

वार्षिक प्रतिवेदन  
**ANNUAL REPORT**  
**2004-2005**



राष्ट्रीय आर्किड्स अनुसंधान केन्द्र  
पाक्योङ- ७३७ १०६, सिक्किम  
**National Research Centre for Orchids**  
Pakyong-737 106, Sikkim





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भारत  
**ICAR**



**Annual Report 2004-05**

**National Research Centre for Orchids**

**Pakyong- 737 106, Sikkim**

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Back cover: *Dendrobium crepidatum*

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## Preface

I am presenting the 6<sup>th</sup> Annual Report for the year 2004-2005 of the Centre.

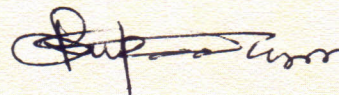
Today, commercial orchid growing has been established in developed countries and it is slowly spreading in developing countries. The ornamental potential of orchids is known and becoming popular in India and awareness about orchids is bound to go up with increase in socio-economic status of the people. Recently a number of new entrepreneurs have entered in this field. Barring a few organized group in South and North Eastern parts of the country most of the private growers mainly depend upon collection from the wild, which is causing a serious threat to native orchid species. India with its varied climatic conditions provides suitable platform for the development of Orchid industry where substantial employment can be generated. The need of the hour is to educate prospective grower in the feasibility of Orchid cultivation as viable commercial venture.

Mass multiplication by the way of tissue culture methods can be best employed for orchid's commercial cultivation. The present strategy applied is to introduce new varieties, identification of location specific suitable species and hybrids, designing low cost polyhouses for protected cultivation, strengthening infrastructure with proper phytosanitary conditions and certification etc. It is high time that indigenous Orchids are screened for production of unique hybrids for cut flower trade at domestic and international market. Considering the fact of commercialization this Centre is modifying demand driven research programs so that technical help, training and supply of planting stock can be backed to the prospective grower.

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

Pakyong

05<sup>th</sup> August, 2005



(R. C. Upadhyaya)  
Director



## कार्यकारी सारांश

- वर्ष के दौरान सिक्किम, नागालैण्ड एवं अरुणाचल प्रदेश में 4 अन्वेषण किये गये, जिससे आर्किड्स के लगभग 350 से अधिक एवं कंदीय एवं अन्य पुष्पीय पौधों के 18 प्रभेदों को एकत्रित किया गया।
- आर्किड्स की लगभग 113 प्रजातियों को विभिन्न प्रमापकों के साथ अध्ययन किया गया, जैसे :- कुल क्लोरोफिल, क्लोरोफिल-ए, क्लोरोफिल बी एवं कैरोटिनाइड्स। प्रजातियों में सार्थक विभिन्नता पाई गई एवं प्रजाति के लक्षण मुख्यतः पत्तियों की संरचना, पत्तियों की लम्बाई एवं चौड़ाई, पत्ती का रंग एवं पुष्प का रंग आदि पर निर्भर रही।
- पहले कुछ वर्षों के दौरान आर्किड्स में बनाये गये संकरणों से प्राप्त संततियाँ पौध, कठोरीकरण एवं पुष्पन अंकुरण की अवस्था में है।
- सिम्बीडियम आर्किड की शोर्गल "कुक्सब्रिज" नामक संकर प्रजाति को ऊतक संवर्धन द्वारा उत्पन्न किया गया। इसमें "निश्च" नामक माध्यम प्ररोह एवं जड़ निर्माण में अन्य से उत्तम पाया गया। इस माध्यम में 1 ग्रा. प्रति लीटर सक्रिय चारकोल, 300 मिली. प्रति लीटर नारियल पानी था, जो पी.एल.बी. के तीव्र एवं अधिक संख्या के निर्माण में उत्तम साबित हुआ। नारियल पानी के साथ इसके लक्षणों में विशेष तीव्रता पाई गई। माध्यम में 30 ग्रा. प्रति लीटर सुक्रोज से पी.एल.बी. बहुगुणन एवं विभेदन उत्तम पाया गया।
- सिम्बीडियम "सोल हन्ट-1" में माध्यम, जिसमें 1 ग्रा. प्रति लीटर सक्रिय चारकोल एवं 0.5 मि.ग्रा. प्रति लीटर बी.ए.पी. एवं सिल्वर नाइट्रेट मिला हुआ था, पी.एल.बी. के बहुगुणन एवं विभेदन के लिए उत्तम पाया गया।
- सिम्बीडियम "लूनेवियन एटलस" को 4 सप्ताह के लिए, इन्क्यूबेशन की परिस्थितियों में, माध्यम जो कि 1.5 ग्रा. प्रति लीटर सक्रिय चारकोल, 0.5 मि.ग्रा. प्रति लीटर ट्राईकन्टेनाल एवं पेक्लोब्यूट्राजोल से पूरित था, ने अच्छे परिणाम प्रदर्शित किए।
- सिम्बीडियम पौधों को, माध्यम, जिसमें रोटन लाग + रेत + नारियल हस्क + ईट के टुकड़े मिले हुए थे, को 1 ग्रा. प्रति लीटर पोलीफीड का छिड़काव करने से पत्तियों/पौधों की संख्या अधिक पाई गई एवं आभासी कंद भी बड़े आकार का पाया गया।
- सिम्बीडियम "सोलहन्ट-6" पौधों को, माध्यम, जिसमें लीफ मोल्ड + गोबर की खाद + चारकोल + नारियल हस्क + रोटन लाग (2:1:1:1:1) मिले हुए थे, को नाइट्रोजन-200 पी.पी.एम., फॉस्फोरस-100 पी.पी.एम., पोटेश-100 पी.पी.एम. के साथ, जब छिड़काव किया गया तो पुष्प डंडी की अधिक लम्बाई (45:15 सेमी.) तथा प्रति पुष्प डंडी पुष्पों की अधिक संख्या (10:20) पाई गई।
- एन<sub>2</sub>:पी<sub>5</sub>:के<sub>5</sub> को 0.3 प्रतिशत की सांद्रता पर, सिम्बीडियम शोर्गल "कुक्सब्रिज" में प्रयोग करने पर, पत्तियों के शुष्क पदार्थ का कुल नाइट्रोजन का उपचालन अधिक (10.1 ग्रा. किग्रा.<sup>-1</sup>) पाया गया, जबकि अधिकतम पोटेश का उपचालन (15.0 ग्रा. किग्रा.<sup>-1</sup>) एन<sub>2</sub>:पी<sub>5</sub>:के<sub>5</sub> उपचार में पाया गया, जब इनकी सांद्रता 0.3 प्रतिशत थी।
- गुलाब की प्रजाति "फर्स्ट रेड" को माध्यम जो कि 2 भाग मृदा : 1 भाग कम्पोस्ट : 1 भाग कोकोपीट एवं एन.पी.के. की आधारीय मात्रा 200 : 320 : 300 किग्रा./हेक्टेयर/वर्ष से पूरित था, को 20 के.पी.ए. सिंचाई रीति के अनुसार प्रयोग करने से पुष्पों का जीवनकाल अधिक पाया गया, जबकि फर्टीगेशन (जल विलेय उर्वरक), पोलीफीड + सूक्ष्म तत्व (2 ग्रा. प्रति लीटर) को जब रोपण पश्चात, मासिक रूप से (सितम्बर से जनवरी) प्रयोग करने पर पुष्पों का जीवनकाल अधिक पाया गया।
- ग्लेडियोलस प्रजाति "आइस गोल्ड" में वी.ए.एम. का आधारीय प्रयोग जो कि एन.पी.के. (200-100-100 किग्रा./हैक्टेयर) एवं गोबर की खाद (50 टन प्रति हैक्टेयर) के साथ किया गया, से पौधों की अधिक लम्बाई (144.40 से.मी.) पत्तियों की लम्बाई (58.59 सेमी),



- पुष्प डंडी की लम्बाई (113.82 सेमी.) रैचिस लम्बाई (69.31 सेमी.), प्रति पौधा पुष्पों की अधिक संख्या (22.42) तथा प्रति पौधा कदिकाओं की संख्या अधिक पाई गई।
- आर्किड्स की विभिन्न प्रजातियों में कुल नाइट्रोजन की मात्रा कम 0.11 प्रतिशत (वेन्डा क्रिस्टाटा) तथा अधिक 0.28 प्रतिशत (डेन्ड्रोबियम फिम्रियेटम), कुल फास्फोरस की मात्रा सबसे कम 0.11 प्रतिशत (वेन्डा क्रिस्टाटा) तथा सर्वाधिक 0.16 प्रतिशत (डेन्ड्रोबियम फिम्रियेटम), कुल पोटाश की मात्रा सबसे कम 0.57 प्रतिशत (वेन्डा क्रिस्टाटा) तथा सर्वाधिक 1.42 प्रतिशत (डेन्ड्रोबियम एफाइलम) में पाई गई।
- कर्णों की सघनता सर्वाधिक गोबर की खाद (0.90 ग्रा. प्रतिघन सेमी.) में तथा सबसे कम कोकोपीट (0.25 ग्रा. प्रति घन सेमी) में पाई गई, कुल संघावकाश सर्वाधिक कोकोपीट (64 प्रतिशत) में तथा सबसे कम लीफ मोल्ड (17.24 प्रतिशत) में पाया गया सर्वाधिक जलधारण क्षमता कोकोपीट (67.6 प्रतिशत) तथा सबसे कम लीफ मोल्ड में पाई गई।
- आर्किड में विल्ट रोग कई प्रजातियाँ जैसे :- डेन्ड्रोबियम क्राइसोटोक्सम, वेन्डा स्टेन्जियाना, वेन्डा सेरुलिया, एकम्पे पेपिलोसा, रोबीक्वेटिया स्पेथुलाटा, फायस टैकरविलि, ऐरिया स्पीकाटा, एवं सिम्बीडियम पेंडुलम पर पाया गया।
- ब्लैक रॉट की उपस्थिति कई प्रजातियाँ जैसे :- सिम्बीडियम एलोइफोलियम, सिम्बीडियम ग्रेंडीफोलियम, सिम्बीडियम हुकेरीएनम, सिम्बीडियम संकरों जैसे:- सिम्बीडियम बर्था पीटर शार्ट, सिम्बीडियम एग्नस नार्टन 'शू ऑफ' आदि पर पाई गई।
- रस्ट फफूँदी की उपस्थिति कुछ आर्किड्स की प्रजातियाँ जैसे :- फायस टैकरविलि, एथ्योगोनियम ग्रेसाइल, हर्मिनियम अंगस्टीफोलियम, केलेन्थे ट्रूलीफोर्मिस, केलेन्थे डिस्कलर एवं केलेन्थे प्लेन्टेजीनिया आदि पर पाई गई।
- सिम्बीडियम में उपचार के लिए मेटालेक्सल (0.1 प्रतिशत), कार्बेन्डाजिम (0.2 प्रतिशत), थायोफनेट मिथाइल (0.1 प्रतिशत) आदि को प्रयोग करने से ब्लैक रॉट की उपस्थिति कम पाई गई।
- लगभग 100 आर्किड्स नमूनों, जिसमें 21 जेनेरा की प्रजातियाँ एवं संकर सम्मिलित थे, की जांच एलीसा, आर.टी.-पी.सी.आर, स्लोट-ब्लोट संकरण तकनीक द्वारा की गई और कई प्रजातियाँ एवं संकरों में सिम्बीडियम मोजेक वायरस एवं ओडोन्टोग्लोसम रिंग स्पॉट वायरस की उपस्थिति पाई गई।
- आर्किड्स के पौधों पर तीन एफिड्स की प्रजातियाँ जैसे :- मेक्रोसीफम प्रजाति, मेक्रोसीफम रोजी एवं टोक्सोप्टेरा औरन्टी की उपस्थिति अंकित की गई।
- सिम्बीडियम की 17 प्रजातियों में से कुछ प्रजातियाँ जैसे :- सिम्बीडियम डेबोनियेनम, सिम्बीडियम एलीगेन्स, सिम्बीडियम एन्सीफोलियम, सिम्बीडियम लोवियानम एवं सिम्बीडियम ट्रेसियेनम को कीटों के प्रति संवेदनशील पाया गया जबकि शेष प्रजातियाँ कीट रहित पाई गई।
- ब्लैक वीविल प्रजाति- सिपेलिनस का उपचार जब डाइमथोएट 30 ई. सी. (2 मिली. प्रति लीटर) एवं क्लोरपाइरीफॉस 20 ई.सी. (2.5 मिली. प्रति लीटर) से किया गया तो प्ररोह क्षति कम पाई गई।
- जब क्रीट की उपस्थिति के लिए, 34 कंदीय पौधों को मूल्यांकित किया गया, तो टिड्डा ने कुछ पौधों के पुष्प एवं पत्तियों को खाकर क्षति प्रदर्शित की, अन्य प्रजातियाँ जैसे :- आइरिस जेपोनिका पर ब्लैक स्केल तथा जैन्टीडेसीया पर हरे एफिड की उपस्थिति पाई गई, शेष पर कीट की उपस्थिति नहीं पाई गई।
- वर्ष के दौरान, कई प्रशिक्षण कार्यक्रम आयोजित किए गए, जिसमें सिक्किम, अरुणाचल प्रदेश, आसाम, नागालैण्ड एवं मणिपुर के लगभग 120 अधिकारियों एवं किसानों को प्रशिक्षण प्रदान किया गया। प्रशिक्षण कार्यक्रम पुष्पोत्पादन पर आधारित था, इसके अतिरिक्त कालिमपोंग के 214 स्वयंसेवी समूहों के सदस्यों एवं मेघालय के 32 किसानों ने केन्द्र का भ्रमण भी किया।



## Executive Summary

- During the year 4 explorations were undertaken in Sikkim, Nagaland and Arunachal Pradesh and collected over 350 accessions of orchids and 18 of bulbous and other flowers.
- About 113 orchid species were studied using the parameters- Total chlorophyll, Chlorophyll a, Chlorophyll b and Carotenoides. Significant variations observed within the species and the quantity of these pigments depend on the morphological characters of the species mainly on leaf structure, length and breadth of leaf, leaf colour, flower colour, etc.
- The progeny derived from the crosses made in orchids during past few years are at plantlet, hardening and flower initiation stage.
- Nitsch media with 1g/l of AC and 300ml/l of coconut water was the best in producing maximum number of Plbs, shoots and roots, however, lower concentration of coconut water (100ml/l) induced rapid Plbs multiplication, early shoot, leaf and root initiation in *Cym. Showgirl* "Cooksbridge".
- Media supplemented with 30g/l of sucrose was the best for Plbs multiplication and differentiation of *Cym. Showgirl* "Cooksbridge" *in vitro*.
- MS media with 1g/l of AC and 0.5mg/l each of BAP and AgNO<sub>3</sub> was the best for Plbs multiplication and differentiation of *Cym. Soul Hunt I*.
- Media containing MS supplemented with 1.5g/l of activated charcoal, 0.5mg/l each of Triacantanol and Paclobutrazol resulted in maximum survival *ex vitro* when incubated for a period of 4 weeks in *Cym. Lunavian Atlas*.
- *Cymbidium* plants grown in the media containing Rotten log + Sand + Coconut husk + Brick pieces and applied with 1g/l polyfeed weekly produced maximum number of leaves/plant and largest pseudobulb.
- Maximum spike length (45.15 cm) and number of flower/spike (10.20) obtained from Module which was comprised of growing media containing Leaf mould + FYM + Charcoal+ Coconut husk + rotten log (2:1:1:1:1) and spraying with N 200 ppm P 100 ppm K 100 ppm+ BA 100 ppm & GA<sub>3</sub>100 ppm in *Cym. Soul-Hunt-6*.
- Application of N<sub>20</sub>: P<sub>5</sub>: K<sub>5</sub> @ 0.3% to *Cym. Showgirl* "Cooksbridge" recorded highest uptake of total N, 10.1 g kg<sup>-1</sup> of dry matter in the leaf, whereas highest K-uptake of 15.0 g kg<sup>-1</sup> was found in the treatment N<sub>5</sub>: P<sub>5</sub>: K<sub>5</sub> @ 0.3% .
- Rose cv. First Red plants when grown in the media consisting of 2 soil: 1compost: 1 coco peat supplemented with basal dose of NPK @ 200:320:300 kg/ha/yr under 20 kPa irrigation regime and supplied with 200 and 300 kg N and K/ha/yr., respectively through fertigation (water soluble fertilizers), spraying of polyfeed + micronutrients (2 g/l) at monthly interval from September to January + bending 6 weeks after planting and also exhibited longest vase life of flowers.



