



# वार्षिक प्रतिवेदन Annual Report

2018 - 2019



ISO 9001 - 2008

भा. कृ. अनु. प-राष्ट्रीय ऑर्किड अनुसंधान केंद्र  
पाक्योंग-737 106, सिक्किम, भारत  
ICAR-National Research Centre for Orchids  
Pakyong-737 106, Sikkim, India



[www.nrcorchids.nic.in](http://www.nrcorchids.nic.in)

**वार्षिक प्रतिवेदन**  
**Annual Report**  
2018 – 19



**भा.कृ.अनु.प.-राष्ट्रीय ऑर्किड अनुसंधान केन्द्र**  
पाकयोंग, सिक्किम-737106  
**ICAR-National Research Centre for Orchids**  
Pakyong, Sikkim-737106  
(ISO 9001 - 2008)  
[www.nrcorchids.nic.in](http://www.nrcorchids.nic.in)



**ICAR-National Research Centre for Orchids**

Pakyong-737106, Sikkim

Tele No: +3592 – 267031, 267032, 267033

Telefax: +3592 – 267032

Email: [director.nrc@icar.gov.in](mailto:director.nrc@icar.gov.in)

Website: [www.nrcorchids.nic.in](http://www.nrcorchids.nic.in)

***Published by:***

Dr. D. R. Singh

Director

ICAR-National Research Centre for Orchids

Pakyong-737106, Sikkim

***Compilation & Editing:***

Dr. Rampal

Dr. Tshering Lhamu Bhutia

Ravi Kishore Pamarthi

A. Loyanganba Meitei

Ajay Bhusal

***Correct Citation:***

ICAR-NRCO, 2019. Annual Report 2018-19,

ICAR-National Research Centre for Orchids,

Pakyong-737106, Sikkim

# CONTENTS

<b>PARTICULARS</b>	<b>Page No.</b>
<b>PREFACE</b>	<b>v</b>
<b>कार्यकारी सारांश</b>	<b>vii</b>
<b>EXECUTIVE SUMMARY</b>	<b>ix</b>
<b>INTRODUCTION</b>	<b>1</b>
<ul style="list-style-type: none"><li>• Mandate</li><li>• Vision</li><li>• Mission</li><li>• Organogram</li><li>• Staff Position</li><li>• Financial Statement</li></ul>	
<b>RESEARCH ACHIEVEMENTS</b>	<b>5</b>
<ul style="list-style-type: none"><li>• Conservation, characterization and sustainable use of diversity in Orchids</li><li>• Genetic improvement of orchids for yield, quality and resistance to biotic and abiotic stresses</li><li>• Development and refinement of production and protection technologies for improved productivity, marketing and utilization of orchids</li><li>• Strengthening farmers and stakeholders through adoption of technologies</li></ul>	
<b>EXTERNALLY FUNDED PROJECTS</b>	<b>19</b>
<ul style="list-style-type: none"><li>• Breeding of selected orchids for cut flowers and pot plants: Strengthening the weakest link between orchid research and industry.</li><li>• DUS testing on Orchids: Preparation for Plant Varieties protection and DUS testing through ICAR-SAU system.</li><li>• Assessment of chemical and genetic divergence of some fragrant orchids of north-east India for sustainable improvement of community livelihood (DBT-TWIN in collaboration with IIT, Kharagpur, West Bengal).</li><li>• National Mission for Himalayan Studies (NMHS).</li><li>• Inventorization of gamma radiation technology for orchid varietal improvement (BRNS-BARC Project).</li><li>• Life cycle cryo-biotechnology of orchids for bio-resources conservation and sustainable development</li></ul>	
<b>TECHNOLOGY ASSESSED AND TRANSFERRED</b>	<b>24</b>
<b>TECHNOLOGICAL OPTIONS FOR DOUBLING FARM INCOME</b>	<b>28</b>
<b>CENTRAL GOVERNMENT SCHEMES</b>	<b>29</b>
<b>OTHER INSTITUTE ACTIVITIES</b>	<b>32</b>
<b>HINDI REPORT</b>	<b>35</b>
<b>TRAINING AND CAPACITY BUILDING</b>	<b>36</b>
<b>LINKAGES AND COLLABORATION</b>	<b>39</b>
<b>NRCO IN MEDIA</b>	<b>40</b>
<b>PUBLICATIONS</b>	<b>41</b>
<b>DISTINGUISHED VISITORS</b>	<b>44</b>
<b>IMPORTANT PROGRAMMES ORGANIZED, ATTENDED AND FACILITATED BY THE DIRECTOR</b>	<b>46</b>
<b>PERSONALIA</b>	<b>50</b>
<b>RESEARCH ADVISORY AND INSTITUTE COMMITTEES</b>	<b>52</b>



# PREFACE

---



It gives immense pleasure to place the Annual Report of ICAR- NRC for Orchids, Pakyong, Sikkim for the year 2018-19. Technological interventions have played a significant role in improving production and productivity

and meeting the unforeseen challenges in Indian agriculture. As a single crop-based Research Centre, ICAR- National Research Centre for Orchids has been catering needs of orchid growers in the country. This Centre of Indian Council of Agriculture is meant to conduct applied and strategic research on conservation, improvement and culture of orchids for enhancing productivity and utilisation on one hand, and transfer of technology and capacity building of stakeholders for enhancing and sustaining the productivity of orchids on the other. Deforestation, defragmentation of natural habitats and human-led developmental activities has created immense pressure on natural habitats. As a result, many species of orchids are becoming threatened. This Centre has collected and conserved 351 species of orchids in its orchidaria.

The year 2018-19 witnessed many accomplishments in research and extension activities of the Centre. The collection and conservation of orchids remain one of the core areas of the Centre. Thirteen species of orchids and 46 hybrids of *Cymbidium* were added to the collection. Seventy species of orchids, several F1 progenies of *Vanda*, *Cymbidium* and *Phalaenopsis*, were characterised. The new cultivation techniques *viz.* hydroponics and vertical farming were tested in orchid cultivation. The production and post-harvest management technologies were refined to maximise the production and reduce the post-harvest losses. Organic solution for feeding of *Cymbidium* and *Zygopetalum* plants were worked out. Studies

were conducted for mass multiplication of *Dendrobium* hybrids and *Cymbidium whiteae*, an endemic and threatened orchid of Sikkim. The institute has worked on several externally funded projects to enhance the research output. One such project funded by Ministry of Environment and Climate Change, Govt. of India under National Mission for Himalayan Studies, under this project geo-reference database on Indian orchids is being compiled; therapeutic orchids are being validated by chemical profiling, the ecological monitoring of endangered orchids has also being carried out. Many crosses were made for the development of commercial hybrids of *Cymbidium* and other orchids. Interspecific crosses of *Calanthe* and *Paphiopedilum* were also made during the period of under report. A BARC supported project on 'Inventorization of gamma radiation technology for Orchid varietal improvement have also been started in orchid breeding' Gamma radiated 'Emma White' *in-vitro* plantlets were analyzed using High Throughput analysis.

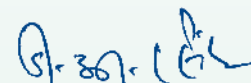
During 2018-19, twenty-three training programmes were organised that benefitted 227 students, 153 farmers and 160 officers on various aspects of Orchids and other horticultural crops. The Centre also organised training under Pt. Deen Dayal Upadhy Unnat Krishi Siksha Yojna on natural farming or cow based farming. Two exposure visits of orchid farmers were organised under tribal sub-plan. Five FLD's was conducted at several places of West Bengal and Sikkim. Thus a great emphasis was laid on demonstration and training and extension related activities for the benefit of the farmers.

I place on record my sincere gratitude to Dr Trilochan Mohapatra, Secretary DARE and Director General, Indian Council of Agricultural Research, New Delhi for support and guidance in accomplishing the mandate of the Centre. I also express my gratitude to Dr A. K. Singh, Deputy Director General (Hort. Sci.) for constant

encouragement and guidance. I am thankful to Dr T Janakiram, Assistant Director General (HS-I) for his critical remarks, constructive suggestions and encouragement. I am very much thankful to Chairman and members of various Committees like QRT, RACs who have been untiringly playing a significant role in shaping this Centre of ICAR.

I also express my gratitude to the line department in Sikkim who has been playing a pivotal role in the research and development of this Centre. All this success came from the active support, contribution and dedicated staff of ICAR-NRC for Orchids, Sikkim and its well-wishers.

Place – Pakyong, Sikkim  
Date – 20.06.2019



**D. R. Singh**  
Director  
ICAR-NRC for Orchids  
Pakyong, Sikkim

## कार्यकारी सारांश

- रिपोर्टाधीन वर्ष के दौरान कुल 61 प्रजातियों का आकृतिविज्ञान लक्षणवर्णन किया गया जिनमें शामिल हैं: एकैम्पे प्रीमोरजा, कैलोस्टाइलिस रिजिडा, क्लाइसोस्टोमा एपेण्डीकुलेटम, सीलोगायने फस्केसेंस, डेण्ड्रोबियम कैपीलाइप्स, डेण्ड्रोबियम हिटेराकार्पम, हाइग्रोचिलस पैरिशार्ड, डेण्ड्रोबियम डिवोनियेनम, डेण्ड्रोबियम रोटण्डेटम, फैलियोनॉप्सिस डेलिसियोसा, सैटाइरियम नेपालेन्स, वैण्डा क्रिस्टेटा, वैण्डा स्टैनगियाना, वैण्डा टेसेलैट, वैण्डा टेस्टासिया आदि।
- इस वर्ष सिम्बीडियम (44 सजीव पौधे, 02 स्पूडोबल्ब) की कुल 46 किस्मों को संकलित किया गया। इसके अलावा, पश्चिम बंगाल के दार्जीलिंग जिले से मूल आर्किड्स की सात प्रजातियों का संकलन भी किया गया।
- सिम्बीडियम वाइटिये पर संख्या एवं आकृतिविज्ञान अध्ययन किए गए। लेकानॉर्चिस सिक्कीमेन्सिस पर प्रारंभिक स्थान विशिष्ट अध्ययन भी किए गए।
- डेण्ड्रोबियम नोबाइल – मिथानॉल सत् की रासायनिक प्रोफाइलिंग से 16 यौगिकों की उपस्थिति का पता चला जिनमें कवक रोधी, जैविक रोधी, प्रति-ऑक्सीकारक विशेषताएं, वैसोडिलेटरी प्रभाव, इनफ्लूजा के विरुद्ध वायरल रोधी गतिविधि, कैंसर रोधी, पीडाहर, पायरेटिक कार्य रोधी तथा हाइपर ग्लाइसीमिया विशेषताएं शामिल हैं।
- सिम्बीडियम वाइटिये के व्यापक गुणनीकरण के लिए, पतली सेक्शन संवर्धन तकनीक स्थापित की गई। कुल चार साइटोकिनिन में से 6 – BAP, BA, जिपेटिन तथा TDZ, 6-BAP एवं जिपेटिन (2 $\mu$ mol), PLB के उत्प्रेरण के लिए इष्टतम पाए गए।
- कैलेन्थी क्लोरोल्यूसा x कैलेन्थी युक्सोमेन्सिस के बीज अंकुरण पर सक्रिय चारकोल के प्रभाव को जांचा गया। परिणामों से पता चला कि वूडी पौधा मीडियम (WPM) @ 500 मिग्रा./लिटर में सक्रिय चारकोल को मिलाने से भ्रूण एवं बीज अंकुरण की वृद्धि को बढ़ावा मिलता है।
- पैफियोपेडिलम विलोसम x पैफियोपेडिलम हिर्सुटीसिमम के बीज अंकुरण के लिए IAA की चार सान्द्रता (1,2,4 एवं 8  $\mu$ mol) को जांचा गया। आधारीय मीडियम में 2 $\mu$ mol/l IAA को मिलाने पर भ्रूण वृद्धि और बीज अंकुरण को बढ़ावा मिला।
- छः पैफियोपेडिलम प्रजातियों एवं संकरों नामतः पी. फ़ैरियेनम, पी. हिर्सुटीसिमम, पी. वेनुस्टम x पी. विलोसम, पी. स्पाइसेरियेनम x पी. विलोसम, पी. स्पाइसेरियेनम x पी. फ़ैरियेनम, पी. फ़ैरियेनम x पी. स्पाइसेरियेनम के भण्डारित बीजों को परिभाषित मीडियम पर संवर्धित किया गया। अधिकतम बीज अंकुरण पी. फ़ैरियेनम, पी. स्पाइसेरियेनम x पी. फ़ैरियेनम, तथा पी. फ़ैरियेनम x पी. स्पाइसेरियेनम में जबकि सबसे कम बीज अंकुरण पी. हिर्सुटीसिमम में रिकॉर्ड किया गया।
- फ़ैइअस प्राइमरी संकर (PBX – 11 – 25/01) के नवीन पारस्परिक क्रास का लक्षणवर्णन किया गया और क्रास क्षमता तथा असंगतता अध्ययन को संक्षेप में प्रस्तुत किया गया।
- आशाजनक वंशक्रम PBX-12-169/01, PBX-12-169/02 तथा MLS (D) के लगातार पुष्पन के साथ साथ नए आशाजनक वैण्डा संतति वंशक्रम का लक्षणवर्णन किया गया।
- कुल सत्रह एनआरसीओ / पैफियोपेडिलम संततियों का मूल्यांकन स्टेशन परीक्षणों तथा आरएमएलटी परीक्षण के अंतर्गत किया गया, कुल छः स्थानों से "Sheetal 1" पर डाटा का संकलन किया गया। पी. वेनुस्टम (नॉग्लवर्ड संकलन), हैप्पी ब्यूटी (मोकारा) का लक्षणवर्णन उनके आकृतिविज्ञान गुणों के लिए किया गया।
- वर्तमान वर्ष में सिम्बीडियम के 200 से भी अधिक प्रत्यक्ष एवं पारस्परिक क्रास को आजमाया गया। सिम्बीडियम के 27 क्रास, कैलेन्थी के 04 तथा पैफियोपेडिलम के 03 क्रास के बीजों का उक्त संवर्धन किया गया।



- PBSx – 18 – 43 (अराण्डा) का बीज संवर्धन और नए 17 क्रास को शामिल किया गया। रूटिंग के लिए 'डेन एम्मा व्हाइट' पर प्रभावी प्रोटोकॉल का मानकीकरण किया गया। PBX – 12 – 119 (ZI) तथा PBX – 12 – 99 (फ़ैलियोनॉप्सिस) की संततियों को अर्ध कठोर रूप दिया गया।
- सिम्बीडियम 'विंटर बीच सी ग्रीन' पर जांची गई कुल नौ पॉटिंग मीडिया में से, कोकोचिप्स + कोकोपीट + ईट के टुकड़े + वृक्ष की छाल वाली पॉटिंग मीडिया में सबसे लम्बी पत्ती, सबसे लम्बा स्यूडोबल्ब, स्यूडोबल्ब की संख्या, अगेती पुष्पन, फूल का आकार तथा प्रति स्पाइक पुष्पकों की संख्या में वृद्धि देखने को मिली।
- सिम्बीडियम आर्किड्स में 1 : 30 के अनुपात में तरल खाद का छिड़काव करने पर अधिकतम पत्ती लंबाई, स्पाइक की लंबाई, रेकिस की लंबाई, प्रति स्पाइक फूलों की संख्या, पुष्प की दीर्घता तथा क्लोरोफिल मात्रा दर्ज की गई।
- चेट्टाली, कर्नाटक में, डेण्ड्रोबियम सिंगापुर व्हाइट में साप्ताहिक अन्तराल पर 10: 20: 10 नाइट्रोजन – फॉस्फोरस – पोटैशियम (NPK) @ 0.1 प्रतिशत का पर्णाय छिड़काव करने पर अधिकतम पत्ती क्षेत्रफल हासिल किया गया और साथ ही प्रति वर्ष प्रति पौधा अधिकतम स्पाइक संख्या का उत्पादन हुआ, प्रति स्पाइक फूलों की अधिकतम संख्या तथा अधिकतम स्पाइक लंबाई और टूटी की पानी में 13.5 दिनों का फूलदान जीवन देखने को मिला।
- सिम्बीडियम के 40, वैण्डा के 20, डेण्ड्रोबियम के 14, ऑसीडियम के 10, कैटलिया के 9, तथा फ़ैलियोनॉप्सिस के 10 संकरों का रखरखाव किया गया और आर्किड्स पर डीयूएस परियोजना के तहत गुणनीकरण किया गया।
- डेण्ड्रोबियम 'एम्मा व्हाइट' के स्व: पात्रे से तैयार गामा विकिरण पादपकों को कठोर बनाया गया और कुछ नमूनों का हाई थ्रूपुट विश्लेषण किया गया। डेण्ड्रोबियम 'एम्मा व्हाइट' के लगभग 120 स्व: पात्रे पादपकों को अर्ध कठोर बनाया गया और 10 Gy तथा 20 Gy गामा स्तरों से आभासी परिवर्त पादपक विकसित किए गए।
- आर्किड्स आधारित कृषि प्रणाली में, बेंचों के नीचे चुनिन्दा सब्जियों को उगाने से आर्किड्स उत्पादकों की आजीविका में सुधार होता है।
- पूर्वी सिक्किम हिमालय के आर्किड्स तथा पुष्पीय संसाधन डाटाबेस के लिए एक नया वेब समर्थ होमपेज की डिजाइन तैयार करके उसका विकास किया गया।
- "Orchids Farming" पर एक एण्ड्रायड मोबाइल ऐप विकसित करके जारी किया गया। यह मोबाइल ऐप आर्किड्स किसानों और आर्किड्स के उद्यमियों के लिए अत्यंत उपयोगी है।

# Executive Summary

- Morphological characterization of 61 species was carried out during the year. The characterized species include *Acampe praemorsa*, *Callostylis rigida*, *Cleisostoma appendiculatum*, *Coelogyne fuscescens*, *Dendrobium capillipes*, *Dendrobium heterocarpum*, *Hygrochilus parishii*, *Dendrobium devonianum*, *Dendrobium rotundatum*, *Phalaenopsis deliciosa*, *Satyrium nepalense*, *Vanda cristata*, *Vanda stangeana*, *Vanda tessellate*, *Vanda testacea*, etc.
- Forty six cultivars of *Cymbidium* (44 live plants, 02 pseudobulbs) were collected during the year. In addition to seven accessions of native orchids were collected from Darjeeling district of West Bengal.
- Population and morphological studies on *Cymbidium whiteae* were conducted. Preliminary site specific studies on *Lecanorchis sikkimensis* were also carried out.
- Chemical profiling of *Dendrobium nobile*-Methanol extract revealed the presence of 16 compounds which possesses anti-fungal, anti-bacterial, antioxidant properties, vasodilatory effect, anti-viral activity against influenza, anti-cancer, analgesic, anti-pyretic action and hyper glycaemia properties.
- For mass multiplication of *Cymbidium whiteae*, thin section culture technique for was established. Out of four cytokinins, 6 – BAP, BA, Zeatin and TDZ, 6-BAP and Zeatin (2µmol/lit) were found optimum for induction of PLB.
- Effect of activated charcoal on seed germination of *Calanthe chloroleuca* × *Calanthe yucksomnensis* was tested. The results revealed that the addition of activated charcoal to Woody Plant Medium (WPM) @ 500mg/lit encourages growth of embryo and seed germination.
- Four concentrations of IAA (1, 2, 4 and 8 µmol/lit) were tested for seed germination of *Phaphiopedilum villosum* × *Phaphiopedilum hirsutissimum*. The addition of 2µmol/lit IAA in basal medium encouraged embryo growth and seed germination.
- The stored seed of 06 *Phaphiopedilum* species and hybrids namely *P. fairrieianum*, *Phirsutissimum*, *P. venustum* × *P. villosum*, *P. spicerianum* × *P. villosum*, *P. spicerianum* × *P. fairrieianum*, *P. fairrieianum* × *P. spicerianum* were cultured on defined medium. The highest seed germination was recorded in *P. fairrieianum*, *P. spicerianum* × *P. fairrieianum* and *P. fairrieianum* × *P. spicerianum* while the lowest was recorded in *P. hirsutissimum*.
- New promising *Vanda* progeny line PBX-12-169/03 characterized, apart from consecutive flowering of promising line PBX-12-169/01, PBX-12-169/02 and MLS (D).
- Seventeen NRCO/*Paphiopedilum* progenies evaluated under station trials and RMLT trial, the data on ‘Sheetal 1’ collected from six locations. *P. venustum* (Nonglwai collection), Happy Beauty (Mokara) characterized for morphological characters.
- Over 200 direct and reciprocal crosses of *Cymbidium* were attempted during the current year. The seeds of 27 crosses of *Cymbidium*, 04 of *Calanthe* and 03 of *Paphiopedilum* were tissue cultured.
- Seed culture of PBSx-18-43 (Aranda) and induction of new 17 crosses were done. Effective protocol on *Den’Emma White* for rooting was standardized. Progenies of PBX-12-119 (ZI) and PBX-12-99 (*Phalaenopsis*) were semi-hardened.
- Out of nine potting media tested on *Cym* ‘Winter Beach Sea Green’, the longest leaf, largest pseudobulb, number of pseudobulb, early flowering, flower size and nos. of florets/spike were recorded in potting media consisted of Cocochips + cocopeat + brick pieces + tree barks.
- Spraying of liquid manure in the ratio of 1:30 recorded maximum leaf length, spike length, rachis length, number of flowers per spike,

flower longevity and chlorophyll content in Cymbidium orchids.

