calendar for growers

General recommendation

Refinement of technologies through proper extension methods. Development of any variety of orchids and its registration. Increase in number of publications in a year. Summarization of 10 years publications..

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

9



Steering committee meeting of “Technology mission for integrated development of horticulture in north eastern states including Sikkim” at New Delhi on 16th Apr., 2010.

R. P. Medhi

National Consultation on Landscape Gardening for aesthetic value and environmental services at IIHR, Hesaraghatta, Bangalore from 29 – 30 Apr., 2010.

D. Barman, T. Usha Bharathi

National Symposium on Floriculture Scenario in the Changing Global Perspective at BCKV, West Bengal from 16 – 18 Apr., 2010.

L.C. De

Conference on Land resources of Sikkim and its optimum Utilisations for integrated development



at Gangtok on 11th May, 2010.

R. P. Medhi

Review committee meeting of DBT project on production of quality planting materials on 13th May 2010.

R. P. Medhi

National Consultation of Agro-biodiversity Management at NASC Complex, New Delhi from 26 – 27 May, 2010.

L. C. De

Stake holders Workshop on Entrepreneurship Development for Agri-Bio-inputs production in the North Eastern Region at North Eastern Regional Centre on 9th June, 2010.

Rampal

R. P. Pant, Rampal, S. K. Naik and N. K. Meena

15th ADNAT convention for three day symposium on Genomics and Biodiversity at CCMB, Hyderabad from 23 – 25 Feb., 2011.

S. Chakrabarti

4th Review Meeting of DUS Test Centres and Projects at NASC Complex, New Delhi on 25th Feb., 2011.

L.C. De

North Eastern Zone Regional Agri- Fair 2010-11 on Biodiversity Conservation and

Entrepreneurship Development at ICAR Research Complex for NEH Region, Umiam , Barapani, Meghalaya from 28th Feb. - 2nd Mar. 2011.

R. P. Pant and N. K. Meena

National Conference on Recent Trends and Future Prospects in Floriculture organized by Ornamental Horticulture Society in collaboration with Chaudhary Charan Singh University of Agriculture & Technology, Modipuram, Meerut from 5 - 8 Mar. 2011.

Ram Pal

National conference on Horticultural Bio-Diversity for livelihood, economic development and Hort-Expo, 2010 at Bagalcot, Bangalore from 28 - 31 June, 2010.

R. P. Medhi, and L.C.De

National Agricultural Bioinformatics Grid held at NBPGR, New Delhi on 7th Aug., 2010.

S. Chakrabarti

Global Plan of Action for conservation and Utilisation of Plant Genetic resources for Food and Agriculture at NBPGR, New Delhi on 30th Aug., 2010.

S. Chakrabarti

12th Executive development programme at NAARM, Hyderabad from 17 - 21 Sept., 2010.

R. P. Medhi

Interactive meeting on Information Communication Technology in ICAR at NASC Complex, Pusa, New Delhi from 3 - 4 Nov., 2010.

N. K. Meena

Interaction meeting and Horticulture - Industry meet at IIHR, Bangalore on 10 - 11 Nov., 2010.

R. P. Medhi, R. P. Pant and S. K. Naik

Interactive Workshop on Bio-rational Management of Pests and Diseases of major crops of Sikkim with special reference to large Cardamom at ICAR Research Complex for NEH Region, Sikkim Centre, Tadong, Gangtok, Sikkim on 12th Nov., 2010.

N. K. Meena

Floriculture workshop held at BCKV, Kalyani

from 13 - 15 Nov., 2010.

R. P. Medhi

Meeting cum workshop on ICAR Zonal Technology Management and Business planning and Development at ICAR Research centre for NEH Region, Barapani from 18 - 19 Nov., 2010.

S. Chakrabarti

4th Indian Horticultural Congress 2010 at Pusa, New Delhi from 18 - 21 Nov., 2010.

D. Barman, L.C. De

Interface meeting of Data sharing/management at New Delhi on 23 - 24 Nov., 2010

R. P. Medhi

2nd North East Expo at ICAR Research Complex, Dimapur, Nagaland from 15 - 19 Dec., 2010.