- Basal application of VAM along with NPK(200-100-100 kg/ha) and FYM (50t/ha) produced longest plant (144.40 cm), longest leaves/plant (58.59 cm), spike length (113.82 cm), rachis length (69.31cm), maximum number of flowers/plant (22.42) and number of cormels/plant in Gladiolus cv. Ice Gold.
- The total Nitrogen content of orchid species varied from 0.11% (*Vanda cristata*) to 0.28% (*Dendrobium fimbriatum*), the total phosphorus content varied from 0.11% (*Vanda cristata*) to 0.16% (*Dendrobium fimbriatum*) and the total potassium content varied from 0.57% (*Vanda cristata*) to 1.42% (*Dendrobium aphyllum*).
- Particle density was found highest in FYM (0.90 gm/cm<sup>3</sup>) and lowest in coco peat (0.25 gm/cm<sup>3</sup>), total porosity was found highest in coco peat (64%) and lowest in leaf mould (17.24%) and maximum water holding capacity was found highest in coco peat (67.6%) and lowest in leaf mould (76.7%).
- Orchid wilt disease was observed on *Dendrobium chrysotoxum*, *Vanda stangeana*, *V. coerulea*, *Acampe papillosa*, *Robiquetia spathulata*, *Phaius tankervilleae*, *Eria spicata* and *Cymbidium pendulum*.
- Black rot was observed on *Cymbidium aloifolium*, *C. grandifolium*, *C. hookerianum* and *Cymbidium* hybrids such as *Cym. Bertha* "Petershort", *Cym. Agnes Norton* "Shoe off".
- Rust pathogen was recorded on some ground orchids like *Phaius tankervilleae*, *Anthogonium gracile*, *Herminium angustifolium*, *Calanthe trulliformis*, *C. discolor* and *C. plantaginea*.
- Treatment with Metalaxyl (0.1%), Carbendazim (0.2%), Thiophanate methyl (0.1%) resulted in least incidence of Black rot of *Cymbidium*.
- About 100 orchid samples including hybrids and species of 21 genera were tested using ELISA, RT-PCR, Slot Blot Hybridization techniques and recorded *Cymbidium* mosaic virus and *Odontoglossum* ring spot virus in many species and hybrids.
- Three aphid species viz., *Macrosiphum* sp., *Macrosiphum rosae* and *Toxoptera aurantii* recorded on orchid hosts.
- Out of seventeen species of *Cymbidium* observed, *Cymbidium devonianum*, *C.elegans*, *C. ensifolium*, *C. lowianum* and *C. traceyanum* were found susceptible while remaining were free from pest.
- Treatment of Dimethoate 30 EC (2ml/l) and Chlorpyriphos 20 EC (2.5 ml/l) resulted in less number of shoot damage by black weevil *Sipalinus* sp.
- Out of Thirty-four bulbous ornamentals evaluated for pest occurrence, grasshopper caused damage to some ornamentals by feeding on leaves and flower, black scale on *Iris japonica* and green aphid on *Zantedeschia*, while remaining were found free from pest.
- Trainings were imparted to about 120 officials and farmers of Sikkim, Arunachal Pradesh, Assam, Nagaland, Manipur on floriculture while around 214 self help group members from Kalimpong and 32 farmers from Meghalaya visited this centre during the year.



# Contents

Preface

कार्यकारी सारांश

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# 1

## Introduction

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### Background

The orchid flowers exhibit exquisite magnificence and diversity of patterns. They are the most pampered plants and have contributed considerably to the international trade both in cut flower and potted plants. Among the top ten cut flowers in the world trade, orchids ranks seventh and thus occupy a large share in floriculture trade. Keeping in view of the export potential of orchids, based on the recommendations of the Planning Commission, the Indian Council of Agricultural Research (ICAR) established a National Research Centre for Orchids during VIII<sup>th</sup> Five Year Plan at Pakyong (Sikkim) since October 1996. The state of

Sikkim has handed over 22.19 acres of land with all other assets belonging to Regional Agricultural Centre at Pakyong on lease basis for 99 years. The Director General, ICAR, New Delhi visited and inaugurated this centre when visited Gangtok (5<sup>th</sup> October, 1996) to attend Regional Committee meeting of zone III. Since then the centre is undertaking mission oriented research programme on crop improvement, crop production, crop protection and post harvest management. In October 1997 the centre also took over the Darjeeling centre of C.P.R.I, Shimla.

### Mandate

For resolving major constraints in production of orchids and other bulbous ornamentals in major growing belt, the Centre has mission mode approach with following mandate.

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



**Staff strength as on 31.03.2005**

Staff	Sanctioned	Filled
Scientific	11	9
Technical	5	3
Administrative	8	5
Supporting	5	7 *
Total	29	24

\* Includes transfer with post.

**Budget for 2004-05**

Head	(Rupees)			
	Plan		Non-Plan	
	Sanctioned	Utilized	Sanctioned	Utilized
Establishment Charges	-	-	46,00,000	44,89,993
Wages	7,50,000	7,47,973	-	
T.A	3,00,000	2,99,997	90,000	89,669
Other charges including equipment	35,62,000	35,61,991	8,00,000	7,99,984
Work	80,00,000	80,00,000	10,000	9,900
Other charges Including I.T	2,75,000	2,74,997		
Land Development	1,00,000	1,00,000		
Human Resources Development	13,000	12,600		
<b>Total</b>	<b>1,30,00,000</b>	<b>1,29,97,558</b>	<b>55,00,000</b>	<b>53,89,546</b>



### Crop Improvement

#### Cytogenetical research on Orchids

##### Biochemical analysis of orchids

About 113 orchid species were studied using the parameters- Total chlorophyll, Chlorophyll a, Chlorophyll b and Carotenoides. The results revealed significant variations within the species and the quantity of these pigments depend on the morphological characters of the species mainly on leaf structures, length and breadth of leaf, leaf colour, flower colour etc. On the basis of the leaf type all the species under study were grouped in two distinct groups.

Group -1 species with thick waxy small pale green leaves and Group -2 species with thin dark green leaf. The species belong to group-1 exhibits a very low amount of chlorophyll whereas the species of group 2 showed high chlorophyll contents.

Species with broad leaves showed high total chlorophyll content. All the species were grouped in three groups on the basis of flower colour. The species with flower colour white or pale yellow or cream showed low amount of carotenoides and grouped in group-1 whereas the species with bright yellow or orange or red flowers exhibits high carotenoid content belongs to group-2. Some of the species having flower colour purple exhibits medium range of pigment quantity and grouped in group -3. Genera wise analysis of each group of species on the basis of these characters is in progress.

##### Natural variation studies in *Cymbidium* Orchid

A natural variation in flower was observed in a *Cymbidium* Hybrid. Phenotypic variation was

characterized. One flower in the spike has double the floral parts i.e. two lips or labellum. sepals, lateral petals and column. Study on the genotypic variation is in progress. Similar variation was observed in the species *Cymbidium traceyanum* with a difference in the number of lip and the dorsal sepal only. The plant was characterized morphologically and genetic variation study is in progress.



Natural variation in flower shape of *Cymbidium* Hybrid with two lips



Natural variation in dorsal sepal of *Cymbidium traceyanum*

#### Breeding superior hybrids in *Cymbidium* and important orchids

Hybridization program was continued in *Cymbidium* and other important orchids. A total of 55 crosses in different combinations were initiated to produce the progeny. Pod setting was observed in maximum number of crosses. Different crosses done earlier were Inter Generic- 2, Inter specific- 3, Inter varietal (Hybrids)- 33, Inter wide- 4, Selfing- 13.

The progeny derived from the crosses made in orchids during past few years were at plantlet, hardening



and flower initiation stage. The characterization of hardened plants was initiated. The crosses under the different phases of hardening stages are mentioned below.

Cross	Stage
<i>Cattleya labiata</i> X <i>C. aurantica</i>	Plantlet
<i>Cym. Oriental Legend</i> X <i>Cym. Showgirl</i> "Cooksbridge"	
<i>Cym. Amesbury</i> X <i>Cym. Showgirl</i> "Cooksbridge"	
<i>Paphiopedilum lawrenceanum</i> X <i>P. Winston Churchill</i>	
<i>Cym. lowianum</i> X <i>Cym. Showgirl</i> "Cooksbridge"	Hardened
<i>Cym. Showgirl</i> "Cooksbridge" X <i>Cym. lowianum</i>	
<i>Cym. Showgirl</i> "Cooksbridge" Selfed	
<i>Renanthera imschootiana</i> X <i>Vanda</i>	
<i>Zygopetalum intermedium</i> Selfed	
<i>Zygopetalum intermedium</i> X <i>Arachnanthe cathcartii</i>	
<i>Epidendrum</i> selfed	
<i>Dendrobium nobile</i> X <i>Dendrobium nobile</i> var. Alba	Flower initiation stage

### In vitro propagation of Orchid: *Cymbidium* and important, rare and endangered species

#### Regeneration of protocorm from embryo

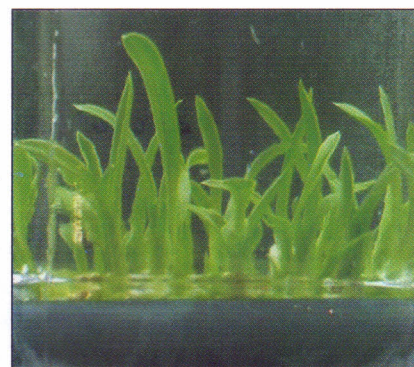
Immature embryos excised from mature green but unburst pods of 10 species and crosses cultured on MS, Nitsch, B5 and Knudson's C media supplemented with or without activated charcoal (AC), plant growth substances (BAP, NAA, Triacantanol and Paclobutrazol) and growth adjuvants (Yeast extract, malt extract, peptone, coconut water and banana pulp). Protocorms regenerated from three crosses/species. In *Cymbidium whitae*, the days taken for germination ranged from 13 to 100 days. Maximum germination was recorded on MS supplemented with 200 g/l of Yeast extract (YE). Addition of AC in the media improved plantlet growth and established better. The response for swelling in *Dendrobium* crosses varied from 3 days to 4 weeks followed by development of protocorm, shoot and root.

#### Regeneration of protocorm from shoot/root tip culture

The meristem excised from newly emerged shoot of pseudobulb of *Cymbidium* Star Guard Mc. Angel, Sleeping Nymph, Pine clash and Jung Frau Dos Pablos was cultured *in vitro* on Murashige and Skoog (MS) and Nitsch media. The protocorms were regenerated on MS with BAP 1 mg/l + 2,4-D 0.5 mg/l, BAP 1mg/l+ NAA 0.5 mg/l, Zeatin 0.25mg/l+ NAA 0.5 mg/l and Zeatin 0.25 mg/l+ 2,4-D 0.5 mg/l were separated and cultured for further proliferation and differentiation.

#### Influence of growth hormones on Plbs of *Paphiopedilum lawrenceanum* X *Paphiopedilum Winston Churchill* *in vitro*

Protocorms regenerated *in vitro* from embryo of *Paphiopedilum lawrenceanum* X *Paphiopedilum Winston Churchill*, were sub cultured on various media having different concentration of growth hormones for further multiplication and differentiation. The results showed that Plbs proliferation was the best on MS with 0.5mg/l of BAP and 0.25mg/l of AgNO<sub>3</sub>. The multiplication and differentiation into shoots was better on MS containing 0.5mg/l of BAP and 0.75mg/l of Tria, as it produced maximum number of shoots of well developed leaf and further growth.



Plantlet differentiation in *Cymbidium*

#### Influence of media for multiplication and growth

The Plbs developed through the embryo culture of *Dendrobium White* X *Dendrobium Pompadour* were again sub-cultured on different media for further multiplication and differentiation. The results revealed that Gamborg (B5) media supplemented with 1g/l of AC and 0.25mg/l each of BAP and AgNO<sub>3</sub> resulted in better multiplication of Plbs, whereas, the MS media



having the same growth hormone composition of 1g/l of activated charcoal and 0.25mg/l each of BAP and AgNO<sub>3</sub> recorded the well developed shoots, large sized pseudobulb and roots, survived 100% in *ex vitro* conditions.

### Crop production

#### Development of agro techniques for commercial scale production of orchids in open and protected condition

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

An experiment was carried out with 14 treatments consisting various growing media viz. T<sub>1</sub> - Perlite + Coco peat + Brick pieces, T<sub>2</sub> - Coco peat + Brick pieces + Leaf mould, T<sub>3</sub> - Perlite + Brick pieces, T<sub>4</sub> - Thermocol + Coco peat + Brick pieces, T<sub>5</sub> - Rotten log + Sand + Coconut husk + Brick pieces, T<sub>6</sub> - Cattus bark + Maize cob + Leaf mould, T<sub>7</sub> - Leaf mould + Sand + Brick pieces + Coconut husk + Charcoal (Farmer's practice) with foliar application of polyfeed viz. N<sub>1</sub> - NPK(19:19:19) 1 g/l - daily and N<sub>2</sub> - NPK(19:19:19) 1 g/l - weekly twice.

The experimental results (Fig 1) showed that plants grown in the media containing Rotten log + Sand + Coconut husk + Brick pieces and applied with 1g/l polyfeed weekly produced maximum number of leaves/plant (8.00) and largest pseudobulb (length=3.33cm and

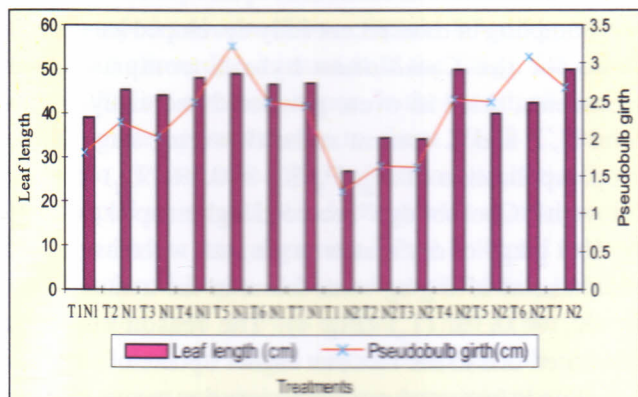


Fig 1. Effect of growing media and interval of nutrient spray on *Cymbidium*

girth=3.22cm) where as growing media containing Thermocol + Coco peat + Brick pieces with foliar spray of 1g/l polyfeed weekly twice produced maximum length of leaves/plant (50.03 cm).

##### To study shade requirement and interval of irrigation for growth and flowering of *Cymbidium*

An experiment was carried out to find out the shade and moisture requirement for growth of *Cymbidium*. The experiment consists of 16 treatment combinations comprising of Shade level - 0%, 30%,50% and 75% and moisture regime - 25 %, 50%, 75% and 100 %.The experimental result revealed that plants grown under 30% shade with 25% moisture regime resulted in maximum of leaves/ plant (7.67), leaf length (48.57cm) and number of pseudobulb (2) (Fig 2).

