ANNUAL REPORT

2011 – 2012

National Research Centre for Orchids
(Indian Council of Agricultural Research)
Pakyong – 737 106, Sikkim, India
Preface

It is my proud privilege to place this document of Annual Report of Institute depicting the various activities of the year 2011-12. This report highlights the significant research achievements of various research programmes and other institutional activities. This year institute has made significant progress in molecular characterization of native orchid species using RAPD and ISSR markers. The institute is striving towards development of new hybrids which would useful as the cultivars for cut flowers/potted plants or the materials for further improvement programme. The programme on collection and conservation was strengthened by adding 350 accessions from various parts of the country. Intraspécific variations of *Pleione humilis, Coelogyne punctulata, Dendrobium amoenum* and *Coelogyne nitida* were identified, described and conserved. The centre has identified vivipary in *Coelogyne nitida* Lindl. which has not been reported so for. Under Crop Production suitable hybrids of *Cymbidium, Dendrobium, Vanda, Mokara, Oncidium, Aranda* and *Cattleya* were identified for commercial cultivation in the region. Improved production technologies of *Cymbidium* and *Dendrobium* were standardized. For increasing post harvest life of cut flowers during transit, the efforts were made to standardize harvest stage and chemicals required for pulsing of *Cymbidium* and *Dendrobium* cut flowers. The centre is taking keen interest for developing dip stick technique for easy detection of orchid viruses at farmer’s level. Considering the adverse effect of pesticides, the centre is working on biocontrol of orchid pest and several botanicals were identified for pest management. DUS test guidelines of three commercial orchid genera viz., *Cymbidium, Dendrobium* and *Vanda* have been finalized and notified.

The staff of the centre was encouraged to participate in different HRD programmes for honing their skill. Research findings were disseminated through organizing trainings and Kishi Mela and conducting demonstrations.

In order to review, monitor and evaluate the research programmes and development activities of the Centre, RAC, IRC and Stakeholders’ meeting were conducted.

The Institute could attract the attention of the public due to untiring and self-less efforts and energy put by every scientist along with other staff members of the Institute. I want to congratulate all of them for their hard work. I hope this document will be able to depict the various activities of the institute in a focused way and the information contained here-in will be able to help the farmers, researchers and planners engaged in the field of orchid research and development.

I consider it a privilege to place on record the encouragement and support given by Dr. S. Ayyappan, Secretary, DARE & Director General, ICAR. We would have not made such achievement without the support and guidance of Dr. H. P. Singh, Deputy Director...
General (Horticulture). We are also grateful to Dr. Umesh Srivastava, ADG (Hort. II) for all the support and advice given to us time to time. I am equally thankful to the Chairman and members of Research Advisory committee for their suggestions to reorient our research programmes.

Place: Pakyong, East Sikkim.                                    (R. P. Medhi)
Dated: 30th June 2012                                           Director
Executive Summary

- 12 species of genus *Vanda* were used for DNA Fingerprinting. 84 RAPD and 22 ISSR primers were identified as polymorphic markers to distinguish the *Vanda* genotypes.
- For genotyping of native 12 nos of *Vanda* species PCR amplifications were done using three nuclear (ITS) and ten plastid loci (microsatellite markers). Significant variability observed in the species.
- 19 species of *Cymbidium* orchids were analysed using RAPD markers. 60 RAPD primers showed polymorphisms to distinguish all the species of *Cymbidium*.
- 59 species of *Dendrobium* orchids were analysed with 28 optimised STM primers and all the primers indicated a high potential to study the genetic variability of the *Dendrobium* species.
- Characterizations of 28 species of orchids were done as per common descriptors.
- New hybrid lines identified from f₁ progeny between the crosses of *Cym. lowianum* and *Cym. tigrinum*.
- Gamborg B5 media was found best for seed germination which took least number of days for swelling (6days), globule formation (12days), greening (21days) and germination (41days) *Coelogyne cristata*.
- DIVA GIS analysis showed that the richness of *Cymbidium* species in Sikkim lay in the areas located between 1500-2000 MSL.
- Foliar application of inorganic nutrient 0.2% of 10:10:10 NPK and GA₃ 100 ppm + BA 100 ppm produces maximum number of spike (2.33) and hastened the early emergence of flower spike by 20days of *Cymbidium* ‘Black Magic’.
- In Cym. hybrid ‘Valley Legend Steffy’ and ‘Winter Beach Sea Green’, pre-harvest spraying with paclobutrazol (100-250 ppm) improved pseudobulb size, spike length, number of florets per spike and chlorophyll content.
- In *Cymbidium* hybrid, ‘PCMV’, out of six treatment combinations, 2% sucrose + 200 ppm 8-HQS had shown maximum vase life (77.6 days) followed by 2% sucrose + 100 ppm Al₂(SO₄)₃ (77.4 days) over control in tap water (65 days).
- In *Cymbidium* hybrid ‘PCMV’, out of five different stages of harvest maturity, two buds opened stage had maximum vase life (66.8 days) and floret opening followed by 3-4 buds opened stage (64.8 days).
- Plants treated with NPK 20:20:20 (0.1%) with Ca, Mg and Mn (each at1g/l) along with BA 50 ppm and GA₃ 100 ppm increased number of spike (2.3), spike length (35.80cm), rachis length (22.7cm), number of flowers (11.1) of *Dendrobium* ‘Emma White’.
• Cattleya hybrids viz. ‘Queen Sirikhit’, ‘Ahmad Seikhi’, ‘Guanmiao City’, Chinese Beauty Orchid Queen’, Blc ‘Mem Ann Balmores Convess’ and ‘Hsinging Catherine’ were found promising for commercial cultivation.

• DUS test guidelines of three commercial orchids, Cymbidium, Dendrobium and Vanda were finalized and notified.

• Mite species, *Tetranychus urticae*, not playing any significant role in the transmission of CymMV and ORSV. Some common weeds of orchids like Drymaria cordata, Crassocephalum crepidiodes, Oxalis corniculata, Oxalis stricta etc. are found hosts of CymMV and ORSV.

• Molecular characterization of orchid anthracnose has been done. The polymerase chain reaction (PCR) assay with the *C. gloeosporioides* species specific primer (CgINT) with ITS4 yielded a single band of 450 bp and ITS1 and ITS4 primer combination amplified 560 bp products. Nucleotide sequencing of the ITS region of ribosomal DNA of all isolates showed 100% homology with *C. gloeosporioides* isolates available in GenBank. This showed that the pathogen involved with anthracnose disease of orchids is *Colletotrichum gloeosporioides*.

• The black spot disease has been reported on Aranda, Cattleya, Oncidium and Mokara hybrids a major constraint with the high incidence of 33-100%. The disease is tentatively identified as *Pestalotia* sp.

• Neem oil 0.03% EC (5ml/lit) and mycomite 3g/lit found effective for controlling mite on Cymbidium.

• IPM module M-5 (tobacco extract 5%, neem oil 0.03 EC and bifenthrin 10EC 0.25%) and M-3 (tobacco extract 5%, econeem 3000ppm 2ml/l and imidacloprid 17.8 SL 0.003%) for controlling mites and aphids respectively.

• B.t. (Dipel) 0.012% and neem oil 0.03% EC 5ml/l were found effective for shoot borer management in Dendrobium chrysotoxum.

• Nine training programmes on cultivation of orchids were conducted for the orchid growers of Sikkim, Kalimpong and Shillong. The farmers were exposed to latest technology on cultivation and management of orchids particularly *Cymbidium* orchids.
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Introduction

The National Research Centre for Orchids was established on 5th October 1996 by the Indian Council of Agricultural Research (ICAR), New Delhi to organize research programme on improvement in productivity, quality and commercialization of orchids. The Sikkim state authorities handed over 22.19 acres of land belonging to Regional Agricultural Centre along with all other assets to ICAR for establishment of the centre. In October 1997, the centre also took over the CPRS, Darjeeling from CPRI and established a campus for research on temperate orchids.

In the initial years of establishment the major focus of research was on collection, characterization evaluation, conservation and utilisation of available germplasm in the country in general and north eastern region in particular. With the changing scenario of floriculture in the country, the centre has modified its approach and thrust areas of research to meet the challenges. Today, the focus is on development of exportable varieties/hybrids, molecular characterization, standardization of agro-techniques, post harvest management, production of quality planting materials through tissue culture and creation of repository of information related to all aspects of orchids. On the basis of recommendations of RACs the research programmes have been modified on the mission oriented research projects on crop improvement, crop production, crop protection and post harvest management.

Mandate

- To collect, characterize, evaluate and conserve germplasm of orchids.
- Molecular characterization to check biopiracy and IPR protection of orchids
- Development of protocol for mass multiplication
- Production of quality planting materials for large scale cultivation
- To develop hybrids/varieties suitable for domestic and export market
- To develop production, protection, and post-harvest technologies for orchids
- To act as a national repository of scientific information on mandate crops
- To coordinate research with other scientific organizations and act as a centre for training

The research work is being carried out under 12 institute projects. In addition to these, research work is also being carried out under 5 externally funded projects viz. Horticulture Mission for Northeast and Himalayan States (HMNEH), Network Projects on Distinctiveness, Uniformity and Stability on Orchids (DUS), DBT’s Mission for North-East for Quality Planting Material and Utilisation for the North East, DBT funded project on ‘Development of protocol for commercialization of paphiopedilum orchids in NE states’ and NAIP’s A Value Chain on Selected Aromatic Plants of North East India.
**Organizational set up**

**Organization**

The Director is the administrative head of the Institute. The Institute Management Committee, Research Advisory Committee and Institute Research Council assist the Director in the matters relating to management and research activities of the Institute. Research on various aspects of mandate crops is conducted in three divisions/sections namely Crop Improvement, Crop Production and Crop Protection. The supporting sections include Administration & Accounts, AKMU (earlier known as ARIS Cell), Library, Documentation and Consultancy Cell.
### Financial statement

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*One promoted from Sr. Scientist to Pr. Scientist through CAS*
Past achievements

Surveys were conducted for collection of orchid germplasm at various parts of the country. The collected accessions were conserved in conservatories. The accessions of tropical and sub-tropical species were conserved at Pakyong (altitude, 1300 msl) while the accessions of temperate species were conserved at Darjeeling campus (altitude, 2150 msl). The germplasm was characterized for various useful morphological traits. The molecular characterization of *Dendrobium*, *Coelogyne*, and *Vandaceous* orchids was carried out, and virus indexing technique, RT-PCR for ORSV has been standardized and being used for the detection of ORSV.

The 9 hybrids and 12 species of *Vanda*, 41 hybrids and 16 species of *Cymbidium* and 14 hybrids and 30 species of *Dendrobium* were studied to develop the DUS testing guidelines for *Vanda*, *Dendrobium* and *Cymbidium*.

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

The surveys were conducted for the diseases and insect-pests causing damage in the farmer’s field as well as in the orchid conservatories at the centre. The causal organisms were identified, epidemiology was studied and control measures were suggested. Cattleya, dendrobium and vanda hybrids were tested against Cymbidium mosaic virus (CymMV), Cymbidium ringspot virus (CyRSV) and Odontoglossum ringspot virus (OSRV) in DAS-ELISA.

The centre has regularly organized training programmes for extension workers and farmers. The quality planting material of orchids was produced and distributed to the farmers to promote orchid cultivation in the region. The demonstrations were conducted at the farmer’s field to encourage farmers for adopting orchid cultivation as a vocation. National conference on ‘National consultation for production and utilization of orchids’ was organized to promote orchid research and development in the region. Approximately 300 scientists, planners, students, commercial growers and farmers participated in the conference.

The centre has developed a library that plays an important role in serving scientific information in the area of horticulture specially orchids and other ornamental crops. During the year near about 133 reference books on different subjects were purchased for strengthening the library facilities for scientists, technical staff and research scholars. Currently, the centre is subscribing for 41 journals including 14 foreign journals and 28
scientific magazines. The institute’s publications were made available to more than 200 organizations in the country.

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

Molecular Characterization of Orchids

Genetic diversity analysis of native *Vanda* species using RAPD markers

12 species of genus *Vanda*, collected from different locations of India were analysed using RAPD markers. Orchid species used in this study were *Vanda alpina*, *V. amesiana*, *V. coerulaea*, *V. coerulescens*, *V. cristata*, *V. parishii*, *V. pumila*, *V. stangeana*, *V. teres*, *V. tessellata*, *Vanda spathulata* and *Vanda wightti*. Leaf materials of these species were used for DNA extraction and fingerprinting. 110 RAPD primers were screened and 84 primers were identified as polymorphic markers to distinguish the *Vanda* genotypes (Fig. 1). These 84 markers were subsequently selected for genetic diversity analysis and DNA fingerprinting of *Vanda* genotypes.