- In Chettalli, Karnataka, foliar spray of 10:20:10NPK@0.1% at weekly intervals in *Den* Singapore White recorded the maximum leaf area, produced the maximum number of spikes/plant/ year, number of flowers/spike and spike length and vase life of 13.5 days in tap water.
- 40 hybrids of Cymbidium, 20 hybrids of *Vanda*, 14 hybrids of *Dendrobium*, 10 hybrids of *Oncidium*, 9 hybrids of *Cattleya* and 10 hybrids of *Phalaenopsis* maintained and multiplied under DUS project on Orchids.
- *In-vitro* raised gamma radiated plantlets of *Den* Emma White were hardened and few samples were analyzed for High Throughput analysis. Approx. 120 *in-vitro* plantlets of

*Den* 'Emma White' were semi-hardened and the putative mutant plantlets developed from 10 Gy and 20 Gy gamma levels.

- Inducted *V. coerulea* seed culture treated with gamma irradiation and Bamboo orchid at globule stage were radiated. Sub-cultured *in-vitro* material of *Zygopetalum* irradiated.
- In Orchid based farming system, the growing of selected vegetables under the benches enhances the livelihood of the orchid growers.
- Designed and developed a new web enabled home page for orchids and floral resource database of Eastern Sikkim Himalayas.
- An Android Mobile Application on "*Orchids Farming*" was developed and released. The mobile app is very useful for orchid farmers and orchid entrepreneurs.

# Introduction



The National Research Centre for Orchids was established on 5<sup>th</sup> 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 utilization 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 marketable 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 in the country. On the basis of recommendations of QRTs and RACs the research programmes have been modified on the mission-oriented research projects on germplasm management, crop improvement, crop production and extension.

## **Mandate:**

Applied and strategic research on conservation, improvement and culture of orchids for enhancing productivity and utilization.

Transfer of technology and capacity building of stakeholders for enhancing and sustaining productivity of orchids.

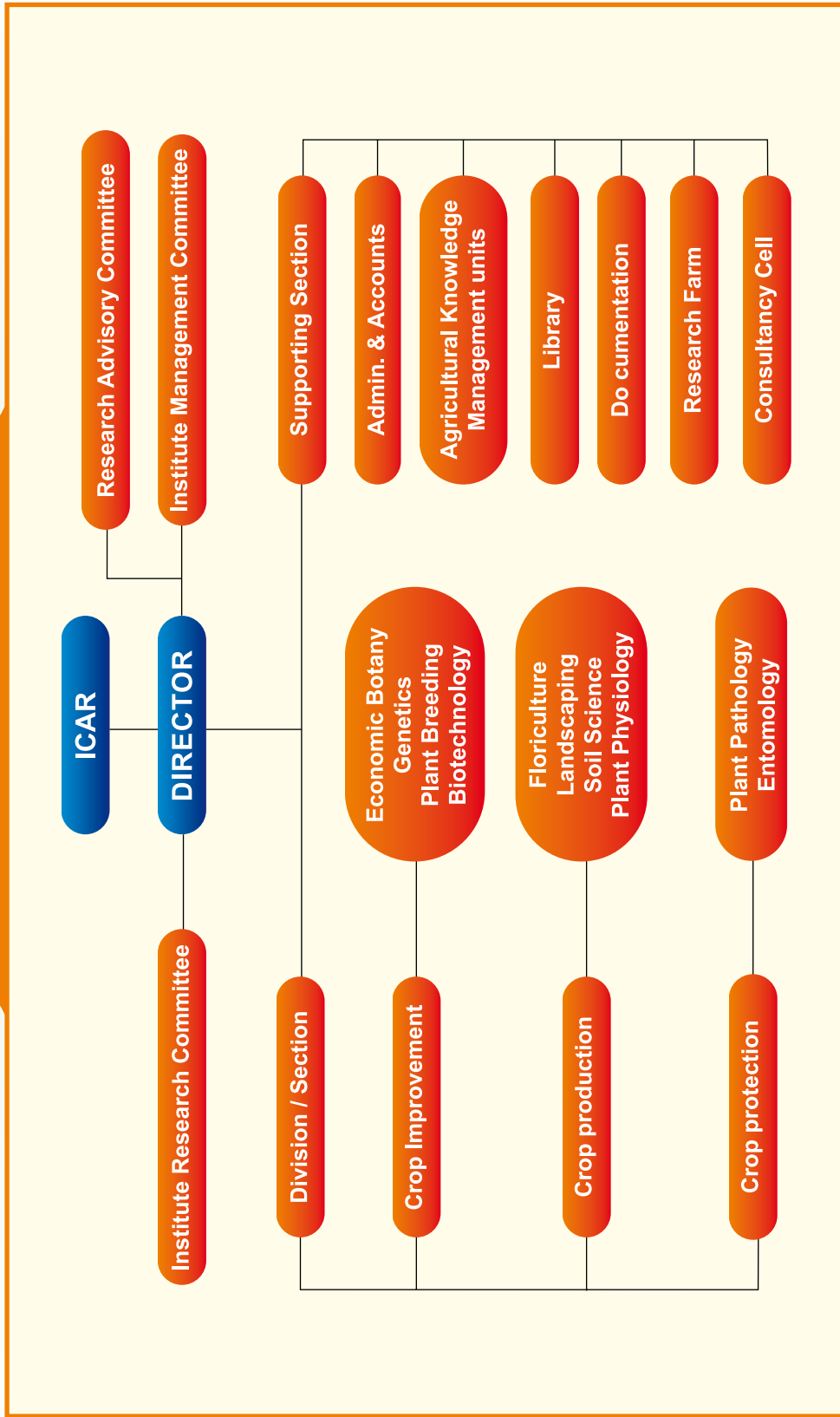
## **Vision:**

To act as a premier centre for research and development activities related to orchid commercialization and sustainable utilization.

## **Mission:**

Science and Technology driven development of orchid industry in the country.

# ORGANOGRAM



Organogram of ICAR-NRC Orchids

## Staff Position (2018-19)

### Category Wise

Category	Sanctioned	In position	Vacant
RMP	01	01	00
Scientific	14	07	07
Technical	07	07	00
Administrative	09*	06	03*
Skilled supporting	07	06	01
<b>Total</b>	<b>38</b>	<b>27</b>	<b>11</b>

\*01 Post of AAO abolished w.e.f 01.03.2016

## Budget (2018-19)

### Rs. In Lakh

Head	BE 2018-19	RE 2018-19	Fund Utilized	(%) Fund Utilized
Salary	298.50	318.39	309.88	97.33
Other than Salary	620.40	337.08 (192.85)	190.54	98.86
<b>Total</b>	<b>918.98</b>	<b>655.47</b>	<b>500.42</b>	

## Details of Research Projects

Sl No	Project Name	Funding Agency	PIs & Co-PIs
<b>Institute Projects</b>			
1	Conservation, characterization and sustainable use of diversity in Orchids	ICAR	Dr. Rampal – PI Dr. L C De Dr. S Chakrabarti* Dr. R Devadas Dr. N Sailo** Mr. Raj Kumar** Mr R K Pamarthi Dr. D.R. Singh
2	Genetic Improvement of Orchids for yield, quality and resistance to biotic and abiotic stresses	ICAR	Dr. R Devadas – PI Mr. Raj Kumar**
3	Development and refinement of production and protection technologies for improved productivity, marketing and utilization of orchids	ICAR	Dr L C De-PI Dr Rampal Dr. N Sailo** Mr. Raj Kumar** Dr. D R Singh
4	Improvement of knowledge and skill of stakeholders for improving production of orchids	ICAR	Dr. L C De – PI Dr. Rampal Dr. R Devadas Dr. N Sailo** Mr. Raj Kumar** Mr R K Pamarthi Dr. D R Singh

Externally Funded Projects			
1	Breeding of selected orchids for cut flowers and pot plants: Strengthening the weakest link between orchid research and industry.	ICAR Extra Mural Project	Dr. Rampal – PI Dr. S Chakrabarti*
2	DUS Testing on Orchids: Preparation for Plant Varieties Protection and DUS Testing through ICAR-SAU System.	PPV&FRA	Dr. L C De – PI Dr. R Devadas Dr. D R Singh
3	Assessment of chemical and genetic divergence of some fragrant orchids of north-east India for sustainable improvement of community livelihood (DBT-TWIN in collaboration with IIT, Kharagpur, West Bengal).	DBT	Dr. S Chakrabarti* – PI Dr. N Sailo** Dr. A Mitra
4	National Mission for Himalayan Studies-Himalayan Research Fellowship (NMHS-HRF).	MoEF & CC, GOI	Dr. D R Singh – PI Dr. Rampal Mr R K Pamarthi Dr T L Bhutia
5	Inventorization of gamma radiation technology for Orchid varietal improvement (BRNS-BARC Project).	DAE, BARC, GOI	Dr. R Devadas – PI Mr RK Pamarthi
6	Life cycle Cryo-biotechnology of orchids for bio-resources conservation and sustainable development	DBT	Dr. Rampal – PI Dr. Rekha Chaudhary

\* Retired and \*\* Transferred

# Research Achievements

## Project 1: Conservation, Characterization and Sustainable Use of Diversity in Orchids

### 1.1. Survey and collection of orchid germplasm

Forty-six cultivars of Cymbidium orchids were collected and conserved at Darjeeling Campus. Of the collected cultivars, 44 were live plants and 02 were pseudobulbs. In addition to Cymbidium cultivars, seven accessions of native orchids were also collected and conserved. These include *Paphiopedilum fairrieianum* (live plant), *Pleione praecox* (live plant), *Cymbidium iridioides* (Capsule), *Cymbidium eburneum* (Capsule), *Cremastra appendiculata* (live plants) and *Cymbidium munronianum* (live plant).

A new sub-project on collection and conservation of orchids of Western Ghats has been initiated in Chettalli, Coorg district, Karnataka. The native orchids of Coorg were collected and conserved. Initially, the orchids have been collected from the coffee based agro-ecosystems. The collected orchid species include *Aerides maculosa*, *Cymbidium bicolor*, *Dendrobium ovatum*, *Luisia macarantha*, *Luisia zeylanica*, *Oberonia denticulate*, *Pholidota pallida*, *Rhyncostylis retusa* and *Vanda tessellata*.

### 1.2. Morphological characterization of orchid germplasm

Characterization of 61 species namely *Acampe praemorsa* (Roxb.) Blatt. & McCann, *Callostylis rigida* Blume, *Cleisostoma appendiculatum* (Lindl.) Benth. & Hook.f. ex B.D. Jacks., *Coelogyne fuscescens* Lindl., *Dendrobium capillipes* Rchb.f., *Dendrobium heterocarpum* Wall. ex Lindl., *Hygrochilus parishii* (Veitch & Rchb.f.) Pfitzer, *Dendrobium devonianum* Paxton, *Dendrobium rotundatum*, *Phalaenopsis deliciosa* Rchb.f., *Satyrium nepalense* D. Don, *Vanda cristata*

Wall. ex Lindl., *Vanda stangeana* Rchb.f., *Vanda tessellata* (Roxb.) Hook. ex G. Don and *Vanda testacea* (Lindl.) Rchb.f.

**1.2.1 *Acampe praemorsa* (Roxb.) Blatt. & McCann:** Robust epiphytic shrubs. Leaves distichous, linear, sheathing at base. Floral bracts scaly, broadly orbicular, broader than long. Flowers 0.8-1.0 cm across. Sepals and petals, ovate-lanceolate, creamy yellow with reddish-brown transverse bands, thick, fleshy. Lip fleshy, creamy white with narrow red streaks, saccate at base, 3-lobed, lateral lobes small, mid-lobe ovate-obtuse, margin crispate, spur short.

**1.2.2 *Coelogyne fuscescens* Lindl.:** Leaves 2, apical, elliptic, acute, plicate, and narrow toward 1.5-2 cm long petiolate base. Inflorescence proteranthous, 16-22 cm long, sub-erect, developing from the rhizome at the base of mature leafy pseudobulb. Flowers 3.7-4.0 cm across, pinkish-brown glabrous. Sepals sub-equal, spreading, externally keeled at the base, pinkish-brown. Petals linear, acute, reflexed, 3-nerved, colour same as sepals with recurved margins.

**1.2.3 *Dendrobium capillipes* Rchb.f.:** Epiphyte with spindle-shaped, 6-node pseudobulbs arising in a cluster and having red-edged sheaths that yellow with age and carry deciduous, ligulate, or lanceolate, acuminate, rather laxly held leaves has an axillary, erect, 6 cm long, racemose, few flowered inflorescence with the racemes arising from the nodes near the apex of the leafless canes. Flowers are bright golden yellow in colour.

**1.2.4 *Dendrobium heterocarpum* Wall. ex Lindl.:** Pseudobulbs are stout, erect or pendant, with many oblanceolate leaves. Inflorescence is lateral and bearing blooms



in fascicles of 1-3 along the nodes. The flowers are 5cm across, ochraceous yellow to cream in colour. Reddish brown colour stripes are found on the labellum.

**1.2.5 *Dendrobium devonianum* Paxton:**

Pseudostems are slender, cylindrical, and pendant with linear-lanceolate leaves. Inflorescence is lateral, 1-3 flowered. Flowers are 2-5cm across, white with purple apex.

**1.2.6 *Dendrobium rotundatum* (Lindl.) Hook.f:**

A pendulous plant with thick woody rhizomes and ovoid pseudo-bulbs arranged 4 to 5 cm apart. Bulbs 2 to 4 cm long partly covered with thin membranous sheaths. Leaves in pairs, oblong, with very short petioles or often sessile, 4 to 7 cm long and around 2 cm in width, apex notched. Flowers solitary, 2 to 3 cm across. Sepals and petals yellowish brown with many veins. Lip yellowish brown, edges of the side lobes with bright orange, apical lobe with a yellow triangle on its mid and the sides with dull purple colour, the base of the lip with two irregular bright orange markings

**1.2.7 *Hygrochilus parishii* (Veitch & Rchb.f.) Pfitzer,:**

Leaves elliptic-oblong that are 11-23cm long. Inflorescences are longer than the leaves which bear 1-6 fleshy flowers that are 3.5-5.0cm across. Sepals and petals are yellow to yellow-green but whitish towards the base, and are densely blotched red-brown. The lip is purple with a paler base and margins.

**1.2.8 *Phalaenopsis deliciosa* Rchb.f.,:**

Leaves oblong-obovate, obtuse, margin wavy, glossy. Flowers are 1.8 cm across, Sepals and petals are pale pink. Lip white with dark pink blotches, side lobes oblong, midlobe obovate, forked at apex. Lip white with dark pink blotches. Species is ideal for hanging baskets.

**1.2.9 *Satyrium nepalense* D.Don,:**

Leaves 2-3, narrowly elliptic, acute somewhat fleshy. Inflorescence erect, smooth terete, pinkish-

green, floral bracts, deflexed, yellowish-green, with faint shade of pink. Flowers 5-7.2mm across, pink, fragrant. Sepals subequal pink. Petals recurved, entire, white. Lip 6-7mm long, superior, ovate, hooded, deeply concave, strongly keeled on the back.

**1.2.10 *Vanda stangeana* Rchb.f.:**

The inflorescences develop from the leaf axils with 5 to 10 flowers. The flowers are 4-6cm across, greenish yellow to ochre in colour, tessellated and dark brown.

**1.2.11 *Vanda testacea* (Lindl.) Rchb.f.:**

Leaves 6-10, conduplicate, keeled, linear-oblong. Inflorescence, 3-4, erects, from below the leaves, stout. Flowers 1.2-1.5cm across, yellow with whitish purple lip, spreading. Sepals, subequal, yellow, dorsally keeled, smooth. Petals spathulate-oblong, falcate obtuse. Lip adnate to the foot of column, spurred, the spur narrowly infandibuliform.