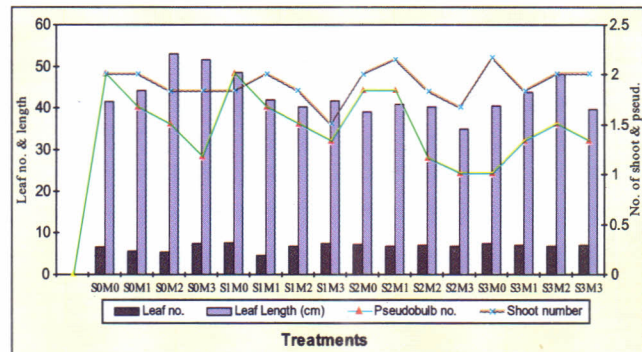


Fig 2. Response of *Cymbidium* to various shade and irrigation regime

(S<sub>0</sub>M<sub>0</sub> - Shade 0% + Moisture 25%, S<sub>0</sub>M<sub>1</sub> - Shade 0% + Moisture 50%, S<sub>0</sub>M<sub>2</sub> - Shade 0% + Moisture 75%, S<sub>0</sub>M<sub>3</sub> - Shade 0% + Moisture 100%, S<sub>1</sub>M<sub>0</sub> - Shade 30% + Moisture 25%, S<sub>1</sub>M<sub>1</sub> - Shade 30% + Moisture 50%, S<sub>1</sub>M<sub>2</sub> - Shade 30% + Moisture 75%, S<sub>1</sub>M<sub>3</sub> - Shade 30% + Moisture 100%, S<sub>2</sub>M<sub>0</sub> - Shade 50% + Moisture 25%, S<sub>2</sub>M<sub>1</sub> - Shade 50% + Moisture 50%, S<sub>2</sub>M<sub>2</sub> - Shade 50% + Moisture 75%, S<sub>2</sub>M<sub>3</sub> - Shade 50% + Moisture 100%, S<sub>3</sub>M<sub>0</sub> - Shade 75% + Moisture 25%, S<sub>3</sub>M<sub>1</sub> - Shade 75% + Moisture 50%, S<sub>3</sub>M<sub>2</sub> - Shade 75% + Moisture 75%, S<sub>3</sub>M<sub>3</sub> - Shade 75% + Moisture 100%)

### Nutrient Management in *Cymbidium* Hybrid

#### Studies on chemical composition of epiphytic orchids at flowering stage

Seven species of epiphytic orchids viz, *Dendrobium densiflorum*, *D. moschatum*, *D. aphyllum*, *D. chrysotoxum*, *D. fimbriatum*, *Luisia filiformis*, *Vanda cristata* were collected from the flowering orchid plant. The leaf samples were dried and analysed for nutrient



content by adopting standard procedure. The total nitrogen content of orchid species varied from 0.11% (*Vanda cristata*) to 0.28% (*Dendrobium fimbriatum*), the total phosphorus content varied from 0.11% (*Vanda cristata*) to 0.16% (*Dendrobium fimbriatum*), and the total potassium content varied from 0.57% (*Vanda cristata*) to 1.42% (*Dendrobium aphyllum*). (Fig 3)

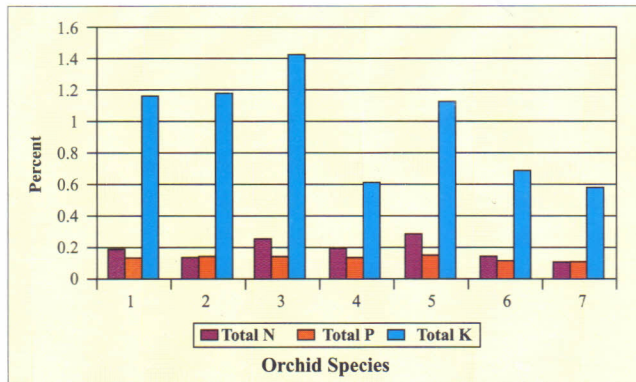


Fig 3. Total N, P and K content of Orchid Species

1-*Dendrobium densiflorum*, 2-*D. moschatum*, 3-*D. aphyllum*, 4-*D. chrysotoxum*, 5-*D. fimbriatum*, 6-*Luisia filiformis*, 7-*Vanda cristata*

### Determination of chemical composition of components of growing media

Different components of growing media like, Perlite, FYM, Coco peat, and Leaf mould were collected. The samples were air dried and analysed for nutrient content by adopting standard procedure. Among the components, FYM contained the highest amount of N, P, K, Ca and Mg of 0.87, 0.34, 1.54, 4.3, and 2.0 % respectively whereas perlite contained the lowest amount of above nutrients, 0.12, Trace, 0.07, 0.5 and 0.3 %, respectively (Table 1).

Table 1. Chemical composition of components of growing media

Total nutrient content (%)	Components of growing media			
	Perlite	FYM	Cocopeat	Leaf mould
Nitrogen	0.12	0.87	0.17	0.22
Phosphorus	—	0.34	0.03	0.10
Potassium	0.07	1.54	0.95	0.56
Calcium	0.5	4.3	2.7	3.2
Magnesium	0.3	2.0	1.32	1.8
Sulphur	0.08	0.18	0.12	0.24

### Determination of physical properties of components of growing media

Different components of growing media like, Perlite, FYM, Coco peat, and Leaf mould were collected. The samples were air dried and determined for various physical properties viz., Bulk density, Particle density, Total porosity and Maximum water holding capacity. Bulk density was found highest in FYM (0.4 gm/cm<sup>3</sup>) and lowest in Coco peat (0.09 gm/cm<sup>3</sup>). Particle density was found highest in FYM (0.90 gm/cm<sup>3</sup>) and lowest in Coco peat (0.25 gm/cm<sup>3</sup>). Total porosity was found highest in Coco peat (64%) and lowest in leaf mould (17.24%). Maximum water holding capacity was found highest in Coco peat (67.6%) and lowest in leaf mould (76.7%) (Table 2).

Table 2. Physical properties of components of growing media

Physical properties	Components of growing media			
	Perlite	FYM	Coco peat	Leaf mould
Bulk density (gm/cm <sup>3</sup> )	0.10	0.4	0.09	0.24
Particle density (gm/cm <sup>3</sup> )	0.26	0.9	0.25	0.29
Total porosity (%)	61.53	55.50	64.00	17.24
Maximum water holding capacity (%)	504.0	211.4	676.0	76.7

### Effect of foliar application of N-P-K on the uptake of nutrient by *Cym. Showgirl* "Cooksbridge"

Sampling of most recent fully developed leaves was done for the *Cymbidium* hybrid, comprising 13 treatments, dried in oven, powdered and analyzed for total N, P and K content at the flowering stage of the crop. Application of N<sub>20</sub>: P<sub>5</sub>: K<sub>5</sub> @ 0.3% (T<sub>12</sub>) to *Cym. Showgirl* "Cooksbridge" recorded highest uptake of total N, 10.1 g kg<sup>-1</sup> of dry matter in the leaf, whereas highest K-uptake of 15.0 g kg<sup>-1</sup> was found in the treatment N<sub>5</sub>: P<sub>5</sub>: K<sub>5</sub> @ 0.3% (T<sub>3</sub>) (Fig 4). The reason could be attributed due to the fact that higher uptake of nitrogen resulting in less uptake of potassium due to antagonistic effect of nitrogen on potassium.



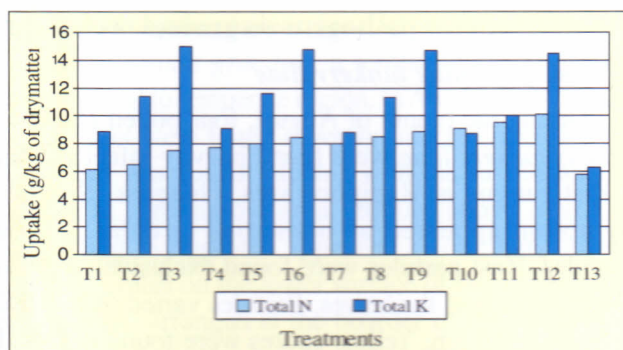


Fig 4. Uptake of nutrients by *Cym. Showgirl* "Cooksbridge"

T<sub>1</sub>=N<sub>5</sub>: P<sub>5</sub>: K<sub>5</sub> (0.1%), T<sub>2</sub>=N<sub>5</sub>: P<sub>5</sub>: K<sub>5</sub> (0.2%), T<sub>3</sub>=N<sub>5</sub>: P<sub>5</sub>: K<sub>5</sub> (0.3%), T<sub>4</sub>=N<sub>10</sub>: P<sub>5</sub>: K<sub>5</sub> (0.1%), T<sub>5</sub>=N<sub>10</sub>: P<sub>5</sub>: K<sub>5</sub> (0.2%), T<sub>6</sub>=N<sub>10</sub>: P<sub>5</sub>: K<sub>5</sub> (0.3%), T<sub>7</sub>=N<sub>15</sub>: P<sub>5</sub>: K<sub>5</sub> (0.1%), T<sub>8</sub>=N<sub>15</sub>: P<sub>5</sub>: K<sub>5</sub> (0.2%), T<sub>9</sub>=N<sub>15</sub>: P<sub>5</sub>: K<sub>5</sub> (0.3%), T<sub>10</sub>=N<sub>20</sub>: P<sub>5</sub>: K<sub>5</sub> (0.1%), T<sub>11</sub>=N<sub>20</sub>: P<sub>5</sub>: K<sub>5</sub> (0.2%), T<sub>12</sub>=N<sub>20</sub>: P<sub>5</sub>: K<sub>5</sub> (0.3%), T<sub>13</sub>=Control

## Crop Protection

### Investigation on fungal diseases of orchids

#### Monitoring the Occurrence of orchid wilt

Orchid wilt disease was monitored on different orchid hosts periodically and it was observed on species of *Dendrobium*, *Vanda*, *Acampe*, *Robiquetia*, *Phaius*, *Eria* and *Cymbidium pendulum* during period under report.

#### Studies on the survival of *Sclerotium rolfsii* in soil

All potting media of last year infected *Vanda* species (*V. stangeana*, *V. corulea*, etc) were collected and mixed well and kept in a bed throughout the year. In 2004, old stems pods, pseudostems of *Thunia* and *Vanda* were chopped and spread over the old infected potting media and allowed to interact with the fungi. This was done in the low cost poly house. In the month of June – July, when temperature rose to about 29-32 °C inside the house, *Sclerotium rolfsii* infection was noticed on the chopped stems and pseudobulbs with characteristic fan shaped white fungal growth. White coloured master shaped sclerotia were also seen on the stems, which later turned into brown colour. This experiment confirmed that *Sclerotium rolfsii* could survive in soil either in active growing condition or in sclerotial form. To confirm this, infected soil was taken and washed

with water through different grades of sieve and searched for the presence of sclerotia. Dark colour sclerotia were also recovered from the last year's old soil, which showed germination on PDA. This also further confirmed that the fungi survived in sclerotial form in soil.

#### Monitoring the Damping off/ shoot rot of *Dendrobium nobile*

**Symptom:** New shoots arising from the old plants were found infected with the damping off type of disease. The new shoot started rotting from the basal region, which continued upward and consequently the whole shoot die and defoliated. The shoot toppled on the potting medium. Sometime older shoots were also observed infected. The stem became gradually brown to black and the leaf started falling one by one and eventually the whole shoot get defoliated but the shoots remained standing straight. The fallen leaves gradually rotten started from petiole end towards tip. In pot, 1-5 shoots were found to be affected depending upon conditions. In wet weather, rotting was found faster and more frequent but in dry weather rotting was slower.

#### Isolation and characterization of the pathogen

Infected leaves were picked up, surface sterilized with 0.5% sodium hypochlorite solution for 1 minute, blotted dry and placed on 2% water agar plates and incubated at 20 ± 1 °C. After 4-5 days of incubation, plates were observed under microscope from the lower side of plate by inversion for the presence of sporangia. Hyphae were hyaline, coenocytic, thin, highly branched. Sporangia, hyaline, spherical, produced on simple unbranched hyphae like sporangiophore, mostly terminally but intercalary sporangia may also occurred. Sporangia were found abundant on 2% water agar at 20 °C. No oogonium and antheridium were found to produce on the same medium. Growth of the pathogen on 2% water agar was appeared to be very fast and within 4-5 days, whole petridish was covered with very thin long mycelial network. Based on the mycelial characters and sporangia, the pathogen was identified as *Phytophthora* sp. (ITCC No 5951.04). The pathogen also produced abundant sporangia, oogonia, and antheridia on infected host tissues during July to August.



**Monitoring the occurrence of black rot on orchids**

The disease was monitored on different orchid hosts periodically and it was observed on species *Cymbidium aloifolium*, *C. grandifolium*, *C. hookerianum* and *Cymbidium* hybrids such as *Cym. Bertha* "Petershort" and *Cym. Agnes Norton* "Shoe off".

**Monitoring the occurrence of anthracnose of Orchids**

Anthracnose pathogen was recorded on 32 species of 11 genera of orchids during 2004. Per cent infection in each species observed is given in Table 3.

**Table 3.** Occurrence of anthracnose (*Colletotrichum gloeosporioides*) on different species of Orchids

Sl No	Species of orchids	No. plant infected/ no observed	% Infection
1.	<i>Agrostophyllum brevipes</i>	2/2	100.00
2.	<i>Agrostophyllum callosum</i>	3/3	100.00
3.	<i>Agrostophyllum khasianum</i>	4/4	100.00
4.	<i>Agrostophyllum</i> sp.	5/7	71.43
5.	<i>Bulbophyllum guttulatum</i>	4/4	100.00
6.	<i>Coelogyne barbata</i>	2/4	50.00
7.	<i>Coelogyne cristata</i>	9/13	69.23
8.	<i>Coelogyne elata</i>	6/11	54.54
9.	<i>Coelogyne flaccida</i>	13/19	68.42
10.	<i>Coelogyne nitida</i>	22/37	59.46
11.	<i>Coelogyne flavida</i>	2/4	50.00
12.	<i>Coelogyne ovalis</i>	4/7	57.14
13.	<i>Cryptochilus sanguina</i>	3/3	100.00
14.	<i>Dendrobium densiflorum</i>	2/5	40.00
15.	<i>Dendrobium moschatum</i>	2/4	50.00
16.	<i>Eria amica</i>	18/30	60.00
17.	<i>Eria bamboosifolia</i>	4/4	100.00
18.	<i>Eria paniculata</i>	3/4	75.00
19.	<i>Eria pubescens</i>	3/15	20.00
20.	<i>Eria radiata</i>	8/8	100.00
21.	<i>Eria spicata</i>	2/5	40.00
22.	<i>Eria vitata</i>	3/8	37.50
23.	<i>Flickengeria eugax</i>	3/8	37.50
24.	<i>Liparis viridifolia</i>	8/10	80.00
25.	<i>Liparis longipes</i>	18/22	81.82
26.	<i>Liparis plantaginea</i>	11/14	78.57
27.	<i>Pholidata articulata</i>	8/10	80.00
28.	<i>Pholidata rubra</i>	3/4	75.00
29.	<i>Thelasis longifolia</i>	3/3	100.00
30.	<i>Vanda coerulea</i>	6/6	100.00
31.	<i>Vanda cristata</i>	8/15	53.33
32.	<i>Vanda stangeana</i>	8/11	72.73

**Monitoring rust pathogens on ground orchids**

**i) Rust of *Phaius tankervilleae***

During the month of August, four potted plants of *Phaius tankervilleae* were found heavily infected with a rust fungus at Ranipool area, Gangtok, Sikkim. Symptom appeared as numerous circular yellow pustules. Rust pustules were found exclusively on the lower surface of the leaves. Pustules varied from 0.1X 0.1- 0.6 x 0.8 cm. Yellow spores were found in raised mass at the boarder of the pustules but the centres appeared as brown to black crater like rupture depression. The spores appeared as very loose and dusty

yellow spores could be noticed with a slight shaking of infected plant. Every leaf of severely infected plant covered with thousand of pustules. Rust pustules were also recorded on the leaf petioles, stems and uncovered pseudobulbs but severity was more on leaves.

In another survey in the month of September 2004 around Pakyong, the same rust disease was also found to infect *Phaius tankervilleae* at Nancheyping (1250m above MSL). The disease was also recorded to infect *Phaius tankervilleae* in the month of December 2004 in the hill of Darjeeling (2100m above MSL). Rust was identified as *Uredo* sp. on *Phaius tankervilleae* seemed to be a new host of this fungus.



**ii) Rust of *Anthogonium gracile***

*Anthogonium gracile*, a terrestrial orchid grown from tropical to temperate region. In August 2004, leaves of the plant were found severely infected by new rust. The plant was found infected with the rust in natural habitat at Jorbunglow area (2000m above MSL) of Darjeeling. Symptoms appeared as circular, orange colour pastules on the lower surface of the leaves. Rust spores were arranged at the boarder of the pastules in sticky raised, orange mass but the centres appeared as black crater like raptures. Pastules varied in size from 0.1-0.2 cm. Thousands of isolated pastules scatteredly distributed throughout the leaves. Sometimes several pastules were found coalesced covering major leaf areas at the tip. Severely affected leaves dried out and remained hang down. The rust was provisionally identified as *Coleosporium* sp. Rust on *Anthogonium gracile* was not reported earlier in the world. This seems to be a new disease on this host.

**iii) Leaf Rust of *Herminium angustifolium***

*Herminium angustifolium*, a herbaceous terrestrial orchid grown in temperate region. In rainy season of 2004 (July -August) the leaves of this orchid plants were found infected severely with an unreported rust in natural habitat at Jorbunglow hill (2000 m above MSL), Darjeeling. Symptom on leaves appeared as elongated rapture orange pastules mainly on the lower surface. Some pastules were oval shaped. Pastules varied from 0.1 X 0.1- 0.1-0.5 cm. Severely infected leaves started drying from tip and completely dried leaves remained hanged down. Pastules were also observed on stem and inflorescences stalk. The rust was provisionally identified, as *Coleosporium* sp. (may be *Coleosporium merillii* Henn.). Rust of *Herminium angustifolium* seems to be a new report.

**iv) Rust of *Calanthe trulliformis***

Rust of *Calanthe trulliformis* appeared as small pinhead brown/orange colour dots on the lower sides of young leaves, which enlarged into larger pastules. Pastules varied from 0.1-0.5 x 0.1 -1 cm. Sometimes several spots coalesced and cover major leaf areas. Mostly young tender leaves were infected. Infection at

the leaf tips were found to be more and coalesced but the stalk end of the leaf was found to be less infected and the pastules were isolated and scattered. Orange coloured pastules were also noticed on the flower stalks as well as sepals and petals of opened flowers.