![Fig. 1. RAPD Banding pattern of Vanda species using primer OPF04 and OPG08](image1)

Molecular variation of species of genus *Vanda* using ISSR markers

12 *Vanda* orchid species viz. *Vanda alpina*, *V. amesiana*, *V. coerulaea*, *V. coerulescens*, *V. cristata*, *V. parishii*, *V. pumila*, *V. stangeana*, *V. teres*, *V. tessellata*, *Vanda spathulata* and *Vanda wightti* were used in this study. PCR amplifications using 22 selected UBC ISSR primers showed multiple banding patterns (Fig. 2). The analysis of results is in process.

![Fig. 2. ISSR Banding pattern of Vanda species using primers UBC 835 and 880](image2)
Genotyping of native *Vanda* orchids using nuclear (ITS) and ten plastid loci (microsatellite markers)

For genotyping of native 12 nos of *Vanda* species PCR amplifications were done using three nuclear (ITS) and ten plastid loci (microsatellite markers). Significant variability was observed in the species under study. The samples were stored for sequencing for development of molecular data base.

Molecular characterisation of native *Cymbidium* species using RAPD markers

19 species of *Cymbidium* orchids collected from different locations were analyzed using RAPD markers. Out of 150 primers PCR amplifications of 60 RAPD primers showed polymorphisms to distinguish all the species of *Cymbidium*. These primers were used for profiling of 182 accessions. (Fig. 3).

Fig 3. RAPD Banding pattern of *Cymbidium* species using primer OPUA03

Molecular analysis for genotyping of *Cymbidium* orchids

19 *Cymbidium* species were used for the study. PCR amplifications using three nuclear (ITS) and ten plastid loci (microsatellite markers) showed significant variability. The amplified samples were stored for sequencing for development of molecular data base of *Cymbidium* orchids (Fig. 4).

Fig 4. Banding pattern of *Cymbidium* species using forward and reverse primer accD1fF5A and accD4rR5
Molecular analysis of *Dendrobium* orchids

610 accessions of 59 species of *Dendrobium* orchids were collected from different locations of India. A set of 28 STM primers which were already optimized for two important parameters of PCR i.e. annealing temperature of primers and MgCl$_2$ conc. are used for PCR amplifications. The result of PCR amplifications of all the primers indicated a high potential to study the genetic variability of the *Dendrobium* species.

Collection, characterization, evaluation and conservation of orchids

Characterization of 28 species was done as per common descriptors. The characterized species were *Phalenopsis lobbii*, *Phiaus flavus*, *Tainia hookerianum*, *Phalenopsis mannii*, *Paplionanthus vandarum*, *Lycaste cruenta*, *Phiaus tankervilleae*, *Coelogyne nitida*, *Asco centrum ampullaceum*, *Calanthe triplicata*, *Eria flava*, *Bulbophyllum odoratissimum*, *Eria pannea*, *Thunia marshalliana*, *Hygrochilus parishii*, *Asco centrum ampullaceum*, *var auranticum*, *Kingidium taenialis*, *Thunia bracteata*, *Phreatia elegans*, *Liparis bistriata*, *Thelasis longifolia*, *Cleisostoma subulatum*, *Platanthera insectifera*, *Podochilus khasianus*, *Microviper a obtusa*, *Bulbophyllum maculosum*, *Bulbophyllum ornatis simum*, *Coelogyne flaccida*.

Mapping of area of *Cymbidium* species

The species diversity and richness was studied from point to point grid analysis option of DIVA GIS. Rainfall and altitude map of the state was prepared using BIOCLIM model of DIVA GiSt. The results indicated that altitude and rainfall are the most important factors influencing the distribution of *Cymbidium* species. High richness was found in the areas located between 1500-2000 msl having annual precipitation between 1500-3000mm.

![Fig. 5. Cymbidium species distribution in Sikkim](image)
Breeding programme

Following successful crosses were made with objective to obtain desirable hybrids of cut flower as well as potted orchids.

Arachnis labrosa X Vanda coerulescence  
Phaius tankervilleae X Phaius flavus  
Phalaenopsis Brother & Sister X  
Phalaenopsis mannii ,  
Vanda stangeana X Aerides odoratum  
Vanda cristata Var. multiflora X Aerides odoratum  
Cymbidium Hybrid Fortininer ‘Alice’  
Cymbidium Free Style No-3 X Cymbidium tracyanum  
Cymbidium Margaret Thatcher X  
Cymbidium tracyanum

Phaius flavus X Phaius tankervilleae  
Phalaenopsis mannii X Phalaenopsis lobbii  
Phalaenopsis mannii X Phalaenopsis  
Brother & Sister  
Vanda cristata X Aerides odoratum  
Coelogyne barbata X Coelogyne fuscens  
Coelogyne barbata X Coelogyne fuscescens  
Cymbidium tracyanum X Cymbidium Free Style No-3  
Cymbidium tracyanum X Cymbidium elegans

New hybrid lines identified from F₁ progeny

Pbx-05-56

Pbx-05-56, a cross between Cym. lowianum and Cym. tigrinum flowered during 2011. It was observed that the appearance of flower and color resemble the combination of both the parents. Sepals and petals of Cym. lowianum are yellow green (RHS-152B) with light brown stripes and Cym. tigrinum these are yellow green (RHS-152A) with brown margin (sepals) and yellow green (RHS-151A) with grey orange (RHS-175B) spots (petals), whereas in a new hybrid, sepals and petals are yellow green (RHS-151A). The color of the lip is same with that of Cym tigrinum with difference in colour pattern. Lip of Cym tigrinum is white with maroon spots and lip of new hybrid is white with margin yellow green (RHS153D) & red purple (RHS-59D) stripe at apical lobe without spots (Fig.6). Flower open type with size 6.5cm X 6.6 cm bigger than the parents. Color of anther cap grey yellow (RHS-160A).
In Vitro Propagation of Orchids

Effect of culture media on germination of selfed and crossed seeds of different species and hybrids.

Seeds from 2 selfed Vanda coerulea, Dendrobium chrysotoxum and 3 crosses of Vanda cristata var. multiflora X Aerides odoratum, Vanda stangeana X Aerides odoratum, Vanda cristata X Aerides odoratum were harvested after 6-7 months of pollination. The harvested capsules were cultured in different media, viz. MS (Murashige and Skoog), Gamborg (B5) and Nitsch (NC) supplemented with activated charcoal and sucrose. The observations on different parameters like time taken for greening, globule formation and germination were recorded. Germinated seeds were further sub-cultured on different media for their proliferation and differentiation. Dendrobium chrysotoxum responded to Nitsch media while others responded to Gamborg B5 media.

Effect of different media and BAP on germination of Cymbidium dayanum.

Selfed seeds of Cymbidium dayanum were sterilized and cultured in different media, viz. MS (Murashige and Skoog), Gamborg (G5) and Nistch (Na) supplemented with activated charcoal (1.5g/l), 0.8 % sucrose and BAP (0.0, 0.2, 0.5mg/l). Among the three basal media tested for the seed germination Gamborg’s B5 supplemented with 0.2mg/l BAP was found to be best, which took least no. of days for globule formation (29days) and first seed germination (38days) compared to MS and Nistch.
Development of complete protocol for mass multiplication of *Coelogyne cristata* through seed culture

In order to develop a protocol for mass multiplication for *Coelogyne cristata*, the seed pods were sterilized and culture was initiated on Gamborg B5, Murashige and Skoog, Knudson C & Nitsch media. Different parameters like swelling, globule formation, greening, germination were observed. Gamborg B5 media was found best for seed germination which took the least number of days for swelling (6days), globule formation (12days), greening (21days) and germination (41days). Shoot initiation was high in case of Gamborg media containing BAP 0.5mg/l whereas the lowest was in Nistch and Knudson C media.

![Graph showing effects of different media on swelling, globule formation, greening, and germination](image)

**Fig.9.** Effect of different media on swelling, globule formation, greening and germination of *Coelogyne cristata*

![Seed culture of *Coelogyne cristata*](image)

**Fig.10.** Seed culture of *Coelogyne cristata*

Development of Protocol for Mass Multiplication of Rare Endangered and Threatened Orchid Species

To collect the planting material of *Renanthera imschootiana* & *Vanda coerulea* a trip was made to Mizoram and 16 plants of *Renanthera imschootiana* and 7 plants of *Vanda coerulea* were collected from Champhai District. The collected plants were planted in pots...
and grown under fibre house. The flowers *Renanthera imschootiana* were selfed for seed formation. Experiments on initiation of cultures using leaf and root tips are under progress.
CROP PRODUCTION

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

Optimization of nutrient requirement for *Cymbidium* plants under hardening

The experiment consists of four concentrations of N, P, K @ 19:19:19 (0%, 0.1%, 0.2% and 0.3%) and two spray intervals [7 days (A) and 15 days (B)] in *Cymbidium* hybrid ‘Sleeping Nymph’. Nutrient solution was given as foliar applications. It was recorded that foliar application of 0.2% at 15 days interval produces maximum number of spikes (2/pot), flower size (86.92 cm), intermodal length (3.1 cm), and flower stalk length (5 cm); whereas spike girth (0.70 cm), and number of flowers (8.25) were recorded maximum in the 0.3% at 7 days interval as compared to other treatments in both the cases.

![Fig. 1. Flower production at different NPK concentration and interval of spraying](image)

Effect of inorganic nutrients and growth regulators on reducing pre-blooming in *Cymbidium* hybrid ‘Black Magic’

For reducing pre-blooming period, N:P:K 10:10:10, 20:10:10 and 30:10:10 at 0.1% and 0.2% and two growth regulators BA and GA₃ at 100 ppm, 200 ppm each and its combinations (GA₃ 100 ppm + BA 100 ppm and GA₃ 100 ppm + BA 200 ppm) were applied as foliar spray. The nutrients were sprayed at weekly interval whereas the growth regulators were given at monthly intervals. The result revealed that foliar application of 0.2% of 10:10:10 NPK and GA₃ 100 ppm + BA 100 ppm produces maximum number of flower spikes (2.33) but the application of 0.2% of 20:10:10 NPK along with GA₃ 100 ppm + BA 100 ppm increased spike length (78 cm), rachis length (34 cm), spike girth (1.12 cm), flower stalk length (5.5 cm). Again numbers of flower per spike (14) were found maximum in the plants sprayed with 0.1% of 30:10:10 NPK and GA₃ 100 ppm + BA 100 ppm.
Influence of drenching and spraying of inorganic nutrients in *Cymbidium* hybrid ‘Levis Duke Bella Vista’

Experiment on drenching and spraying of inorganic nutrients in *Cymbidium* hybrid has been carried out with three inorganic nutrients like 30:10:10, 20:20:20, and 15:30:30 NPK at two different concentrations viz, 0.05% and 0.1 %. Of two mode of application, drenching with 0.1 % of 30:10:10 NPK increased the number of leaves (7.33), plant height (48.65 cm), leaf length (45.53 cm) and number of shoots (6.91) as compared to other treatments and spraying mode.

![Graph of Influence of drenching of nutrient on production of vegetative characters](image)

**Fig. 2. Influence of drenching of nutrient on production of vegetative characters**

Influence of frequency and mode of application of different growth regulators on *Dendrobium* hybrid ‘Thongchai Gold’

Growth regulators like GA₃ (50,100,200 ppm) and BA (50, 100 ppm) were applied in two frequencies (morning and evening spray) and in two different modes like foliar spraying and drenching. Maximum flower spikes (2.08) and (2.0) were found in drenching and morning spraying of BA 50 ppm. Drenching of BA 100 ppm increased spike length (42.87cm), rachis length (30.31cm), spike girth (0.61 cm), and number of flowers per spike (15.25 cm). Overall flowering was found more in morning spray as compared to evening spray and drenching.

Influence of plant growth regulators and inorganic nutrients on flower regulation of *Dendrobium* hybrids ‘Emma White’

Different treatments consisting of inorganic nutrients (NPK 20:20:20 and 30:30:30 along with Ca, Mg and Mn) and growth regulators (BA 10, 25, 50 ppm and GA₃ 50, 100, 200 ppm) and distilled water as control were experimented to regulate flowering in winter season. Plants treated with NPK 20:20:20 with Ca, Mg and Mn along with BA 50 ppm and GA₃ 100 ppm increased number of spike (2.3), spike length (35.80cm), rachis length
(22.7cm), number of flowers (11.1) and intermodal length (3.0). Whereas stalk length (4.25cm) and flower size (40.75cm) were found maximum in the plants treated with NPK 30:30:30 with Ca, Mg, Mn along with BA 25 ppm and GA$_3$ 50 ppm.

**Development of Integrated Floriculture Enterprise**

Seven hybrids of *Cymbidium* namely PCMV, Soul Hunt-6, Ensikhan, Valley Legend Stefi, Sleeping Nymph, Winter Beach and Korean-4 (pot plant) are under this experimentation. Among these hybrids Korean-4 produced more number of spikes (4/pot) as compared to others. ‘PCMV’ produced 3.0 flower spikes per pot, Soul Hunt-6 (2.0), Valley Legend Stefi (1.0), Sleeping Nymph (2.0), Winter Beach (2.0). Potted plants of Azalea, Christmas plant, Cycas, Fern, Thuja, Asparagus etc were multiplied.