**1.2.12 *Vanda tessellata* (Roxb.) Hook. ex G.Donand:**

Leaves oblong, recurved conduplicate, 2-lobed at apex, with a central acute tip, base sheathing, coriaceous, closely packed. Racemes axillary; flowers 5 cm across, white outside, inner tessellate with brown spots; petals to 5 cm; The lip is indigo blue, 3-lobed, side lobes 7 mm; spur 5 mm, conical; column 5

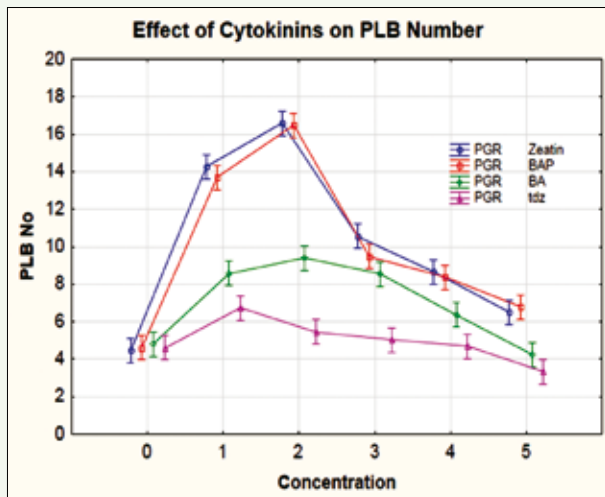
### 1.3. Effect of Cytokinins on thin cell section culture of *Cymbidium whiteae*

In order to develop an efficient procedure for rapid and mass *in vitro* propagation of *Cymbidium whiteae* through *in vitro* culture of thin cross-sections (TCSs) derived from young protocorms. The TCS explants were excised from the protocorms obtained by culturing seeds on Murashige and Skoog (MS) medium supplemented with 20g/l sucrose. The TCS culture medium was supplemented with 0, 1, 2, 4 and 8 µmol/l of N6-benzyladenine (BA), 6-Benzylaminopurine (BAP), Zeatin and Thidiazuron (TDZ). It was observed that Protocorm-like bodies (PLBs) were directly induced from the TCS explants and developed completely into shoots within 8-10 weeks of culture. The optimal growth regulators

combination for maximal PLB development was 2  $\mu$  mol/l Zeatin or BAP, giving rise to 68% of responding explants with an average 16.6 and 16.4 PLBs per explant.

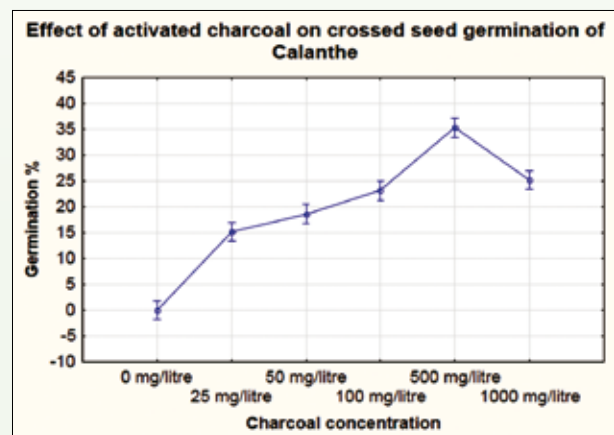
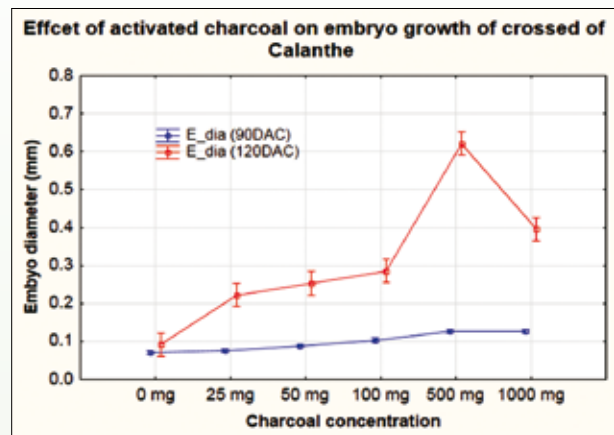


Fig.1. PLBs of *Cymbidium whiteae*



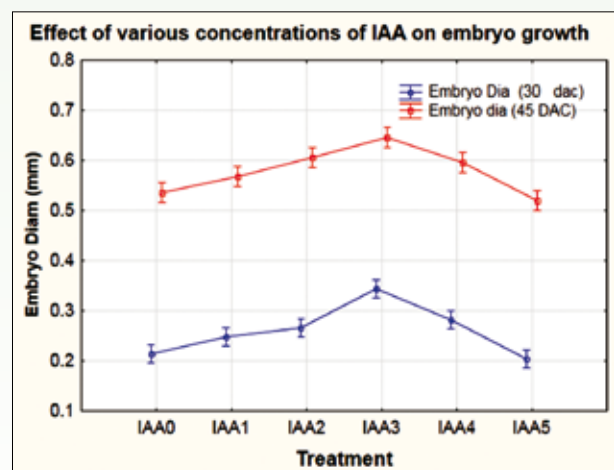
### 1.4 Effect of activated charcoal on *Calanthe yoksomnensis* × *Calanthe chloroleuca* seed germination

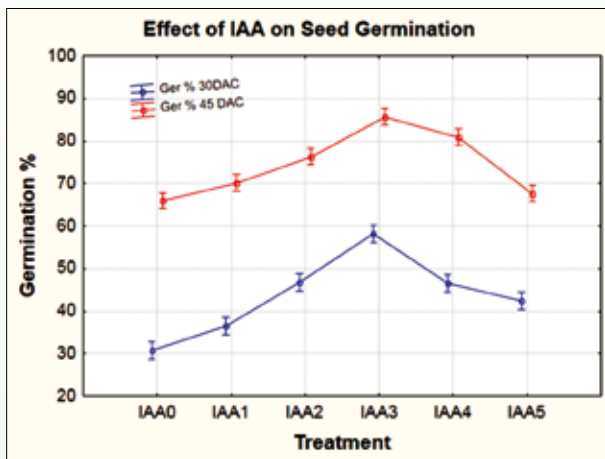
Effect of activated charcoal on *C. yoksomnensis* × *C. chloroleuca* seed germination was studied. Woody Plant Medium (WPM) was added with 0, 25, 50, 100, 500 and 1000mg/lt. The basal media supplemented with 500mg per litre activated charcoal recorded maximum embryo growth and highest seed germination after 90 and 120 days of culture.



### 1.5 Effect of IAA on *Paphiopedilum villosum* × *Paphiopedilum hirsutissimum* seed germination

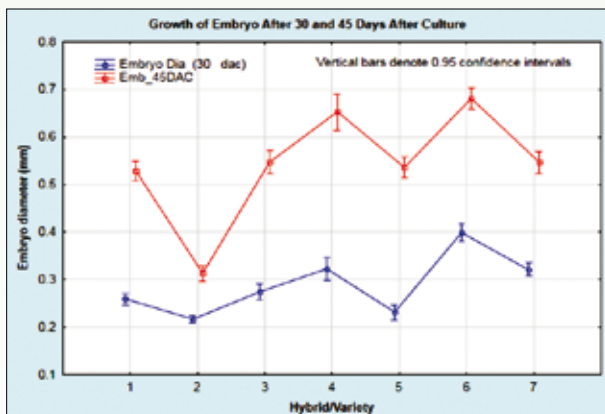
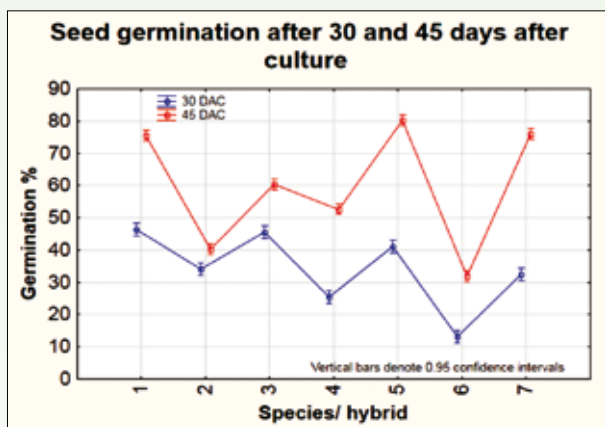
The seeds of *P. villosum* × *P. hirsutissimum* were cultured on a defined basal media supplemented with various concentration of Indole-3-acetic acid (IAA). Addition of IAA to basal media increased the growth of embryo and encouraged seed germination. Incorporation of IAA @ 2  $\mu$  mol/l enhanced seed germination to 85%.





### 1.6 Seed germination of species and hybrids of *Paphiopedilum*

The stored seeds of six *Paphiopedilum* species and hybrids namely *P. fairrieianum*, *P. hirsutissimum*, *P. venustum* × *P. villosum*, *P. spicerianum* × *P. villosum*, *P. spicerianum* × *P. fairrieianum*, *P. fairrieianum* × *P. spicerianum* were cultured on a defined medium. The highest seed germination was recorded in *P. fairrieianum*, *P. spicerianum* × *P. fairrieianum*, and *P. fairrieianum*



× *P. spicerianum* while lowest was recorded in *P. hirsutissimum*.

## Project 2: Genetic Improvement of Orchids for Yield, Quality and Resistance to Biotic and Abiotic Stresses

### 2.1 Genetic Enhancement

Flowering pattern of different progeny lines, genetic stocks and parental lines or species (281 no.) was monitored and recorded for maintenance purposes. *P. villosum*, *P. venustum* (Nonglwai collection) and Happy Beauty (Mokara) were characterized for morphological characters. Forty-three selective crosses were made during flowering season.

### 2.2 New breeding lines identified and selected

First novel *Cymbidium* combination of breeding line, derived from cross *Cymbidium gammieanum* × *Cymbidium dayanum* (PBX-05-490/04) was documented and characterized. Three other 1<sup>st</sup> blooming *Cymbidium* progeny population recorded viz., PBX-11-150 ('Margaret Thatcher' × *Cymbidium tracyanum*), PBX-11-144 (Cym Pine Clash 'Moon Venus' × *Cymbidium tracyanum*), PBX-11-155 ('CymFree Style No. 3' × *Cymbidium tracyanum*) and PBX-05-46 ('Red Star' × Cym Amesbury). New promising *Vanda* progeny line, PBX-12-169/03 was characterized derived from cross {*Vanda* 'Bernice Miller' × (*V. coerulea* × *V. roxburghii*)}. Seven new *Phalaenopsis* breeding lines were characterized viz., PBX-12-99/09, PBX-12-99/12, PBX-12-99/05, PBX-12-99/10, PBX-12-99/12, PBX-12-99/15 and PBX-12-99/16.

**PBX-05-490/04:** Early-mid flowering progeny (4<sup>th</sup> Wk, Oct). Novel combination with small size flowers characters with slender foliage suitable for potted variety. Spike length-34 cm, thin and drooping nature. Flower size medium, 4.6 cm × 6.5 cm and dominated by medium yellow-green colour (145B) with pale purple shade pointed lip inside. Dorsal sepal- 4 × 0.9 cm, narrow oblong shape and lateral sepals slightly incurved. Petals - 3.5 × 0.6 cm (R) & 3.55 × 0.62 cm (L), narrow

oblong with pointed tip. Potted vase life 32 days recorded.

**Late flowering Cymbidium progenies:** Characterized late flowering progenies of Cymbidium population (14 no.) for qualitative and quantitative traits *viz.*, PBX-05-884, *viz.*, PBX-05-884/02, PBX-05-46/03, BxH/02, HxB/12, HxB/20, HxB/21, HxB/22, HxB/31, BxH/02, BxH/12, BxH/14, BxH/18, BxH/20, BxH/35, BxH/37 derived from tertiary crosses

from previous season, in addition to 3 mid-late progenies. Cymbidium progenies *viz.*, BxH/02 and BxH/24 found to be similar during flowering. Late flowering progenies evaluated at Sikkim were found to take more number of days to flowering (DTF) than other early, mid and mid-late progenies even though flower bud initiation was initiated in Sept - Oct. Heat tolerant late progenies of Cymbidium (02 no.) *viz.*, **PBX-05-56** and **PBX-05-57** derived from cross *C. lowianum* x *C. tigrinum* were also compared.

**Table.1 Qualitative and quantitative traits of late flowering Cymbidium progenies**

Character	Spike length (cm)	Florets	Flower size	Flower colour	DTF	DTW
PBX-05-884/02	52.33	12.00	4.5 x 9.5	RHS/159D	133.00	68.0
PBX-05-46/03	30.25	8.00	9.1 x 10.8	RHS/63D	140.50	76.0
NRCO/HxB/12	50.00	5.00	10.2 x 10.2	RHS/8C	138.00	70.0
NRCO/HxB/20	58.50	12.00	6.8 x 9.0	RHS/1D	109.00	68.0
NRCO/HxB/21	65.00	9.00	5.5 x 8.4	RHS12B/C	136.00	88.0
NRCO/HxB/22	62.00	19.00	6.0 x 8.2	RHS/N144B	161.00	51.0
NRCO/HxB/31	61.00	8.00	8.2 x 9.3	RHS/187A	139.00	80.0
NRCO/BxH/02	56.00	8.00	7.5 x 10	RHS/163B	136.00	44.0
NRCO/BxH/12	59.50	14.00	7.3 x 8.2	RHS/166D	123.00	73.0
NRCO/BxH/14	34.80	8.00	8.2 x 8.0	RHS/60C	96.00	64.0
NRCO/BxH/18	53.70	13.00	7.0 x 8.3	RHS/160C	136.00	69.0
NRCO/BxH/20	43.00	10.00	7.2 x 8.0	Grey Orange	106.00	63.0
NRCO/BxH/35	60.00	19.00	5.3 x 8.0	RHS/153C	145.00	67.0
NRCO/BxH/37	58.00	8.00	10.5 x 9.5	RHS/9C	126.00	82.0
PBX-05-56/06	59.87	10.67	6.4 x 9.4	RHS/153C	132.50	72.0
PBX-05-57/01	63.50	10.00	7.5 x 8.5	RHS/153C	141.0	57.0

**Early flowering Cymbidium progenies:** Twenty two early Cymbidium progenies characterized for both quantitative and qualitative traits *viz.*, PBX-05-29/95, PBX-05-771/05; PBX-05-772/94; NRCO/3x6/04, PBX-05-772/136; PBX-05-772/127; PBX-05-772/171; PBX-05-772/153; PBX-05-772/84; PBX-05-772/379; PBX-05-772/409; PBX-05-772/189; PBX-05-772/47; PBX-05-772/454; PBX-05-772/158, PBX-11-150/66, PBX-11-150/67, PBX-11-144/25, PBX-11-155/02; PBX-11-155/06 and PBX-11-155/03. Among these early lines, it look 2-3 months for

days to flowering (DTF) and only three progenies shown stable performance for the second consecutive year (PBX-05-771/05, 84, 158).

**Mid-early Cymbidium progenies:** Nine mid-early Cymbidium progenies were characterized for both quantitative and qualitative traits *viz.*, PBX-05-772/107, PBX-11-155/01; PBX-11-155/04; PBX-11-155/05, PBX-11-150/03, PBX-05-751/07, PBX-11-150/04, **PBX-05-21/27**, PBX-11-144/14. Only one progeny line (PBX-05-21/27) shown second-year consecutive flowering.

**Table.2 Qualitative and quantitative traits of early flowering Cymbidium progenies**

Character	Spike length (cm)	Florets	Flower size	Flower colour	DTF	DTW
PBX-05-29/95	46.25	11.50	6.5 x 6.5	Yellow-Gr	61	36
PBX-05-771/05	60.50	15.00	5 x 10.5	Gr-yellow	92	44
PBX-05-772/94	66.00	12.00	3.5 x 9.6	RHS/154A	54	58
PBX-05-772/146	42.00	5.00	5 x 9.6	RHS/163B	54	31
NRCO/3x6/04	41.50	6.00	5 x 10	RHS/163B	55	54
PBX-05-772/136	60.50	13.00	4.5 x 8.5	RHS/163B	70	51
PBX-05-772/127	79.00	17.00	6 x 9.8	RHS/163B	65	53
PBX-05-772/171	50.00	9.00	4 x 10.3	RHS/163B	46	51
PBX-05-772/153	51.00	8.00	6.5 x 11	RHS/163B	52	45
PBX-05-772/84	34.00	8.00	4.5 x 8.6	RHS/151A	80	27
PBX-05-772/379	18.00	5.00	5.5 x 8.5	RHS/151A	80	71
PBX-05-772/401	58.00	14.00	4.2 x 10.6	RHS/151A	79	55
PBX-05-772/189	50.00	10.00	6.5 x 11.1	RHS/21A	69	74
PBX-05-772/47	65.00	11.00	4.5 x 10	RHS/13C	73	*
PBX-05-772/454	58.00	10.00	7.8 x 11	RHS/151A	72	48
PBX-05-772/158	56.00	8.00	4.6 x 10.5	RHS/183A	66	48
PBX-11-150/66	40.00	4.00	7 x 10.2	RHS/160B	87	60
PBX-11-150/67	30.00	2.00	9.3 x 10.5	RHS/17D	90	85
PBX-11-144/25	24.00	3.00	9 x 11.4	RHS/13B	75	110
PBX-11-155/02	33.00	1.00	5.5 x 7.5	RHS/13B	78	104
PBX-11-155/06	41.00	5.00	7.5 x 10	RHS/160B	81	88
PBX-11-155/03	49.50	6.00	7.8 x 9.8	N144A/B	75	103

**Mid Cymbidium progenies:** Fourteen mid Cymbidium progenies characterized for all qualitative and quantitative characters *viz.*, PBX-05-10/16, PBX-05-10/13, PBX-05-34/83, PBX-05-34/09, PBX-05-34/19, PBX-05-34/90, PBX-05-34/96, PBX-05-34/25, PBX-05-34/29, PBX-05-34/84K, PBX-05-34/97, PBX-11-144/24, PBX-11-144/18 and PBX-11-144/15), apart from 2 mid-late Cymbidium progenies *viz.*, BxH/33 and BxH/12. Among these lines only three progeny lines exhibited second consecutive flowering. Seventeen late flowering progenies under being flowering for evaluation *viz.*, PBX-05-34/02, PBX-05-34/12, PBX-05-34/31; ABxSG, HxB/01, HxB/04, HxB/06, HxB/08, HxB/10, HxB/19, HxB/21, HxB/22, HxB/31, BxH/08, PBX-05-57/01, PBX-05-57/03 & PBX-05-57/06. Among

late-flowering lines four lines exhibited repeated flowering for second consecutive year (HxB/21, 22, 31 & PBX-05-57).