**v) Rust of *Calanthe discolor***

Rust of *Calanthe discolor* appeared more or less similar but orange colour pastules were scattered throughout the leaf lamina, mostly on the lower surface. Pastules varied from 0.1-1.0 X 0.1-3.0 mm.

**vi) Rust of *Calanthe plantaginea***

At initial stage the pastules on *Calanthe plantaginea* appeared identical to those of *Calanthe trulliformis* and *C. discolor* but later the spots appeared larger in size. Pastules on *C. plantaginea* were mostly circular or oval and pastules varied from pinhead dot to 1.2 cm in diameter. The urediospores were found arranged at the boarder of the pastules as a raised mass but the centres were later turned to dark brown to dark. Pastules were mostly isolated and distributed scatteredly on the lower parts of the leaf lamina but pastules coalesced covering major areas of leaf lamina at the tip and infected leaf later turned brown to black and dried. The rust pathogen was identified as *Uredo* sp.

**Management of Black rot of *Cymbidium* with fungicides**

An experiment was laid out in the farmer's field for the management of black rot of *Cymbidium* with six fungicidal treatments [Metalaxyl (0.1%), Indofil M 45 (0.2%), Dithane Z 78 (0.2%), Carbendazim (0.2%), Thiophanate methyl (0.1%) and Control (water)] with three replications. Each replication consisted of 5 pots and spraying was given as soil drenching at an interval of 15 days as follows 13.7.04, 28.7.04, 12.8.04, 27.8.04, 11.9.04 and 26.9.04. Disease incidence was recorded at 15 days intervals. It was observed that treatment Metalaxyl (0.1%), Carbendazim (0.2%), Thiophanate methyl (0.1%) resulted in least incidence of Black rot. (Fig 5)



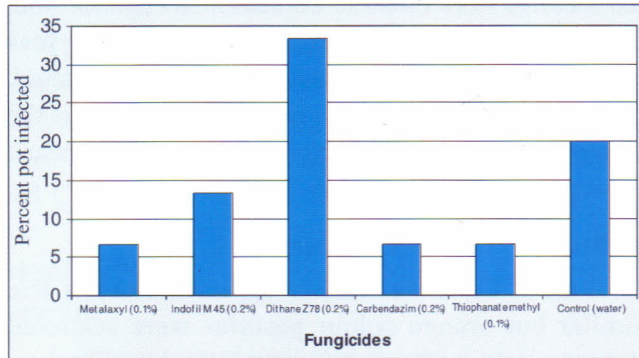


Fig 5. Incidence of black rot in different treatments of fungicides

### Indexing of virus infecting orchids

About 100 orchid samples including hybrids and species of 21 genera were tested using ELISA, RT-PCR, Slot Blot Hybridization techniques. Among these *Cym. Jangfrau "Dos Pablos"*, *Cym. San Francisco "Delrio"*, *Den. White*, *Den. Pompora*, *Den. Sakura*, *Vanda cristata*, *Dendrobium densiflorum*, *Phaius mishmensis*, *Papilionanthe teres*, *Cymbidium traceyanum*, *C. grandiflorum*, *Dendrobium aggregatum*, *D. pierardii*, *D. acinicipformae*, *Straupsis undulata*, *Liparis longipes* were found infected with Cymbidium Mosaic Virus (CyMV). Whereas Odontoglossum Ring Spot Virus (ORSV) was detected on *Cym. Arabian Night*, *Cym. Jangfrau "Dos Pablos"*, *Cym. San Francisco "Delrio"*, *Cym. Red Star*, *Cym. Hawtescens*, *Cym. Show girl "Cooksbridge"*, *Cymbidium traceyanum*, *C. tigrinum*, *C. grandiflorum*, *C. elegans*, *C. lowianum*, *C. iridioides*, *C. devonianum*, *C. pendulum*, *C. aloifolium*, *Dendrobium nobile*, *D. densiflorum*, *D. aphyllum*, *D. primulinum*, *D. moschatum*, *D. ochreatum*, *D. chrysanthum*, *D. chrysotoxum*, *D. pierardii*, *D. acinicipformae*, *D. transparens*, *D. eriaeflorum*, *Den. White*, *Den. Pompora*, *Den. Sakura*, *Paphiopedilum venustum*, *P. villosum*, *P. hirsutissimum*, *P. fairrianum*, *Vanda coerulea*, *V. stangeana*, *V. cristata*, *V. parviflora*, *V. parishii*, *Aerides multiflorum*, *A. odoratum*, *A. fieldengii*, *Bulbophyllum ornatissimum* and *Phaius tankervilliae*.

## Pest management in orchids and bulbous flowering plants

### Aphid fauna on orchids

Three aphid species viz., *Macrosiphum* sp., *Macrosiphum rosae* and *Toxoptera aurantii* recorded on orchid hosts. Yellow aphid *Macrosiphum* sp. found to infest *Vanda cristata*, *Acampe papillosa*, *Dendrobium nobile*, *Goodyera procera*, *Epidendrum radicans* and *Cymbidium* hybrids. Rose aphid *Macrosiphum rosae* recorded to infest *Cymbidium* hybrids. Black aphid *Toxoptera aurantii* have been recorded on *Cymbidium lowianum*, *Oncidium Gower Ramsay*, *Dendrobium densiflorum*, *Cymbidium* and *Dendrobium* hybrids. Both nymph and adults of aphid suck the sap from spike and flower. High humidity and cloudy weather fasten the population build up. Affected plants retard growth and flower quality affected.



Yellow aphid on *Cymbidium*



Black aphid on *Cymbidium*

### Monitoring of different pests on orchids

Orchids are subject to attack by various kinds of pests. A clean, airy environment with optimum humidity, suitable temperature is certainly conducive to the well



being of plants but not an absolute guarantee to be free from pests. Even under best conditions pest may attack the plants and only constant and attentive vigilance can keep the pests at bay. The major pests, orchid hosts and plant portion damaged and duration of occurrence are given below (Table 4).

Table 4. Occurrence of different pests on orchids hosts

Sl. No.	Name of pest	Orchid infested	Plant portion damaged	Duration of occurrence
1	Scale			
i.	<i>Pinnaspis buxi</i>	<i>Cymbidium</i> hybrids and species	Leaf/ petiole/ pseudobulb	Round the year
ii.	<i>Coccus hesperidum</i>	<i>Paphiopedilum hirsutissimum</i> , <i>Liparis</i> sp., <i>Papilionanthe</i> sp.	Leaf/ pseudobulb/ spike/ flower	Round the year
iii.	<i>Lecanium</i> sp.	<i>Phaius flavus</i> , <i>Epidendrum</i> sp. <i>Dendrobium hookerianum</i>	Stem/ spike	Round the year
iv.	<i>Chrysomphalus aeneidum</i>	<i>Cymbidium</i> sp.	Leaf	Round the year
v.	<i>Diaspis boisduvalii</i>	<i>Cattleya</i> hybrid	Leaf/ petioles/ root	Round the year
vi.	Black scale	<i>Renanthera imscotiana</i>	Shoot	Round the year
2.	Mite <i>Tetranychus urticae</i>	<i>Cymbidium</i> species and hybrids, <i>Dendrobium moschatum</i>	Leaf/ flower	March to September
3.	Aphid			
i.	<i>Macrosiphum</i> sp.	<i>Vanda cristata</i> , <i>Acampe papillosa</i> , <i>Dendrobium nobile</i> , <i>Goodyera procera</i> , <i>Epidendrum</i> sp., <i>Cymbidium</i> hybrids	Leaf /bud/ flower	Round the year/ when flowering occur
ii.	<i>Toxoptera aurantii</i>	<i>Cymbidium lowianum</i> , <i>Oncidium</i> Gower Ramsay, <i>Dendrobium densiflorum</i>	Flower bud/ flower	January to June
4.	Shoot borer (Black moth) <i>Peridaedala</i> sp.	Many species of <i>Dendrobium</i> , <i>Acampe</i> , <i>Aerides</i> , <i>Eria</i> , <i>Arachnanthe</i> , <i>Ascocentrum</i> , <i>Epidendrum</i> , <i>Liparis</i> , <i>Vanda</i>	Shoot	Rainy season
5.	Mealybug <i>Pseudococcus maritimus</i>	<i>Phaius flavus</i> , <i>Phaius tankervilleae</i> , <i>Cattleya</i> hybrid	Leaf/ flower	Round the year
6.	Black weevil <i>Sipalinus</i> sp.	Species and hybrids of <i>Cymbidium</i> , <i>Dendrobium</i> , <i>Phaius</i> , <i>Coelogyne</i>	Leaf/ shoot/ pseudobulb	Rainy season
7.	Grasshopper	<i>Cymbidium</i> hybrid	Leaves/ buds/ flower	Onset of monsoon
8.	Lepidopteran caterpillar	<i>Cymbidium</i> , <i>Cattleya</i> , <i>Thunia</i>	Buds/ flower	Post monsoon
9.	Snail <i>Cryptaustenia verrucosa</i> and <i>C. heteroconcha</i>	Many species and hybrids	Pseudobulb/ leaf/ flower	Rainy season

### Evaluation of *Cymbidium* species for insect resistance

Seventeen species of *Cymbidium* were evaluated for insect resistance. Out of which *Cymbidium devonianum* and *C. tracyanum* were found susceptible to scale insects, *C. elegans* and *C. ensifolium* to grasshopper, *C. tracyanum* to mite, while *C. lowianum* was infested with black aphid. Remaining *Cymbidium* species were found resistance to insect. Hence the resistant species can be incorporate into breeding programme.

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

Six growing media viz., bare rooted plants (Aeroponics), tree fern, wooden log, mixed media, coconut husk, coco peat were tested against the pest incidence of *Peridaedala* sp. on *Dendrobium nobile*. The results showed that shoot borer damage was least where plants were grown in media coconut husk followed by bare rooted plants and coco peat. However *Peridaedala* sp. damage was at par in media tree fern, wooden log and mixed media (Fig 6).



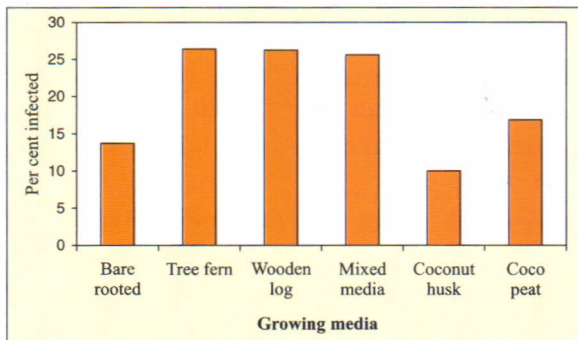


Fig 6. Shoot borer *Peridaedala* sp. infestation on *Dendrobium* grown on different media

**Management of black weevil *Sipalinus* sp.**

Six insecticides viz., metacid, econeem, chlorpyrifos, imidacloprid, dimethoate and monocrotophos were tested against black weevil on *Cym.* H. C. Aurora under low cost polyhouse. The results showed that treatment of dimethoate 30 EC 2ml/l and chlorpyrifos 20 EC 2.5 ml/l resulted in less number of shoot damage (Fig 7).

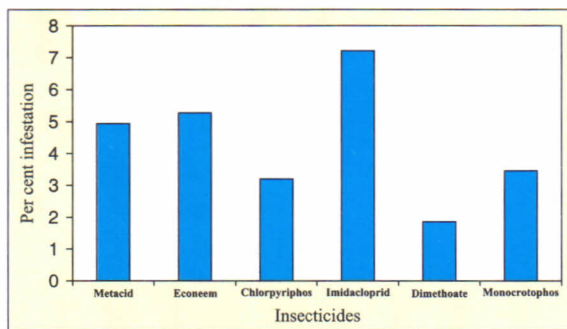


Fig 7. Effect of Insecticidal spray against black weevil on *Cym.* H. C. Aurora

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

Four insecticides viz., phosalone, econeem, chlorpyrifos, and monocrotophos were tested against shoot borer *Peridaedala* sp. on *Dendrobium nobile* under low cost polyhouse. The results showed that treatment of econeem (10000ppm) 2.5ml/l and chlorpyrifos 20 EC 2.5 ml/l lessen the shoot borer damage.

**Evaluation of bulbous ornamentals for pest damage**

Thirty-four bulbous ornamentals were evaluated. It was observed that grasshopper damage to some

ornamentals by feeding on leaves and flower viz., *Agapanthus africanus*, *Amaryllis bellaona*, *Crinum* sp., *Crocsmia aurea*, *Eucaris amazonia*, *Gladiolus calianthus*, *Hemanthes multiflorus*, *Iris pallida*, *Iris* sp., *Polyanthes tuberosa*, *Zantedeschia oculata*, *Zantedeschia elliotiana*. Black scale was recorded on *Iris japonica* and green aphid on *Zantedeschia elliotiana* and *Z. oculata*. While remaining bulbous ornamentals were found free from pest.

**Darjeeling campus**

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

**Collection**

Two explorations were conducted to collect the orchids from natural habitat occurring in the district of Darjeeling. The exploration resulted in adding one new species of *Calanthe* (not identified), one species of *Coelogyne* (not identified) to the previous collection. One species *Paphiopedilum fairrieianum* have been added to the collection by procuring the plants from local nursery. Apart from wild species, 3 new *Cymbidium* hybrids have been procured and added to the previous collection. An alba form of *Coelogyne cristata* that has been described as *Coelogyne cristata* var. *hololeuca* has also been introduced. It is a very rare form of *Coelogyne cristata* and reports on collection of this species exist in the locality.

**Evaluation**

The species evaluated in the current year include *Cymbidium ensifolium*, *C. lowianum*, *C. traceyanum*, *C. elegans*, *C. gammieanum* and *C. devonianum*. Species *Cymbidium eburneum*, *C. tigrinum* and *C. iridoides* did not flowered this year. Among the *Paphiopedilum* species, *Paphiopedilum insigne*, *P. villosum*, *P. farrieianum* and *P. spicerianum* have been evaluated. Among *Pleione* species, *Pleione hookeriana*, *P. humilis* have been evaluated. Similarly, other species which came in to flowering, have been evaluated.



### Multiplication

The old and mature pseudobulbs of sympodial orchids are generally not detached from the plant, these dry and wither on the plant itself. The pseudobulbs of different orchids were removed and planted in sand/sphagnum moss produced plantlets. Thus the orchids could also be multiplied by old unused bulbs. In a preliminary study the old pseudobulbs of *Calanthe yokshmensis*, a terrestrial orchids were soaked for 24 hrs in varying concentrations of Cytokinins (BAP). BAP at lower concentration (less than 200 ppm) is useful forcing dormant buds to sprout. The best results obtained by 100 ppm.



Multiplication of orchids by bulbs

### Maintenance

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

### Collection, conservation, evaluation and multiplication of bulbous ornamental crops

#### Collection

This year 16 cultivars of Asiatic lily and one cultivar of Oriental lily have been added to the previous collection

The collected hybrids of liliium are: Andiew, Best seller, Brunello, Casa Bella, Elite, Guronde, Modern Style, Real Time, San Palbo, Time less, Val Desele, Valdi sole, Warm welcome, Black out, Lime star, Novona, and Pollyanna. Apart from Asiatic lilies one more cultivar of hycinthus (unnamed) have collected and maintained at the campus.

### Evaluation

The newly added cultivars would be planted for evaluation.

### Studies on bulb production of liliums

#### Effects of Ethylene concentration and soaking time on growth and development of Asiatic lily cultivar 'Nove Cento'

The experiment did not yield the results as expected (ethylene treatment results from Easter lily) but soaking of bulbs for 36 hours in a solution of 500 ppm increased the bulb weight 264.54%. The soaking of bulbs in a solution of similar strength increased weight by 226.82 per cent. The contrary results from previous experiment (Easter lily) might be due to developmental stage of bulbs. It seems ethylene acts in different way on sprouted and dormant bulbs.