**Production Management of Tropical and Sub-tropical Orchids**

**Evaluation of tropical and subtropical hybrids of commercially grown orchids**


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

In *Cymbidium* hybrid ‘PCMV’, biochemical analysis of 10 pre-harvest foliar applications of (0.3% NPK, cow urine (1:20), coconut water (1:10) Ca(NO$_3$)$_2$ (1%), micronutrient mixture (0.05%), glucose (0.1%), mustard cake (1kg/50lts), GA$_3$ (50 ppm), BA (200 ppm) GA$_3$ + BA (50 ppm+200ppm) indicated that both phosphorus and potassium content was
more in flower than leaf for all the treatments. In Cymb. hybrid ‘Valley Legend Steffy’ and ‘Winter Beach Sea Green’, pre-harvest spraying with paclobutrazol (100-250 ppm) improved pseudobulb size, spike length, number of florets per spike and chlorophyll content.

**Growth and flowering of Cymbidium hybrid ‘Levis Duke Bella Vista’ as affected by pot and potting mixture under organic culture**

Out of seven potting mixture and three types of pots, plastic pot with a mixture of Cocochips + Cocopeat + Brick pieces + Slow release fertilizer (3:3:1: 1g/pot) showed maximum pseudobulb diameter (3.00cm) and maximum chlorophyll content (75.4.4mg/100g).

**Evaluation of Cattleya hybrids**

In *Cattleya*, out of nine hybrids ‘Queen Sirikhit’, ‘Ahmad Seikhii’, ‘Guanmiau City’, Chinese Beauty Orchid Queen’, Blc ‘Mem Ann Balmores Convess’ and ‘Hsinging Catherine’ were found promising. Maximum longevity of spike was recorded with ‘Ahmad Seikhii’ (49 days) while maximum spike length was recorded in ‘Hsinging Catherine’ (35cm).

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

Out of fourteen hybrids of Dendrobium, Den. ‘Big White Jumbo’ had highest vase life (37.5 days) followed by Den. ‘Madam Pompadour’ (37 days), Den. ‘Erika’ (34.8 days) and Den. ‘Ear Sakul’ (33.5 days). In flowers, maximum carbohydrate content was recorded in Den ‘Kating Daang’ (260mg/g) followed by Den. ‘Erika’ (259 mg/g) while it was minimum in Den. ‘Triple Pink’ (85mg/g). In pseudobulbs, Den ‘Erika’ had maximum amount of carbohydrate ((279 mg/g) followed by Den. ‘Madam Pink’ (259 mg/g) and Den. ‘Kating Daang’ (248 mg/g) and the lowest amount of carbohydrate (65 mg/g) was found with Den. ‘Dang Saard’.

**Performance of orchid species under ground culture**

Post-harvest Technology of Orchids

Evaluation of different hybrids of Cymbidium orchids

Out of ten hybrids evaluated, Bob Marlin Lucky’ showed maximum longevity of first floret (51 days) and vase life (57 days) followed by ‘Fire Storm Blaze’ (47 days & 53 days).

Effect of chemical preservatives on vase life of Cymbidium Pine Clash ‘Moon Venus’

In Cymbidium hyb. ‘PCMV’, out of five different stages of harvest maturity, two buds opened stage had maximum vase life (66.8 days) and floret opening followed by 3-4 buds opened stage (64.8 days). Out of four treatments (0%, 2% cane sugar, 4% cane sugar and 8% cane sugar), 2% cane sugar had maximum longevity of first floret (54 days), zero percent of flower dropping, maximum solution uptake (24ml) and highest vase life (61.2 days) followed by 4% cane sugar. Increasing sugar concentration to 8% reduced the longevity of first floret (27.2 days) and vase life (36.2 days). A combination of 2% sucrose + 200 ppm 8-HQS showed maximum vase life (77.6 days) followed by 2% sucrose + 100 ppm Al₂(SO₄)₃ (77.4 days) over control in tap water (65 days).

Evaluation and biochemical analysis of backbulbs and mature bulbs of Cymbidium hybrids

Out of sixteen hybrids of Cymbidium orchids, fourteen hybrids came into flowering. Maximum width (9.0cm) and length (14.5cm) of flowering pseudobulb and spike length (81cm) was recorded in ‘Fire Storm Blaze’. Longevity of flowers on plants was recorded highest in ‘Caripepper Peachy Keen’ (70 days). In backbulbs, carbohydrate content ranged from 70mg/g in ‘Pink’ to 152 mg/g in ‘Fire Storm Blaze’ whereas in flowering pseudobulbs it varied from 88mg/g in ‘Pink’ to 180mg/g in ‘Fire Storm Blaze’. Fire storm Blaze had maximum chlorophyll content (71.20 mg/g) followed by ‘Hazel Fay Tangerine’ (58.80mg/100g) and minimum in ‘Red’ (19.20mg/100g).
CROP PROTECTION

Disease Management of Orchids

Characterization, detection and management of viruses infecting orchids

A. Detection of orchid viruses by reverse transcription polymerase chain reaction (RT-PCR) and Enzyme linked immunosorbent assay (ELISA)

1. By RT-PCR


![Fig.1](image1.png)

*Fig.1. M= marker, lane no.4, 9, 11, 5, 18 and 20 are showing CymMV positive bands*

![Fig.2](image2.png)

*Fig.2. M= marker lane no.1, 3-6 and 8-22 are showing ORSV positive bands*
2. By ELISA

(i). Virus indexing of orchid samples from Shillong, Meghalaya
Seventeen orchid species under seven genera namely *Cattleya*, *Cymbidium cyperfolium*, *Paphiopedilum fairrieanum*, *Cymbidium devonianum*, *C. eburneum*, *C. lancifolium*, *Renanthera*, *Esmeralda cathcartii*, *Oncidium* from Shillong, Meghalaya were collected from local farmers and tested against CymMV, ORSV and CyRSV in DAS-ELISA test. It was found that most of the samples were virus free except *Oncidium* species which was found positive with CymMV.

(ii). Virus indexing of orchid samples from TBGRI, Trivandrum
Twenty samples of *Dendrobium*, *Acampe*, *Coelogyne*, *Paphiopedilum*, *Vanda*, *Cymbidium* etc. were collected from Tropical Botanical Garden and Research Institute, Trivandrum checked for CymMV, ORSV and CyRSV in ELISA test. ELISA test revealed that all the samples were free from these viruses.

(iii). Virus indexing of Aranda, Mokara, Oncidium, Paphiopedilum and Renanthera
50 samples including 15 Aranda hybrids, 12 Mokara hybrids, 13 Oncidium hybrids, 9 Paphiopedilum hybrids and one Renanthera hybrid imported from Thailand were screened against CymMV, ORSV and CyRSV. ELISA results revealed that one hybrid of Aranda Salaya Red, three hybrids of Mokara Char Juan Pink, Mokara Khan Pink Suan V Kultana Gold and Mokara Happy Beauty (B), 8 hybrids of Oncidium namely Oncidium Colm Pixie Ruth, Oncidium Taka, Oncidium Janik Rainbow Orange Red, Oncidium Taka Yellow, Oncidium Sherry Baby Sweet Fragrance (B), Oncidium Gower Ramsey, Oncidium Sweet Sugar and Oncidium Jairak Rainbow, Orange Spot and two species of Paphiopedilum namely *P. hirsutisimum* and *P. villosum* were infected with CymMV while 2 hybrids of Oncidium namely Oncidium Colm wild Cat Carmera and Oncidium Sherry Baby Sweet Fragrance (B) were also found positive with ORSV. CyRSV was not found in any of the samples.

(iv). Virus indexing orchid samples from Kalimpong, West Bengal
16 samples of *Aerides*, *Arachnanthe*, *Asco centrum*, *Cymbidium*, *Dendrobium* and *Vanda* species were collected from Hulumba Nursery, Kalimpong and checked for CymMV, CyRSV and ORSV. Only one species of *Cymbidium sikkimensis* was found infected with ORSV. Rest of the samples was free from the viruses.
(v). Virus indexing of Cymbidium hybrids from Pakyong

17 samples randomly selected from polyhouse in Pakyong were checked for CymMV and ORSV from 9 samples from Vivacious Super White, 7 samples of Levis Duke Bella Vista and one sample of Burgundian Sydney were checked for ORSV and CymMV. ELISA results revealed that 6 samples of Vivacious Super White and two samples of Levis Duke Bella Vista were infected with CymMV while 6 samples of Levis Duke Bella Vista and 2 samples of Vivacious Super White were found infected with ORSV.

(vi). Virus indexing of Cymbidium hybrids from Yangang

30 samples of Cymbidium hybrids Margret Thatcher and Levis Duke Bella Vista were checked for CymMV and ORSV in DAS ELISA test from Yangang South Sikkim. It was found that 24 samples were detected positive with ORSV and 19 samples were positive with CymMV.

3. Role of mites in virus transmission

An experiment was conducted to see the role of mite (Tetranychus urticae) in the transmission of CymMV and ORSV, if any. Mites were collected gently with the help of brush from the virus infected Cymbidium hybrids and immediately transferred to test plants of young Datura stramonium, Chenopodium amaranticolor and Gomphrena globosa. 10 numbers of mites were allowed to feed in one test plant. The test plants were then covered by plastic cages. Necrotic lesions were developed after about two weeks. These plants were tested by ELISA for the transmission of CymMV and ORSV. ELISA results revealed that none of the plants were positive with CymMV and ORSV. Further these samples were tested by RT-PCR. RT-PCR results showed that only one Datura plant was found positive with CymMV and one with ORSV. This showed that mite is not playing active role in virus transmission. However, being highly contagious viruses, CymMV and ORSV can be contaminated by mite species by their mouth parts or body parts.

![Fig.3a. Cymbidium hybrid showing mite infestations](https://via.placeholder.com/150)

![Fig.3b. Inoculation feeding](https://via.placeholder.com/150)

![Fig.3c. Development of necrotic lesions on Datura stramonium leaves](https://via.placeholder.com/150)
4. Role of weeds in virus transmission

Like any other crops, weeds are very common in orchids. Some of the weeds like *Drymaria cordata*, *Crassocephalum crepidiodes*, *Oxalis corniculata*, *Oxalis stricta* and two more unidentified weeds are observed very common on orchid plantation. These weeds were tested for the presence of CymMV and ORSV. Samples were processed and total viral RNA was isolated using Qiagen RNeasy mini isolation kit and RT-PCR was performed using virus specific primers designed from CP gene sequences of CymMV and ORSV available in GenBank. RT-PCR results showed that these weeds are positive with CymMV and ORSV. Therefore, it is concluded that weeds are the hosts of CymMV and ORSV and can play important role in virus transmission.
A. Molecular characterization of orchid anthracnose

Anthracnose disease of orchids caused by *Colletotrichum gloeosporioides* is most destructive disease of orchids and is serious production constraint in orchid production in Sikkim. To confirm the pathogen 25 isolates from different hosts were collected from NRCO germplasm house and characterized on the basis of morphological and molecular basis. The culture of *C. gloeosporioides* varies from white, grey, orange and pink colour. The polymerase chain reaction (PCR) assay with the *C. gloeosporioides* species specific primer (CgINT) with ITS4 yielded a single band of 450 bp and ITS1 and ITS4 primer combination amplified 560 bp products. Nucleotide sequencing of the ITS region of ribosomal DNA of all isolates showed 100% homology with *C. gloeosporioides* isolates available in GenBank. This showed that the pathogen involved with anthracnose disease of orchids is *Colletotrichum gloeosporioides*.

B. Studies on bacterial rot of orchids

The causal organism of bacterial rot was studied in detail. Three bacterial species were found associated with the disease including saprophytic bacteria. All the three organisms were sequenced and pathogenecity test is being conducted for the confirmation of the actual pathogen.
C. Incidence of black spot of Aranda, Cattleya, Oncidium and Mokara hybrids

Hybrids of Aranda, *Cattleya, Oncidium, Mokara* and *Renanthera* imported from Thailand showed severe incidence of black spot disease on leaves and stem. The disease initially appears as small yellow or brown or black spots on the leaves. Under optimum environmental conditions the spots may enlarge and coalesce to form leaf blight. The disease also produces dieback symptoms in several hybrids. The incidence of the disease is ranging from 33 to 100%. The causal organism is tentatively identified as *Pestalotia* sp. The sample and culture of the fungus have been sent to Indian Type Culture Collection at Division of Plant Pathology, Indian Agricultural Research Institute, New Delhi for identification.