### Phalaenopsis progeny lines evaluated during current flowering season

Early flowering elite Phalaenopsis lines *viz.*, **PBX-12-99/02 and PBX-12-99/03** were characterized for 2<sup>nd</sup> year. Ten other early flowering progenies of Phalaenopsis, of which six were newly flowered for first time *viz.*, PBX-12-99/05, PBX-12-99/09, PBX-12-99/10, PBX-12-99/12, PBX-12-99/15 (mid) and PBX-12-99/16 (mid) and depicted; apart from PBX-12-99/01, PBX-12-99/06, PBX-12-99/07, PBX-12-99/14, PBX-12-99/01, PBX-12-99/06, PBX-12-99/07 flowered for second consecutive flowering, except

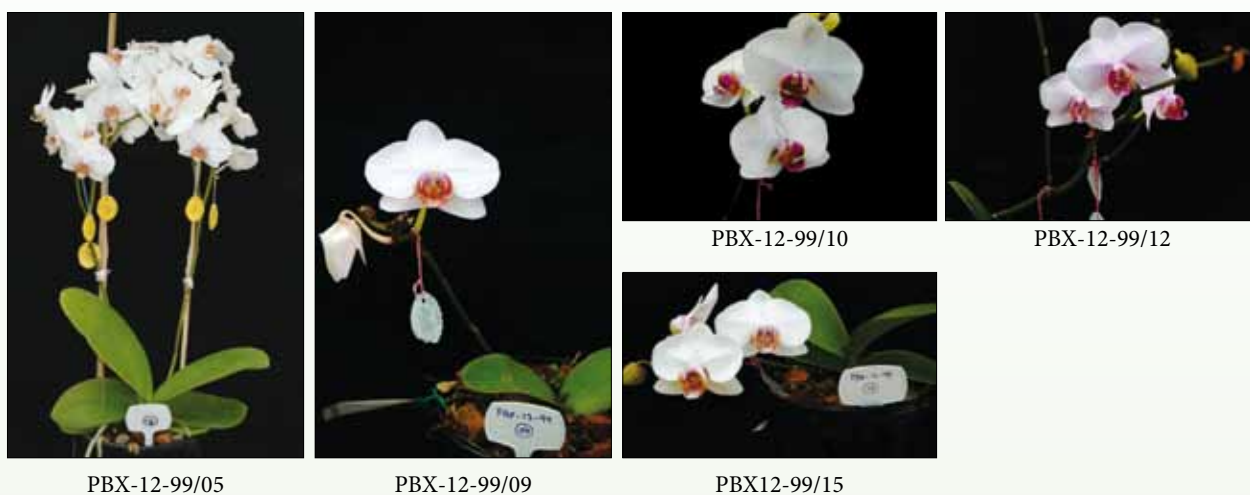


Fig. 2. Newly flowered progenies of Phalaenopsis

**Table.3 Qualitative and quantitative traits of mid early flowering Cymbidium progenies**

Character	Spike length (cm)	Florets	Flower size	Flower colour	DTF	DTW
PBX-05-772/107	39.00	6.00	5.0 x 10.5	RHS/13A	80	67
PBX-11-155/01	41.00	5.00	6.5 x 11.0	RHS/17D	71	64
PBX-11-155/04	53.00	8.00	5.5 x 9.50	Yellow-green	76.5	101.5
PBX-11-155/05	39.00	4.00	6.5 x 10.5	RHS/153B	91	78
PBX-11-150/03	34.50	4.00	9.0 x 9.50	RHS/17D	84	86
PBX-05-751/07	55.00	13.50	6.0 x 7.0	Yellow-green	-	87
PBX-11-150/04	53.00	8.00	9.3 x 10.8	RHS/151C	81	107
PBX-05-21/27	46.00	1.00	8.3 x 9.4	Pale yellow	-	46
PBX-11-144/14	38.00	6.00	9.0 x 10.5	RHS/13B	73	90

**Table.4 Qualitative and quantitative traits of mid early flowering Cymbidium progenies**

Character	Spike length (cm)	Florets	Flower size	Flower colour	DTF	DTW
PBX-05-10/16	65.0	11	8.5 x 9.3	White	87	82
PBX-05-10/13	72.0	13	10.5 x 12	Whitish	95	83
PBX-05-34/83	71.5	13	7 x 8	RHS/172A	96	97
PBX-05-34/09	60.0	13	10.5 x 12	Yellow	138	69
PBX-05-34/19	37.0	06	7.5 x 7	Yellow	94	83
PBX-05-34/90	57.0	07	10 x 11	Yellow	111	73
PBX-05-34/96	60.0	10	9 x 10	RHS11B/A	123	108
PBX-05-34/25	56.0	06	9.5 x 10	Pale yellow	142	80
PBX-05-34/29	58.0	05	8 x 9.5	Pale yellow	127	54
PBX-05-34/84K	72.0	09	7.4 x 8	RHS/7B	138	68
PBX-05-34/97	67.0	10	9.5 x 10.7	RHS/3DC	104	68
PBX-11-144/24	23.5	01	8.5 x 12	Med yellow	77	85
PBX-11-144/18	50.0	08	7.3 x 9.8	Med yellow	87	-

Character	Spike length (cm)	Florets	Flower size	Flower colour	DTF	DTW
PBX-11-144/15	28.0	04	9.5 x 10.5	Golden yellow	88	91
NRCO/BxH/33	32.0	07	6.5 x 7	Pale yellow	107	74
NRCO/BxH/12	38.0	10	7 x 8.5	Med. yellow	138	-

**Table.5 Qualitative and quantitative traits of Phalaenopsis progenies**

Character	Spike length (cm)	Florets	Flower size	Blooming	DTF	DTW
PBX-12-99/02	58.5	12	7.2 x 8.4	Mar-July	97	122
PBX-12-99/03 67.5		15	7 x 8.5	Mar-July	96	(*)
PBX-12-99/04	65.0	17	6.5 x 8.7	Apr-July	111	97
PBX-12-99/05	63.0	18	5.8 x 7.8	Mar-July	115	102
PBX-12-99/06	54.6	13	5.3 x 6.7	May-Aug	62	90
PBX-12-99/07	41.0	06	6.3 x 7.5	Apr-July	130	76
PBX-12-99/09	40.0	10	7 x 8.7	Apr-July	86	87
PBX-12-99/10	43.0	07	7.4 x 9	May-Aug	80	108
PBX-12-99/12	47.0	18	6.3 x 8.2	May-July	45	67
PBX-12-99/14	39.0	05	7.2 x 8.7	May	50	(*)
PBX-12-99/15	22.0	04	7.3 x 8.5	Feb	42	-
PBX-12-99/16	45.2	11	6 x 7.5	Jun-Dec	38	133

PBX-12-99/01 which has bud expression problem and flowered later shifting to warm conditions.

### Station trails of selected Pl × Pw series:

Seventeen NRCO/Paphiopedilum populations evaluated viz., *P. venustum* clones 1, 2; Plx-

Pw/05, PlxPw/08, PlxPw/30, PlxPw/33, PlxPw/28, PlxPw/23, PlxPw/26, PlxPw/38, IC 614753, IC 61450, IC 614751, IC 614752, IC 617522, IC 614523 and IC 614524. Flowers were dried in Plx-Pw/05 and IC 614524 before opening of flowers for last consecutive years.

**Table.6. Qualitative and quantitative traits of Paphiopedilum populations**

Sl. No.	Breeding line	Height (cm)	Peduncle height (cm)	Fl. Size(cm)	DTF	DTW
1	<i>P. ven</i> _clone/1	10.50	19.05	9.75 x 10.10	57.50	66.00
2	<i>P. ven</i> _clone/2	11.85	32.25	9.50 x 11.50	60.00	120.00
3	PlxPw/04	13.00	23.00	11.50 x 11.00	55.00	111.00
4	PlxPw/08	22.00	27.50	11.20 x 10.00	59.00	115.00
5	PlxPw/23	17.00	21.85	10.20 x 11.50	82.00	82.00
6	PlxPw/26	19.50	16.75	12.00 x 12.50	119.50	89.00
7	PlxPw/28	21.00	26.50	11.50 x 12.75	57.50	138.50
8	PlxPw/30	21.25	26.50	11.00 x 11.25	74.50	108.00
9	PlxPw/33	17.75	23.25	10.60 x 11.35	56.50	106.00
10	PlxPw/38	18.50	26.75	9.65 x 9.90	115.00	71.50
11	IC 614753	13.00	12.00	9.75 x 10.15	67.25	98.25

Sl. No.	Breeding line	Height (cm)	Peduncle height (cm)	Fl. Size(cm)	DTF	DTW
12	IC 614750	18.00	15.83	12.90 x 13.10	64.83	98.16
13	IC 614751	17.50	22.50	12.50x13.00	60.00	83.00
14	IC 614752	19.00	19.50	10.30 x 10.50	95.00	95.33
15	IC 617522	16.00	18.00	9.50 x 10.50	73.00	97.16
16	IC 614523	13.00	15.00	9.50 x 9.70	67.25	93.50
17	IC 614524	19.67	16.00	10.43 x 11.60	56.33	83.67
<b>Check (<i>P. ven</i>)</b>		13.00	12.50	7.50 x 7.60	73.00	83.00

### Characterization of other breeding lines:

The reciprocal combination of *P. flavus* and *P. tankervilleae* were used as female and male parents (PBX-11-25/01) flowered during July-Aug, 2018. The morphological features of plants derived from reciprocal cross are similar to direct cross, except smaller size of flowers and light tinge of pale green colour on tips of sepals and petals. Mid-late flowering Zygopetalum progenies (PBX-05-31) characterized and off-season crosses were attempted between Zygopetalum and Cattleya (TC) plants.

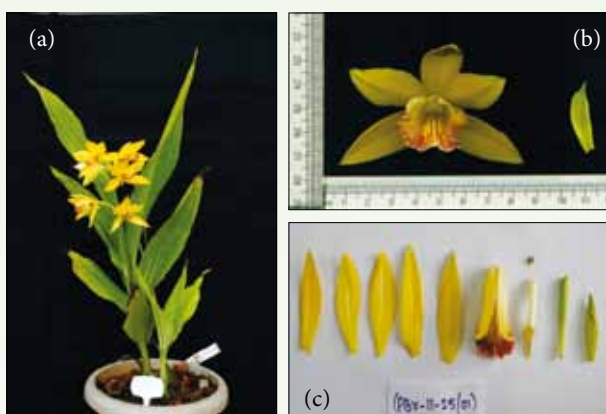


Fig. 3. Phaius reciprocal cross (PBX-11-25/01) plant [a], flower [b] & floral parts [c]

**Evaluation of Vandaceous progenies:** Multiple flowering of promising lines *viz.*, PBX-12-169/01, PBX-12-169/02, & MLS (D) was observed and data from first flush presented. Newly flowered PBX-12-169/03 characterized, apart from reference collection Happy Beauty (K) and Bernice Miller were characterized. Repotting and data collected on field trial on Aranda hybrid at Mohitnagar.

**State local trials:** Field visit at Kalimpong, West Bengal; Yangang, South Sikkim; Sombaria, West Sikkim; Hee-Gyathang, North Sikkim and Karthok, East Sikkim was completed for field data recording of local trial on 'Sheetal 1' and assisted farmers for repotting of plants.

### 2.3 Propagation of *in-vitro* plantlets

**PBX-12-119 (Dendrobium cross):** Around 300 small plantlets (1 cm height and 3-4 leaves) of Dendrobium cross were cultured on Gamborg medium added with sucrose (2%), BAP (2 mg/l), IBA (1mg/l) with and without activated charcoal (AC) to enhance further growth of shoots. Medium with AC was found good for shoot development (2-2.5 cm height and 6-7 leaves) and plantlets are now ready for rooting.

**Table.7 Qualitative and quantitative traits of Vandaceous progenies**

Breeding line	Height (cm)	Spike length (cm)	Floret no.	Fl. Size (cm)	DTF	DTW
PBX-12-169/01	29.00	34.50	09	10 x 10.1	21	30
PBX-12-169/02	30.50	48.50	17	8.5 x 9.0	81	67
PBX-12-169/03	23.50	19.20	03	10.4 x 10	28	21
MLS(D)	176.00	48.50	12	8.2 x 9.0	22	22
Berniece Miller	62.50	50.00	12	8.5 x 10.5	28	38
Happy Beauty	38.00	52.00	18	8.3 x 7.9	-	-



**PBX-12-99 (Phalaenopsis cross):** Small plantlets were sub-cultured twice (April 2018, December 2018) into fresh Q1 medium for further growth. The well-developed plantlets (3 cm ht; 4-5 leaves; long and thick roots) were at semi-hardening stage.

**PBX-12-58 (Dendrobium cross):** Plantlets sub-cultured for effective hardening to established strong roots on Gamborg medium supplemented with IBA (mg/l), NAA (0.5 mg/l), and sucrose (2 %) with bricks, stone chips and coco-chips. Well established plantlets with strong roots (7-8 no/plant. ; 6-7 cm long) and shoots (8-9 cm; 9-10 leaves/plant) semi-hardened for the first 02 months in coco-peat and later into potting mixture containing bricks pieces, leaf moulds, coco-chips and charcoal.

**PBX-15-127 (Zygopetalum cross):** Plantlets sub-cultured for rooting on 04 different rooting media (RLT1, RLT2, RLT3, RLT4) failed to established good roots. The plantlets poorly developed roots (0.2-0.4 cm) with few leaves turning yellow. Thus plantlets transferred to an established rooting media RG (A): Gamborg added with PGRs. Some well-developed plantlets are in semi-hardening stage.

**PBSx-17-01 (Zygopetalum natural cross):** As per institute requirement of planting materials of *Zygopetalum*, >1,000 plantlets (3-3.5 cm; 5-6 leaves/plant) sub-cultured for rooting in an established rooting media: RG (A). Well-developed plantlets were later semi-hardened. *Zygopetalum* (UK/TCB): Approximately 1000 small plantlets were sub-culture for rooting in an established rooting media: RG (A) and later semi-hardened. 300 plants (100 potted and 200 semi-hardened) given to farm section.

**Table. 8 Production of plantlets of orchid species and hybrid**

S. No	Species & crossed progenies	Plantlet no.
1	PBX-12-58 (Dendrobium cross)	52
2	'Emma White' (Dendrobium hybrid)	392

S. No	Species & crossed progenies	Plantlet no.
3	PBSx-17-01 ( <i>Zygopetalum</i> natural cross)	2,008
4	PBX-15-127 ( <i>Zygopetalum</i> cross)	24
5	PBX-12-99 ( <i>Phalaenopsis</i> cross)	41
6	PBX-11-154 ( <i>Cymbidium</i> progenies)	350
7	<i>Zygopetalum maculatum</i> (*UK/TCB)	1,757
8	<i>Phalaenopsis</i> (*UK/TCB)	05

### Project 3: Development and Refinement of Production and Protection Technologies for Improved Productivity, Marketing and Utilization of Orchids

#### 3.1. Effect of potting media on growth and development on full grown plants of *Cym* Winter Beach Sea Green

Nine different potting media were used to study its effect on growth and development of *Cymbidium* cultivar 'Winter Beach Sea Green'. It was observed that the vegetative growth of full grown *Cymbidium* plants had shown variable response with different combinations of potting media. Out of nine potting media used, longest leaf (70.6cm), maximum pseudobulb size (5.5 cm x 4.2 cm), number of pseudobulb (6.5) as well as early flowering (3 years after planting) with a single spike having spike length (36.7 cm), flower size 10.1cm and 4 numbers of florets/spike were recorded with cocochips + cocopeat + brick pieces + tree barks.

#### 3.2. Effect of potting media on growth and development on young plants of *Zygopetalum maculatum*

In *Zygopetalum maculatum*, nine different potting mixtures were used to study its growth and development. Out of these media, cocochips + cocopeat + brick pieces + tree barks, cocochips + cocopeat + brick piece + leaf mould cowdung and cocochips + cocopeat + brick piece + rice husk produced maximum number of leaves (8),

longest leaf (30cm), highest number of bulbs (5) per plant and maximum bulb size (3.0 x 2.5 cm).

### 3.3 Effect of liquid manure spray on growth, development and flowering in *Cym Winter Beach Sea Green*

Spraying of liquid manure improved vegetative growth of young plants of *Cymbidium* orchids. Maximum pseudobulb size (4.20cm) and number (4.0) recorded with 1:30 and 1:20 dilution, whereas the highest number of leaves (10), leaf length (62.8m), and chlorophyll content (67.2 mg/100g) were recorded with 1:5 ratio.

In flowering size plants, maximum leaf length (84cm), spike length (60cm), rachis length (25cm), number of flowers per spike (7), flower longevity (110 days) and chlorophyll content (61g/100g) were observed with the spray of liquid manure in the 1:30 ratio. The plants sprayed with liquid manure in the ratio of 1:20 had broader pseudobulb (8.0cm), and flower width (11cm).

### 3.4 Effect of tree barks on growth and development of young plants of *Cym Winter Beach Sea Green*

Ten tree barks were tested as potting media for young plants of *Cym Winter Beach Sea Green*. Of the ten tree bark medium, the highest number of leaves was recorded with Lapsi barks, *Choerospondias axillaris* (9.5) while the maximum leaf length (75 cm) and number of bulbs (6) was recorded with Malato barks, *Macaranga pustulata*. Both Paiyun barks, *Prunus cerasoides* and Lapsi barks, *Choerospondias axillaris* produced the largest pseudobulb 3.9 and 4.25 cm, respectively. The highest chlorophyll content was found with Payun barks, (67.95 mg/100g) followed by Tuni barks, *Cedrella febrifuga* (66.9 mg/100g).

### 3.5 Effect of ionic strength of nutrient solution and medium composition of *Zygopetalum maculatum*

For testing ionic strength of nutrient solution and growing medium for semi-hydronic cultivation of *Z. maculatum*, the uniform sizes

of plants were planted in four growing mixture namely perlite, vermiculite, moss, and cocopeat media in six-inch plastic pots. The plants were applied with ¼, ½ and full strength of Hoagland Solution at monthly interval. All together 12 treatment combinations were tested. The results revealed that the application of half strength of Hoagland Solution in plants grown in moss growing medium increases plant height (80.9cm), and number of shoots/plant (4.67) whereas application of one-fourth strength of solution enhances number of leaves (61) and leaf length (64.96cm). Application of full strength of the solution improves the spike length (75.5 cm) and spike longevity (52.3 days).

### 3.6 Effect of inorganic nutrients on growth and flowering of orchids

An experiment was laid out to study the effect of inorganic nutrients on growth and flowering of orchids, *Dendrobium* cv. Singapore White at CHES, Chetalli, Coorg. The experiment comprised of twelve nutrient doses replicated thrice in CRD. Foliar sprays of the nutrients were given at weekly intervals. The number of leaves/plant, leaf area, number of pseudobulbs/plant and internodal length varied significantly among the treatments (Table 9). Different floral traits and the vase life of cut flowers were recorded (Fig 4). The number of spikes /plant, number of florets/ spike, spike length, flower size (length and breadth) was found to significantly vary with the different nutrient doses. Vase life was recorded under ambient conditions in tap water and did not vary significantly among the treatments.