#### Effect of growth regulators on propagation of Asiatic lily cultivar 'Nove Cento' trough bulb scales

The scales of Asiatic lily cultivar 'Nove Cento' were treated with auxins (IBA, IAA, NAA) at concentrations ranging from 100 to 500 ppm. The scales were planted in coco peat during the month of April 04. The Maximum numbers of bulblets (2.76/ per scale) were obtained from IBA 100 ppm followed by IAA 200 ppm (2.59 bulblet/scale), and IBA 300 ppm (2.49 bulblets/ scale). From untreated bulb scale (control) only 1.1 bulblets/ scale were obtained. The size of bulblets also varied with the treatment. The largest size (0.64 gm)of bulblets were obtained from the scale treated with 500 ppm followed by NAA 300 ppm (0.49 gm/ bulblet) IAA 300 ppm ( 0.43 gm/bulblet). The least average weight per bulb scale was recorded from bulbs



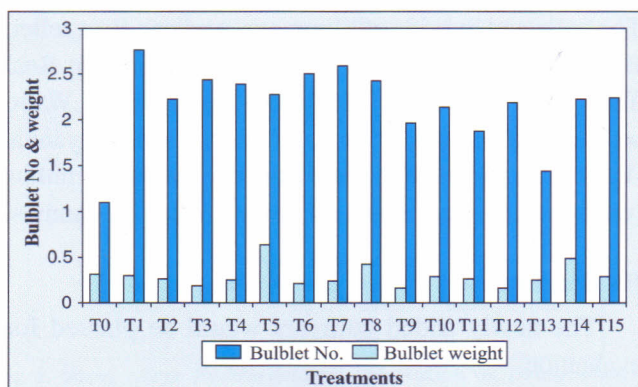


Fig 8. Effects of growth regulators on bulb production of 'Nove Cento' through scales

T0=Control, T1=IBA 100, T2=IBA 200, T3=IBA 300, T4=IBA 400, T5=IBA 500, T6=IAA 100, T7=IAA 200, T8=IAA 300, T9=IAA 400, T10=IAA500, T11=NAA100, T12=NAA200, T13=NAA300, T14=NAA400, T15=NAA500

treated with NAA 400 ppm and IAA 400 ppm (0.16) followed by NAA 100 ppm (0.18 gm/ bulb scale) (Fig 8)

### Standardization of potting mixture for propagation of Asiatic Lily cultivar 'Nove Cento'

The detached scales of 'Nove Cento' were planted in 13 different cutting media viz. (i) FYM (ii) Leaf mould (iii) saw dust, (iv) coco peat (v) perlite (vi) and their combinations. The maximum number of bulblet /scales was obtained from coco peat (3.39 bulblet per scale) followed by leaf mould (3.29 bulblet/ scale), 1 part perlite (3.19), 1 part perlite and 2 part leafmould (3.15). The least number of bulblets were obtained from sand and leaf mould combination (2.19 bulblet per scale). The average weight of the bulblets also found to be affected by different medium. Sand and leaf mould in 1:1 ratio (v/v) produced largest size (0.36 gm) of bulblets followed by FYM (0.30 gm) and perlite and FYM in 1:1 ratio (0.29). A combination of perlite and leaf mould in 1:1 ratio produced smallest size of bulblets (0.19 gm) (Fig 9)

### Effect of growth regulators on production of stem bulbs in Asiatic lily cultivar 'Nove Cento'

The flowers of liliium were harvested at maturity leaving 15 cm above the ground. Thereafter, 8-10 leaves

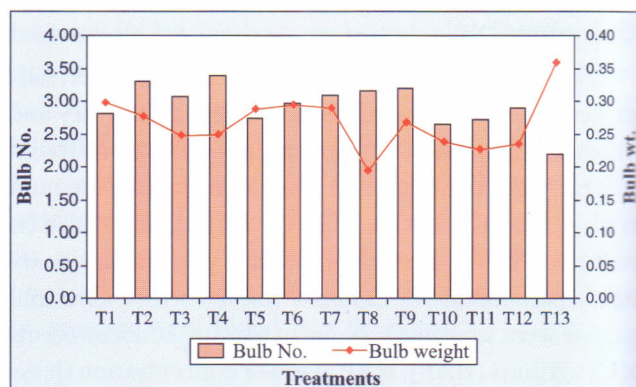


Fig 9. Standardization of potting mixture for propagation of Asiatic Lily cultivar 'Nove Cento'

T1- FYM, T2 -Leafmould, T3- Saw dust, T4 -Coco peat, T5- Perlite:FYM(1:1), T6- Perlite:FYM(1:2), T7-Perlite:FYM(1:4), T8-Perlite:Leafmould(1:1), T9- Perlite:Leafmould(1:2), T10-Perlite:Leafmould(1:4), T11-Sand: Leafmould(1:1), T12- Sand: Leafmould(1:2), T13-Sand: Leafmould(1:4)

were removed and the exposed stems were covered with soil. Hereafter, at every 15 days interval various growth regulators applied at different concentrations. The bulbs harvested when started showing yellow color. Maximum (4.23) average number bulblets were obtained from IAA 500 followed by IBA 500 ppm (4.18), Ethylene 100 ppm (4.14) and ethylene 300 ppm (3.85). The least number of bulblets were obtained from Kinetin 100 ppm (2.10). The average weight of the bulblets produce on the stem also varied with the treatment. The largest size of bulblets were obtained from IAA (1.59) followed by ethylene 200 ppm (0.68)

### Effect of ethylene concentration and soaking time on propagation of Asiatic Lily cultivar 'Brunello'

The bulbs of Asiatic lily cultivar 'Brunello' were soaked in a solution containing varying ethylene concentration for different time of intervals to optimize soaking time and ethylene concentration for maximization of bulb production. The maximum number (10.4) of stem bulblets was obtained by soaking bulbs for 24 hrs in solution containing 1500 ppm ethylene. The soaking of the bulbs at this concentration more than 24 hrs reduced number of bulblets. The concentration of ethylene more than 1500 ppm was found to reduce the number stem bulblets.



Externally funded Projects

NATP

Sustainable management of plant biodiversity - Collection, evaluation, maintenance of orchids and ornamental plant germplasm from NEH Region

Exploration, collection and characterization

During the year 4 explorations were undertaken in Sikkim, Nagaland and Arunachal Pradesh. Collected over 350 accessions of orchids and 18 accessions of bulbous and other flowers. From North Sikkim District of Sikkim the species collected documented *Agrostophyllum* 1, *Bulbophyllum* 13, *Coelogyne* 6, *Cymbidium* 22, *Dendrobium* 19, *Eria* 4, *Goodyera* 3, *Liparis* 2 and *Otochilus* 1. Besides these, 2 accessions each of *Rhododendron*, *Hedychium* and *Iris* were also collected. The accessions from Kohima and Peren Dist. of Nagaland are *Aerides*, *Bulbophyllum*, *Bletilla*, *Calanthe*, *Cleisostoma*, *Coelogyne*, *Cymbidium*, *Dendrobium*, *Epigenium*, *Eria*, *Liparis*, *Luisia*, *Oberonia*, *Otochilus*, *Pholidota*, *Thunia*, *Vanda*, etc. The species wise accessions are 28 accessions of *Dendrobium*, 1 of *Pleione*, 3 of *Oberonia*, 2 of *Pholidota*, 7 of *Bulbophyllum*, 4 of *Epigenium*, 16 of *Eria*, 1 of *Calanthe*, 4 of *Luisia*, 1 of *Thunia* and 13 of *Vanda* collected from different altitudes, soils, forest types and topography. The accessions from the Upper and Lower Subansari District of Arunachal Pradesh belong to 32 genera and 158 accessions. These are *Aerides* 4, *Agrostophyllum* 1, *Arachnis* 2, *Anoectochilus* 1, *Arundina* 1, *Anthogonium* 3, *Bulbophyllum* 15, *Calanthe* 9, *Coelogyne* 5, *Cleisostoma* 2, *Cryptochillus* 1, *Cymbidium* 13, *Dendrobium* 17, *Epigenium* 1, *Eria* 23, *Flickengeria* 1, *Gastrochilus* 2, *Goodyera* 7, *Liparis* 4, *Oberonia* 1, *Ornithochillus* 1, *Otochilus* 5, *Phaius* 2, *Pholidota* 4, *Pleione* 1, *Retie* 2, *Saccolobium* 1 and *Vanda* 6. Besides, 6 accessions of *Hedychium*, 7 other ornamental and 1 accession of wild cardamom were also collected. The summary of collected accession is given in Table 5.

The accessions collected are being maintained in the National active germplasm site for orchids at National Research Centre for Orchids. About 171 accessions characterized for eighteen important morphological and floral characters, 17 accessions of bulbous flowers were characterized for 10 morphological characters.

Table 5. Summary of collection programmes, collaborator and accessions collected

Sl. No	Collaborator	Areas explored	Accessions	Orchids	Other ornamentals
1	NRCO+ ICARRC	Kohima and Peren Dist. Of Nagaland	116	115	1
2	NRCO	North Sikkim	77	71	6
3	NRCO+ ICARRC	Upper and Lower Subansari of Arunachal Pradesh	165	154	11
4.	NRCO+ ICARRC	Kohima of Nagaland	10	10	-
Total accessions collected			368	350	18

Orchid biodiversity collected and maintained



*Eria javonica*



*Eria spicata*



*Phaius tankervilleae*



*Acampe rigida*



*Vanda pomila*



*Dendrobium densiflorum*



## Protected cultivation of vegetables and flowers in Plains and Hills

### Effect of various media, moisture regime and chemicals on growth and flowering of Rose cv. First Red

An experiment was carried out with 13 modular treatments distributed in the randomized block design with three replications. The experimental results showed that floral characters of Rose cv. First Red improved when the plants were grown in the media consisting of 2 soil: 1compost: 1coco peat supplemented with basal dose of NPK @ 200:320:300 kg/ha/yr. under 20 kPa irrigation regime and supplied with 200 and 300 kg N and K/ha/yr., respectively through fertigation (water soluble fertilizers), spraying of polyfeed + micronutrients (2 g/l) at monthly interval from September to January + bending 6 weeks after planting (M-2). Same treatment also exhibited longest vase life of flowers. Flower yield in respect of number of flowers/m<sup>2</sup>/yr. was the maximum (135) when media combination was 2 soil:1compost:1 coco peat at 40 kPa irrigation regime keeping all other inputs the same (M-5).

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

An experiment was conducted to study the effect of growing media, nutrients and plant growth regulators. This experiment was consisted of 11 treatments in modular form and replicated five times in completely randomized block design. The module 1 was the farmers'

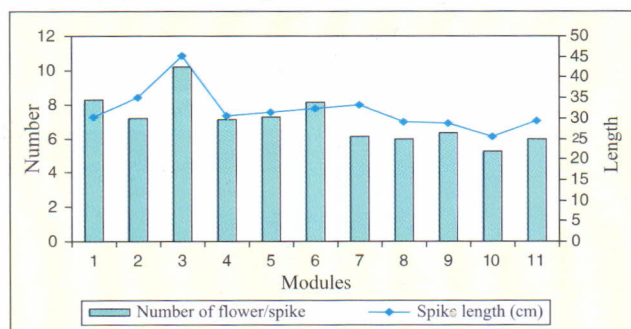


Fig 10. Flower yield and spike length as influenced by different modular treatments

practice. It was recorded maximum spike length (45.15 cm) and number of flower/spike (10.20) from M- 3 which was comprised of growing media containing Leaf mould + FYM + Charcoal+ Coconut husk + rotten logs (2:1:1:1:1) and spraying with N 200 ppm P 100 ppm K 100 ppm+ BA 100 ppm & GA<sub>3</sub>100 ppm (Fig 10).

## Technology Mission

### Technology Mission on Integrated Development of Horticulture in North Eastern States including Sikkim, Uttranchal, H. P. and J. & K. (Mini-Mission I)

#### Activity 1. Development of conventional and micro propagation techniques

#### Effect of silver nitrate on protocorm of Cymbidium hybrids

The morphogenetic response of different concentration of AgNO<sub>3</sub> for *in vitro* multiplication of Cym. Lunavian Atlas and Cym. Showgirl "Cooksbridge" revealed that Cym. Lunavian Atlas responded better as it produced maximum number of Plbs, shoot and roots at a rapid pace. The Plbs multiplication was better at 4mg/l as it produced maximum number of Plbs and shoot differentiated early. Early shoot emergence and maximum roots obtained at 3mg/l (Fig. 11). Thus, for *in vitro* multiplication of Cym. Showgirl "Cooksbridge" required higher concentration of AgNO<sub>3</sub>. While this can be achieved at 3.5-4mg/l in Cym. Lunavian Atlas.

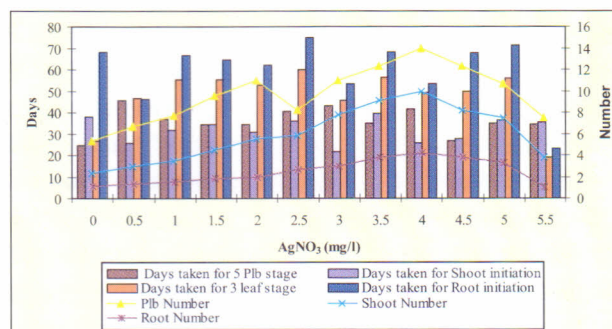


Fig 11. Influence of different concentration of AgNO3 on Plbs differentiation



**Response of *Cym. Showgirl* "Cooksbridge" plbs to coconut water**

The Plbs of *Cym. Showgirl* "Cooksbridge" subcultured on Murashige and Skoog and Nitsch media containing with or without AC supplemented with various concentration of coconut water. The observations revealed that Nitsch found most suitable for fastest multiplication rate and formation of maximum number of protocorm. Early shoot, leaf and root emergence and more number of shoot and roots differentiation was also recorded. AC has a profound influence on Plbs differentiation by producing maximum number of protocorm, shoot and root, at fastest multiplication rate besides, early shoot, leaf and root initiation (1g/l). The number of Plbs, shoots and roots increased with the increase in coconut water, and maximum number plbs obtained on media containing 300 ml/l. However, at 100ml/l the multiplication rate was rapid with early shoot, leaf and root emergence. The interaction of coconut water and AC revealed that, incorporation of AC in the media was better for Plbs multiplication, as it favors early root initiation. The results revealed that Nitsch with 1g/l of AC and 300ml/l of coconut water was the best in producing maximum number of Plbs, shoots and roots, however, lower concentration of coconut water (100ml/l) induced rapid Plbs multiplication, early shoot, leaf and root initiation.

**Influence of growth adjuvant on proliferation of *Cym. Showgirl* "Cooksbridge"**

Due to expensive growth promoting substances used for regeneration and growth, tissue culture propagation is costly affair. To minimize the cost, studies were carried out with three types of growth adjuvants viz., Yeast extract, Peptone and Malt extract at various concentration using Plbs of *Cym. Showgirl* "Cooksbridge" obtained from the meristem culture.

The data revealed that, maximum number of Plbs was obtained on Yeast extract, however, shoot and root number was more on media containing Peptone. The rapid Plbs multiplication, shoot and root initiation and early leaf emergence was also attributed to the media containing Yeast extract. Among different concentration

of growth adjuvant, maximum Plbs, shoot and root were obtained on media containing growth adjuvant at 300mg/l (Fig. 12) besides rapid multiplication of Plbs. Whereas the shoot, leaf and root initiation was fastest at 200mg/l. The interaction between the growth adjuvant and concentration showed that maximum number of shoots and roots obtained on YE at 300mg/l. However, the early emergence of shoots, leaf and root was early on YE at 200g/l.

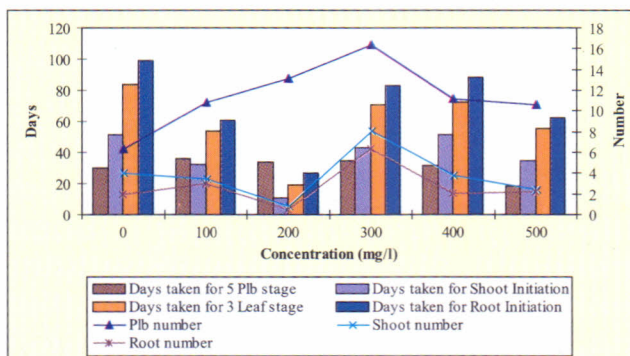


Fig 12. Influence of different concentration of growth adjuvant on plbs differentiation

**Influence of growth adjuvants on proliferation of *Cym. Lunavian Atlas***

The influence of growth adjuvants on proliferation and growth of protocorms in Murashige and Skoog media with activated charcoal (1g/l) revealed that, maximum Plbs, shoot and root obtained on Yeast extract, however, shoot and root initiation and early leaf emergence observed on media containing Peptone extract. Mean influence of different concentration of the growth adjuvant revealed that, maximum number of Plbs was observed in media containing 300mg/l of growth adjuvant, whereas, shoot and root number was maximum in media containing growth adjuvant 400mg/l (Fig 13). Fastest multiplication of the Plbs recorded on media containing 300mg/l of growth adjuvant. However, the shoot, leaf and root initiation was fastest at a concentration of 100mg/l. The interaction between the growth adjuvant and their concentration showed that maximum Plbs obtained on media containing 300g/l of YE, however, shoot and root number was more at 400g/l YE.