![Fig. 6a. Black spot symptoms on Aranda hybrid](image1)

![Fig. 6b. Fungal colony on PDA](image2)

![Fig. 6c. Conidia of Pestalotia sp.](image3)

### Integrated Pest Management in Orchids

**Insect-orchid host preference studies in orchids**

**Survey on pests associated with orchids- host range**

The qualitative and quantitative surveys for pest infestation along with its host range on orchids have been made at Pakyong, Kartok, Raigoan, Dikling, Assamlinzey, Rumtek (HCCD Department), Somaria, Jorethang (West Sikkim), Mirik, Darjeeling and Kalimpong (WB). The visual observations were recorded on randomly selected plants and the infested material was collected from the places of visit right from April, 2011 to March, 2012. Three species of scale insects (ti-scale, *Pinnaspis buxi*; soft brown scale, *Chrysomphalus aonidum* and boisduval scale, *Diaspis boisduvali*) were reported to infest on *Cymbidium aloifolium*, *Cymbidium pendulum*, *Cymbidium devonianum*, *Cymbidium lancifolium* and many *Cymbidium* hybrids. Apart from *Cymbidium* it was also noticed on other orchids like *Ascocentrum amputaceum, Bulbophyllum leopardinum, Calanthe triplicata, Calanthe mannii, Coelogyne nitida, Coelogyne flaccida, Coelogyne cristata, coelogyne ochracea, Cleisostoma, Dendrobium aphyllum, Dendrobium chrysotoxum, Dendrobium densiflorum, Dendrobium moschatum, Dendrobium thrysiflorum, Liparis, Eria, Papilionanthe, Epidendrum, Phaius, Pholidota, Oncidium, Phalaenopsis* and...
Zygopetalum. Two spotted spider mite, *Tetranychus urticae* was noticed on *Coelogyne nitida*, *C. flaccida*, *C. corymbosa*, *Calanthe triplicata*, *Cymbidium aloifolium*, *C. devonianum*, *C. longifolium*, *C. mastersii*, *C. dayanum* and hybrids like Cym. H C Aurora, Cym Winter Beach Sea Green, Cym. Soul Hunt-6, Cym Red Star, Cym. WW Wondrous, Cym. Show Girl, Cym. Forest King, Cym-40, Cym. Howtescence, Cym. Pine Clash Moon Venus, Vivacious 'Super White', Cecil Park, Cym. Sleeping Nymph etc., *Dendrobium nobile*, *D. moschatum*, *D. fimbriatum*, *D. densiflorum*, *Epidendrum* sp., *Eria javanica*, *Pholidota articulata*, *P. rubra*, *Phaius tankervilliae*, *Oncidium* hybrid, *Thunia marshalliana* and *Zygopetalum intermedium*. Shoot borer, *Peridaedala* sp. was reported to damage on *Dendrobium nobile*, *D. aphyllum*, *D. chrysanthum*, *D. fimbriatum*, *D. moschatum* and hybrids like D. Emma White, Thongchai Gold, A. Abraham, Bangkok Blue, Madam Pink, *Epidendrum* sp., *Acampe rigida*, *Aerides multiflorum*, *Arachnanthe*, *Asocentrum*, *Chryptochilus*, *Eria*, *Gastrochilus* and *Vanda cristata*; thrips, *Dichrothrips nakahari* feeds on foliage as well as flowers of many species and hybrids of *Cymbidium* and *Dendrobium*, *Epigenium*, *Luisia* and *Phaius* whereas, aphids, *Macrosiphum luteum* was recorded on *Anthogonium gracile*, *Acampe rigida*, *Calanthe triplicata*, *Coelogyne nitida*, *Cymbidium* hybrids, *Dendrobium nobile*, *D. densiflorum*, *D. chrysanthum*, *D. fimbriatum*, *Epidendrum* sp., *Phaius tankervilliae*, *P. flavus* and *Oncidium* while mealybug, *Pseudococcus* sp. was observed to infest the orchids like *Acampe*, *Calanthe*, *Cattleya*, *Coelogyne*, *Papiaonanthe*, *Cymbidium*, *Bulbophyllum*, *Luisia*, *Dendrobium*, *Epidendrum*, *Phaius* and *Rhynchostylis*. Based on infested material collected, the infestation of above insects was noticed at different level due various abiotic factors.

**Monitoring of pests on orchids**

The constant observations at weekly intervals were recorded for natural pest infestation on hybrids and orchid germplam maintained in conservatories of the centre.

It was found that,

- The infestation of two spotted spider mite, *Tetranychus urticae* was reported on *Earia*, *Calanthe*, *Coelogyne*, *Cymbidium*, *Dendrobium*, *Epidendrum*, *Luisia*, *Pholidota*, *Thunia*, *Zygopetalum*. Its infestation was being active throughout the year in different level. Population of mite reached at maximum in second to third week of May which remained most severe up to September and then decline subsequently.

- Five species of scale insects reported to infest on many species and hybrids of orchids. Its incidence was also noticed throughout the year. Both nymph and adult suck the cell sap from leaves, petioles, pseudobulbs and flowers and cause loss of vigor which
ultimately hamper plant growth. 200 plants of *Dendrobium nobile* were observed and found that 130 plants were severely infested by *Diaspis boisduvalii*.

- Aphids (*Macrosiphum luteum* and *Toxoptera uaranti*) were recorded to infest on new shoots, flower spikes and flowers of many orchids like *Anthogonium*, *Cymbidium*, *Dendrobium*, *Epidendrum*, *Oncidium*, *Phaius* and *Vanda*. Its infestation started in November-December and continued to April with different levels of damage. The levels of damage also varied species to species. Out of 150 plants of *Cymbidium “HC Aurora”* 90 plants were found infested.

- Thrips, *Dichromothrips nakahari* was reported to infest on many species and hybrids of *Cymbidium* and *Dendrobium*. Its incidence was being active throughout the year on orchids causing damage by sucking the cell sap from lower surface of leaves, flower buds and flowers with the help of rasping type mouth parts. The total 100 plants of *Cymbidium ‘Sleeping Nymphs’* were observed for the infestation of thrips on leaves and it was found that all plants were infested (100 per cent).

- The infestation of shoot borer, *Peridaedala* sp. was recorded on flowers of *Dendrobium nobile*, *D. chrysotoxum*, *D. moschatum*, *D. densiflorum*, *D. thrysiflorum* as well as its hybrids Thongchai Gold, Emma White, Madam Pompadour and Madam Pink and other orchids like *Arachnanthe*, *Acampe*, *Ascocentrum*, *Cryptochilus*, *Epidendrum radicans* etc. Its infestation started in mid May and continued till September with varying levels of damage. In “Thongchai Gold” 64% and in “Emma White” 70% plants were found infested.

**Pest management in Cymbidium**

**Relative efficacy of bio-pesticides against two spotted spider mite, *Tetranychus urticae* on Cymbidium**

Two experiments were carried out to evaluate the bio-efficacy of botanical products and bio pesticides against two spotted red spider mite (TSSM) on *Cymbidium “Winter Beach Sea Green”* under polyhouse conditions. The nine treatments (including control) viz., Neem oil 0.03% EC @ 5 ml/lit., garlic extract 5%, chilaune leaf extract (*Schima wallichii*) 10%, dhatura leaf extract 10%, B.t. (Dipel) 0.012%, titapat extract (*Artimissia*) 10%, tobacco extract 5% and mycomite 3g/lit were applied on four-year old potted plants. The experiment was laid out in simple complete randomized design (CRD) and replicated thrice. The data on average percent reduction in mite population showed that all the treatments were significantly superior over control. The maximum percent reduction (78.13 %) in mite population was recorded on the plants treated with neem oil followed by mycomite (74.10%). The minimum percent reduction (40.18%) in mite population was recorded in B.t. (Dipel) followed by titapat extracts (10%).
Relative efficacy of seven IPM Modules against mite infesting *Cymbidium “H C Aurora”*

Seven IPM modules were tested against two spotted spider mite, *Tetranychus urticae* under polyhouse condition. The seven IPM modules (M1-Sanitation + econeem 3000ppm 2 ml/lit. + propargite 57 EC 0.25%, M2- Garlic extract 5% + ethion 50 EC 0.05% +sanitation, M3- Chilaune leaf extract 10% + neem guard 2.5ml/lit. + profenophos 50EC 1.5ml/lit, M4- Dhatura leaf extract 10% + NSKE (achook) 1500ppm 5ml/lit. + mycomite 3 g/lit, M5- Tobacco extract 5% + neem oil 0.03EC 5ml/lit. + bifenthrin 10 EC 0.25%, M6- Titapat extract 10% + forced water treatment + imidacloripid 17.8 SL 0.003% and M7- control) were applied at ten days interval from the emergence of pest. Results showed that all the modules were found significantly superior over control. The maximum percent reduction (100%) in mite population was recorded in M5 followed by M1 and M6 reduced 98.00 and 95.22 per cent, respectively.

**Evaluation of IPM modules against aphid infesting *Cymbidium***

Seven IPM modules were tested against aphid, *Macrosiphum luteum* in *Cymbidium* under polyhouse condition. The seven IPM modules (M1- Sanitation + neem guard 2.5ml/lit. + propargite 57 EC 0.25%, M2- sanitation + Garlic extract 5% + ethion 50 EC 0.05%, M3- Tobacco extract 5% + econeem 3000ppm 2 ml/lit. + imidacloripid 17.8 SL 0.003%, M4- Dhatura leaf extract 10% + NSKE (achook) 1500ppm 5ml/lit. + profenophos 50EC 1.5ml/lit, M5- Chilaune leaf extract 10% + neem oil 0.03EC 5ml/lit. + cow urine 50%, M6- Titapat extract 10% + forced water treatment + bifenthrin 10 EC 0.25%, and M7- control) were applied at ten days interval from the emergence of aphid. The results showed that all the modules were found significantly superior over control. Among seven IPM modules, M-3 (Tobacco extract 5% + econeem 3000ppm 2 ml/lit. + imidacloripid 17.8 SL 0.003%) was most effective in reducing aphid population (94.33 %).

**Field evaluation of efficacy of bio-pesticides against aphid on flowers of *Cymbidium***

A field experiment was conducted to evaluate the efficacy of botanicals and bio-pesticides against aphids on the flowers of *Cymbidium “H C Aurora”* under polyhouse conditions. The treatments were applied at emergence of aphids on flower buds and flowers. Nine treatments (including control) viz., neem oil 0.03% EC (5 ml/lit.), garlic extract 5%, chilaune leaves extract (Schima wallichii) 10%, dhatura leaf extract 10%, econeem 3000 ppm 2ml/lit., titapat extract (Artimissia) 10%, tobacco extract 5%, and cow urine 50% were applied. The results showed that all the treatments were significantly superior over control. The maximum percent reduction (78.12%) in aphid population was recorded in plants sprayed with econeem followed by neem oil (77.54%). The minimum per cent
reduction aphid population (42.05%) was noticed on the plants treated with titapat (Artimisia) extract 10 per cent. The rest of the treatments were categorized as middle order of effective against insect.

**Relative efficacy of bio-pesticides against scale insect on Cymbidium**

An experiment was conducted to evaluate the efficacy of bio-pesticides against scale insect infesting *Cymbidium* under polyhouse conditions. The nine treatments (including control) viz., neem oil 0.03% EC @ 5 ml/lit., econeem 3000ppm 2 ml/lit., chilaune leaf extract (*Schima wallichii*) 10%, dhatura leaf extract 10%, titapat extract (Artimisia) 10%, garlic extract 5%, tobacco extract 5%, and cow urine 50% were applied on four year old potted plants. All the treatments were significantly superior over control. The maximum reduction (92%) in scale insect population was recorded in econeem followed by neem oil.

**Organic control of pest complex of Dendrobium**

**Field evaluation of bio-pesticides for their efficacy against mite on orchid (Dendrobium nobile)**

A field experiment was conducted to evaluate the efficacy of botanicals and bio pesticides against mite under polyhouse conditions. Nine treatments (including control) viz., neem oil 0.03% EC 5ml/lit., garlic extract 5%, chilaune leaf extract (*Schima wallichii*) 10%, dhatura leaf extract 10%, B.t. (Dipel) 0.012%, titapat extract (Artimisia) 10%, tobacco extract 5%, and mycomite 3g/lit were applied on potted plants. The results showed that all the treatments were effective in reducing mite population over control. The maximum per cent reduction (74.30%) in mite population was recorded in neem oil treatment followed by mycomite (72.96) The treatment B.t. (Dipel) 0.012% was least effective followed by chilaune leaf extract.