Foliar spray of 10:20:10NPK @ 0.1% at weekly intervals was found to be the best for foliar feeding of *Den Singapore White*. The treatment recorded maximum leaf area of 54.39 cm<sup>2</sup>, produced the maximum number of spikes /plant/ year (9.53), number of flowers/spike (16.85) and spike length (58.30 cm). The spikes harvested from this treatment recorded a vase life of 13.5 days in tap water.

**Table.9 Effect of inorganic nutrients on vegetative characters of *Den Singapore White***

Treatments	Plant height (cm)	No. of leaves per plant	Leaf area (cm <sup>2</sup> )	No. of pseudo- bulbs per plant	Internodal length (cm)	Girth of pseudobulbs (mm)
T <sub>1</sub> : NPK @ 10:10:10@ 0.1%	54.13	18.00	42.83	4.00	2.86	12.07
T <sub>2</sub> : NPK @ 10:20:10@ 0.1%	59.93	17.40	54.39	3.87	2.95	11.80
T <sub>3</sub> : NPK @ 10:10:20@ 0.1%	54.53	15.93	38.91	3.53	2.95	11.05
T <sub>4</sub> : NPK @ 10:20:20@ 0.1%	42.67	13.73	35.15	3.20	3.09	10.00
T <sub>5</sub> : NPK @ 20:10:10@ 0.1%	38.47	9.33	30.25	2.60	3.23	9.60
T <sub>6</sub> : NPK @ 20:20:10@ 0.1%	43.53	10.53	37.09	3.40	3.26	9.13
T <sub>7</sub> : NPK @ 20:10:20@ 0.1%	33.33	6.80	30.44	2.73	3.01	9.47
T <sub>8</sub> : NPK @ 20:20:20@ 0.1%	42.00	12.27	34.14	3.33	3.29	10.13
T <sub>9</sub> : NPK @ 30:10:10@ 0.1%	47.07	11.60	36.08	3.20	2.86	10.40
T <sub>10</sub> : NPK @ 30:20:10@ 0.1%	41.67	12.93	34.52	3.67	3.15	10.80
T <sub>11</sub> : NPK @ 30:10:20@ 0.1%	43.33	14.20	37.50	3.60	3.00	10.40
T <sub>12</sub> : NPK @ 30:20:20@ 0.1%	47.20	14.53	38.63	3.20	2.96	11.93
SeM(±)	5.33	1.67	4.03	0.27	0.10	0.73
CD (p=0.05)	NS	4.91	11.83	0.81	0.29	NS

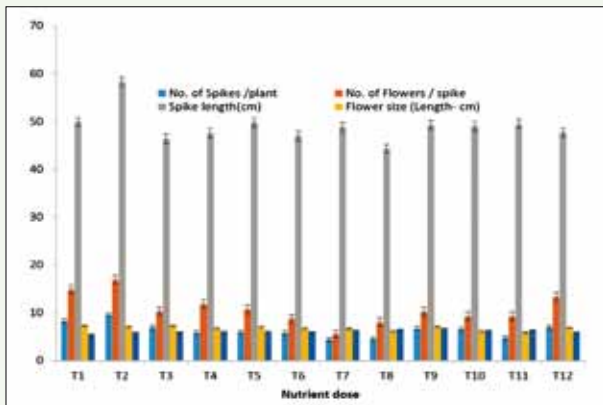


Fig. 4 Influence of varying doses of inorganic nutrients on flower yield and floral traits of *Den Singapore White*

### 3.7 Development of orchid based farming system

The aim of orchid based farming system is to utilize maximum space and to generate an additional income. Orchid comes to flowering in 3-4 years which is quite a long time. Moreover, the area below the orchid benches remains unutilized, which can be utilized to cultivate vegetables or to produce planting materials of ornamental crops

for generating an additional income in this type of farming system. In an experiment conducted at the institute Fig. 5, vegetables were grown season wise grown under the benches of orchids. The maximum income of Rs. 110/- per m<sup>2</sup> was obtained by cultivating mustard leaf-coriander (mustard leaf was harvested three times) followed by mustard leaf-pea.



Fig. 5 Orchid based farming system

### 3.8 Post-harvest management of orchids

Post-harvest life and quality of cut-flowers in orchids are influenced by stages of harvest and type of orchid. The commercial stage of harvest, flower spike length and vase life in various cultivated genera are given as below:

**Table. 10 Post-harvest life and quality of cut flower in orchids**

Sl.No.	Orchid hybrid	Commercial stage of harvest	Spike length (cm)	Vase life (days)
1	Aranda	50% bloom	45-60	18-28
2	Cattleya	2-4 days before bud open	25-40	10-20
3	Cymbidium	75% bloom	60-125	55-60
4	Dendrobium	All flowers except top bud	40-60	14-21
5	Oncidium	80% bloom	60	25-35
6	Paphiopedilum	3-4 days after opening of flowers	25-40	30-56
7	Phalaenopsis	Fully open flowers	40-60	25-40
8	Vanda	Fully open flowers	50-75	14-30

**Table.11 Post-harvest technology in Cymbidium**

Sl. No.	Particulars	Recommendations for testing under field trial
	Evaluation of elite hybrids for vase life	<i>Cym</i> Bob Marlin 'Lucky' (57 days), <i>Cym</i> Fire Strom 'Blaze' (53 days), <i>Cym</i> Hazel Fay 'Tangerine' (50 days), Everett <i>Cym</i> Stockstill 'Bullai' (48 days), <i>Cym</i> Caripepper 'Peachy Keen' (43 days), <i>Cym</i> Hana Akari (41 days), <i>Cym</i> Fire Storm 'Ruby' (36 days)
2.	Spike length and vase life of different classes of Cymbidium	Miniature (30-60cm): 30-34 days Intermediate (60-75cm): 35-37 days Standard (> 75cm): 55-59 days
3.	Optimal stage of harvest of <i>Cym</i> Pine Clash 'Moon Venus' for maximum vase life	Two buds opened stage (66.8 days)
4.	Best impregnation treatment of <i>Cym</i> Pine Clash 'Moon Venus' for maximum vase life	CoCl <sub>2</sub> (1000ppm) for 15 minutes (46 days)
5.	Best pulsing treatment of Cymbidium for maximum vase life	5% sucrose for 8 hours (56 days)
6.	Best pre-harvest spray of Cymbidium for maximum growth and vase life	GA <sub>3</sub> (50 ppm) + BA (200 ppm)
7.	Best chemical treatment for opening of tight buds of Cymbidium cutflowers	Sucrose 4% + Salicylic acid 200 ppm with 75% opening and vase life of 45 days
8.	Best holding solution for improved vase life of Cymbidium	2% sucrose + 200 ppm 8-HQS with vase life of 76.6 days
9.	Best packaging material of Cymbidium spikes and florets for improved vase life	Cellophane (56 days)
10.	Best harvesting stage of Cymbidium florets for improved vase life	Fully opened florets with vase life of 48 days.

### Project 4: Improvement of knowledge and skill of stakeholders for improving production of orchids

Eight training programmes for officers, supporting staffs, students and farmers were organised during the year 2018-19. The

participants of training programme represented different states such as Jammu & Kashmir, Haryana, West Bengal and Sikkim. Altogether 120 participants were trained in various subjects related to orchids. The summary of training programmes is given as below:

**Table.12 List of training programme organized for orchid production**

S.N.	Topic	Place	Date	Total No of participants
1	Production Technology of Orchids & Other Cut Flowers	Pakyong	14-18 <sup>th</sup> May, 2018	5 Officers (Jammu)
2	Production Technology of Orchids & Other Cut Flowers	Pakyong	21 <sup>st</sup> -25 <sup>th</sup> May, 2018	5 Officers (Jammu)
3	Year Round Production Technology of Tropical and Subtropical Orchids	Pakyong	16 <sup>th</sup> Nov 2018	16 Students, (BCKV, West Bengal)
4	Training on Basic Skill in Computer Operation	Pakyong	19 <sup>th</sup> Nov, 2018	6 (Supporting staff), ICAR-NRCO, Pakyong
5	Horticulture in NE Region	Pakyong	24 <sup>th</sup> Nov, 2018	37 Students (Rolep, East District)
6	Commercial Floriculture and Bio-Technology	Pakyong	1 <sup>st</sup> Dec, 2018	20 Students, (College of Horticulture, Sikkim)
7	Post-harvest Processing of Horticultural Crops	Pakyong	22 <sup>nd</sup> Feb, 2019	15 Students, (CAE& PHT, Ranipool Sikkim)
8	Orchid Farming	Pakyong,	28 <sup>th</sup> Feb, 2019	16 Farmers (Haryana)

# Externally Funded Project

## Project 1: Breeding of Selected Orchids for Cut Flowers and Pot Plants: Strengthening the weakest link between orchid research and industry

### 1.1 *In vitro* culture of seeds from the crosses made during 2017-18

Of the 38 crosses of *Cymbidium* made during 2017-18, only four, *Cym* Satin Doll × *Cym* Valley Legend Steffi, *Cym* Amesbury × *Cymbidium hookerianum*, *Cymbidium eburneum* × *Cymbidium lowianum* and *Cym* Margaret Thatcher × *Cym* Ruby Lips set the seeds. The seeds of these crosses were cultured on MS media for raising the seedlings.

### 1.2 *In Vitro* culture of seeds of the crosses made during 2016-17

Seeds of the *Cymbidium* crosses made during 2016-17 (18) and 2015-16 (7) were cultured during 2018-19 along with the seeds of the crosses made during 2017-18. Seeds from three crosses of *Paphiopedilum* (*Paphiopedilum venustum* × *Paphiopedilum villosum*, *Paphiopedilum villosum* × *Paphiopedilum hirsutissimum*, *Paphiopedilum spicerianum* × *Paphiopedilum fairrieianum*) and four crosses of *Calanthe* (*Calanthe chloroleuca* × *Calanthe plantaginea*, *Calanthe plantaginea* × *Calanthe brevicornu*, *Calanthe brevicornu* × *Calanthe plantaginea*, *Calanthe chloroleuca* × *Calanthe yoksomnensis* were also raised.

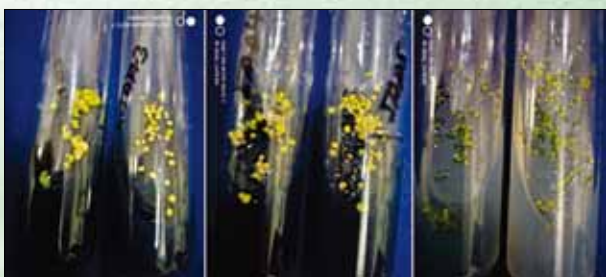


Fig. 6 Seed culture of crosses of *Paphiopedilum* orchids

### 1.3 Growing of progenies

The progenies of twenty-seven crosses are being raised under polyhouses at Darjeeling Campus of NRC for Orchids.

## Project 2: DUS testing on Orchids: Preparation for plant varieties protection and DUS testing through ICAR-SAU System

- 40 hybrids of *Cymbidium*, 20 hybrids of *Vanda*, 14 hybrids of *Dendrobium*, 10 hybrids of *Oncidium*, 9 hybrids of *Cattleya* and 10 hybrids of *Phalaenopsis* maintained and multiplied under DUS project on Orchids.
- Database management in Reference and Example varieties of *Cymbidium*, *Dendrobium*, *Vanda*, *Phalaenopsis*, *Cattleya*, *Oncidium* and *Mokara* studied.

## Project 3: National Mission on Himalayan Studies- Himalayan Research Fellowship (NMHS-HRF):

### H-RA-001: Conservation, sustainable use and equitable benefit sharing arising out of use of natural resources (Orchids)

- Eight species of orchids namely, *Epidendrum radicans*, *Aerides odoratum*, *Cymbidium aloifolium*, *Arundina gramanifolia*, *Dienia ophrydis*, *Calanthe sylvatica*, *Paphiopedilum villosum* and *Paphiopedilum venustum* were studied for *in vitro* seed germination.
- Two different media were used for i.e Nitsch Medium for *Epidendrum radicans*, *Aerides odoratum*, *Cymbidium aloifolium*, *Arundina gramanifolia* while MS Medium was used for remaining four species.
- The germination has started in *Cymbidium aloifolium* while other are in process.

### H-RA-002: Long-term ecological/ environment monitoring of Orchids and assessment of threats to biodiversity and Extent of IKP documentation & strengthened

- Population study of *Diplomeris hirsuta* conducted at Chavang, North Sikkim and Assam Lingzey, East Sikkim.
- Population study of orchid species for long term environmental study for orchid species carried out at Parakha (East Sikkim) and Kitam Bird Sanctuary, Namchi (South Sikkim).
- Surveyed and documented Indigenous Knowledge and Practices (IKP) on orchid at villages of Sikkim. Identification of orchid species, *Otochilus lancilabius* and *Dendrobium amplum* through IKP documentation having indigenous importance.

### H-JRF-001: Carry out survey and GIS mapping of orchids population of Sikkim Himalayas

- GIS software based shapefile of India and Sikkim and location map generation of Sikkim.
- Distribution maps of 17 different species of orchids in Sikkim.
- Map showing orchid population in East Sikkim and West Sikkim was prepared based on the primary or *in-situ* measurements



Fig. 7 Orchid Database

### H-JRF-002: Orchid biodiversity database of Darjeeling and Sikkim Himalayas

#### Database of Orchids of Sikkim Himalaya:

- Designed and developed a new web enabled home page for orchids floral resource database of Eastern Sikkim Himalayas.
- A complete information about orchid species of Sikkim Himalayas (250 orchids species and RET species) has been provided. This webpage can be accessed by everyone easily. It is very useful for the researchers to get updated information from the webpage as and when required.

Table 13 Characterization of *Diplomeris hirsuta*

Parameters	<i>Diplomeris hirsuta</i> at North Sikkim	<i>D. hirsuta</i> at East Sikkim
Flowering time	June to August	June to August
Host	Found in the rock	Found in the rock
Population structure (Quadrate)	Number of plants/quadrate- 5-6 No. of quadrate taken- 5	Number of plants/quadrate-2-3 No. of quadrate taken- 5
Associated vegetation	Fern, Moss, wild colocasia, Arundina sp., <i>Coelogyne</i> sp., <i>Liparis deflexa</i> and other small herbaceous plants.	Fern, Moss, wild colocasia, wild begonia, small herbaceous plants.
Morphological character	Plant height- 4.2-5.0 cm tall Flower -2.3cm x 3.0 cm Sepals-1.2-1.4 x 0.6-0.7 cm Petals- 1.7-1.8 x 1.6-1.7 cm	Plant height- 3.2-4.0 cm tall Flower-2.1cm x 2.9 cm Sepals- 1.2-1.3 x 0.4-0.6 cm Petals- 1.4-1.5 x 1.3-1.2 cm



Fig. 8 On-farm conservation by the farmer

### H-JRF-003: Assessment of natural population of Orchids in Sikkim Himalayan region by accounting methods and field testing

#### a. Population studies of *Cymbidium whiteae* King & Pantl.: An endemic and endangered orchid species from Sikkim, India (Second year)

- It was observed that *C. whiteae* was growing naturally in the Dzongu region of North Sikkim.
- Simultaneously, the nearby area was tracked for its population and found the species in 17 different locations. Each site the number of mature plant population was 2-7 and a total of 48 populations found.
- Completed morphological studies of *C. whiteae*.

#### b. Site specific studies of *Lecanorchis sikkimensis* N.Pearce & P.J.Cribb

- *Lecanorchis sikkimensis* N.Pearce & P.J.Cribb is mycoheterotroph and restricted to a

particular locality. The preliminary site specific studies have been completed. Survey was conducted in Kartok (Namcheybong) Reserve Forest of East Sikkim. It lies between latitude of 27.13,55.0"N to 27.14,42.8"N and longitude of 88.33,37.2"E to 88.40,02.4"E and its elevation range from 1676-2132 m altitude.

- Plants 35-42 cm tall, erect, slender, tapering towards apex. Inflorescence is almost few flower majority are 3-5 flower and 1.2-1.6 cm long. Sepals are sub-equal, not spreading, 3-nerved, dull purple and dorsal sepal 2-1.5x 0.3-0.4 cm whereas lateral sepal 1.3-1.5x0.4-0.6 cm. Petals are 1.3-1.5x0.45-0.55 cm. Lip 1-1.2x0.55-0.6 cm, column 6-7 mm long; Anther quadrate with two elliptic- oblong, obtuse; flowering: May to June.

#### c. Survey of *Dactylorhiza hatagirea*

- Distribution and conservation status of *Dactylorhiza hatagirea*, an endemic to the Hindu- Kush Himalaya. It is categorized as endangered in CAMP Pokhara (2001) conservation list and strictly banned for collection, utilization and sale. During the field survey, it was found in a natural habitat of East Sikkim and studies are under progress.

#### d. Population of *Coelogyne nitida* var. *alba*

- *Coelogyne nitida* var. *alba* was found in Kartok Reserve Forest (East Sikkim) which lies between latitude of 27.13,55.0"N to 27.14,42.8"N and longitude of 88.33,37.2"E to 88.40,02.4"E and its elevation range from 1676-2132 m.



Fig. 9. *Lecanorchis sikkimensis*



Fig. 10. *Coelogyne nitida* var. *alba*



### H-JRF-004: Prediction and impact of climate change and rise in temperature on natural survival and pollination of orchids

- Prepared migrated orchid list by reviewing literature, books and old herbarium
- Surveyed different areas of Sikkim Himalayan region altitude wise.
- Artificial hand pollination of *Dendrobium nobile* carried out to study its pollination behaviour and seeds have been developed but yet to mature.
- Simulated the habitat of *Diplomeris hirsuta* under controlled condition for cultivation. Morphological data were recorded from both controlled as well as natural conditions. In controlled condition, it was observed that plants watered during February emerged earlier (298 days from last season withering) than other two treatments. However, a day to bud emergence, flower emergence and flower withering was earlier with April watering as compared to other treatments. Maximum leaf length (11.06cm) and leaf breadth (3.20cm) was recorded with February watering plants.

### H-JRF-005: Chemical profiling of medicinally important orchids, *in-vitro* multiplication and reintroduction of selected rare orchid species of Sikkim Himalayas in their natural habitat.

#### Chemical profiling of *Dendrobium nobile*-methanol extract:

GC-MS analysis of methanol extract of native *Dendrobium nobile* revealed the presence of 16 compounds. Of these, 6 compounds possess many biological properties. Longifolene possess antifungal, antibacterial and antioxidant properties, 1-Heptatriacotanol has anti-hypercholesterolemic and anti-microbial effect. Whereas Z,Z-6,28-Heptatriactontadien-2-One has the vasodilatory effect and most importantly Dendroban-12-One has antiviral activity against influenza A viruses, anticancer (Lungs cancer treatment), analgesic, antipyretic action

and hyperglycaemia. It proves the importance of *Dendrobium nobile* in the medical uses.