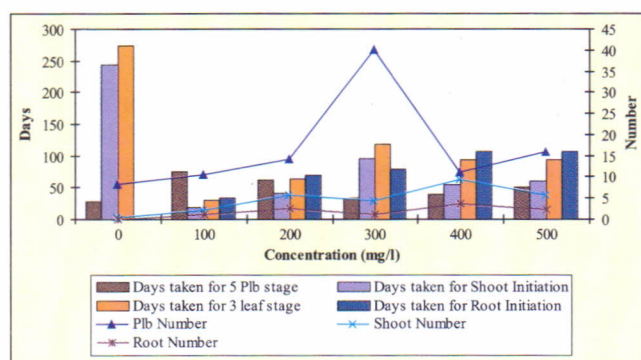


Fig 13. Effect of different concentration of growth adjutant on Plbs differentiation

### Response of Plb explants of *Cymbidium Showgirl* "Cooksbridge" to different carbon sources

Carbohydrates are provided in the form of sugars are main source of energy in micropropagation. To find out suitable CHO and their concentration for the tissue culture proliferation of Plb explants of *Cym. Showgirl* "Cooksbridge" three different carbon sources viz., Sucrose, Sugars and Mannitol at a concentration of 0, 20, 30 and 40g/l was used. Mean response of the different carbon sources over the different concentration revealed that Sucrose as the carbon source was the best for the multiplication of *Cym. Showgirl* "Cooksbridge", as it produced maximum number of Plbs and shoots. The better root development was also attributed to the Sucrose in the media. The rate of multiplication of Plbs as well as the shoot and leaf emergence was also fastest in media containing sucrose as the carbon source. The influence of carbon sources concentration on Plbs differentiation revealed that 30g/l of the carbohydrate was optimum for the better multiplication and differentiation of Plbs *in vitro*. This not only resulted in maximum Plbs and shoots but also fastest multiplication of Plbs and quickest shoot and leaf emergence. The interaction of carbon sources and their concentration showed that Sucrose at 30g/l in the media was most suitable for better multiplication and differentiation, as it resulted in maximum number of Plbs, shoots, roots and fastest multiplication of Plbs and early shoot and root emergence. Thus, it can be concluded that the media supplemented with 30g/l of Sucrose was best for Plbs multiplication and differentiation of *Cym. Showgirl*

"Cooksbridge" *in vitro*. Thus Sucrose at 30g/l is the most suitable source of carbon.

### Influence of cytokinins on Plbs of *Cym. Soul Hunt I*

Cytokinins play a major role in the protocorm multiplication of the *Cymbidium* hybrids through tissue culture method of propagation and it is one of the most important growth hormone used in micropropagation. A large number of cytokinins are now available; among them a few are used widely in tissue culture multiplication. Keeping this in mind an experiment was undertaken to find out the efficacy of the cytokinin with their concentration for *in vitro* multiplication of *Cym. Soul Hunt I* using three most commonly used cytokinins viz., Benzyl Amino Purine (BAP), Zeatin and Kinetin at various concentrations. The Plbs of *Cym. Soul Hunt I* was subcultured in Murashige and Skoog medium supplemented with 1g/l of activated charcoal and various concentrations.

The results revealed that, BAP was the most successful cytokinin as it gives maximum number of Plbs, that too at a very low concentration of 0.25mg/l. The other two cytokinins viz., Zeatin and Kinetin did not result in high number of Plbs and even it required a higher concentration of about 2mg/l. The fastest rate of Plbs multiplication was also attributed to BAP but at a higher concentration of 1mg/l. Thus it can be concluded that, BAP at 0.25 mg/l was best cytokinin for multiplication of *Cym. Soul Hunt I*.

### Influence of growth hormones on Plbs of *Cym. Soul Hunt I*

To study the influence of various growth hormones either alone or in combination on the Plbs multiplication of *Cym. Soul Hunt I*, an experiment was carried out with a view to standardize the type of cytokinin with their optimum concentration for better Plbs proliferation. The Plbs obtained from the meristem culture were subcultured in Murashige and Skoog media supplemented with 1g/l of activated charcoal with BAP (0, 0.25, 0.5mg/l), Triacantanol (0, 0.25, 0.5mg/l) and Silver Nitrate (0, 0.25, 0.5mg/l) either alone or in possible combination.



It was observed that MS media supplemented with 1g/l of activated charcoal, 0.5mg/l of BAP and 0.5mg/l of AgNO<sub>3</sub> produced maximum number of Plbs and roots and also resulted in rapid Plbs proliferation, early shoot and root initiation. The number of shoot differentiated was however maximum in MS media containing 0.5mg/l each of BAP and Triacantanol. Thus, MS media with 1g/l of AC and 0.5mg/l each of BAP and AgNO<sub>3</sub> was best for Plbs multiplication and differentiation of *Cym. Soul Hunt I*.

### Influence of subculture frequency on regeneration

An experiment was conducted with a view to study the frequency of sub culture on regeneration potential of the Plbs of *Cym. Soul Hunt I*. *In vitro* regenerated Plbs were separated and cultured on a same media of MS supplemented with 1g/l activated charcoal and 0.5mg/l of BAP for multiplication. The sub culturing was done at an interval of one month, two month and three month for a period of six months. The results showed that the maximum number of Plbs was attributed to the one-month sub-culturing interval, however the size of the Plbs was small. The two-month sub-culturing interval also resulted in sufficient number of Plbs of big size and roundish shape. The results obtained from three-months sub-culturing interval was not at all satisfactory as it resulted in less number of Plbs followed by browning of media and high rate of infection.

### In vitro hardening

#### Influence of pre hardening media on Plant growth

To reduce the mortality rate *ex vitro* and to provide congenial condition for their growth *ex vitro*, an investigation was carried out with the view of finding the suitable *in vitro* pre hardening media for better establishment, maximum survival and continuous growth *ex vitro*. MS media with 1g/l AC either alone or in combination with 100ml/l coconut water and different concentration of banana pulp was tested. The results showed that the plantlets obtained from the MS media supplemented with 1g/l AC, 100ml/l of coconut water and 150g/l of banana

pulp was better as it produced well developed plant of good shoot and root system. However, the plantlets obtained from MS media along with 1g/l AC and 100ml/l of coconut water alone produced the longest plants but the plants were lanky and roots were not properly developed. Percentage dry matter content increased with the increase in the banana pulp concentration in the media. Well developed roots and dry matter content are the primary requirement for the better survival and growth of the plants *ex vitro*, which could be obtained by the process of *in vitro* hardening on a media containing MS with 1g/l of AC, 100ml/l of coconut water and 150g/l of banana pulp for a period of 4 to 6 months.

### Ex vitro hardening

#### Influence of incubation period and growth hormones on ex vitro survival

To increase the survival rate *ex vitro*, the well-developed plantlets of *Cym. Lunavian Atlas* at 4-6 leaf stage were incubated in *in vitro* culture media containing various concentration of Triacantanol and Paclobutrazol prior to *ex vitro* shifting for 1, 2, 3 and 4 weeks. The results revealed that, mortality rate reduced with the increase of incubation period irrespective of the media, but media containing MS supplemented with 1.5g/l of activated charcoal, 0.5mg/l each of Triacantanol and Paclobutrazol resulted in maximum survival *ex vitro* when incubated for a period of 4 weeks (Table 6).

**Table 6.** Influence of hormones and incubation period on survival *ex vitro*

Media	Survival Percentage (%) / Pulsing Duration			
	1 Week	2 Week	3 Week	4 Week
MA <sub>1.5</sub>	33.3	33.3	33.3	33.3
MA <sub>1.5</sub> T <sub>0.25</sub>	33.3	33.3	33.3	33.3
MA <sub>1.5</sub> T <sub>0.5</sub>	33.3	33.3	33.3	33.3
MA <sub>1.5</sub> PBZ <sub>0.25</sub>	33.3	33.3	33.3	66.7
MA <sub>1.5</sub> PBZ <sub>0.5</sub>	66.7	66.7	66.7	66.7
MA <sub>1.5</sub> T <sub>0.25</sub> PBZ <sub>0.25</sub>	66.7	66.7	66.7	66.7
MA <sub>1.5</sub> T <sub>0.25</sub> PBZ <sub>0.5</sub>	66.7	66.7	66.7	82.3
MA <sub>1.5</sub> T <sub>0.5</sub> PBZ <sub>0.25</sub>	33.3	66.7	66.7	82.3
MA <sub>1.5</sub> T <sub>0.5</sub> PBZ <sub>0.5</sub>	66.7	66.7	66.7	82.3



### **Influence of salts concentration, incubation and sucrose on survival *ex vitro***

The effect of sucrose (7.5, 15, 30 and 60g/l), and salts concentration (full, half and one fourth strength) and incubation period (1, 2 and 4 weeks prior to shifting to the *ex vitro* environment) on survival of *Cym. Showgirl* "Cooksbridge" revealed that, half strength MS with 1g/l of activated charcoal and 60g/l of sucrose incubated for 4 weeks in the culture room resulted in maximum survival of plantlets in *ex vitro* conditions and thereby reduced the rate of mortality.

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

#### **Production of quality flowers/planting materials of bulbous plants on large scale**

An experiment was conducted to produce quality planting materials of *Gladiolus* cv. Ice Gold on large scale. The treatments consisted of Control, NPK, FYM, VAM, NPK+ FYM, NPK+ VAM, FYM+ VAM and NPK+ FYM+ VAM replicated thrice in randomized block design. The results showed that basal application of VAM along with NPK(200-100-100 kg/ha) and FYM (50t/ha) produced longest plant (144.40 cm), longest leaves/plant (58.59 cm), spike length (113.82 cm), rachis length (69.31cm) and maximum number of flowers/plant (22.42). Same treatment also resulted in early flowering (72.00 days) compared to control (80.30 days). Corm multiplication was also significantly influenced by the application of VAM. It was interesting to note that two number of corms of almost equal diameter were found with the application of VAM. Number of cormels/plant (22.42) was also highest with application of VAM.

### **Activity 3. Refinement and transfer of production technologies for commercial production of ornamentals**

- ❖ 15 horticulture officers were trained on "Crop improvement, production and protection of orchids" from Sikkim, Nagaland and Manipur.
- ❖ 3 ADOs, 10 officials and 6 farmers from Assam, Arunachal Pradesh were trained on "Production technology of orchids"
- ❖ 192 School drop-outs and self help group trainees visited research farm and obtained farm training on orchid cultivation in 5 separate batches.
- ❖ 54 farmers from Arunachal Pradesh and Meghalaya visited research farm and obtained farm training on orchid cultivation.

### **Network project on Distinctness, Uniformity and Stability of Seed**

#### **Preparation for plant variety protection and conducting test for Distinctness, Uniformity and Stability for Orchids**

This year observations on different characters viz., plant size, pseudobulb, leaf, inflorescence, peduncle, pedicelate-ovary, flower, dorsal petal, lateral sepal, petal, column and lip length etc (both qualitative and quantitative) of plant parts of species *Coelogyne elata*, *C. flaccida*, *C. flaccida* var. *crispata*, *Cymbidium hookerianum*, *C. lowianum*, *Dendrobium* A Abraham, *Dendrobium nobile*, *Paphiopedilum insigne*, *P. spicereanum*, *P. venustum.*, *P. villosum*, *Vanda coerulea*, *V. crispata* initiated.



# 3

## Education and Training

### Training for NRCO Staff

Dr. D. Barman, Sr. Scientist (Hort) attended advance training on "Management of Orchids in Protected conditions" at Department of Tropical Plant and Soil

Science, University of Hawaii, Honolulu during 01- 28 September 2004 under NATP - Protected Cultivation of Vegetables and Flowers in Plains and Hills.

### Training programme organized by NRCO under NATP and MM I

Sl. No.	Name of training	Period	Participants
1.	Residential training on Agri-Horticulture for SHG Under SGSY Scheme" hosted by W.B. CADC, Kalimpong of Kalimpong	14.07.2004.	Unemployed self help group
2.	Protected cultivation of Cymbidium and Rose	12.08.2004	35 Farmers of Sikkim
3.	Crop improvement, production and protection of orchids	13.10.2004 - 14.10.2004	10 Officers of Sikkim
4.	Crop improvement, production and protection of orchids	13.12.2004 - 17.12.2004	5 Officers of Sikkim, Nagaland, Manipur
5.	Production technology of orchids	24.02.2005 - 27.02.2005	19 officials and farmers from Arunachal Pradesh and Assam



Trainees from Arunachal Pradesh



Self help group trainees from Kalimpong



**Group of farmers visited**

Sl No.	Farmers from	Date	Number of farmers	Remarks
1	Kalimpong	22.04.2004	40	School dropout and self help group trainees
2	Kalimpong	13.07.2004	40	School dropout and self help group trainees
3	Arunachal Pradesh	28.08.2004	22	Farmers
4	Kalimpong	04.10.2004	40	School dropout and self help group trainees
5	Kalimpong	11.02.2005	47	School dropout and self help group trainees
6	Meghalaya	17.02.2005	32	Farmers
7	Kalimpong	04.03.2005	25	School dropout and self help group trainees



# 4

## Awards and recognition

### Award

Dr. V. Nagaraju, Dr. R.C. Upadhyaya and Dr. D. Barman awarded Fakhruddin Ali Ahmed Award for the biennium 2002-2003 for outstanding contribution in the

field of orchid cultivation. The award was received from Hon'ble Minister of State for Planning Shri. M.V. Rajasekharan on 19<sup>th</sup> October 2004.