**Evaluation of botanicals and bio-pesticides against pests of other orchids**

**Relative efficacy of bio-pesticides against shoot borer, Peridaedala sp. on Dendrobium chrysotoxum**

An experiment was conducted to test the efficacy of bio-pesticides against shoot borer under polyhouse conditions. Nine treatments viz., neem oil 0.03% EC 5ml/lit., garlic extract 5%, chilaune leaves extract (*Schima wallichii*) 10%, dhatura leaf extract 10%, B.t. (Dipel) 0.012%, titapat extract (Artimisia) 10%, tobacco extract 5%, and NPV 0.10% were applied on plants at fortnightly interval. The results showed that all the treatments were significantly superior over control. The minimum (6.72%) shoot borer infestation was recorded on the plants treated with B.t. (Dipel) followed by neem oil (7.10%) and NPV (8.24%). at 7 days after second treatments.
Phytotoxicity of Econeem 3000 ppm on bud and full bloom stage of *Cymbidium “WBSG”*

An experiment was conducted to evaluate the phytotoxicity of different doses of econeem 3000 ppm @ 1.5, 2.0, 3.5, 5.0, 7.5 and 10 ml/litre at bud and full bloom stage under laboratory conditions. No phytotoxic symptoms were observed econeem application @1.5 to 5.0 ml/lit., however, application of econeem @ 7.5 ml/lit developed small irregular shaped white spots on blooms. Econeem @ 10.0 ml/litre caused burning symptoms.

Phytotoxicity of neem oil 0.03% EC on full bloom stage of *Cymbidium “WBSG”*

A lab experiment was conducted to evaluate the phytotoxicity of different doses of neem oil 0.03% EC @ 2.5, 3.5, 5.0, 7.5 and 10 ml per litre of water on the flowers of *Cymbidium* hybrid “WBSG” at full bloom stage. No phytotoxic symptoms were observed on applying neem oil @ 2.5 to 5.0 ml/litre of water on partially or fully opened flowers. The small dark brown patches and burning symptoms were observed on the sepals and petals when applied at higher dose @ 10 ml/litre of water. The flowers treated with lower doses of chemical longer life.

**DARJEELING CAMPUS**

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

**Germplasm collection**

Explorations for collection of orchids were conducted in different parts of Darjeeling district of West Bengal. The areas surveyed include Chatakpur, Bijanbari, Maneybhang, Allobari, Tista Valley, Rangey Rung, Takdah, Rampuria, Sitong and Mangpoo. Altogether 86 accessions belonging to *Oberonia*, *Dendrobium*, *Pleione*, *Cymbidium*, *Eria*, *Malaxis*, *Tainia*, *Liparis*, *Calanthe*, *Bulbophyllum*, *Gastrochilus*, *Coelogyn*, *Platanthera*, *Odontochilus*, *Neogyne*, *Pholidota*, and *Peristylis*. Apart from collecting orchids from natural habitat, *Paphiopedilum villosum*, *P. villosum* var. boxallii, *P. venustum*, *P. fairrieanum*, *P. hirsutissimum* were procured from the nurseries located in Darjeeling district of West Bengal and in Shilong Meghalaya. Five hybrids of *Paphiopedilum* namely Paph. Jolly Green Jem Mikkabi x Okayama Fresh ‘Fast River’, Pacific Ocean Ann x Small World, Paph Helas Jim x Vallarrow ‘Red Challenge’ Paph. Silhouette ‘Chanson’ and Startler x Hamana Emy x Teafor Twa were also procured during the year.
Morphological characterization and evaluation of orchid species

The orchids collected at Darjeeling Campus of NRC (O) were characterized and evaluated for their horticultural traits. The information on vegetative as well as reproductive traits was collected. The plants were photographed for preparation of digital herbarium. The species viz. *Cremasra appendiculata*, *Epigenium amplum*, *Epigenium rotundatum*, *Coelogyne nitida*, *C. occultata*, *C. ovalis*, *C. barbata*, *Cymbidium elegans*, *C. cyperifolium*, *C. erythreum*, *C. gammieanum*, *Spiranthes sinensis*, *Otochilus albus*, *Calanthe biloba*, *C. plantaginea*, *C. puberula* etc. were studied for morphological, vegetative as well as reproductive traits.

Molecular characterization of *Cymbidium*

DNA isolation, purification and quantification from 24 accessions of *Cymbidium tracyanum* was carried out. Protocol standardization for random primers was completed and RAPD profiling has been initiated. Heterologous SSR primers (41) were identified.

![RAPD profile of 24 accessions of Cymbidium tracyanum using RAPD primer A10](image)

Conservation of wild species and cultivars

The collected species of orchids were grown in pots as well as ‘simulated natural habitat’. Orchids in pots required more attention than those tied on trees (artificial natural habitat). The loss of germplasm in artificial natural habitat were almost nil. The artificial natural habitat aims at providing almost similar conditions as that of nature in which epiphytes were tied on the tree trunks while terrestrial were grown on grounds under the shady locations.

Promising genotypes identified

The following variants of *Pleione humilis* (2), *Coelogyne nitida* (1), *Coelogyne occultata* (1) *Dendrobium amoeneum* (1), were collected from Darjeeling district of West Bengal during exploration and are summarized as below:

1. Variant of *Pleione humilis* collected from Chatakpur, Darjeeling district of West Bengal. Variant is allied to *Pleione humilis* but differed in pseudobulbs having ovoid, ridged, tapering towards apex flushed light pink nearly half from the base,
sub orbicular lip and presence of pink spots and stripes instead of purple spots and stripes on the lip.

2. Another variant of *Pleione humilis* collected from Darjeeling district of West Bengal, India. This variant is allied to *Pleione humilis* but differs in having ovoid yellowish green pseudobulbs, acute sepals and petals, suborbicular heavily fringed lip and presence of very light yellow patches and very light purple stripes instead of purple line and patches on lip.

3. Variant of *Dendrobium amoenum* Wall ex. Lindl. from Takdah, Darjeeling district of West Bengal, India. The variant is allied to *Dendrobium amoenum* but differs in absence of purple spots on sepal, petal and lip and whitish green pedicellate ovary instead of purple.

4. Variant of *Coelogyne* was collected from the sub temperate hilly region Darjeeling district of West Bengal. In general appearance, this has much resemblance to *C. nitida* Lindl. but differs in presence of rays emerging from the yellow spots on the apical lobe of the lip and reniform pollinia.

5. During botanical explorations in Shillong district of Meghalaya (India) an undescribed taxon of *Coelogyne punctulata* was collected. In general appearance, this has much resemblance to *Coelogyne punctulata* Lindl. but differed by presence of very light yellow blotch on anterior of lateral lobe and the base of epichile instead yellow blotch bordering with orange and column with very light brown shades rather than clearly distinct 3 dark brown lines.

**Four new records for orchids to West Bengal**

During the field exploration in hitherto under or unexplored areas in Darjeeling district of West Bengal under orchid germplasm conservation programme several orchid species have been collected and conserved at National Research Centre for Orchids, Darjeeling Campus, Darjeeling. Out of them, upon critical studies based on literature King and Pantling (1898), Pradhan (1979), Lucksom (2007) and Chowdhary (2010) and consultation of regional herbaria LBG and CAL, 4 species have been identified as *Calanthe mannii* Hook f. *Calanthe yucksomnensis* Lucksum, *Calanthe pachystylis* and *Cymbidium cyperifolium* Lindl., which were not recorded earlier from the state.
Natural seed germination in Calanthe Yucksomnensis  S. Z. Lucksom under captivity

Seeds of orchids are small measuring less than a millimetre in length and less than a tenth to a quarter in widths. They also have little or no food reserves to carry out normal metabolism during germination. Hence, they require assistance of fungus to mobilize certain nutrients and growth factors. Though the seed germination in Calanthe under captivity were achieved by spreading seeds around potting mixture when the role of the fungal associates were not known. The efforts resulted in development of a hybrid named Calanthe Dominii in 1852. The study of fungal associates is not only essential for multiplication of a species but also for an accurate understanding of the ecology of orchids, improved management, and translocation opportunities for terrestrial orchids particularly with aim of rebuilding wild population. Calanthe yucksomnensis is a terrestrial orchid species first reported from Yucksom in Sikkim Himalaya. The species flowers in the month of March and April and seeds are matured and dehisce during August-October. A luxurious sapling growth of plantlets was observed in 2011 and it was comprehended that seeds may be germinating in the potting mixture. The plants were monitored for germinating seeds. The protocorms of various stages were found near the clump base and roots during the month of April – May. Histological observation from the roots of mature plants and protocorms suggested presence of mycorrhiza. No fungus association was observed in leaf primordial region. The isolation and identification of fungal associate may be useful in seed germination and hardening of tissue cultured plants.

Vivipari in Coelogyne nitida Wall ex. Lindl.

Though occurrence of pseudo vivipary has been reported in Orchidaceae family but true vivipary has not so for been documented in this family. True vivipary was observed in Coelogyne nitida. It is white flowered scented orchid distributed in India, (N. Himalaya, Sikkim, W.B.), Bhutan, China, Myanmar and Nepal at an altitude of 1500 – 2500m. It flowers in the month of April – May and pods are split during the month of June and July. Geminating seeds in dehisced seed pods during continuous rain and high humidity were observed in some plants.
**Development of new hybrids**

Out of 500 progenies of a cross (*Cym Sleeping Nymph ‘Glacier’x Cym lowianum*), the five flowered during the year. The colour of flowers was green with shades and faint lining of brown on sepals and petals. The flowers were semi round in shape and their number on floral spike varied from 2-5. Marked differences in lip banding pattern was observed. The three different lip banding pattern were present in F₁ population (Fig. ). Most of the progenies are expected to flower next year when it would be possible to make a selection of superior genotype from the progenies on the basis of their morphological desirable traits.
**EXTERNALLY FUNDED PROJECTS**

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

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

<table>
<thead>
<tr>
<th>Crop</th>
<th>Variety</th>
<th>Type of planting material</th>
<th>Targets 2011-12</th>
<th>Achievement 2011-12</th>
<th>Shortfall (if any)</th>
<th>Reason for Shortfall</th>
<th>Distribution of planting materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orchid</td>
<td>Cymbidium (7 hybrids) Cattelya hybrid</td>
<td>Tissue culture</td>
<td>12000</td>
<td>10000</td>
<td>2000</td>
<td>-</td>
<td>Free distribution (4000 nos. of seedling to 11 nos. of beneficiaries)</td>
</tr>
</tbody>
</table>

**Programme II: Standardization of production and protection technologies**

1. **Standardization of organic fertilizer for Cymbidium**
   Cymbidium with different slow release organic sources like Aishwarya (20:20:20), Biophos (20P), Biopotash (20K), Megacal (Ca, Mg + other micro nutrients), Pushkal (20N), EM Compost, Vermicompost and bone meal at different concentrations. Result indicated different slow released organic nutrient sources did not influences profoundly the growth of plant in terms of shoot development, pseudobulb and back bulb production and generation of leaves.

2. **Water management of Orchids**
   To study the water stress on flowering of Cymbidium. The treatment consisted of regular watering at 7 days interval, withheld of watering at the time of emergence, withheld of watering after 10, 20, 30, 40, 50 and 60 days of emergence. Moisture content of media, leaf, back bulb at different stress period, transpiration, leaf water potential and vase life were recorded and observed that moisture content of growing media, leaf, back bulb were recorded maximum at regular watering; however deteriorated as the withheld of watering progress and minimum recorded at 60 days interval. Same trend was also followed in case of transpiration and leaf water potential. The vase life was positively influenced by withheld of watering.

3. **Preharvest management of cymbidium**
   Cymbidium plants were treated with different concentration of NPK (10 :10 :10, 10 :20 :20, 10 :30 :30 at 0.2 and 0.3% concentration from April to September at 10 days interval. Application of NPK (10 :30 :30) at 0.2% concentration increased growth of plant in terms of shoot development (3.5), pseudobulb (4.5) and generation of leaves (6.3 per shoot) as compared to other treatment. However, number of spike (4.5), spike length (65.50 cm) and number of florate(12.50) were recorded at NPK(10 :20 :20) at 0.3% concentration
DUS Testing on Orchids: Preparation for Plant Varieties Protection and DUS Testing through ICAR - SAU System

In the present study, 16 species and 41 hybrids of *Cymbidium*, 30 species and 14 hybrids of *Dendrobium* and 12 species and 9 hybrids of *Vanda* were included for development of DUS test guidelines for common descriptors. In *Cymbidium*, out of 62 characteristics, pseudobulb size, inflorescence length, number of flowers, flower width, flower duration, flower predominant color, lip ornamentation, blooming time; in *Dendrobium*, out of 52 characteristics, plant height, internode length and number, inflorescence length, flower width, lip color, and ornamentation and flowering time and in *Vanda*, out of 54 characteristics, plant type, internode length, leaf type, spike length, flower number, inflorescence colour, sepal and petal ornamentation, lip shape, colour and ornamentation, spur length and flowering time were used for grouping of species and hybrids.