R. P. Pant and N. K. Meena

National Symposium on Molecular approaches for Management of fungal diseases of crop plants at IIHR, Bangalore from 27 - 30 Dec., 2010.

R. P. Pant

Interface meeting with dept. of Vety. & Animal Husbandry, Agriculture, Horticulture and Forestry, Govt. of Nagaland at Medziphema, Nagaland on 4th Feb., 2011

R. P. Medhi

National Conference on National Conference on National Consultation for Production and Utilisation of Orchids at NRC for Orchids, Pakyong, Sikkim from 19 - 21 February, 2011.

R. P. Medhi, D. Barman, L. C. De, S. Chakrabarti,

R. P. Pant, Rampal, S. K. Naik and N. K. Meena

15th ADNAT convention for three day symposium on Genomics and Biodiversity at CCMB, Hyderabad from 23 – 25 Feb., 2011.

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L.C. De

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R. P. Pant and N. K. Meena

National Conference on Recent Trends and Future Prospects in Floriculture organized by Ornamental Horticulture Society in collaboration with Chaudhary Charan Singh University of Agriculture & Technology, Modipuram, Meerut from 5 - 8 Mar. 2011.

Ram Pal



Prof. Modayil,
member ASRB



Dr. H. P. Singh,
DDG (Hort.), ICAR, KAB-II, Pusa, New Delhi

I. Scientific

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

II. Administration

Shri Ajen Lama	Assistant Admn. Officer
Shri. Rishi Kant Singh	Assistant Finance and Account 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	Tech. Asstt. (T-3)
Shri Noni Gopal Debnath	Computer Asstt. (T-II-3)
Shri. Ram Chandra Gurung	Driver (T-3)
Shri. Manoj Adhikari	Tech. Asstt. (T-1)

Miss. Meena Kumari Chettri	Tech. Asstt. (T-1)
Shri. Deepak Khattri	Driver (T-1)
Shri Ajay Bushal	Tech. 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
Mrs. Rabin Kala Subba	SSG-I

Transfer

- Mrs. Prema Nagaraju, Jr. Clerk transferred to NIANP, Bangalore on 20th May, 2010
- Ms. T. Usha Bharathi, Scientist (Floriculture) transferred to IIHR, Bangalore on 17th July, 2010
- Dr. S. K. Naik, Scientist (Soil Sci.) was selected as Senior Scientist, HARP, Plandu, Ranchi (Jharkhand) and relieved on 28th March, 2011 to join his new post.

Resignation

- Shri. Janaki Mandi, Technical Asstt. (T-II-3) resigned from the post on 28th October, 2010

Organisation of National Seminar

The National Research Centre for Orchids organised National Consultation for Production and Utilisation of Orchids from 19 - 21, February 2011. There were six sessions, Genetic diversity (Conservation and utilisation), Biotechnological interventions, Production of quality flowers and planting materials; Post harvest management and value addition; Plant health management and environmental safety; and Climate change and livelihood security. A total of ten invited presentations and eighteen oral presentations were made. 80 posters were presented.

Summary of recommendations:

- i. Floricultural produce is no longer confined to religious purpose alone but it has become a part of modern lifestyle. It provides financial security to the farmers thus enabling their capacity to reach other social security needs. It requires less space and gives great returns. Orchids occur in all places from Alpine to tropics with great scope for market. India is endowed with rich orchid wealth. This orchid wealth has to be conserved and utilized for commercialisation purpose. Since orchids come in different types depending upon the climate, it is of great importance to collect, conserve and utilize these genetic resources in a network mode with NRC Orchids playing a pivotal role in Project Directorate
- ii. There is a lot of taxonomic confusion in the orchids. This needs to be resolved using both traditional taxonomy and molecular taxonomy. TBGRI along with NRC Orchids in collaboration with others working in the field. IIHR can help in the bar-coding of the orchids. There are others working on bar-coding outside NARS and their collaboration may also be taken up.
- iii. Orchids are highly prized internationally due to the incredible range of diversity it possesses in terms of size, colour, and shape and vase life. Breeding programmes have led to the development of over 1.25 lakhs hybrids in orchid world over. But, the number of orchids registered internationally as hybrids are only about

mode with following centres networking with NRC.