< Dr. V. Nagaraju

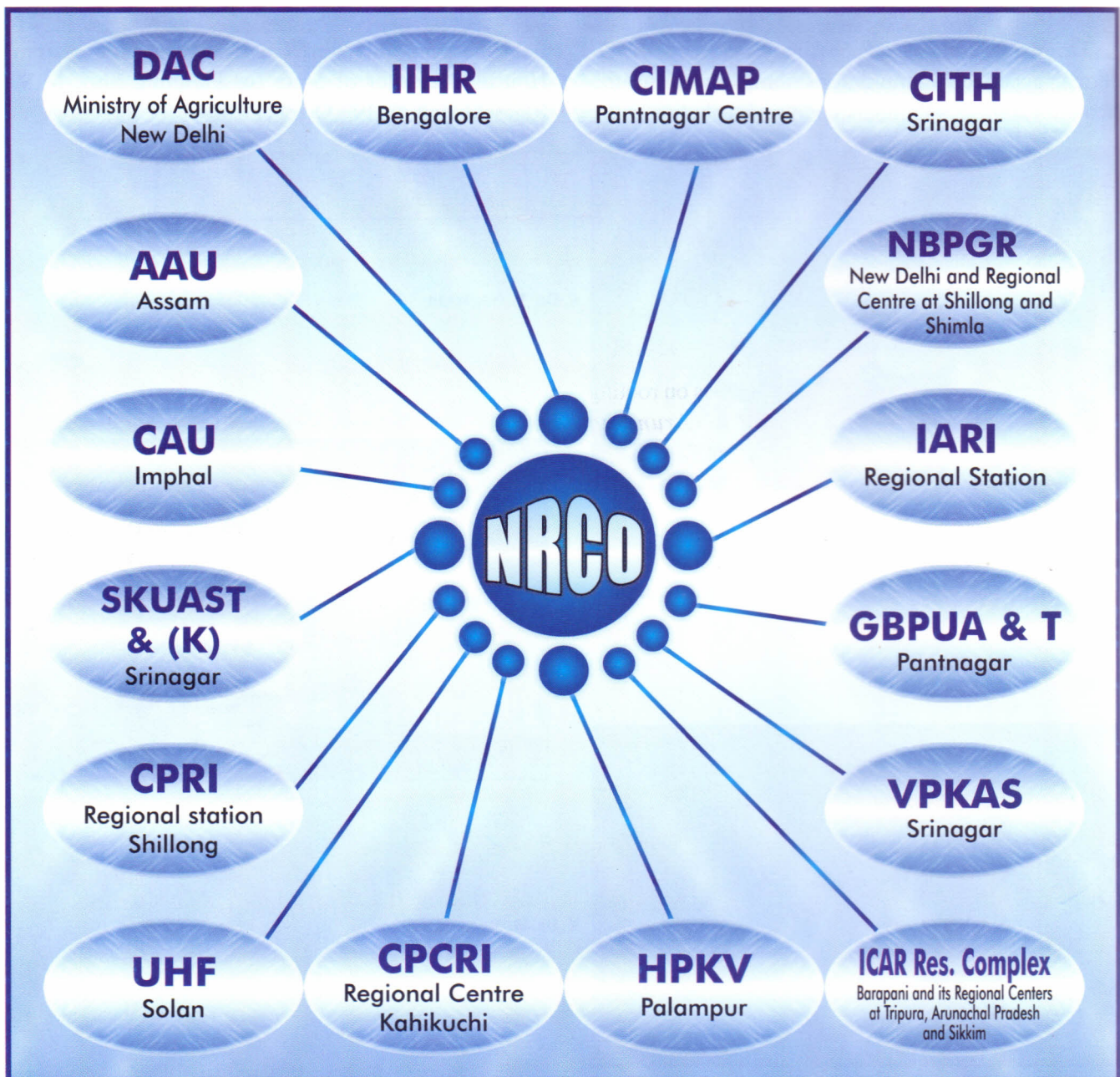
Dr. R.C. Upadhyaya >



< Dr. D. Barman



## Linkages and collaboration





## Research articles

1. Bag, T. K. 2004. Two new orchid hosts of *Sclerotium rolfsii* Sacc. from India. *Pl. Pathology* 53: 255
2. Bag, T. K. 2004. Occurrence of orchid wilt (*Sclerotium rolfsii* Sacc) in *Cymbidium* and its hybrids. *Sci. & Cult.* 70 (7-9): 287-88
7. Bag, T. K. 2004. Fungal diseases of some ornamental and flowering plants in the hills of Sikkim. *Farm Science Journal* 13(2): 192-194
8. Barman, D. and Rajni, K. 2004. Studies on rooting in the keikis of bamboo orchid (*Arundina graminifolia* L.) *J. Ornament. Hort.* 6(3): 260-263
9. Barman, D. and Rajni, K. 2004. Effect of chemicals on dormancy breaking, growth, flowering and multiplication in gladiolus. *J. Ornament. Hort.* 7(1): 38-44
10. Barman, D., Rajni, K. and Upadhyaya, R. C. 2004. Post harvest life of gladiolus cut flower as influenced by silver salts. *J. Hill Res.* 17(1):6-10
11. Barman D., Rajni, K. Das, S. P., Nagaraju, V. and Upadhyaya, R.C. 2004. Response of auxins to rooting and shoot growth in back bulbs of *Cymbidium* hybrid Show Girl Cook's Bridge. *J. Ornament. Hort.* 7(1): 118-120
12. Mani, S. K. and Nagaraju, V. 2004. Influence of potting media on acclimatization and growth of *in vitro* plantlets of *Cymbidium* hybrids. *J. Ornament. Hort.*, 7(3): 307-312
13. Nagaraju, V. and Mani, S. K. 2004. Influence of basal media, triacantanol and paclobutrazol on *Cymbidium tracyanum* Rolfe. *J. Hill Res.* 17 (1): 20-22
14. Nagaraju, V. and Mani, S. K. 2004. *In vitro* multiplication of *Cymbidium* Golden Girl as influenced by various growth hormones. *J. Ornament. Hort.*, 7: 31-37
15. Nagaraju, V. and Mani, S. K. 2004. Influence of triacantanol and paclobutrazol on *in vitro* growth and *ex vitro* survival of *Cymbidium* Lunavian atlas. *J. Ornament. Hort.*, 7(3-4): 320-324
16. Nagaraju., V., Das, S. P., Pema C. Bhutia and Upadhyaya, R.C. 2004. *In vitro* multiplication of *Dendrobium chrysotoxum* and two *Dendrobium* crosses (*D. Nobile* x *D. Nobile* var. Alba and *D. Nobile* X *D. heterocarpum*) through embryoculture. *J. Orchid Soc. India* 18: 47-51
17. Nagaraju, V. and Mani, S. K. 2005. Rapid *in vitro* propagation of *Zygopetalum intermedium*. *J. Pl. Biochem. Biotech.* 14: 27-32.
18. Nagrare, V. S. 2004. Occurrence of Mollusca *Cryptaustenia verrucosa* (Godwin – Austin) on Orchid *Calanthe* spp.- A new report. *Sci & Cult.* 70(7-8): 289
19. Nagrare, V. S. 2004. The black aphid *Toxoptera aurantii* infesting Orchids, *Orchid News* Vol. 20 December 2004, Published by The Orchid Society of India, Chandigarh
20. Nagrare, V. S. 2004. The black aphid, *Toxoptera aurantii* (B. De F.) infests the Orchid, *Oncidium* Gower Ramsay. *Entomon* 29(2): 193-195



### Popular articles

1. Ram Pal and Nagrare, V. S. 2004. *Cymbidium* sunakhari Fulko kheti Keen? Kahan? Ani Kasari game? Part 1, 2, 3, September 3-5, 2004, Himalayan Darpan, Siliguri (Nepali)

### Paper presented in seminar/ symposia

1. Bag, T. K. 2004. Orchid wilt incited by *Sclerotium rolfsii* on Vandaceous orchids and its cultural management (Absts.). National Symposium on Recent Trends and Future Strategies in Ornamental Horticulture, 1-4<sup>th</sup> December 2004, UAS, Dharwad.
2. Bag, T. K. 2004. Phytosanitary Risk of Tissue Cultured Orchids and Some Techniques for its Avoidance. National Symposium on Advances in Fungal diversity and Host pathogen interactions, 7-9<sup>th</sup> October, 2004, Goa University, Goa.
3. Bag, T. K. and Ram Pal 2004. Rust of *Calanthe* - A New Orchid Disease. National Symposium on Advances in Fungal diversity and Host pathogen interactions, 7-9<sup>th</sup> October, 2004, Goa University, Goa.
4. Barman, D., Rajni, K., Naik S. K and Upadhyaya R.C. 2004. Effect of nitrogen, phosphorus and potassium on growth and flowering of *Cymbidium*. National Symposium on Recent Trends and Future Strategies in Ornamental Horticulture, 1-4<sup>th</sup> December 2004, UAS, Dharwad.
5. Barman, D., Rajni, K., Naik, S. K and Upadhyaya R.C. 2004. Influence of growing media and system of planting on growth and flowering of *Cymbidium traceyanum*. First Indian Horticulture Congress 2004, 6-9<sup>th</sup> November, 2004, New Delhi.
6. Barman, D., Rajni, K., Singh, D. K. and Upadhyaya R.C. 2004. Sustainable production of rose under partially modified green house conditions. First Indian Horticulture Congress 2004, 6-9<sup>th</sup> November, 2004, New Delhi.
7. Chakrabarti, S. 2004. Leaf chlorophyll analysis of *Cymbidiums*. First Indian Horticulture Congress 2004, 6-9<sup>th</sup> November, 2004, New Delhi.
8. Chakrabarti, S. 2005. Application of RAPD technique to study the genetic relationship of orchids. National symposium on Biotechnological intervention for improvement of horticultural crop, 10-12<sup>th</sup> January 2005, KAU, Trichur.
9. Chakrabarti, S. 2005. Current status and future opportunities of introduced *Cymbidium* hybrids in India. International Symposium on Plant Introduction: Achievements and Opportunities in South Asia, 15-17<sup>th</sup> February 2005, New Delhi.
10. Das, S. P., Nagaraju., V., Barman, D. and Upadhyaya, R.C. 2004. Evaluation of Orchid resources of NEH for utilization and diversification in Indian Floriculture. First Indian Horticulture Congress 2004, 6-9<sup>th</sup> November, 2004, New Delhi.
11. Das, S.P., Singh, A.K. and Nagaraju, V. 2004. Effect of culture media on *in vitro* germination and PLBs formation in embryos from cross *Cymbidium* Oriental Legend X *C. Show Girl*. First Indian Horticulture Congress 2004, 6-9<sup>th</sup> November, 2004, New Delhi.
12. Das, S.P., Singh, A.K. and Nagaraju, V. 2004. Effect of culture media on *in vitro* PLB formation by immature embryo of *Cattleya labiata* X *C. aurantica*. National Symposium on Recent Trends and Future Strategies in Ornamental Horticulture, 1-4<sup>th</sup> December 2004, UAS, Dharwad.
13. Nagaraju, V. and Mani, S. K. 2004. *In vitro* multiplication of *Cymbidium* Golden Girl as influenced by various growth hormones. National Symposium on Recent Trends and Future Strategies in Ornamental Horticulture, 1-4<sup>th</sup> December 2004, UAS, Dharwad (Awarded Best Poster Paper).
14. Nagaraju, V. and Mani, S. K. 2004. Influence of Triacotanol and Paclbutrazol on *in vitro* growth and *ex vitro* survival of *Cymbidium* Lunavian Atlas.



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15. Nagaraju, V. and Mani, S. K. 2004. Influence of triacontanol and paclobutrazol on *in vitro* differentiation and growth of *Cymbidium* Golden Girl. First Indian Horticulture Congress 2004, 6-9<sup>th</sup> November, 2004, New Delhi.
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18. Nagrare, V. S. 2005. Insect pest of Orchids. 18<sup>th</sup> World Orchid Conference, 11-14<sup>th</sup> March 2005, Dijon, France.
19. Upadhyaya, R. C., Devdas, R. and Nagaraju, V. 2005. Scope of Orchid Cultivation in Oil Palm Plantations. National Seminar on Research and Development of Oil Palm in India, 19-20<sup>th</sup> February 2005; Pedavegi, Andhra Pradesh.
20. Upadhyaya, R. C., Nagaraju, V. and Mani, S. K. 2004. Present status, constraints and opportunities in export of orchids from India. First Indian Horticulture Congress 2004, 6-9<sup>th</sup> November, 2004, New Delhi.
21. Upadhyaya, R. C., Nagaraju, V. and Mani, S. K. 2005. Orchid conservation and ecotourism. Seminar on Agro Eco Tourism, 19-20<sup>th</sup> January 2005, Goa.
22. Upadhyaya, R.C., Nagaraju, V., Das, S.P. and Das, P. 2004. Diversity of Orchid in Sikkim Himalayas and its conservation. National Symposium on Recent Trends and Future Strategies in Ornamental Horticulture, 1-4<sup>th</sup> December 2004, UAS, Dharwad.

## Technical publications

1. Agro-biodiversity (PGR)-1. National Agricultural Technology Project on Sustainable management of Plant biodiversity- Survey and collection of orchids and ornamental bulbous plants of North Eastern Hill Region-Activities and outcome. Compiled and edited by Nagaraju, V., Partha Das and Upadhyaya, R. C., December 2004. **Folder**
2. NRCO: A Profile. National Research Centre for Orchids, Pakyong, Sikkim. Compiled and edited by Bag, T. K. and Nagrare, V. S., November, 2004. **Folder**

## Book chapter

1. Bag, T. K. 2004. Recent Advances in the Diagnosis and Management of Orchid Viruses. *In: Advances in Plant Protection Sciences.* (Ed. Dr. D. Prasad, and A. Singh) Published by Akansha Publishing House, Ansari road, Darya Ganj, New Delhi, pp 343-361.
2. Nagaraju, V. and Mani, S. K. 2004. Acclimatization of tissue culture regenerated plantlets- problems and solution. *In: Emerging Trends in Ornamental of Horticulture,* (Eds. B. Sathyanarayana Reddy, T. Janakiram, B. S. Kulakarni and P. Narayanaswamy) Indian Society of Ornamental Horticulture, Division of Floriculture Landscaping, IARI, New Delhi, pp 138-144.
3. Nagaraju, V. and Mani, S. K. 2004. Tissue culture in Bulbous crops. *In: Bulbous Ornamentals* (Ed Rajeevan, P. K., Singh, K.P. and Valsalakumari, P. K.) Indian Society of Ornamental Horticulture, New Delhi, pp 186-203.
4. Upadhyaya, R. C. and Nagaraju, V. 2004. Orchid Scenario in NE State region: issues and strategies. *In: Horticulture for sustainable income and environmental protection, Vol I.* (Ed.) Singh, V.B, Concept Publishing Company, Daryaganj, New Delhi.



# 7

## List of ongoing Projects

<b>Institute projects</b>		
<b>Project title</b>	<b>PI</b>	<b>CoPI</b>
Development of agro – techniques for commercial scale production of orchids in open and protected condition.	D. Barman	S. K. Naik & R.C. Upadhyaya
<i>In vitro</i> propagation of Orchid: <i>Cymbidium</i> and important, rare and endangered species	V. Nagaraju	S. Chakrabarti & S. P. Das
Cytogenetical research on orchids	S. Chakrabarti	
Breeding superior hybrids in <i>Cymbidium</i> and other important orchids	S.P. Das	V. Nagaraju & S. Chakrabarti
Collection, conservation, characterization, evaluation and maintenance high altitude orchid germplasm	Ram Pal	
Collection, conservation, evaluation and multiplication of bulbous ornamental crops	Ram pal	
Sudies on bulb production of <i>Lilium</i>	Ram pal	
Pest management in orchids and bulbous flowering plants	V. S. Nagrare	
Investigations on fungal diseases of orchids	T. K. Bag	
Nutrient Management in <i>Cymbidium</i> Hybrid	S. K. Naik	D. Barman
<b>NATP Projects</b>		
<b>Project title</b>	<b>CCPI</b>	<b>CoCCPI</b>
*Sustainable management of plant bio-diversity “Collection, evaluation, maintenance of Orchids and ornamental plants germplasm From NEH Region”.	V. Nagaraju	R.C. Upadhyaya, S. Chakrabarti, D. Barman, T. K. Bag, Rampal, S. P. Das & V. S. Nagrare
**Protected cultivation of vegetables and flowers in plains and hills	D. Barman	
*Strengthening of Library Information	T. K. Bag	
Preparation for Plant Variety Protection and Conducting Test for Distinctness, Uniformity and Stability for Orchids	V. Nagaraju	R. Devdas



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

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

<b>Activity</b>	<b>Associates</b>
Development of conventional and micro-propagation techniques	V. Nagaraju, D. Barman & S. P. Das
Production of planting material under low cost poly-houses.	D. Barman, T. K. Bag & V. S. Nagrare
Refinement and transfer of production technologies for commercial production of ornamentals through training.	R.C. Upadhyaya, V. Nagaraju, S. Chakrabarti, D. Barman, T. K Bag, Ram Pal, S. P. Das & V. S. Nagrare

\* Terminated on 31.03.2005

\*\* Terminated on 31. 12. 2004



## RAC, SRC and IMC meetings with recommendations

### RAC

#### Recommendations of Research Advisory Committee meeting held on 15<sup>th</sup> May 2004

- A report on the survival of the germplasm collected so far under different projects should be presented in the next meeting. The germplasm evaluation should indicate hereafter percentage survival of each material / line collected. Similar data should be collected on each hybrid population and the micro-propagated plants.
- Response of different media should be specifically quantified as 2, 3 or 4 days faster than other media used for comparison, instead of stating that particular treatment was 'good' for rapid multiplication.
- A specific hybrid for all experiments e.g. culture initiation, regeneration, proliferation, differentiation, prehardening, hardening for testing all chemicals etc should be taken for developing a complete flow chart of the protocol. It should later be repeated for other hybrids recommended for commercialization.
- A standard protocol should be used to compare with a protocol of a particular hybrid being developed.
- During characterization, information already available in the literature should be appropriately indicated, and that which are new findings would be the gaps filled by the Centre.
- Dr. Nagaraju and Dr. Das would handle the work on "Collection, Evaluation, Characterization and Maintenance of orchids" and Dr. Chakraborti would look after the "Cytogenetical and biochemical analysis" of same orchid species. She should be provided desired quality of plant materials needed for such studies.
- Biochemical analysis of all collected materials should be done within a specific time frame. Biochemical analysis of 398 species of orchids should be completed by the end of 2006. Dr. Chakraborti should revise the entire plan of work on the basis of discussion held in the meeting.
- Name of the experiment (2.1.3) should be changed as "Effect of different levels of inorganic nitrogen and growth regulator on growth and flowering of *Cymbidium*" instead of "Effect of inorganic nutrients and growth regulators on reducing pre-blooming in *Cymbidium*"
- There should be only one source of inorganic nitrogen instead of two in the experiment. In case of fertilizer (like growth regulator G<sub>0</sub>) also take one treatment as control (F<sub>0</sub>) without applying any NPK.
- Details of the new project "Orchid based model floriculture system for entrepreneurs" should be worked out with objectives, treatments and observation to be taken and the same should be circulated to the RAC members for approval without waiting for next year RAC.
- While formulating nutritional project, scientist should give one or two objectives only. They should consult literature and write review on each project. The second objective of the project "Nutrient



management in *Cymbidium* Hybrids" should be dropped. Nutrient combination, which gave best result in the vegetative stage, be kept as a control and different doses of nutrients should be added for their response during reproductive stage.

- The best treatment of ethylene concentration and soaking time observed with the multiplication of Oriental lily should also be tested with Asiatic lily at Darjeeling centre.
- The State Department should be consulted to find out suitable farmers field surrounding Gangtok for fungicidal trial for the management of *Cymbidium* black rot in the farmers' field.
- Confirmation should be done about bud borer / black weevil in consultation with Sri G. K. Gurung, Secretary (Hort.), Govt. of Sikkim prior to conducting trial on control of weevil. There should be quantification of pest damage based on (a) extent of damage, (b) extent of area damaged and (c) extent of growers affected.
- Proposal for approval of MOU with other ICAR Institutes and national research organizations for collaborative work should be prepared immediately after consulting with concerned persons.
- There should be a monthly meeting with scientists chaired by Director to review the targets and achievements.
- The programme of each RAC meeting should include without fail two agenda items, namely (i) confirmation of the proceedings of the previous meeting, and (ii) Report on the action taken on the recommendations of the last meeting. The Director of the Centre should present the action taken report in every meeting.
- The entire research programme of the NRC should reorganized into programme-mode and each programme and the project under each programme should be given a specific number as is used in RPF files. Each project should be given a specific time frame for completion, and monitoring done accordingly.