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

Production of quality planting material of *Cymbidiums*

The five cultivars namely Levis Duke ‘Bellavista’, Pine clash ‘Moon Venus, Margaret Thatcher “Diplomat”, Vivacious “Super white” and Soul Hunt - 6 were selected for multiplication. These cultivars were multiplied through meristem culture. The targeted
plantlets, 11,000 were produced for the demonstration of *Cymbidium* cultivation in Sikkim.

**Performance of *Cymbidium* cultivars under different locations**

The demonstration units were setup in five different locations of Sikkim namely Karthok, Pakyong, Assam Lingzey, Sombaria and Yang Yang. The plant growth parameters were recorded maximum in Yang Yang followed by Karthok and Sombaria. Some plants flowered during the current year and full flowering is expected next year.

**Development of Protocol for Mass-multiplication of Paphiopedilum Orchids and their Commercialization in North Eastern States of India**

The project aimed at developing the protocol for mass multiplication of six native *Paphiopedilum* species and 4 hybrids subsequently mass multiplication and setting up 10 demonstration units for their commercialization. The project is jointly being carried by National Research Centre for Orchids, Pakyong, Sikkim and The Energy and Resources Institute (TERI), New Delhi. The mother plants of six species of Paphiopedilum orchids namely *Paphiopedilum insigne*, *P. villosum*, *P. spiceranum*, *P. hirsutissimum* and *P. venustum* were collected from Shillong and Kalimpong. The flowers were sib-mated for seed formation. The seeds were cultured on different culture media namely Thomale GD (TGD), Burgeff (BF), Mitra et al. (M), Murashige and Skoog (MS) and Knudson C (KC) and incubated in dark. The earliest seed germination was observed on Burgeff medium. The splitting of seed coat occurred in 55-60 days and the PLBs were formed in 82-90 days and for developing complete plant it required nearly 120-140 days. The seedlings of *Paphiopedilum villosum* and *P. insigne* were cultured on NC medium supplemented with various concentrations of BAP (0, 0.2, 0.4, 0.6, 0.8 & 1.0 mg/l) for three months. It was observed that increasing concentration of BAP increased the fresh weight of the seedlings but reduced drastically when the concentration of BAP was increased. The optimum BAP concentration for *P. villosum* and *P. insigne* was 0.4 and 0.6 mg/l, respectively.

**NAIP Project – A Value Chain on Selected Aromatic Plants of North East India**

**Component 2: A value chain on selected aromatic plants of North East India**

Different growing media namely leaf mould, coconut husk, brick pieces, tree bark and sand at various combination and NPK (10:10:10, 20:10:10, 30:15:10, 40:20:10, 50:30:20, 50:30:30) at 1g/l and plant protection through organic sources for maximization of flowering. It was recorded that growing of *D. chrysotoxum* in leaf mould, coconut husk and brick pieces (1:1:1) media, application of N30 P10 K101g/l and *Artimisia* juice @ 1:50 enhanced the cane production (4.0/pot) and flowering (16flowers / inflorescence).
## Training Programme

<table>
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<tr>
<th>Date</th>
<th>Topic</th>
<th>Number of Participants</th>
<th>Category of Participants</th>
<th>Venue</th>
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<td>28-29&lt;sup&gt;th&lt;/sup&gt; April, 2011</td>
<td>Cultivation and Management of Orchids</td>
<td>32</td>
<td>Officers of Horticulture Department, Govt. of Meghalaya and Horticulture staff posted at Raj Bhavan, Shillong</td>
<td>Raj Bhavan, Shillong</td>
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<tr>
<td>03-05&lt;sup&gt;th&lt;/sup&gt; May, 2011</td>
<td>commercial cultivation of Orchids</td>
<td>26</td>
<td>Farmers of Meghalaya</td>
<td>NRC(O)</td>
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<tr>
<td>20-29&lt;sup&gt;th&lt;/sup&gt; July, 2011</td>
<td>Short course on Current trends in commercial floriculture</td>
<td>11</td>
<td>Officers and Scientists of ICAR and SAU</td>
<td>NRC(O)</td>
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<tr>
<td>17-19 Nov., 2011</td>
<td>Production and Management of <em>Cymbidium</em> Orchids</td>
<td>39</td>
<td>Farmers from Ganchung, Sapong and Tenkilakha, Sikkim</td>
<td>NRC(O)</td>
</tr>
<tr>
<td>21-23 Nov., 2011</td>
<td>Production and Management of <em>Cymbidium</em> Orchids</td>
<td>17</td>
<td>Farmers of Assam Lingzey and Pabong, Sikkim</td>
<td>NRC(O)</td>
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<tr>
<td>23&lt;sup&gt;rd&lt;/sup&gt; Nov- 17&lt;sup&gt;th&lt;/sup&gt; Dec, 2011</td>
<td>Vocational Training</td>
<td>23</td>
<td>Class XII Students of Government Senior Secondary School, Sikkim</td>
<td>NRC(O)</td>
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<tr>
<td>24&lt;sup&gt;th&lt;/sup&gt; January, 2012</td>
<td>Training-cum-Awareness Programme on PPV &amp; FRA</td>
<td>50</td>
<td>Scientists, Officers, RAs of ICAR and SAU of Sikkim</td>
<td>NRC(O)</td>
</tr>
<tr>
<td>19&lt;sup&gt;th&lt;/sup&gt; March, 2012</td>
<td>Cultivation and Management of orchids</td>
<td>44</td>
<td>Farmers of Kalimpong, W.B.</td>
<td>NRC(O)</td>
</tr>
<tr>
<td>26&lt;sup&gt;th&lt;/sup&gt; March, 2012</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Stake Holders Meeting</td>
<td>21</td>
<td>Officers and Scientists of ICAR, SAU, NHB, NABARD, HCCD Dept of Sikkim and Members of growers association of Sikkim and Darjeeling.</td>
<td>NRC(O)</td>
</tr>
</tbody>
</table>
Training Programme on ‘Cultivation and Management of Orchids’ at Raj Bhavan, Shillong

Short course on ‘Current trends in commercial floriculture’


Training Programme on ‘Production and Management of Cymbidium Orchids’ – 21-23rd Nov., 2011


**Education & Training**

**Scientist**

NAIP sponsored training programme on “Scientific Report Writing and Presentations” at NAARM, Hyderabad from 19 – 22\textsuperscript{nd} March, 2012.

M. Chakrabarti

Twenty One days winter school on “Molecular Mechanisms Involved in Conferring Abiotic Stress Tolerance to the Biological Control agents *Chrysoperla, Trichogramma, Trichoderma* and *Pseudomonas*” at NBAII, Bangalore form 01-21\textsuperscript{st} December, 2011.

N. K. Meena

International training course on *In vitro* and cryopreservation techniques for conservation of plant genetic resources organized by NBPG (ICAR) –Biodiversity international Centre of Excellence at NBPG (ICAR) New Delhi from 14-26\textsuperscript{th} Nov., 2011

Rampal

Training on development of dipstick kit for orchid viruses from 17-19\textsuperscript{th} April, 2011.

R. P. Pant

Training on Employer’s Perspective on Labour Related Laws at NAARM, Hyderabad from 10-12\textsuperscript{th} May, 2011

R. P. Medhi and D. Barman

Winter school on “Molecular Approaches for Allele Mining and Crop Improvement” at Division of Genetics, IARI, New Delhi from 5-25\textsuperscript{th} January, 2012.

S. Chakrabarti

**Administrative**

Training on Employer’s Perspective on Labour Related Laws at NAARM, Hyderabad from 10-12\textsuperscript{th} May, 2011

D. Joseph
Linkages and collaboration

The centre has linkages with several universities, research institute and developmental agencies for collaborative research and developmental activities in orchids and other mandate floriculture crops.
List of publications

Books


Book chapter


Research papers


**Popular articles**


**Bulletin**


Dendrobium spp. Protection of Plant Varieties and Farmers Rights Authority, NASC Complex, New Delhi


**Paper presented in Seminar/ Symposia**


Awards/Rewards/Recognition/Bodies acquired during the year.


List of ongoing projects

Institute projects

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<td><em>In vitro</em> propagation of orchid: <em>Cymbidium</em> and important, rare and endangered species</td>
<td>R. P. Medhi</td>
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<tr>
<td>Cytogenetical research on orchids</td>
<td>S. Chakrabarti</td>
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<tr>
<td>Improvement of orchids</td>
<td>D. Barman</td>
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<tr>
<td>Development of agro–techniques for commercial production of orchids in open and protected conditions.</td>
<td>D. Barman</td>
</tr>
<tr>
<td>Production management of tropical and sub-tropical orchids</td>
<td>L. C. Barman</td>
</tr>
<tr>
<td>Development of Integrated floriculture enterprise</td>
<td>D. Barman</td>
</tr>
<tr>
<td>Post harvest technology of orchids</td>
<td>L. C. De</td>
</tr>
<tr>
<td>Collection, conservation, characterization, evaluation and maintenance of high alt. orchid germplasm</td>
<td>Ram Pal</td>
</tr>
<tr>
<td><em>In vitro</em> conservation of orchids</td>
<td>Ram Pal</td>
</tr>
<tr>
<td>Development of protocol for mass multiplication of rare, endangered and threatened orchid species.</td>
<td>N. Sailo</td>
</tr>
<tr>
<td>Disease management of orchids</td>
<td>R. P. Pant</td>
</tr>
<tr>
<td>Integrated pest management in orchids</td>
<td>N. K. Meena</td>
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Externally Funded Projects

1. Mini Mission – I

Project title: “Horticulture Mission for North East and Himalayan States”
Principal Investigator: R. P. Medhi

<table>
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<th>Associated Scientists</th>
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<td>Programme I: Production of nucleus/basic seed and planting material of horticultural crops</td>
<td>R. P. Medhi, D. Barman</td>
</tr>
<tr>
<td>Programme II: Standardization of Improved production technologies for horticultural crops</td>
<td>D. Barman, L. C. De, R. P. Pant &amp; N. K. Meena</td>
</tr>
<tr>
<td>Programme III: Technology refinement and imparting of training to extension functionaries</td>
<td>D. Barman, L. C. De, S. Chakrabarti, R. P. Pant, Rampal, N. K. Meena and N. Sailo</td>
</tr>
</tbody>
</table>

2. DUS Testing Project

Project title: “DUS testing of orchid varieties /species for development of NTG”
Principal Investigator: L. C. De

3. DBT Project

Project title: “DBT mission for quality planting material production & Utilisation for the North East”
Principal Investigator: R. P. Medhi, Co-Principal Investigator: Rampal

4. DBT – II Project

Project title: “Development of protocol for commercialization of paphiopedilum orchids in NE states”
Principal Investigator: R. P. Medhi, Co-Principal Investigator: Rampal

5. NAIP Project

Project title: “A Value Chain on Selected Aromatic Plants of North East India”
Co-Principal Investigator: R. P. Medhi, CCPI: D. Barman and Rampal
The RAC (Research Advisory Committee) Meeting of NRC Orchids convened on 14th and 15th October 2011 at the Conference Hall under the Chairmanship of Prof. D.P. Ray, Vice Chancellor, OUAT, Bhubaneswar, Orissa- 751003 and with other following members.

- Dr. Umesh Srivastava, Member, ADG (Hort. II), ICAR, New. Delhi
- Prof. S. P. Vij, Member, Ex Head Deptt. of Botany, Punjab University, Chandigarh
- Dr. S. N. Sinha, Member, Ex Head, IARI Regional Station, Karnal
- Prof. S. K. Mitra, Member, Faculty of Horticulture, BCKV, Mohanpur
- Dr. R. C. Srivastava, Member, Joint Director, BSI, Kolkata
- Dr. R. P. Medhi, Member, Director, NRCO, Pakyong
- Dr. J.G. Varshney, Member IMC, Joint Director ICAR Res. Complex for NEH region, Sikkim Centre
- Mr. P.T. Bhutia, Representative, IMC Nominee, State Dept. of Horticulture and Cash Crops, Govt. of Sikkim
- Mr. Nirmal Yonzon, Progressive Orchid Grower, Pakyong, E. Sikkim
- Dr. D. Barman, Member Secretary and Principal Scientist (Horticulture), NRCO, Pakyong

The following Scientists of NRC Orchids, Pakyong, Sikkim attended the meeting, presented their research achievements and work plan for the future.

- Dr. L.C. De, Principal Scientist (Horticulture)
- Dr. S. Chakrabarti, Senior Scientist (Genetics)
Dr. R.P. Pant, Senior Scientist, (Plant Pathology)
Shri Rampal, Scientist SS (Horticulture) Darjeeling Campus
Dr. N.K. Meena, Scientist (Entomology)
Shri N. Sailo, Scientist SS (Plant Physiology)

In addition to above, Research Associates also participated in the meeting.