Tropical Orchids – KAU, TNAU and UHS (Karnataka), Tripura (ICAR Complex), IIHR

Subtropical orchids – AAU, BCKVV, UBKVV, ICAR Res.Complex (Manipur, Mizoram), CAU (Pasighat), VPKAS (Almora), GBPUA&T (Pantnagar)

Temperate - NRC Orchids, ICAR Complex (Barapani), YSP Univ.of H&F (Solan)

Alpine – CITH (Srinagar)

100 from India. Indian hybrids have to be more competitive and we may have to develop ideal ideotypes which have long spikes, attractive shape and colour besides long vase life. There are quite a few hybrids available in India and also breeding population. These must be used to develop mapping population to tag the useful genes. These can be used in the Genomic Aided Breeding programmes to develop commercial hybrids.

iv. Orchids have great market. Orchids are primarily propagated using tissue culture techniques. Most of the South East Asian countries have taken up the mass multiplication using the Bioreactor technology. Unfortunately, India is yet to get into this aspect of mass multiplication. Research on Bioreactor technology to encash on the success obtained in micropropagation is the need of the hour. The bioreactors can work as factories producing, besides orchids, other horticultural crops. This can be taken as a network project with IIHR as the lead centre with others such as CISH, NRC Orchids, Citrus, Banana, CITH, IISR and CPRI participating in the programme to produce large number of quality planting materials.

v. The production technology needs to be very economical. Hence use of indigenous materials as medium for growing orchids needs emphasis. Leads obtained using coconut chips, coco peat and other plant wastes can be used for growing orchids in homesteads as well as commercially. There

is a need for intensified research for pot plant production of orchids.

vi. Orchids are reported to be affected by about 130 diseases besides many insect pests. Viral diseases are major concern since orchids are vegetatively propagated. There is an urgent need to take the help of other virologists working on diagnostics to develop suitable diagnostics.

vii. Black rot is a serious disease of orchids caused by *Phytophthora*. The work can be included in the net work programme going on under the name 'Phytofura' at IISR as nodal centre. If possible, this can be included in this programme.

viii. An export quality orchid should have the prescribed standards such as minimum eight standard blooms per stem, flowers must be cleaned, evenly coloured, and arranged with two thirds of stem covered with flowers; and free from physiological disorders. The flowers must have firm texture and luminescent sheet with the base diameter of the stem should be a minimum of 10mm. To obtain these characters, the harvesting has to be timely so that when it reaches the market they are in the above specification. This also requires intensive study depending on the species/varieties. The orchids have to be suitably packed to stand the transport. The post harvest treatments need to be perfect. Hence the post harvest management needs an intensified research. This requires strengthening of NRC Orchids with adequate man power.

- ix. The domestic floriculture market is estimated at Rs.500 crores and is growing annually by 25%. Orchids are gaining much importance in this direction. India is endowed with diverse ecological zones as indicated in (i) above. There is a need to earmark the production zones for each kind of orchid. The Agribusiness research on orchid production may be taken up by NRCO and NCAP.
- x. Value addition of orchids would fetch a good market, attractive and innovative packing as per requirement of the consumer add to the value of the product. The product like Cilindra (gift box of glass cylinder with mini cymbidium) and stylish setting (festive packing for special occasions) are entering in the market. Thus area has good scope in the country. However, some basic studies on packing material, varietal suitability, enhancement post harvest life etc. need to be addresses by NRCO. This area needs study along with Post harvest.



National Conference on 'National Consultation for Production and Utilisation of Orchids'

Celebration of Independence Day at NRC for Orchids



Hindi Saptah at NRC for Orchids

Sadhbavna Diwas at NRC for Orchids



Celebration of Republic Day at NRC for Orchids

Vigilance week at NRC for Orchids



Glimpses of National Conference





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