- Farmers should be allowed to participate in the RAC as a special invitee. Director should take initiative to find out suitable local orchid growers.
- Council should ensure minimum manpower in different technical and scientific categories without which work of this Centre would be seriously affected. Priority should be given for providing scientists of Taxonomy, Plant Physiology, Agricultural Extension, Economics and Statistics.
- Refinement of technology and its transfer to the growers should be done on a regular basis, and proven technology disseminated through publications, audio and video aids. Research and extension should go side by side to disseminate the standardized technology.
- Status of domestic and international market, post harvest handling, packaging etc. should be prepared in the form of a folder. Besides, market trends may also be given in Centre's Newsletter from time to time
- The Centre should attempt to determine the lowest viable size of an orchid unit where one person will be involved with ½ day work. Two or three units may be tried to choose the best one for commercial purpose.
- Scientists should go and interact with the growers to get more and more information and feedback
- Economics of each technology coming out of a particular project should be worked out to ensure its economic viability.

### SRC

#### Recommendations of Staff Research Council Meeting held on 10<sup>th</sup> June 2004

- Model floriculture project on "Orchid based model floriculture system for entrepreneurs" may be taken up at the Government farm with the support of State. Mr. K. G. Bhutia, Principal Director (Hort.) was nominated as chairman of the committee formed along with Sri D. K. Bhandari, Sri Padam



Subba and Dr. D. Barman for formulating objectives of the programme.

- Correlation among biochemical analysis of orchids with other growth parameters, light requirement and flowering behavior should be worked out.
- Maize cob husk and *Alnus napalensis* barks/dry twigs may be used in the experiments laid for standardization of potting media. Nutrients may be tried in low concentration as foliar and pot application in liquid forms.
- Details of Post harvest management should be worked out and published.
- Pesticidal experiments should be modified in the direction of cultural and IPM for the management of black rot and pod borer considering the organic farming policy of the state. The Chairman agreed to support to layout the experiments in some selected farmers' field as per RAC suggestion.

## **IMC**

### **Recommendations of 5<sup>th</sup> Institute Management Committee meeting held on 12.5.2004**

- The IMC after going through the details of equipments, recommended equipment costing Rs. 54.5 Lakhs including foreign equipments to be purchased during 2004-05.
- Due to shortage of manpower including temporary mazdoors IMC recommended to provide security services at NRC (O) Pakyong and Darjeeling Centre. 6 Home Guards for this office and 3 Home Guards for Darjeeling Centre are recommended for

the year 2004 & 2005 to provide security services within ICAR limit.

- 4 Private Hospital/Nursing home viz., Nayak Nursing home, Appollo Hospitals Siliguri branch, Suraksha and Dr. Changs hospital at Siliguri are identified for providing medical facilities to the family members of the staff of NRC (O) and recommended to be included as recognized hospitals. Further, IMC recommended having the services of part time doctors visit twice a week at this centre. The IMC recommended consolidated honorarium of Rs. 5000/- per month.
- IMC recommended paying differential amount of Rs. 18.20 Lakhs on account of revised estimate of Lab-cum-Admn. building by savings of around Rs. 10 Lakhs from Orchidarium/ Net House/ Mist House and Rs. 8.2 Lakhs from transformer/ generator/street light.

### **Recommendations of 6<sup>th</sup> Institute Management Committee meeting held on 22.12.2004**

- IMC recommended purchase of scientific instruments - Purchase of additional equipments and enhance the cost of some equipments from saving by dropping some equipments costing Rs. 18.5 lakhs and replacement and cost escalation Rs. 13.75 lakhs
- The details of works examined and recommended for sanction by the IMC committee Rs.68.93 lakhs for Type IV RE, Rs. 47,93,742 for type V quarter, Rs. 65.21 for nala training
- Recommended security for of main campus and Darjeeling Campus for 2005-06.



## Participation of Scientists in Conferences, Meetings, Workshops, Symposia, etc.

Name of Scientist	Particulars	Duration	Venue
R. C. Upadhyaya	Seminar on Agro Eco Tourism	19.01.2005- 20.01.2005	Goa
V. Nagaraju	Zonal workshop on NATP Plant biodiversity Workshop to familiarize the Personnel Management information System (PERMISnet) 1st Annual group meeting of the Project Preparation of Plant variety protection and DUS testing through ICAR-SAU system Workshop on Utilization of Plant Genetic Resources  Brainstorming session for development of network project on use of wild species in crop improvement Agribusiness support project Priority setting Workshop Organized by the Asian Development Bank Workshop on Personnel Management Information System (PERMISnet) Workshop cum training on Prioritization, Management and Evaluation of Research programmes	29.07.2004 17.08.2004 - 18.08.2004 30.09.2004 - 01.10.2004 05.10.2004 - 06.10.2004 07.10.2004  14.02.2005- 15.02.2005  15.03.2005  17.03.2005	Barapani, Meghalaya New Delhi  NBPGR, New Delhi  New Delhi New Delhi  Gangtok.  New Delhi New Delhi
S. Chakrabarti	Regional workshop on Social and institutional Framework for female Participation in Agriculture	16.02.2005 - 17.02.2005	Bhubaneswar
D. Barman	Protected cultivation of vegetables and flowers in plains and hills (NATP)	05.04.2004 - 06.04.2004	IIHR, Bangalore
T. K. Bag	National Symposium on Advances in Fungal diversity and Host pathogen interactions	07.10.2004 - 09.10.2004	GU, Goa
R. C. Upadhyaya, V. Nagaraju and V. S. Nagrare	First Indian Horticulture Congress 2004	06.11.2004 - 09.11.2004	New Delhi
V. Nagaraju and D. Barman	National Symposium on Recent trends and Future Strategies in Ornamental Horticulture	01.14.2004 - 04.12.2004	UAS, Dharwad
R. Devdas	National Seminar on Research and Development of Oil Palm in India	19.02.2005 - 20.02.2005	Pedavegi, Andhra Pradesh



## Workshops, seminars, summer institutes, farmers' day etc.

### Kisan Mela

Kisan mela was organized on 24<sup>th</sup> March 2005 under Technology mission. Farmers and nurserymen of different locations of Sikkim who are involved in the cultivation of floricultural crops were invited to participate in the mela with their exhibits. About 70 farmers of Sikkim participated in the mela. Shri Somnath Poudyal, Hon'ble Minister for Food Security and Agriculture and Horticulture and Cash Crops development, Govt. of Sikkim graced the occasion as chief guest and Shri Bhim Prasad Dhungel, MLA & Chairman, Agri Farmers' Welfare Board and Ms. Manita Mangar, MLA were the guests of honor. All the state and central govt. officials related to floriculture/ agriculture were also invited to participate.

On this occasion a lecture was organized on *Cymbidium* orchid cultivation. Three selected nurserymen were felicitated for their remarkable contribution in the field of floriculture. Some agri-inputs were distributed through Honorable Minister to the participating farmers in the mela under Mini Mission I and also released a pamphlet on "National Agricultural Technology Project on Sustainable Management of plant Biodiversity". Shri Bhim Prasad Dhungel and Ms. Manita Mangar addressed the farmers and advocated for the cultivation of the floricultural crops on priority basis in selected locations involving unemployed youths of the State. Shri Somnath Poudyal appreciated the farmers for their contribution in the development of floricultural crops.



Felicitating of farmers by Shri Som Nath Poudyal, Hon'ble Agriculture Minister, Sikkim



Shri R. K. Patra, Chief Justice, Sikkim High Court	11.09.2004
Dr. S. B. Singh, Vice Chancellor, Dr RML Avadh University, Faizabad	9.10.2004
Shri Gautam Basu, Addl. Secretary & FA, ICAR, New Delhi	19.11.2004
Dr. J. C. Katyal, DDG (Edn.), ICAR, New Delhi	26.11.2004
Dr. Mangala Rai, Director General, ICAR, New Delhi	27.11.2004
Dr. Gautam Kalloo, DDG (Hort), ICAR, New Delhi	27.11.2004
Dr. J. S. Samra, DDG (NRM), ICAR, New Delhi	27.11.2004
Shri Som Nath Poudyal, Agriculture Minister, Sikkim	24.03.2004
Shri Bhim Prasad Dhungel, MLA, Sikkim	24.03.2004
Ms. Manita Mangar, MLA, Sikkim	24.03.2004



Dr. Mangala Rai, Director General and Dr. Gautam Kalloo  
DDG (Hort), ICAR, New Delhi



Dr. S.B. Singh, Vice Chancellor, Dr. RML  
Avadh University, Faizabad (Left)



Shri Gautam Basu, Addl. Secretary & FA, ICAR, New Delhi (Right)



(As on March 31, 2005)

**I. Scientific**

1. Dr. R.C. Upadhyaya	Director
2. Dr. V. Nagaraju	Sr. Scientist (Biotechnology)
3. Dr. Syamali Chakrabarti	Sr. Scientist (Genetics)
4. Dr. D. Barman	Sr. Scientist (Horticulture)
5. Dr. T. K Bag	Scientist Sr. Scale (Plant Pathology)
6. Shri Ram Pal	Scientist Sr. Scale (Horticulture)
7. Dr. S. P. Das*	Scientist Sr. Scale (Plant Breeding)
8. Dr. V. S. Nagrare	Scientist Sr. Scale (Entomology)
9. Shri S.K. Naik	Scientist (Soil Science)
10. R. Devdas**	Scientist (Plant Breeding)

**II. Administration**

1. Shri. Sunil Kumar Das	Assistant Finance and Accounts Officer
2. Miss Lakit Lepcha	Assistant
3. Shri Rajat Kumar Das	Sr. Clerk
4. Mrs. Diki Bhutia	Jr. Clerk
5. Mrs. Dil Maya Subba	Jr. Clerk

**III. Technical**

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

**IV. Supporting**

1. Shri T.B. Singh	SSG – III
2. Shri Gopal Brahmin	SSG – III
3. Shri Phigu Tshering Bhutia	SSG – II
4. Ms. Meena Kumari Chettri	SSG – II
5. Shri Dawa Bhutia	SSG – I
6. Shri Tularam Dulal	SSG – I
7. Shri Trilok Singh Balmiki	SSG – I

**Promotion**

1. Shri Rampal has been promoted to Scientist Sr. Scale (Horticulture) w.e.f. 22.04.2003.
2. Dr. V.S.Nagrare has been promoted to Scientist Sr.scale (Entomology) w.e.f. 18.11.2003.

**Transfer**

- \*Dr. S.P.Das Scientist (Plant Breeding), has been transferred from this centre to ICAR Research Complex for NEH Region Tripura centre, Lembuchera, Agartala, on 05.10.2004.
- \*\*Shri Devdas Ramgopal, Scientist (Plant Breeding) has been transferred from ICAR Research complex for NEH Region, Tripura centre, Lembuchera, Agartala and joined to this centre on 07.01.2005.
- Mrs Diki Bhutia, Junior clerk has been transferred to National Research Centre for Orchids, Darjeeling Campus on 30.06.2004.



### Building inaugurated

Newly constructed Laboratory cum administrative building has been inaugurated on 27.11.2004 by the Chief Guest Dr. Mangala Rai, Secretary DARE & Director General, Indian Council of Agricultural Research, New Delhi. On this occasion Dr. Gautam Kalloo, Deputy Director General (Horticulture) and Dr. J. S. Samra, Deputy Director General (Natural Resource Management), New Delhi were the Guests of Honor.

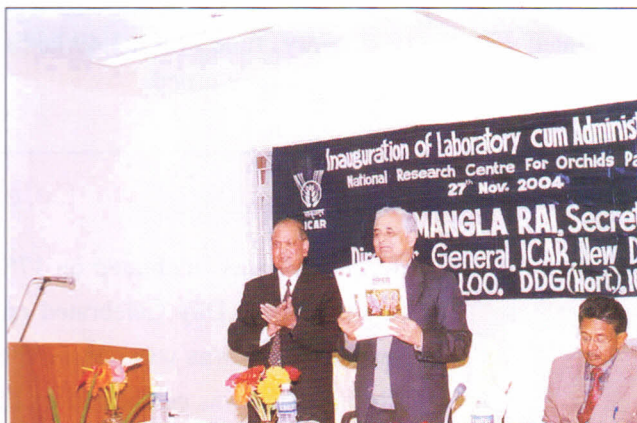
The inauguration of building has been initiated by breaking coconut followed by cutting ribbon and unveiling inauguration stone. Thereafter Chief Guest, guests of honor and invited dignitaries inspected building and visited polyhouses where experiments are set up on orchids. About 200 officials from Central government offices and state government of Sikkim have witnessed this function. While visiting farm tree saplings were planted in 'Smriti Van' by the Chief guest and Guests of Honor.

In inaugural function, Dr. R. C. Upadhyaya, Director of this centre welcomed the Chief Guest Dr. Mangala Rai, Dr. Gautam Kalloo, Dr. J. S. Samra and all invited dignitaries and briefed about building construction, accrued cost and research and development programme at this centre. In his inaugural speech Dr. Mangala Rai expressed his happiness towards meticulously construction of building. He mentioned that in horticulture, orchids would play an important role and it needs proper R & D programme considering global competition. Dr. Gautam Kalloo, spoke about role of horticulture in Indian export in general and orchids in particular.

On this occasion technical bulletin on "Orchids cultivation: Understanding critical factors" and "NRCO A Profile" released by Dr. Mangala Rai and Dr. Gautam Kalloo, respectively.



Inauguration of building by Dr. Mangala Rai, DG, ICAR



Release of NRCO: A Profile by Dr G. Kalloo, DDG (Hort)



## Library

A total of 72 new books were purchased during 2004-05. Besides important books on orchids and Biotechnology viz., The genus: *Paphiopedilum*, Orchid Basics: Selection, Hybridization and Propagation, The Orchids of India: Biodiversity and Status of *Vanda*, The Orchids of India: Biodiversity and Status of *Bulbophyllum*, The Nucleic Acid Protocols Hand Book, and PCR Cloning Protocols were also procured for Library as reference books.

Subscription of several national and international journals of Horticultural importance viz. Indian Journal of Agricultural Sciences, Indian Journal of Horticulture, Indian Journal of Ornamental Horticulture, Indian Journal of Plant Physiology, Indian Journal of Genetics and Plant Breeding, Indian Phytopathology, Indian Horticulture, Indian Farming, Current Science; Foreign journals viz. Orchids, The Orchid Review, The Australian Orchid Review, Orchid Digest, CSA journal, Hort Science, Journal of Genetics and Breeding, Journal of Economic Entomology and Phytopathology were continued for enrichment of library facilities.

Library received Rs. 1.5 lakhs for Purchase of CD-ROM data base /online database under NATP project entitled "Strengthening of Library Information System". Subscription of Hort CD for the period of 2004-05 was continued with NATP (Library) fund of Rs. 1.49 lakhs and the rest (Rs.0.01 lakhs) was returned.

## ARIS/Computer Cell

The internet facilities have been upgraded at this centre under NATP programme using 1.8 m C-Band Antenna using Gilat Skyblaster 360E C-Band VSAT IDU SB360.

## Works/Building/Infrastructure

The construction of Laboratory cum administrative building was completed. Rainwater harvesting underground tank with 1 lakhs liters capacity storage tank have been constructed. The narrow terraces have been broadened and developed flat area of 500 sq. meters for construction of poly houses. Construction of 12 numbers residential quarters of 4 each of Type I, II and III completed and ready for occupation. Transformer cum generator house have been constructed. Equipments for research have been procured and orders placed for the construction of protected structures. Construction of retaining wall along the road was also undertaken.

## Revenue generation

Sl.No	Particulars	Amount (Rs.)
1	Sale of farm produce	53,213
2	Interest of STDR	79,557
3	Training	15,000
4	Selling of Tender Document	13,300
	<b>Total</b>	<b>161,070</b>

## Celebrations

**ICAR Day** was celebrated on 17<sup>th</sup> July 2004.

**Independence Day** Celebrated on 15<sup>th</sup> August 2004

**Sadbhavna Diwas** was observed on 23<sup>rd</sup> August 2004.

**Hindi Diwas** was celebrated on 22<sup>nd</sup> September 2004.

**Raising Day** of the Centre was celebrated on 5<sup>th</sup> October 2004.

**Raising Day** of Darjeeling Campus celebrated on 28<sup>th</sup> October 2004.

**Republic Day** celebrated on 26<sup>th</sup> January 2005.



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