**Summary of Recommendation**

**General recommendation**

- Booklets/Technical bulletins of package of practice should be in local language also like Nepali as well on other languages of NE India for the benefit of farmers.
- All projects which are more than 5 years old should be phased out and final RPF to be submitted. Also scientist should submit new projects.
- Plant materials should be imported only through NBPG. While purchasing from Indian agents, the plant material may be routed through NBPG for quarantine clearance.
- NRC Orchid should keep only those hybrids whose parentages are known. Without parentage, hybrids may not be used for further improvement.
- The centre should not work only on *Cymbidium*. Emphasis may also be given to other commercial orchids like *Dendrobium, Phalaenopsis, Oncidium, Cattleya* etc.
- Till date NRCO could not be able to develop even one commercial hybrid. Scientists should be devoted to develop hybrids as early as possible and to register through NBPG for so that NRCO could capture the demand of domestic market.
- Research should be oriented as per demand of market, as orchids are highly market driven crop. While formulating projects, consumers’ preference should also be considered.
- Scientists should visit regularly to farmer’s field to collect infected plants and to advocate necessary suggestions for controlling diseases and pests.
- Two publications, one entitled “15 Glorious years of NRCO” and other “NRCO Research Abstracts” may be completed by June 2012. Hindi version of the same may also be published.
- Portable meteorological kit, global positioning system (GPS) and DIVA-GIS software are essential for conservation and collection of orchids.
- Herbarium and digital herbarium consisting of Indian species and hybrids should be developed within 2 years. The RAC assigned Dr. L. C. De to take-up the matter
for preparing herbarium and Rampal for digital herbarium. BSI’s help may be taken up for guidance, if needed.

**Crop Improvement**

- Cytological studies of all orchid germplasm of NR CO including Darjeeling campus within a time frame and phase wise. At least 50 species should be completed within a year with existing facilities.
- Collection and conservation of at least 50 species of orchid from Arunachal Pradesh and other states should be completed within this year.
- A list of species which are endemic and endangered should be prepared with the help of BSI and Orchidologist before starting work on *in-situ* conservation of orchids.
- NR CO may register the elite-clone and hybrids developed immediately through NB PGR.
- Breeding and micro propagation of *Dendrobium* and *Phalaenopsis* may be taken up for mass multiplication; at least 4 protocols in each genus may be worked out.
- In tissue culture, Isabgol jell or other cheaper jelling agent should be tried instead of agar and other costly jelling agent in the media. Instead of glucose, table sugar can also be used.
- Development of suitable hybrids/varieties of cut flower and pot plant of *Cymbidium* is very much essential. The breeding work for development of suitable hybrid of *Cymbidium* may be assigned to Darjeeling campus exclusively.

**Crop Production**

- Cost benefit ratio may be worked out before advocating any technology to farmers.
- Multi-location trial is essential for assess the performance and viability of any technology. Multi-location trial of two hybrids of tropical orchids particularly Mokara, Aranda and Oncidium may be conducted.
- Development of package of practices for *Dendrobium* and *Phalaenopsis* species including post harvest management may be taken up during the year.
- Technology for round-the-year production of Orchids is required to generate sustainable income for the grower. The centre may take pro-active role in developing programme for round-the-year production of *Dendrobium* and *Phalaenopsis* (at Pakyong) and *Cymbidium* (at Darjeeling campus).
- A collaborative project on stress management of orchids may be formulated and submitted as soon as possible.
• Training on isolation and culture of root Mycorrhizae and other beneficial fungi may be imparted to scientists.

**Crop Protection**

• Virus indexing of ORSV through “Dipstick” method may be developed for easy detection.

• Disease free planting material is an important criteria for quality flower production. Concerned scientist may take up work in collaboration with plant breeder to screen out viruses using *in vitro* techniques. Virus free planting material for at least 7 infected *Dendrobium* and 9 infected *Cattleya* hybrids may be made available within a year.

• Identification of the causal organism of bacterial rot may be worked out in collaboration with other institutes and its Control measures may be developed in a year

• More botanical product like *Clerodendron inforturatum* leaf extract against the insects may be taken up in experimentation.

• Control measures of at least two major pests for *Cymbidium* and *Dendrobium* may be worked out within a year.
Recommendations of the 10th “Institute Research Committee” (IRC) meeting, National Research Centre for Orchids (ICAR) Pakyong, East Sikkim-737 106

The Institute Research Committee meeting of NRC for orchids, Pakyong, Sikkim-737 106 was held on 30th December, 2011 under the Chairmanship of Director, Dr. R. P. Medhi at the Conference Hall of the Institute. Following members were present in the meeting:

1. Prof. S.P. Vij, FNASc., FPAS, FLS, Scientist Emeritus, Deptt. of Botany, Punjab University, Chandigarh-160014
2. Prof. G.S. Yanzon, Chairman & Director, Darjeeling Society of Education Research and Development, Darjeeling-734101
3. Dr. Saroj Toppo, Representative, ICAR Research Complex for NEH Region, Tadong, Sikkim, Member
4. Sh. Deo Rai, Farmers’ Representative, Member
5. Dr. L. C. De, Principal Scientist (Hort.) and Member Secretary, NRC for Orchids, Pakyong

The following scientists of NRC for Orchids, Sikkim attended the meeting:
1. Dr. D. Barman, Principal Scientist (Horticulture)
2. Dr. S. Chakrabarti, Senior Scientist (Genetics)
3. Dr. R. P. Pant, Senior Scientist (Plant Pathology)
4. Shri. Rampal, Scientist SS (Horticulture), Darjeeling Campus.
5. Dr. N.K. Meena, Scientist (Entomology)
6. Dr. M. Chakrabarti, Scientist (Plant Breeding)
7. Sh. N. Sailo, Scientist (Plant Physiology)

Expert Remarks:
- Research areas must be conforming to our institute mandate
- Awareness creation programme for potential orchids
- Development of cultivation packages for farming community and un-employed youth
- Precise in selection for breeding and cultivars especially market preferences
- New requirements or preferences of the farmers
- Breeding programme for obsolete hybrids
- Entrepreneurship or businessman may be involved for propagating quality planting materials through MOU
- Focused research programme should be taken up
Summary of Recommendation

Crop Improvement

Genetics

- Preparation of list of Rare, Endangered and Threatened orchid species, DNA Fingerprinting of specified endangered orchids, Molecular characterization of rare *Paphiopedilum* species, Identification of parental lines and development of secondary hybrids of *Dendrobium* orchids

Plant Breeding and Tissue Culture

- GIS interpretation of Diversity of orchids in NE Region, Integrated Approach to conserve two rare orchid species, Development of Phalaenopsis hybrids, In–vitro propagation of some selected hybrids of *Cymbidium*, *Dendrobium* and Phalaenopsis. Development of protocols for *in–vitro* flowering *Cymbidium* orchids; Multiplication of *Cym. Whiteae*

Plant Physiology

- In–vitro propagation of *Renanthera inschootiana* and *Vanda coerulea* from explants derived from various plant parts; Mycorrhizal association studies in orchids

Crop Production and Post Harvest Handling

Horticulture

- Evaluation and multiplication of two (2) hybrids each of *Mokara*, *Aranda*, *Oncidium* hybrids, Evaluation of *Cymbidium*, *Dendrobium* and *Cattleya* orchids using cheap and locally available growing media, round the year production of *Dendrobium* and Phalaenopsis orchids; Standardization of harvesting stages of *Cymbidium*, *Dendrobium*, *Aranda*, *Oncidium* and *Mokara* hybrids, Effect of chemical preservatives on vase life of *Cymbidium* hybrid, Effect of packaging materials on vase life of *Cymbidium*, *Dendrobium*, *Vanda* orchids; Development of DUS test guidelines in *Phalaenopsis* and *Cattleya* orchids

Darjeeling Campus

- Selection, identification and procurement of parental lines for development of *Cymbidium* hybrids; utilization of old popular hybrids as parental lines; initiation of polyploidy breeding; Selection of parental lines having heat tolerant characteristics and development of *Cymbidium* hybrids within 3 to 4 years;
Submission of a modified project for continuation of *in-vitro* and *ex-vitro* conservation of orchid germplasm; Molecular characterization of temperate orchids; studies on Apomixis of specified orchids at cell, ploidy and genome level

**Crop Protection**

**Pathology**

- Virus indexing of orchid species and hybrids by ELISA and RT-PCR technique, characterization of orchid fleck virus; Protocol development for production of virus free plants in *Dendrobium* and Cattleya; refinement of dip-stick method for identification of Cym. MV diseases

**Entomology**

- Eco-friendly management of insect-pests of *Cymbidium* orchids, Pest occurrence on *Cymbidium* orchids and climatic effect, Screening of popular *Cymbidium* hybrids against mites, biology of major *Cymbidium* pests, Use of locally available bio-pesticides and botanical products for assessment of efficacy against pests of *Dendrobium*, Cattleya, *Vanda* and *Oncidium* orchids
Participation of Scientists in Conferences, Meetings, Workshops, Symposia, Seminar etc in India and abroad

North East Agri-Fair 2012, February 10-12, 2012, Khanapara, Guwahati

Joint Research Co-ordination Committee of NEH Region meeting at AAU, Khanapara on 13th April, 2011.
R. P. Medhi

Meeting on Disease diagnostics of Horticultural Crops at Central Potato research Institute, Shimla on 16th April 2011
R. P. Pant

Regional Committee Meeting at ICAR Research Complex for NEH Region, Barapani from 5-6th May, 2011.
R. P. Medhi

Central Steering Committee meeting of Horticulture Mission for North East and Himalayan States at CPRI, Shimla on 2nd June, 2011.
R. P. Medhi

NBPG- NAGs workshop at NBPG, New Delhi from 29 - 30th July, 2011
S. Chakrabarti

Agribusiness Campaign at NIRJAFT, Kolkata from 11-12th August, 2011
S. Chakrabarti

Scientific Advisory Committee (SAC) meeting of Krishi Vigyan Kendra (ICAR) at Ranipool, East Sikkim, on 19th August, 2011.
R. P. Medhi

L.C. De

Joint Research Co-ordination Committee meeting for NEH Region at ICAR, RC for NEH Region, Barapani, Meghalaya on 7th October, 2011.

R. P. Medhi

64th Annual Meeting of Indian Phytopathological Society and National Symposium on Biology of Infection, immunity and disease control in pathogen – plant interaction, held at Department of Plant Sciences, School of Life Sciences, University of Hyderabad from 2-4th December, 2011.

R. P. Pant

Two day work shop under International Union of Microbiological Societies (IUMS) National committee, Indian National Science Academy (INSA) and Indian Agricultural Research Institute held at INSA office at Bahadurshah Jafar Marg, New Delhi from 7-8th December, 2011.

R. P. Pant

Borer meet at Bangalore on 9th December, 2011.

R. P. Medhi

Review meeting of progress at NIRJAFT, Kolkata from 16-17th December, 2011

S. Chakrabarti


R. P. Medhi, D. Barman, L. C. De, R. P. Pant

North East Agri Fair 2012 at Khanapara, Guwahati from 10-12th February, 2012 and exhibited different Cymbidium hybrids and other technology of NRC for Orchids, Pakyong.

R. P. Pant and N. Sailo

SFAC meeting of BPD unit at NIRJAFT, Kolkata on13th February, 2012

S. Chakrabarti

R. P. Pant and N. Sailo


R. P. Pant and M. Chakrabarti


R. P. Medhi
Distinguished visitors

Shri. Sudhir Bhargava, Member, ICAR Governing Body, New Delhi 11/05/2011
Shree Singey Phub, Pr. Research Officer, R&D Centre Bajo, Dept. of Agriculture & Forest, Royal Govt. of Bhutan. 04/06/2011
Shri. Dawa Norbu Thakarpa, Hon’ble Agriculture Minister, Govt. of Sikkim. 07/03/2012
Shri. Bhim Dhungel, Hon’ble Forest Minister, Govt. of Sikkim. 07/03/2012
Prof.(Dr.) S. Rajan, ADG (Hort.- I), ICAR, New Delhi 14/03/2012
Personnel

I. Scientific
Dr. R. P. Medhi, Director
Dr. D. Barman, Principal Scientist (Horticulture)
Dr. L. C. De, Principal Scientist (Horticulture)
Dr. Syamali Chakrabarti, Sr. Scientist (Genetics)
Dr. R. P. Pant Sr. Scientist (Plant Pathology)
Shri. Rampal, Scientist Sr. Scale (Horticulture)
Dr. N. K. Meena, Scientist (Agril. Entomology)
Dr. M. Chakrabarti, Scientist (Plant Breeding)
Shri. N. Sailo, Scientist (Plant Physiology)

II. Administration
Shri. Davis Joseph                       Administrative Officer
Shri. Ajen Lama                       Assistant Administrative Officer
Shri. Rishi Kant Singh  Assistant Finance and Account Officer
Mrs. W. Stella Sasa   PA to Director
Mrs. Diki Bhutia   Sr. Clerk
Shri. Phigu Tshering Bhutia Jr. Clerk
Mrs. Sangeeta Lepcha Jr. Clerk

III. Technical
Shri. Noni Gopal Debnath Computer Assistant (T-II-3)
Shri. Ram Chandra Gurung Driver (T-3)
Shri. Manoj Adhikari Technical Asstt. (T-1)
Miss. Meena Kumari Chettri Technical Asstt. (T-1)
Shri. Deepak Khattri Driver (T-1)
Shri. Ajay Bushal Technical Asstt. (T-1)

IV. Supporting
Shri. Gopal Brahmin SSG-IV
Shri. Dawa Bhutia SSG-II
Shri. Tularam Dulal SSG-II
Shri. Trilok Singh Balmiki SSG-II
Shri. Arjun Gurung SSG-I
Mrs. Rabin Kala Subba SSG-I
V. Appointments

Scientific

- Shri. N. Sailo joined as Scientist (Plant Physiology) on 5th September, 2011
- Dr. M. Chakrabarti joined as Scientist (Plant Breeding) on 21st November, 2011 transferred from IGFRI, Jhansi.