### Project 4: Inventorization of gamma radiation technology for Orchid varietal improvement (BARC-BRNS)

#### 4.1 Regeneration of mutant plantlets of *Dendrobium* 'Emma White'

First batch of irradiated PLBs of *Dendrobium* 'Emma White' was sub-cultured at a regular interval in to different treatments for their growth and proliferation. Out of 05 different doses of gamma radiation i.e. 10, 20, 40, 60, and 80 Gy; only first 03 doses generated plantlets. PLBs of 60 and 80 Gy remained undifferentiated.

***In-vitro* mutant plantlets:** Some abnormalities were noted during *in-vitro* proliferation of *Dendrobium* 'Emma White' at 10, 20, and 40 Gy from M1V3 generation. Abnormalities observed in terms of leaf colour, leaf shape, stunted growth, multiple shoots, twisted leaves, double veins leaf, rough leaf surface, irregular leaf edges, depigmentation, and anthocyanin pigmentation.

#### 4.2 *In-vitro* propagation of irradiated PLBs of *Zygopetalum maculatum* (PBSx-17-01; Batch II)

Post-irradiation, PLBs were transferred to Gamborg medium added with BAP (1 mg/l), NAA (0.2 mg/l), sucrose (2%) and AC (2g/l) up to M1V2 (generation) for differentiation. The culture was maintained in a culture room and monitored after every 30 days wherein survival% and days to differentiation was recorded. Initially (30 days), survival % was found to be increasing with increasing gamma doses. However, after 90 days of culture, the survival % reduced drastically with 100% mortality at higher dose of 40 and 50 Gy. The well grown plantlets were sub-culture to



Fig. 11. *In-vitro* propagation of irradiated PLBs

an established rooting media with BAP (1 mg/l), IBA (1 mg/l) and NAA (0.2 mg/l).

#### **4.3 Seed culture of irradiated capsules to understand the response:**

*Vanda coerulea* (PBS-16-61; PBS-16-62), *V. coerulea* x *V. roxburghii* (PBS-16-51), *Zygopetalum maculatum* (PBS-16-53) capsules were cultured after irradiation. As per the 17<sup>th</sup> IRC recommendation, Bamboo orchid, *Arundina graminifolia* (Bamboo orchid) germinated seeds culture (PBX-18-14) and capsules (PBX-18-15, 16, 17 & 18) was irradiated with gamma rays of different doses at BCKV, Mohanpur. Asymbiotic germination of irradiated seeds was cultured on 03 basal media as depicted.

### **Project 5: Life Cycle Cryo-biotechnology of Orchids for Bio-resource Conservation and Sustainable Development**

#### **5.1 Effect of boric acid on pollen germination of *Cymbidium lowianum***

To study the effect of boric acid on pollen germination of *Cymbidium lowianum*, the pollen germination medium was supplemented with 0, 5, 10, 20 and 40mg/l boric acid. Boric acid concentration significantly influenced pollen

germination and growth of pollen tube. The highest pollen germination (48.83%) and longest pollen tube length was recorded with pollen germination medium supplemented with 10mg/l boric acid whereas the lowest germination was recorded with the medium supplemented with 40mg/l boric acid.

#### **5.2 Effect of sucrose on *Cymbidium lowianum* pollen germination**

To study the effect of sucrose on pollen germination of *Cymbidium lowianum*, the pollen germination medium was supplemented with 0, 0.5, 2.0, 4.0 and 8.0g/l sucrose. The highest per cent of pollen germination (49.93) was recorded on the medium supplemented with 2g/l sucrose.

#### **5.3 Effect of KNO<sub>3</sub> on *Cymbidium lowianum* pollen germination**

To study the effect of KNO<sub>3</sub> on pollen germination of *Cymbidium lowianum*, the pollen germination medium was supplemented with 0, 5.0, 10.0, 15.0 and 20.0mg/l. The highest pollen germination (54.23 %) was obtained on pollen germination medium supplemented with 10 mg/l. The longest pollen tube length (154.25µm) was observed on medium supplemented with 10mg/l KNO<sub>3</sub>.

# Technology Assessed & Transferred

Sl. No	Programme	Date	From	No. of Participants
1	Production technology of orchids and its conservation	25 <sup>th</sup> April, 2018	SHUATS, Allahabad, UP	17 students
2	Production technology of Orchids	1 <sup>st</sup> Aug, 2018	ATMA, Nagaland	11
3	Production technology of Orchids	19 <sup>th</sup> Sept, 2018	Gujarat farmers	14
4	Orchid cultivation and its importance	3 <sup>rd</sup> Oct, 2018	State Co-operative Horticulture Federation, Bengaluru	20
5	Orchid cultivation	3 <sup>rd</sup> Oct, 2018	SHUATS, Allahabad, UP	44 students
6	Orchid cultivation and value addition	12 <sup>th</sup> Oct, 2018	Dept. of Horti., Andhra Pradesh	16 extension officer, farmers and entrepreneur
7	Cultivation of tropical orchids	29 <sup>th</sup> Oct, 2018	Horticulture Training Institute, Vehani-Karnal, Haryana	18 Farmers
8	Exposure visit to ICAR NRCO, Pakyong	24 <sup>th</sup> Nov, 2018	Rolep Sr Sec School, E. Sikkim	46 students and staff
9	Exposure visit on Orchid cultivation to ICAR NRCO, Pakyong	1 <sup>st</sup> Dec, 2018	CAU, CAEPHT, Ranipool	18 students
10	Production technology of orchids and cut flowers	18 <sup>th</sup> Dec, 2018	ATMA, Madhya Pradesh	11 Project Directors
11	Exposure visit on Orchid cultivation	19 <sup>th</sup> Jan, 2019	CoA, Lembucherra, Tripura	19 students
12	Awareness on conservation and cultivation of orchids	14 <sup>th</sup> mar, 2019	Andaman and Nicobar Island	16 farmers

### **Five-day training programme on cultivation of orchids and other cut flowers**

A five days training programme on “Cultivation of Orchids and Other Cut Flowers” was conducted at ICAR NRC for Orchids, Pakyong, Sikkim (Batch - I ) from 14<sup>th</sup> to 18<sup>th</sup> May, 2018 and Batch - II from 21 to 25<sup>th</sup> May, 2018 for the officials of Department of Floriculture, Govt. of Jammu & Kashmir, Kashmir. The programme started with a brief discussion on current farm practices, procedures and future farming plans. Dr. L.C. De Principal Scientist took practical class followed by Institute’s field/farm visit. Presentations and lectures on different topics viz. floriculture in hill region, biotechnological interventions in commercial flowers, IPR issues in ornamental plants, practical on potting, re-potting and vermi-composting, biodiversity management in orchids, production of quality seeds and planting materials of commercial flowers, production technology of bulbous ornamentals, practical on propagation techniques, off-season cultivation of ornamental plants, post-harvest management of cut flowers, IPM in orchids, breeding approaches in orchids, utilization of orchid genetic resources and value addition & physiological disorders in ornamental plants, were delivered by the Scientist, Technical Staff, followed by practical demonstration on media preparation, potting and re-potting of orchids.

### **Tribal Sub Plan Scheme**

#### **Off-campus training and demonstration programme on orchid cultivation under TSP Project**

Off-campus training and demonstration programme on orchid cultivation under TSP Project was conducted at Hee-Gyathang, Dzongu, North Sikkim on 29<sup>th</sup> Nov, 2018. The Chief Guest of the programme was Ms. Sonam Kipa Bhutia, Panchayat President, Hee-Gyathang G.P.U. Other delegates present were Nimlay Lepcha, Panchayat Vice-President and Norzey Lepcha, Panchayat, Hee-Gyathang

G.P.U. More than 40 farmers from different villages of Dzongu participated in the training programme. Dr. Tshering Lhamu Bhutia, Scientist (Vegetable Science) and Nodal Officer, TSP, ICAR-NRCO, Pakyong welcomed the guests as well as the participants and briefed about the TSP project in details including the objective of the project, the importance of growing orchids for increasing an additional income to the farmers. It was followed by practical demonstration of cultivating orchids by Sh. Ajay Bhusal, Technical Assistant. The farmers actively participated in the programme interacting with the experts from the institute clearing all the doubts about orchid cultivation and its problems. More than 300 nos. of planting material were distributed to the farmers after demonstration. Mr RK Pamarthi, Scientist (EB & PGR) also attended the programme.

#### **One day training programme on orchid cultivation at Sombaria, West Sikkim**

One day training programme on orchid cultivation was organized at Rumbuk, Sombaria, West Sikkim on 20<sup>th</sup> Dec, 2018. Forty farmers participated in the said training programme. Delegates from the State Department Shri Ongdi Sherpa, D.N Sherpa HDOs, Telmit Lepcha, Ward Panchayat, Guest from Scotland David, Officials from ATMA Sanita Tamang and BTM Shri Dawa T Sherpa also participated in the programme. The programme started by welcoming the guests. Dr. Tshering Lhamu Bhutia, Scientist and Nodal Officer, TSP, ICAR-NRCO, Pakyong welcomed the guests as well as the participants and briefed about the TSP project in details including the objective of the project, the importance of growing orchids as a component in an integrated farming system for increasing an additional income to the farmers. Mr. Ravi Kishore Pamarthi, Scientist (EB & PGR), ICAR NRCO, Pakyong also delivered an awareness lecture on conservation of orchid species, farmers’ right, etc. It was followed by a meeting cum interaction with the farmers about the problems of growing orchids in the selected area. All the farmers actively participated in the interaction and were also very enthusiastic about

taking up orchid as a component of farming system after taking thorough trainings from the experts of the institute.

### **Exposure visit of Dzongu, North Sikkim farmers on Orchid Cultivation**

A team of 30 farmers from Dzongu, North-Sikkim visited ICAR-NRCO, Pakyong on 27<sup>th</sup> Dec, 2018 on an exposure visit for Capacity Building-cum-Awareness under Tribal Sub-Plan Project for conservation and cultivation of orchids. The team was accompanied by Panchayat President, Ms. Sonam Kipa Bhutia and Panchayat Member, Ms. Laden Ongmu Lepcha. Dr. Tshering Lhamu Bhutia, Scientist (Horticulture) and Nodal Officer, TSP welcomed the participants. Dr. L.C. De, Principal Scientist (Horticulture) delivered the talk on the importance and significance of Floriculture in Hill Region and also interacted with farmers on various aspects involved in conservation and cultivation of orchids and other ornamental flowers. Farm visits and practical demonstration on planting/repotting of orchids was led by Mr. Ajay Bhusal, Technical Assistant (F/F). At the end of the programme, Dr. D.R. Singh, Director, ICAR NRC for Orchids had an effective interaction with farmers.

### **Intellectual Property Rights**

#### **Awareness cum training programme on orchid conservation**

ICAR-NRCO organized “Awareness cum Training Programme on Orchid Conservation” at Hee-Gyathang, Dzongu, North Sikkim, Sikkim

on 29<sup>th</sup> Nov, 2018. Forty-two farmers participated in the training programme. The inaugural session was addressed by Mr. Ravi Kishore, Scientist (EB & PGR) with a brief introduction about IPRs. Further, he delivered the lecture on Farmers Rights, Plant Breeder Rights, PPVFRA etc.. Dr. T. L. Bhutia, Scientist & Nodal Officer, TSP delivered a talk on Biopiracy and IPR issues of Orchids. All the participants actively participated in discussion with the experts on IPR issues. During the programme, Smt. Sonam Kripa Bhutia, Panchayat President, Shri. Namrey Lepcha, Vice- President and Smt. Norzey Lepcha, Panchayat were also present.

#### **Awareness cum Training Programme on Intellectual Property Rights”**

ICAR-NRCO, Pakyong, Sikkim organized “Awareness cum Training Programme on Intellectual Property Rights” at Rumbuk, Sombaria, West Sikkim, Sikkim, on 20<sup>th</sup> Dec, 2018. During the programme, delegates from the State Department Sh. Ongdi Sherpa, HDO, Sh. D.N Sherpa, HDO, Sh. Telmit Lepcha, Ward Panchayat, Mr. David, a guest from Scotland and Ms. Sanita Tamang, ATMA and Sh. Dawa T Sherpa, BTM also participated in the programme along with 31 farmers. Mr. Ravi Kishore, Scientist (EB & PGR) welcomed all the participants and gave a brief introduction about IPRs. Further, he explained the importance of Farmers rights, Plant Breeder Rights, PPFRA etc. All participants actively participated in the interaction with scientific staff and department officials regarding IPR issues.

## Technology Developed: 'Orchids Farming' Mobile application



# Android Application: Orchid Farming

Ankur Tomar, R. K. Pamarthi & D. R. Singh  
ICAR-National Research Centre for Orchids, Pakyong-737106, Sikkim



---



### NRCO Orchids Farming

#### Overview

The Orchid Farming mobile app has been designed and developed by ICAR- National Research Centre for Orchids, Pakyong, Sikkim to impart scientific knowledge and skills to the farmers/growers / Entrepreneur and orchid lovers who want to grow orchids. This is an educational App providing information on about different aspects of orchids management by choosing their selective measures.

“Smartphones have become a useful tool in agriculture because their mobility matches the nature of farming, that give users a richer and faster access to services of their choice in real time.”

Mostly in orchid farming, Cymbidium & Dendrobium in North-East India, and Dendrobium, Phalaenopsis, Vanda & Mokara hybrids in South India, are cultivated. Our android application helps to orchid growers for implementation of better and timely farming decisions by applying the management skills.

#### Features of the App

- ❖ Offline Application.
- ❖ Android Version 4.1 platform.
- ❖ Present size is 8.4 MB.
- ❖ Currently application is in English language, but its Hindi version would be launched soon.
- ❖ It is specially designed to assist researchers, extension personnel of agriculture and farmers for effective management of Orchids.
- ❖ For feedback, a specific e-mail support is provided, through which they can send feedback/ queries to the developers or they choose direct SMS support in it.
- ❖ For more guidance about the orchids, choose more info for contact detail or organisation.

#### Content of the App

- ❖ The major contents covered in the App are as follows:
- ❖ Five genera covered namely Cymbidium, Dendrobium, Phalaenopsis, Vanda & Mokara.
- ❖ Each species contain their introduction, different varieties with picture presentation and management techniques that simplify farmer's doubts and daily basis problems.
- ❖ Extension Activities, Technologies, More Info & Feedback are some additional content.
- ❖ Management and Control of Insect & diseases (under various subheads of What & Why, Symptoms, Treatment and Prevention)

The App can be downloaded from below link or scan the QR code.

<https://drive.google.com/uc?authuser=0&id=1sK5LCmcK8pqlb2tQa8C74rKnPVGa286T&export=download>





**Digital India**  
Power To Empower



Acknowledgements: Application developed based on the previous report and Orchids developed structure under ICAR- National Research Centre for Orchids, Pakyong, Sikkim.

# Technological options for Doubling Farm Income

## A. Vertical farming system (Orchid based farming system)



Orchid + leafy vegetables

## B. Growing of orchids on walls in open condition.



## C. Waste to wealth

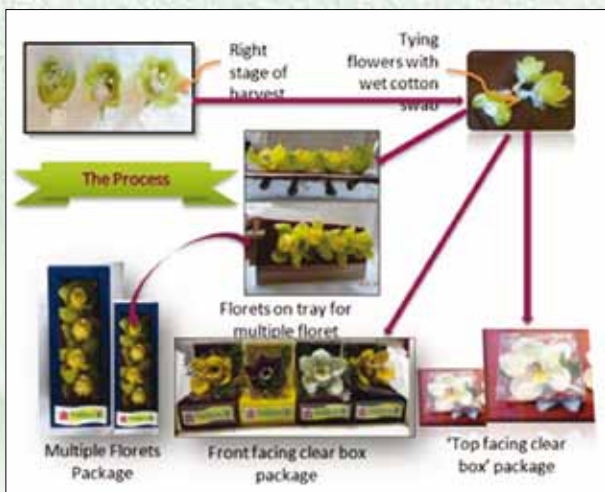


Utilization of waste plastic pipes

## D. Value addition of dry Cymbidium leaves



## E. Single flower packing techniques



## F. Value addition of Orchids



# Centrally Sponsored Government Schemes

## I. Mera Gaon Mera Gaurav

### Adopted Village: Khop, Namthang, South Sikkim

A Collaborative program of KVK, Namthang, South Sikkim and ICAR-NRC for Orchids, Pakyong, Sikkim was held on 27<sup>th</sup> July, 2018 at Khop Village, South Sikkim. In this joint program, Shri I.P. Shivakoti, Head & I/c, Subject Matter Specialists Dr. C.N. Bhutia, Shri Pravesh Shivakoti, Mrs. Yangchenla Bhutia, Dr. Nation Chamling, Ms. Meena Pradhan, Shri Wilson Rai, Tulasha Sharma from KVK, South Sikkim and Dr. L.C. De, Principal Scientist, and other staff namely

Shri Rakesh Singh, Shri Ajay Bhusal, Shri Deepak Rai and Sh. Nima Tshering Bhutia from ICAR-NRC for Orchids, Pakyong, Sikkim and 55 farmers from Khop village participated. In this programme, extension activities like 'Launching of Mera Gaon Mera Gaurav Program' was carried out under the leadership of Dr. L. C. De, Principal Scientist (Horticulture) as well as 'Training cum Awareness on Insurance of Milch Cows' and 'Input Distribution Program for Doubling of Farmer's Income' under the leadership of KVK i/c, Shri I.P. Shivakoti and supported by SMS, KVK, South Sikkim, Namthang for the benefit of farmers of Khop village.