Administration

- Shri. Davis Joseph joined as Administrative Officer on 20th April, 2011.
- Mrs. W. Stella Sasa joined as PA to Director on 23rd March, 2012.

VI. Transfer on Deputation

Administration

- Shri. Rajat Kr. Das, Assistant transferred on deputation to Coast Guard, Haldia on 6th May, 2011.
Organisation of 3rd Krishi Mela

The 3rd Krishi Mela (Farmers’ Fair) of National Research Centre for Orchids (NRCO) was jointly organized with National Horticulture Board (NHB) on 7th March, 2012 at Pakyong of East Sikkim District for the benefit of Orchids Farmers of Sikkim State. Shri Dawa Narbu Thakarpa, Hon’ble Minister of Agriculture, Govt of Sikkim, inaugurated the Krishi Mela and graced the occasion as chief guest. Shri Bhim Prasad Dhungel, Hon’ble Minister of Forest & Environment; Govt. of Sikkim was the guest of honour. The other dignitaries present on this occasion were Shri Vishal Chauhan, Secretary, Agriculture; Shri D. K. Rai, Principal Director (HCCDD); Dr. P.K. Srivastava, Dean, CA&PHT, CAU, Ranipool; Shri A. K. Singh, Centre-In-charge, NHB, Gangtok and Dr. R. P. Medhi, Director, NRCO. In addition, numbers of State Agricultural Officers, Village Panchayet, NGOs’ and farmers were also present. The fair was organised with a view wherein growers of flowers, agri-business, entrepreneurs, researchers and students have direct interaction with each other on different technologies related to orchids. In this occasion, the technologies developed by the Centre were exhibited and demonstrated. A number of indigenous orchid species and hybrids collected by NRCO were displayed. The progressive Orchids Growers from Kartok, Assam Lingzey, Dikling and Mirik also exhibited their produce. Approximately 300 farmers from different parts of Sikkim participated in the Krishi Mela. Farmers appreciated the technologies developed by NRCO and shown their willingness to adopt them.

Director, Dr. R. P. Medhi, NRC for orchids welcomed all and he narrated the achievement of the Institute. Further, he mentioned that every technical help will be provided to farmers for better growth of orchid farming.

Shri A.K. Singh emphasized the role of National Horticulture Board in development of Horticulture/ commercial horticulture. He informed about various and schemes subsidies for North east India for integrated horticulture. NHB, also provide training to farmers outside Sikkim. He mentioned that the NHB has already sent the farmers of North & West Sikkim to Solan for training on Mushroom cultivation. He also emphasized on organic ginger cultivation and commercial flower cultivation.

Dr. P.K. Srivastava emphasized importance of Orchids and role played by CA&PHT, CAU in commercialization and value addition of Orchids, especially on shrink packaging. He also added that the self life of Orchid flower is more than 3 weeks which helps in transportation. Dr. Srivastava requested farmers to learn shrink packaging technology; moreover he mentioned that the farmers should try other flowers besides Orchids.
Shri D.K. Rai stated that Sikkim is agriculture state and people of Sikkim should know new technologies in the field of agriculture/horticulture for higher production. He suggested that economic status of farmers can be improved by growing of high value crops, especially *Cymbidium*. He informed about the schemes of state government in expansion of *Cymbidium* cultivation. In this connection he mentioned that the department is distributing 500 imported *Cymbidium* plants to each farmers. Likewise, the govt. had selected clusters of 50 farmers’ from south district and provided them with 500 plants to each farmer. He also stated that the state govt. has selected 9 Constituencies in east district. He urged to do cultivation of other flowers like rose, gerbera, alstroemeria etc. as well as fruits vegetables & spices like guava, drumsticks, ginger, turmeric, round chilly etc. Besides, he also encouraged farmers for bamboo & medicinal plants cultivation and conveyed that the state govt. is always ready for the help. Shri Rai informed that 52 farmers have been selected around Pakyong area for loose flower cultivations like marigold. He urged farmers of Pakyong & surrounding areas to get full advantage of having NRCO in their area and requested them to visit NRCO frequently to learn more about orchids & its management.

Shri Vishal Chauhan informed about the various schemes of the govt. for farmers & urged them to take full advantage of those schemes especially latest technologies in order to increase productivity of all crops, and requested them to visit NRCO time to time & to take full advantage of it. Emphasized on marketing of orchids, he advised them, for marketing not just to depend upon govt. but to capture all markets by themselves working in groups, starting from own markets of Sikkim. He also emphasized on organic ginger cultivation and informed that 300 metric tons of organic ginger is required by the govt. to supply outside the state as well as abroad especially Netherland. Hence, the farmers can produce more & more organic ginger as its rate is always higher comparing to inorganic ones.

Shri Bhim Prashad Dhungel highlighted on flowers cultivation and told that from the floriculture one can earn more from limited land. He mentioned that the people of Pakyong are lucky to have airport in their locality which will help in easy supply of their flowers to outside state or country by air from 2015. Shri Dhungel also informed that the cold storage and flower auction centre will be constructed in Pakyong, and urged farmers that the big opportunity is there in front of them to widen their trade, so they should not lose it.

Shri Dawa Narbu Thakarpa emphasized how to earn more from less land, because of limited land in Sikkim but the state is God gift for floriculture, it has unique agro-climatic characteristics for floriculture. He pointed out that people should take advantage of Pakyong airport by tourism, transportation of high value crops etc. As the state of Sikkim is cultivating mostly cymbidium orchids he suggested of doing commercial cultivation of
other orchids as well, like cattleya, oncidium, vanda etc. according to their altitudinal and environmental requirements. He mentioned that the completion of airport will bring many foreigners here and the flower growers can easily sale them their flowers as per tourists preference such as cut flowers, potted plants etc. One can grow all varieties of orchids from miniature to intermediate & standard. But emphasized more for growing standard varieties as the rate of cut flower is high. He also appreciated Assam Lingzey for their commercial cultivation of *Cymbidiums*, and urged all farmers to come in competition in the field of floriculture. He also stated that the farmers can cultivate the flowers of their own interest such as Gerbera, Gladiolus and Rose etc. It is not compulsory to grow orchids only. He encouraged farmers for green house cultivation of vegetables and also informed them that govt. is having papaya seedlings for distribution to farmers, they can earn lakhs of rupees from its cultivation. He also explained that the govt. has already started drip irrigation system in Sikkim for oranges, papaya etc. He also mentioned that, there will be good benefit from orange cultivation. Shri Thakarpa also urged that if the farmers are facing any problem of diseases, pests etc. and facing any difficulties in the management of their farming they should consult immediately to scientists, experts, govt. organizations etc. for the solution. Govt. is always ready to help its people.

A series of lectures useful for the farmers were delivered by the Scientists of NRCO, progressive orchids farmers, entrepreneur and funding agencies. The one day programme ended with distribution of garden tools to the farmers by Dr R.P. Medhi, Director, National Research Centre for Orchids.

At the end Dr. D.Barman heartily thanked all for active participation and cooperation for organizing the Krishi Mela.
The first stake holders meeting of NRC for orchids, Pakyong, Sikkim-737 106 was held on 26th March, 2012 under the Chairmanship of Director, Dr. R. P. Medhi at the Conference Hall of the Institute. Following other members were present in the meeting:

- Dr. P.K. Srivastava, Dean, College of Agricultural Engineering and Post Harvest Technology, CAU, Ranipool, Sikkim
- Shri Padam Subba, Deputy Director, Horticulture and Cash Crop Development Department, Govt. of Sikkim, Krishi Bhawan, Gangtok, Sikkim
- Dr. A. K. Mohanty, Programme Coordinator, Krishi Vigyan Kendra- East Sikkim, ICAR Research Complex for NEH Region, Sikkim Centre, Ranipool, Sikkim.
- Shri Anup Kumar Das, Deputy General Manager, Sikkim Regional Office, NABARD, Gangtok, Sikkim.
- Shri Kailash Rai, Deputy General Manager, Sikkim State Cooperative Supply and Marketing Federation Limited, Gangtok, Sikkim.
- Shri A.K Singh, Centre i/c, NHB, Gangtok, Sikkim.
- Shri Kumar Yonzon, Progressive Farmer, Kartok, Sikkim.
- Dr. L. C. De, Principal Scientist (Hort.) & Member Secretary, NRC for Orchids, Pakyong.
- Dr. D. Barman, Principal Scientist (Hort.), NRC for Orchids, Pakyong.
- Dr. S. Chakrabarti, Senior Scientist (Genetics), NRC for Orchids, Pakyong.
- Dr. R. P. Pant, Senior Scientist (Plant Pathology), NRC for Orchids, Pakyong.
- Mr. Rampal, Scientist SS (Hort.) & i/c NRC for Orchids, Darjeeling.
Potential Commercial Products

- **Germplasm line of Epidendrum radicans** x **E. xanthium**
- A cross of **Den. Emma White** x **Den. Pompadour**
- Four new genotypes of **Paphiopedilum insigne**, two new genotypes of **Liparis bootanensis**, three new genotypes of **Coelogyne nitida** one each of **Calanthe puberla** and **Eria spicata**
- A cross of **Arachnanthe cathcartii** x **Vanda coerulae**
- Protocols for seed culture in **Zygopetalum intermedium**, **Coleogyne cristata**, **Phaius tankervilleae**, **Vanda coerulae**, **Cymb. dayanum**, **Cattleya maxima**

Potential Commercial Process

- Package of practices for production and multiplication of lilies, rose and gladiolus
- Package of practices for production of **Cymbidium** orchids
- Package of practices for production of **Dendrobium** orchids
- Package of preparation of slow release organic fertilizers
- Standardization of processes for DNA isolation, purification, PCR, Gel electrophoresis, RAPD analysis, ISSR analysis and STM analysis
- Identification of new insect pests in orchids
- Standardization of botanical extracts for control of shoot borer, thrips and mite in orchids
- Identification of natural enemies for management of insect pests of orchids

Potential Technology Development

- Characterization of valuable species and hybrids of orchids through DUS test guidelines
- Identified commercial hybrids of **Cymbidium**, **Dendrobium**, **Vanda**, **Cattleya**, **Aranda**, **Mokara**, **Oncidium** and **Phalaenopsis** for different location of Sikkim Himalaya
- Low cost production technology of **Cymbidium** orchids
Post-harvest Management of *Cymbidium* Orchids

Propagation of *Cymbidium* orchids through backbulbs

Improved propagation techniques in lilium

Biocontrol for anthracnose of orchids

Availability of dipsticks for virus detection

**Services**

- DNA finger printing of orchid species in protecting the orchid biodiversity from illegal use
- Providing technical support to private sector laboratories for multiplication and expansion of orchid cultivation
- Human resource development through MTC, Short course training, on/off campus training
- Evaluation of floriculture related research projects
- Preparation of course curriculum on floriculture in graduate and post-graduate levels.

**Expert Remarks:**

- NRCO should develop market driven hybrids on consumers demand
- The institute should proceed for commercialization for fragrant pot plants from wild species or cut flowers with improved colour, shape, forms and productivity though mass multiplication.
- Identification of commercial hybrids with long transportation capacity and self-life for different altitudes and development of their cultivation packages for farming community and un-employed youth
- Adoptability of planting materials of commercial orchids should be tested for different location of the region.
- Preferences of the farmers for supplementary commercial flowers other than orchids.
- Selection of location specific early, medium and late varieties of *Cymbidium* orchids having five colours such as white, yellow, green, pink and maroon.
- Entrepreneurship or businessman may be involved for propagating quality planting materials through MOU
- Single stalk or bulk packaging of graded cut flowers of orchids
Independence Day Celebration
National Integration Week Celebration
(19 – 25th November, 2011)
Celebration of Hindi Saptah
(14 – 20 Sept., 2011)
Celebration of Republic Day
Vigilance Week
(31st Oct. – 5th Nov., 2011)
Play cards displayed during vigilance week celebration