## II. Swachh Bharat Abhiyan

### Swachhta Hi Sewa (15<sup>th</sup> Sept 2018 to 2<sup>nd</sup> Oct 2018)

Date	Activity
15.09.2018	A Spath Taking Ceremony & Launching of Swachh Monitoring System was organized at Training Hall, ICAR-NRC for Orchids, Pakyong. On this occasion, Swachhta Pledge was administered by Dr L.C. De, Nodal Officer, SBA to all staff viz. Scientists, Administrative Staff, Technical staff, Supporting staff, Project staff, TSM and contractual staff of this institute both in English and Hindi.
17.09.2018	A Celebration of Shramdan Diwas with the cleaning of jungles and sweeping of office premises was organized at office approach area, ICAR-NRC for Orchids, Pakyong. On this occasion, jungles and weeds of 2000m <sup>2</sup> of approach areas of the office were swept by at ICAR-NRCO staff for the screening of atmosphere and supply of fresh and quality air.
18.09.2018	A program of recitation on Poems, Slogans, Rhymes, Quotes, Songs related to Swachh Bharat was organized in Training Hall, ICAR-NRC for Orchids, Pakyong. Altogether 20 staff of this institute participated in the program.
19.09.2018	A Celebration of Shramdan Diwas with cleaning of jungles and sweeping at public places (Nag Mandir & Bhanu Bhatika, Pakyong) was organized. On this occasion, jungles and weeds of 1500m <sup>2</sup> of public places were cleaned and swept by at 16 number of ICAR-NRCO staff for the screening of atmosphere and supply of fresh and quality air.
20.09.2018	A Campaign on Swachh Bharat was organized at Pakyong, Dikling Road. On this occasion, 16 number of ICAR-NRCO staff participated in the program.
21.09.2018	An awareness program on organic compost management through vermicomposting was organized at Research Farm, ICAR-NRC for Orchids, Pakyong. On this occasion, 20 number of ICAR-NRCO staff participated in the program.
22.09.18	A program on organic compost management through leaf mould collection was organized at Research Farm, ICAR-NRC for Orchids, Pakyong. On this occasion, 15 number of ICAR-NRCO staff participated in the program.



Date	Activity
23.09.2018-24.09.18	A program on display of banner was organized at Office Premises, ICAR-NRC for Orchids, Pakyong during the Sikkim visit of Hon'ble Prime Minister of India.
27.09.2018	An awareness program on sanitation and cleaning was organized at Elbethel School, Pakyong, Sikkim. On this occasion, 21 number of staff of ICAR-NRC for Orchids, Pakyong, 120 students and ten teachers of El Bethel School participated in the program.
28.09.2018	A program on Essay Writing was organized in Conference Hall, ICAR-NRC for Orchids, Pakyong wherein 14 staff of ICAR-NRC for orchids participated.
29.09.2018	A program on organic compost management through leaf mould collection was organized at Research Farm, ICAR-NRC for Orchids, Pakyong. On this occasion, 14 number of ICAR-NRCO staff participated in the program.
02.10.2018	An Award Ceremony on 'Swachhta Hi Sewa' was organized in Training Hall, ICAR-NRC for Orchids, Pakyong. On this occasion, 40 number of ICAR-NRCO staff participated in the program. Out of 40 NRCO staff, 11 participants were awarded for essay writing and 6 participants were awarded for active participation in 'Swachhta Hi Sewa' program.

### Swachhta Pakhwada (16<sup>th</sup> Dec 2018 to 31<sup>st</sup> Dec 2018)

Date	Activity
16.12.2018	A Sapath Taking Ceremony & Launching of Swachh Monitoring System were organized at Training Hall, ICAR-NRC for Orchids, Pakyong. On this occasion, Swachhta Pledge, display of banner and planting of ornamental plants were administered by Dr L.C. De, Nodal Officer, SBA to 21 staff of this institute both in English and Hindi.
17.12.2018	A Celebration of Shramdan Diwas with cleaning of jungles and sweeping of office premises was organized at Farm area, ICAR-NRC for Orchids, Pakyong. On this occasion, jungles and weeds of 1000m <sup>2</sup> of Farm areas were cleaned and burnt by 30 ICAR-NRCO Staff.
18.12.2018	A program on competition of Essay writing, Quiz etc. related to Swachh Bharat was organized at Conference Hall, ICAR-NRC for Orchids, Pakyong. Altogether 11 staff of the institute participated.
19.12.2018	A program on Waste Management through collection of leaf mould from reserved forest of ICAR-NRC for Orchids, Pakyong, Sikkim. Altogether 26 Staff of this institute participated in the aforesaid program.
20.12.2018	A program on Cleaning and Sweeping in public places viz. Sai Mandir, Nag Mandir and Bhanu Bhatika, Pakyong, East Sikkim was organized. Altogether 25 staff of the institute participated in the program.
21.12.2018	A program on organic compost management through vermi-composting, rain-water harvesting and planting of ornamental plants was organized at the institute. Altogether 26 staff of this institute participated in the aforesaid program.
22.12.2018	A program on cleaning of drainage system/ waterline/ street in public places (Rai Gaon) organized. Altogether 07 staff of the institute and 05 persons from Rai Gaon participated in the program.
23.12.2018	A program on Celebration of Farmers Day/ Kisan Diwas in Upper Namcheypong, East Sikkim was organized. Altogether 18 persons accounting 07 Staff of the institute and 11 Farmers from Namcheypong participated in the program. In the program, Dr L.C. De, HRD Nodal Officer & Nodal Officer, SBM of ICAR-NRC for Orchids narrated the importance of Kisan Diwas and up to date achievements of different Division of ICAR and finally distributed the literatures and garden tools to the farmers.
24.12.2018	A program on Videos/ short films on Swachh Bharat Abhiyan was organized at the institute. Altogether 11 staff of the institute participated in the program.

Date	Activity
25.12.2018	A program on basin cleaning of Christmas plantation was organized at the institute. Altogether 20 staff of this institute participated in the program.
26.12.2018	A program on jungle cleaning and sweeping of steps to Residential Complex was organized at the institute. Altogether 20 staff of the institute participated in the program.
27.12.2018	A program on Technology demonstration, Exhibition and Expert talks was organized at the institute. Altogether 30 farmers of North Sikkim and 06 staff of the institute participated in the program.
28.12.2018	On the eve of 'Swachhta Pakhwada', a program on Water Conservation Measures for Hill Ecosystem was organized at the institute. Altogether, 10 staff of the institute participated in the program.
29.12.2018	A program on Organic Compost Management through Leaf mould collection was organized at this institute. Altogether, 20 staff of the institute participated in the program.
30.12.2018 & 31.12.2018	A program on Exhibition, Technology Display and Award Ceremony was organized at this institute. Altogether 37 staff of the institute participated in the program.

## Other Institute Activities

### Meeting with Additional Director MSME, GoI for entrepreneurship development

Dr D.R. Singh, Director, ICAR-NRC for Orchids conducted meeting with Additional Director MSME, GoI for entrepreneurship development of ICAR-NRC for Orchids, Sikkim on 23<sup>rd</sup> April 2018.

### XVII<sup>th</sup> Institute Research Council Meeting

XVII<sup>th</sup> Institute Research Council Meeting was held on 8<sup>th</sup> May 2018 under the Chairmanship of Dr D. R. Singh, Director, ICAR-NRC for Orchids at the Conference Hall of the Institute. The Chairman suggested all the scientists have to publish research papers for completed experiments in good journals and also to participate in MGMG and Swachh Bharat programme actively. All the scientists presented their achievements of the 2017-18 and new projects. All the Scientist and project staff participated in the meeting.

### IV<sup>th</sup> International Yoga Day

IV<sup>th</sup> International Yoga Day was celebrated on 21<sup>st</sup> June, 2018 at training hall of ICAR-NRCO, Pakyong. Scientists, Technical, Administrative, TSM, Project staffs of the Institute participated with great enthusiasm and energy in the Yoga Day. Yoga asana started with prayer and all the staffs followed the asana and pranayama practices as per video released by Ministry of Ayush, Government of India



### MOU Signed with Department of Horticulture, Government of Sikkim

MOU was signed between ICAR-NRC for Orchids, Pakyong and Department of Horticulture, Government of Sikkim on 16<sup>th</sup> Aug, 2018 for the long term collaboration for promotion of research in cutting edge areas and to facilitate the use of research infrastructure and promotion of Orchid cultivation in the state.

### Vigilance Awareness Week

ICAR-National Research Centre for Orchids observed Vigilance Awareness Week from 29<sup>th</sup> Oct - 03<sup>rd</sup> Nov, 2018. The programme was inaugurated by Director NRCO and the Integrity Pledge was taken by all the staff of the institute. He highlighted the menace corruption in our daily lives and how we can be vigilant and reduce the corruption. The Administrative Officer (i/c) of the institute Sri Arvind Kumar Chauhan appraised the participants about step taken to eliminate the chances of corruption. He told about e-procurements, digitization of office records, e-tendering, biometric for attendance etc. He emphasized that increasing transparency we can reduce the corruption. Posters and banners were displayed. Lectures were organized at the centre so that staff can be made aware about the rules and regulation concerning with administration and finances. Important of

them were drawing and settling the advances, estimating the work and executing it so that it is not split, claiming TAs, and entitlement of various kinds of leaves etc. Dr Ram Pal, Principal Scientist and Vigilance Officer, ICAR NRC (O), Pakyong briefed about the discussion and deliberations held at the Vigilance Officers' Meeting at NAARM Hyderabad. The relevant literature from NAARM was handed over to AAO & AF & AO for their knowledge.

### **Department Related Parliamentary Standing Committee on Commerce**

ICAR-NRC for Orchids, Pakyong participated in the Department related Parliamentary Committee on Commerce held at hotel Mayfair Ranipool on 20<sup>th</sup> Nov, 2018. Various issues related to orchids cultivation, conservation, production management, packaging, storing, transportation and marketing were discussed. Dr D.R Singh, Director, ICAR NRCO, Pakyong highlighted that Orchid is a high-value crop and needs to be included in the Crop Insurance. Various initiatives like value addition, wealth from orchid waste, Orchid Based Integrated farming system had already taken by the ICAR - NRCO to achieve the target of "Doubling Farmers Income". Hon'ble Chairman and members of the committee highly appreciated the research work and the issues being addressed by the institute.

### **Agriculture Education Day**

Agriculture Education Day was celebrated at ICAR NRC for Orchids on 3<sup>rd</sup> Dec, 2018. On the occasion, the presentation was made about the activities of different agriculture institutes, Universities in India and its scope for better carrier options in agriculture. All the staff of the institute participated in the programme.

### **World Soil Day**

World Soil Day was celebrated at ICAR NRC for Orchids on 5<sup>th</sup> Dec, 2018. The HRD Nodal Officer, ICAR NRCO, Pakyong gave a lecture on the importance of Soil Day through the presentation on the topic 'Healthy Soils for Healthy Life'. Farmers from the nearby village,

all the staff of the institute participated in the programme.

### **Sikkim Organic Day cum Krishi Unnati Mela-2019**

ICAR - NRC for Orchids participated in Sikkim Organic Day cum Krishi Unnati Mela-2019 on 18-19<sup>th</sup> Jan, 2019 at Mannan Kendra, Gangtok which was organized jointly by Food Security & Agriculture Development Department, Horticulture & Cash Crops Development Department and ICAR-NOFRI, Tadong, Gangtok. The programme was inaugurated by the Chief Minister of Sikkim Shri Pawan Kumar Chamling on 18<sup>th</sup> Jan, 2019. The institute stall displayed orchids (hybrids & species), cymbidium baskets, publications, back bulb propagating materials, a poster of different orchid's diversities, technology and achievements. Hon'ble Chief Minister visited all the exhibited stalls and had an interaction with the participants. He appreciated the innovative technology of the institute of making a basket out of the Cymbidium leaves. Further, the Chief Guest stressed on developing different biopesticides for increasing production of organic produce and to be self-sufficient. On the next day, Hon'ble Governor of Sikkim Shri Ganga Prasad was the Chief Guest in the Valedictory function. He also visited all the stalls being displayed by different institutes and departments and had a thorough interaction with the participants. ICAR institutes, State Departments, Central Agricultural Universities, KVKs, Self Help Group, farmers participated in the programme.

### **National Horticulture Fair - 2019 for promoting Rural Prosperity**

ICAR NRC for Orchids, Pakyong, Sikkim, participated in Nation Horticulture Fair on Horticulture for Promoting Rural Prosperity from 23-25<sup>th</sup> Jan, 2019 at IIHR, Bengaluru organised by ICAR Indian Institute of Horticultural Research, Hesargatta, Bengaluru in collaboration with Society for Promotion of Horticulture, Bengaluru, Department of Horticulture, Government of Karnataka,

National Horticulture Board, Gurugram & CDB (DAC). The institute exhibited its technology like baskets and mats made from cymbidium leaves, information regarding the conservation and cultivation of orchid's species and hybrids were displayed through posters and banners, orchid based integrated farming system and value-added products for doubling farmer's income were also displayed and explained and the initiatives were highly appreciated by all the visitors visited the stall. An android app on Orchid farming developed by the institute was also installed in more than hundred android users. More than 200 personnel including students, research scholars, scientists, officers, professors, stakeholders, farmers, NGOs, FPOs etc. visited the stall.

### **Exhibition cum Workshop on “Biodiversity Utilization for Ecotourism as an Enterprise”**

ICAR-NRCO organized Exhibition cum Workshop on “Biodiversity Utilization for Ecotourism as an Enterprise” during 25-26<sup>th</sup> Feb, 2019. The exhibition was inaugurated by Shri. Alok Kumar Srivastava, Hon'ble Chief Secretary of Sikkim. A total of 18 stalls were displayed by the farmers, KVK and other Govt. institutions of the region. Around 306 species of orchids and hybrids were displayed. Among all five farmers were adjudged best and awarded. On the same day, a workshop on Biodiversity and Sustainable Agriculture for doubling farmers income in Sikkim was also organized which was chaired by Dr A K Singh, DDG, Horticulture. Mrs. Sushma Singh, Vice-President, Women Commission, Uttar Pradesh and Dr. S.K. Sharma, Dean, College of Horticulture, CAU, Ranipool were the Chief Guest and Guest of Honour respectively and the convenor was Dr D.R. Singh, Director, ICAR-NRC for Orchids, Pakyong. Various centre Govt. Organisations viz., ICAR- NRCO, NOFRI, Sikkim University, CAEPHT, IBSD, GB Pant Institute, AYUSH, IIFSR etc. participated in the workshop and presented their technologies and achievements for doubling farmers' income.



Dr. A.K. Singh, DDG (HS), inaugurated the workshop on “Biodiversity Utilization for Ecotourism as an Enterprise”

### **International Women's Day celebrated**

ICAR NRC for Orchids, Pakyong celebrated International Women's Day on 8<sup>th</sup> Mar, 2019. The programme started with a formal meeting with the women staff of the institute wherein the role of women was emphasized in today's world and the impact they make in daily life which was followed by some games. In the valedictory function, Director, ICAR NRC for Orchids stressed about celebrating women day not only today but every day and women play an important role in shaping the world. He also distributed the prize to the winners.

### **Voter Awareness Forum Programme**

Voter Awareness Forum Programme was conducted at the institute on 22<sup>nd</sup> Mar, 2019 by Sh. Arvind Chauhan, Nodal Officer, Voter Awareness Forum. The programme was attended by Scientists, Technical, Administrative, project, Contractual staff of the institute. All staff were welcomed by Nodal Officer and briefed the audience regarding (i) Voter Awareness Forum (ii) Who shall be the member of VAF (iii) What shall we do in VAF (iv) Structure of VAF (v) What is the role of Nodal Officer (vi) Various activities of VAF. Also, video clip for voter awareness by Election Commission of India was also displayed during programme.

# हिन्दी रिपोर्ट

राष्ट्रीय आर्किड्स अनुसंधान केंद्र, पाक्योग मे हिन्दी पखवाड़ा कार्यक्रम का उद्घाटन समारोह दिनांक 14 सितंबर, 2018 को आयोजित किया गया।

दिनांक, समय;	प्रशिक्षण कक्ष	उद्घाटन समारोह, स्वरचित कविता पाठ एवं आशू भाषण प्रतियोगिता	श्री अरविंद चौहान
14 सितंबर, 2018, 3:00 से 4:00 बजे	प्रशिक्षण कक्ष	उद्घाटन समारोह, स्वरचित कविता पाठ एवं आशू भाषण प्रतियोगिता	श्री अरविंद चौहान
18 सितंबर, 2018, 3:00 से 4:00 बजे	प्रशिक्षण कक्ष	गाना	
27 सितंबर, 2018, 3:00 से 4:00 बजे	प्रशिक्षण कक्ष	श्रुतलेखन, प्रशासनिक शब्दावली	
28 सितंबर, 2018, 3:00 से 4:00 बजे	प्रशिक्षण कक्ष	अंताक्षरी	

राष्ट्रीय आर्किड्स अनुसंधान केंद्र, पाक्योग मे हिन्दी पखवाड़ा कार्यक्रम का उद्घाटन समारोह दिनांक 14 सितंबर, 2018 को आयोजित किया गया। स्वरचित कविता पाठ एवं आशू भाषण प्रतियोगिता का आयोजन भी किया गया। श्री अरविंद चौहान, सहायक एवं हिन्दी प्रभारि, रा. आ. अनु. केंद्र, पाक्योग ने कार्यशाला (कार्यालय मे उपयोग होने वाली हिन्दी) का आयोजन किया। इसके अलावा श्रोता गणों को हिन्दी का महत्व समझाकर हिन्दीभाषा का अधिक से अधिक प्रयोग करने एवं हिन्दी पखवाड़े के दौरान आयोजित कार्यक्रमों मे भाग लेने के लिए प्रोत्साहित किया।

दिनांक 14 से 28 सितंबर, 2018 को अधिकारियों और कर्मचारियों को हिन्दी मे कार्य करने के लिए प्रोत्साहित करने हेतु विभिन्न गतिविधियों का आयोजन किया गया जैसे: गाना, अंताक्षरी, श्रुतलेखन, प्रशासनिक शब्दावली, पत्र लेखन आदि। सभी अधिकारियों और कर्मचारियों ने विभिन्न गतिविधियों मे बढ़ चढ़ कर उत्साह पूर्वक भाग लिया। हिन्दी पखवाड़ा समापन समारोह दिनांक 02 अक्तूबर, 2018 को आयोजित किया गया। कार्यक्रम के दौरान संस्थान के निदेशक महोदय ने पधारे हुए श्रोतागणों को अपने से संबन्धित कार्यालय के कार्यकलापों मे हिन्दी भाषा का अधिकतम प्रयोग करने हेतु आग्रह किया। पखवाड़े के दौरान आयोजित विभिन्न गतिविधियों एवं प्रतियोगिताओं के विजेता गणों को पुरस्कार से सम्मानित भी किया गया। श्री अरविंद चौहान, सहायक एवं हिन्दी प्रभारि, रा. आ. अनु. केंद्र, पाक्योग ने कार्यक्रम के अंत मे सभी को सफल कार्यक्रम आयोजित करने हेतु बधाई एवं धन्यवाद ज्ञापन दिया।

## गणित [कौक]

भा. कृ. अनु. प. राष्ट्रीय आर्किड्स अनुसन्धान केंद्र दार्जीलिंग कैंपस में 06 सितम्बर से 21 सितम्बर तक हिंदी चेतना पखवारा मनाया पुरस्कार हिंदी चेतना पखवारा के अंतर्गत 06 सितम्बर से 21 सितम्बर तक विभिन्न कार्यक्रमों का आयोजन किया गया जिसमें राष्ट्रीय आर्किड्स अनुसन्धान केंद्र दार्जीलिंग कैंपस के सभी कर्मचारियों ने हिस्सा लिया। हिंदी पखवारा के अंतर्गत स्वरचित कविता का पठन पाठन, तर्क वितर्क, पत्र लेखन, निबंध लेखन प्रतियोगिता संस्थान में किये जा रहे कार्यों पर प्रश्नावली, अंत्याक्षरी प्रतियोगिता, नोटिंग, इमला लेखन, श्रुतलेख, शब्दार्थ प्रतियोगिता प्रमुख थे। इन प्रतियोगिताओं में संस्थान के अस्थायी एवं स्थायी कर्मचारियों ने भाग लिया। कार्यक्रम का समापन दिनांक 26-09-2018 को डॉ अजय कुमार की अध्यक्षता में सम्पन्न हुआ। सभी विजयी प्रतिभागियों को अध्यक्ष द्वारा पुरस्कार वितरित एवं सम्मानित किया गया। इस कार्यक्रम के दौरान केंद्र के प्रभारी डॉ. रामपाल मौजूद रहे। उन्होंने सभी विजेताओं को बधाई दी और उन्हें हिंदी में बढ़ चढ़ कर हिंदी में काम करने के लिए आग्रह किया। कार्यक्रम का समापन हिंदी प्रभारी, श्री मनोज अधिकारी के धन्यवाद ज्ञापन प्रस्ताव के साथ संपन्न हुआ।

# Training and Capacity Building

## (A) Physical targets and achievements in training

Sl No	Category	Total no of employees	No of trainings planned for 2018-19 as per ATP	No of employees undergone training during April'18-Mar'19	% realization of trainings planned during 2018-19
1	Scientist	07	04	01	25
2	Technical	07	02	04	200
3	Administrative & Finance	06	03	00	-
4	SSS	06	01	06	600
	<b>Total</b>	<b>26</b>	<b>10</b>	<b>11</b>	

## (B) Financial targets and achievements under HRD program (All employees)

Actual Expenditure with effect from 01/04/2018 – 31/03/2019 for HRD			% Utilization of allotted budget
Financial Target		Actual Expenditure	
NEH	Other than NEH		
(Lakh Rs.)	(Lakh Rs.)	(Lakh Rs.)	2018-19
2.00	Nil	2.00	100

## (C) Training programmes attended by Staff

Sl. No	Name of the Employee	Designation	Programme attended
1	Dr. L C. De	Pr. Scientist	MDP for HRD Nodal Officers of ICAR for Effective Implementations of Training Functions. March, 14-16, 2019 at NAARM, Hyderabad
2	Dr. B P. Mallikarjuna	Scientist	Professional Attachment Training Programme for three months at ICAR-IIHR, Bengaluru
3	Mr. S S Biswas	Scientist	Professional Attachment Training Programme for three months at ICAR-CRIJAF, Kolkata
4	Sh. Deepak Khattri	Driver	“Automobile Maintenance, Road Safety and Behavioural Skills during Jan 15-22, 2019 at ICAR-CIAE, Bhopal
5	Sh. Manoj Adhikari	Sr. Technician	Capacity Building and Skill Upgradation Programme on Farm Management during Sept, 14-20, 2018 at IIFSR, Modipuram, Meerut
6	Sh. Ajay Bhusal,	Sr. Technician	Capacity Building and Skill Upgradation Programme on Farm Management during Sept, 14-20, 2018 at IIFSR, Modipuram, Meerut
7	Smt. Meena Chettri	Technician	Competence Enhancement Program on Motivation, Positive Thinking and Communication Skills for Technical Staff of ICAR during Oct 4-10, 2018 at NAARM, Hyderabad.

## Orientation Programme

Two newly joined scientists, Dr B P Mallikarjuna and Dr S S Biswas visited ICAR NRCO- Darjeeling Centre, Botanical Garden, farmers field and other institute during their orientation programme.

**Visit to NRCO Darjeeling Campus, observing the Cymbidium plants and hands on training on tissue culture techniques:** Observed the conservation, characterization and breeding of Cymbidium orchids for cut flowers. Visited different farms at the centre and learnt basic tissue culture techniques.

**Visit to Lloyd Botanical Garden at Darjeeling and observing conservation of native species of orchids:** Visited orchidarium and observed conservation of *Cymbidium*, *Pleione*, *Phaius*, *Calanthe*, *Coelogyne*, *Bulbophyllum*, *Paphiopedilum*, *Epigonium*, *Dendrobium*, *Oberonia* etc.

**Visit to farmer's field at Mirik and Pokhriabong and observing the cultivation of Cymbidium orchids:** Visited Shri. Sushil Bantwa's orchid farm and observed different collections of *Cymbidium*, *Vanda*, *Dendrobium* species etc.

**Visit to ICAR-IARI Regional Station, Kalimpong and farmer's field at Kalimpong and observing the cultivation of Cymbidium orchids:** Visited the orchid farm of Shri Pawan Pradhan and Shri. Sachin Rai where *Cymbidium* species was maintained under low cost bamboo houses.

**Visit to farmer's field at Kurseong and observing the cultivation of Cymbidium orchids:** Visited the nurseries of Shri. Laxman Sharma and Sri. Lachman Rai and observed various collections of *Cymbidium*, *Dendrobium*, Moth orchid, *Phalaenopsis*, *Coloegyne*, etc and their cultivation on terrace.

## Characterization of Sexual Systems in Marigold Breeding Population

Marigold (*Tagetes erecta* L.) is an annual plant belongs to the family Asteraceae and a native of

Central and South America, especially Mexico. The genus *Tagetes* consists of 33 species, of which two species, namely *Tagetes erecta* (African marigold) and *Tagetes patula* (French marigold) were popularly grown as a cut flower, loose flower, potted plant, bedding plant in garden and for its various medicinal values. A study was undertaken during winter season of 2018-19 to characterize the sexual systems in marigold breeding population at Floriculture Experimental plot, ICAR-Indian Institute of Horticultural Research, Hesaraghatta, Bengaluru. The study material consisted of marigold breeding population comprising 91 accessions of *T. erecta*, 18 accessions of *T. patula*, and one *T. minuta* accession. The population was observed regularly during flowering season and recorded for their sexual forms (female, hermaphroditic, gynodioecious, gynodioecious). The female flowers were classified as petaloid or apetaloid based on the type of floret. Whereas the fertile flowers were grouped as single fertile, semi-double fertile and double fertile. The female flowers were classified as petaloid or apetaloid based on the type of floret. Overall, the most frequent sexual morph in the marigold breeding population was the hermaphrodite (67.27%), followed by the gynodioecious (15.45%) and female (13.64%). The proportion of hermaphroditic plants within populations ranged from 60.44% (in *T. erecta*) to 100% (in *T. patula* and *T. minuta*), whereas the proportion of gynodioecious plants were 18.68% in *T. erecta*, while the species *T. patula* and *T. minuta* did not exhibit the gynodioecious plants. The proportion of gynoecious/female plants was 16.48% in *T. erecta* while other two species did not exhibit gynoecious plants. Similarly, the range of gynomonocious plants was zero in the species *T. patula* and *T. minuta* to 2.20% in *T. erecta*. At species level, the *T. erecta* showed lowest proportion of hermaphrodite flowers (60.44%) in the population and highest proportion was exhibited by *T. patula* and *T. minuta* (100%). Pure female (gynoecious) plants were observed in the species *T. erecta* only.



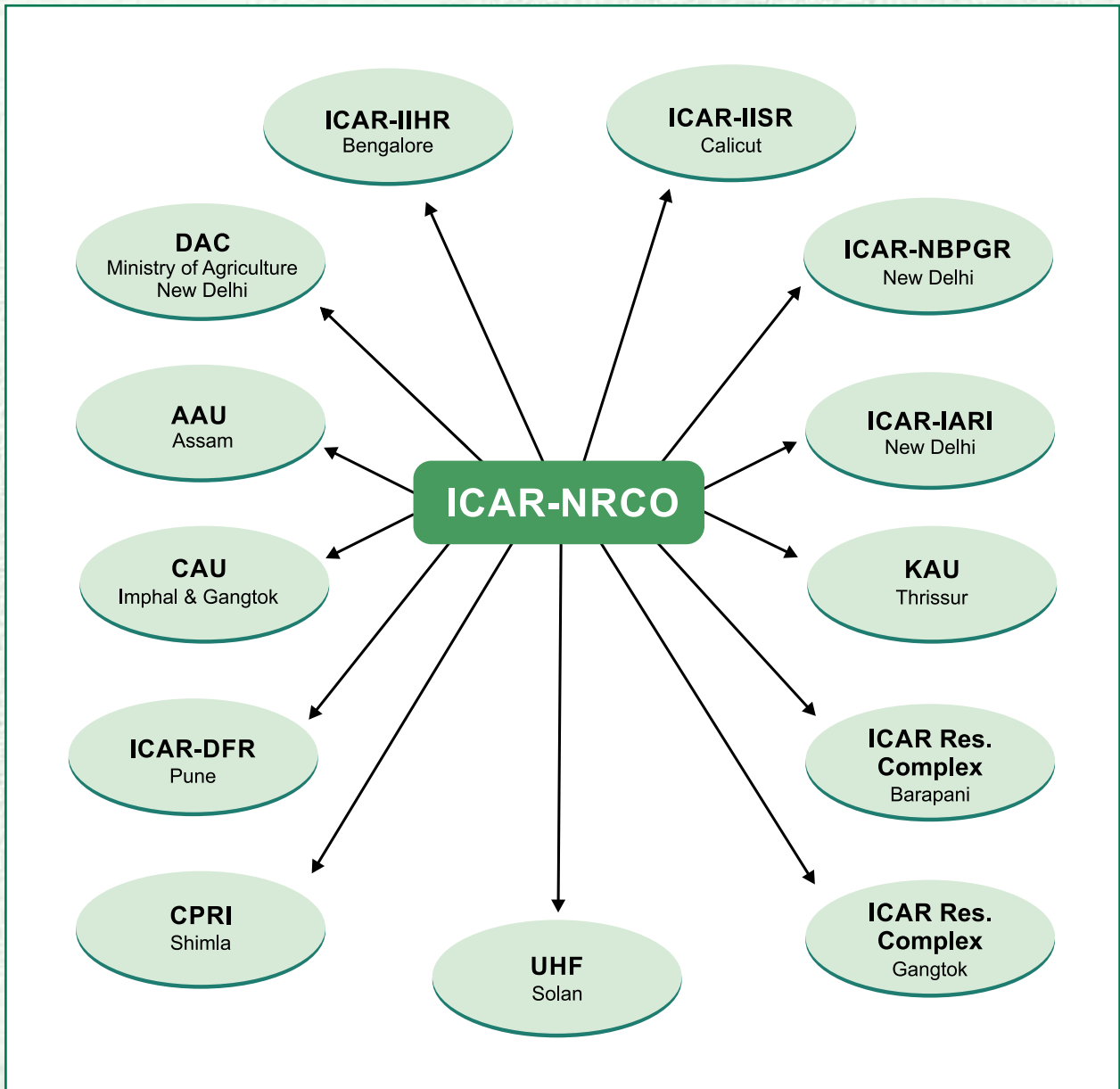
**Effect of long term ST-TY equation based INM on Phosphorus (P) fractions; P fixation capacity of soil under Jute based cropping systems**

A field experiment was conducted by soil test based-target yield (ST-TY) equation based INM approach at ICAR-CRIJAF, Barrackpore, to study their effect on crop yield and P uptake taking Jute-rice-lentil as cropping sequence on a long term basis, to compare the effect of organic and inorganic P inputs and their combination on soil P fractions and to compare the effect of added inorganic P and organic materials on P fixation capacity of the soil at different temperature. For this, the soil was treated with different treatments like T<sub>1</sub>: Control, T<sub>2</sub>: STCR-TY (40q ha<sup>-1</sup>) [92.0:31.0:62.5 :: N:P:K Kg ha<sup>-1</sup>], T<sub>3</sub>: T<sub>2</sub> (STCR-TY (40q ha<sup>-1</sup>) [92.0:31.0:62.5 :: N:P:K Kg ha<sup>-1</sup>]) + Farm Yard Manure (FYM)@ 5t ha<sup>-1</sup>, T<sub>4</sub>: T<sub>2</sub> (STCR-TY (40q ha<sup>-1</sup>) [92.0:31.0:62.5 :: N:P:K Kg ha<sup>-1</sup>]) + Biofertilizers (Azospirillum +PSB), T<sub>5</sub>: T<sub>3</sub> (STCR-TY (40q ha<sup>-1</sup>) [92.0:31.0:62.5 :: N:P:K Kg ha<sup>-1</sup>]) + FYM@ 5t ha<sup>-1</sup> +

Biofertilizers (Azospirillum +PSB), T<sub>6</sub>: Cultivated Fallow, T<sub>7</sub>: Undisturbed fallow. Soil was collected after harvesting of rice. We found that integrated application of chemical fertilizers along with FYM can provide significant higher grain and straw yield, grain P content as well as P uptake in above ground biomass. Not only the available P of soil but also all other soil P fractions (saloid P, aluminium (Al) bound P, Iron (Fe) Bound P, Calcium (Ca) bound P and reductant soluble P) were affected by the crop production practices. Integrated application of chemical fertilizers along with FYM or FYM+ biofertilizers can maintain higher amount of saloid P, Al bound P, Fe bound P and comparatively less amount of Ca bound P as compared to sole chemical fertilizer treatment. Application of FYM as well as bio fertilizer (PSB) can reduce P fixation capacity of the soil and with increasing temperature P fixation capacity of the soil increase. At 35°C increased activity of phosphate ion could nullify the effect of FYM and PSB on P fixation reduction at 15 °C.

# Linkages and Collaboration

The centre has linkages with several universities, research institute and developmental agencies for collaborative research and developmental activities in orchids.



## Memorandum of Understanding Signed:

1. ICAR-NRCO, Pakyong and Department of Horticulture, Government of Sikkim, Sikkim

# NRCO in Media

## Training, demonstration on orchids



**SE Report**  
**GANGTOK, March 28:** An off campus training and demonstration on orchid cultivation, production and management was conducted by ICAR-National Research Centre at

Orchids, Pakyong at Sangdong village, Dzongu, North Sikkim recently. Nodal officer N. Sailo briefed the gathering regarding the activities of TSP, orchids cultivation and orchids biodiversity while JRF Deepak Rai explained the importance of conservation of local orchid species and bio-piracy, a press release informs. The training programme was attended by more than 25 farmers and farming kits were also distributed to the farmers.

## Series of farmer training progs conducted at Khop



## Satpal Maharaj & Uttarakhand team study Sikkim orchids, organic farming

**PAKYONG, September 4:** Uttarakhand Tourism minister Satpal Maharaj along with some other officials from the Uttarakhand government visited the ICAR National Research Centre for Orchids (NRCO) at Pakyong today. The delegation on their four-day study tour to Sikkim, were welcomed by NRCO principal scientist L.C. De and Pakyong SDM Tenzing Dzonogpa and other officials at the centre. During the visit, the minister and his team were briefed about orchids, its varieties, management, marketing and its medicinal values. They also examined the different process of orchid farming, species house, orchid herbarium and experimental farming of orchid in NRCO premises. Maharaj said the team has come here at Pakyong NRCO to know more about orchids, how it is grown as the climate of Sikkim are same and orchid cultivation can be done in Uttarakhand too. "More and more people are getting attracted to this cash crop and thus this culture of orchid farming needed to be



implemented in Uttarakhand as well. The income of farmers will also go up by producing orchids along with other kind of mixed farming and value addition in orchid farming," he stated. Satpal Maharaj also applauded the organic farming mission of Sikkim saying Uttarakhand also wants to learn more about organic development like Sikkim. He said Sikkim had been in the forefront in conserving environment and in lieu of the bonus would serve as an additional drive. The team also visited Pakyong airport where airport director R. Manjunatha informed team about its structures and upcoming inauguration schedule.

## Training on cultivation of orchids in Pakyong



## Free visit to Pakyong orchid research centre

**SE Report**  
**GANGTOK, February 24:** ICAR-NRCO, Pakyong has announced that farmers, media dwellers, students, media persons and people of Sikkim can visit the centre and witness technologies and innovations made by the scientists there free of cost from February 26 to February 28. The initiative is being taken so that public can observe the outstanding work on orchids. Also, attempts are being made to popularize the promotion of orchid cultivation in Sikkim.

**SE Report**  
**GANGTOK, May 21:** A five-day training programme on orchid cultivation was conducted at ICAR NRC for orchids, Pakyong from May 14 to 18 for floriculture department officials of Jammu and Kashmir. Training coordinator L.C. De gave brief introduction of the current farm practices, procedures and future farming plans including practical demonstration. Lectures on different aspects and topics on orchids cultivation were delivered by the expert staff. During the part of the programme, participants visited Kartok village, CAEPHT Ranipool and NOFRI, Tadong, a PIB release informs. NRCO director D.R. Singh who was present at the valedictory function highlighted the significance and importance of floriculture.

# Publications

## Research papers

- De, L.C., A.N. Rao, D.R. Singh, S.R. Dhiman, Ravi Prakash and Rakesh Singh (2018). DUS Test guidelines in Mokara orchids. *International Journal of Horticulture*, 8 (4): 29-35.
- De, L.C., N. Sailo and D.R. Singh (2018). Growth and developmental aspects in commercial orchids. *Floriculture Science*, 2(1):6-15.
- P. Bera, S. Chakrabarti, N. K. Gaikwad, N. N. Kutty, M. Barman & A. Mitra (2019) Developmental variation in floral volatiles composition of a fragrant orchid *Zygopetalum maculatum* (Kunth) Garay. *Natural Product Research*. 33(3):435-438.
- Pant, R.P., Y.B. Basavaraj, N. Srivastava, A. Bhattarai, A. Kumar, V.K. Baranwal, N. Sailo, Rampal and D. Barman (2019) First report of Groundnut bud necrosis virus infecting *Phalaenopsis* in India, *New Disease Reports*, 39, 17.
- Singh D.R., R.K. Pamarthi, Raj Kumar, D Rai, AL Meitei and P Kiran Babu (2019). Traditional artifacts from dried leaves of *Cymbidium* species (Orchidaceae) in Indian state of Sikkim. *Indian Journal of Traditional Knowledge*. (Accepted)

## Books/Book Chapters/Compendium/ Technical Reports/Popular article

- Bhutia, T.L. (2019). Role of women in Agriculture. *Women in Agriculture (The Invisible partners in Development)* edited by Surya Rathore and Pratibha Sharma. Published by Jaya Publishing House, New Delhi, 248p.
- De, L.C. (2018). *Fundamentals of Horticulture*, pp. 184, published by Aavishkar Publishers & Distributors, Jaipur, Rajasthan.

- De, L.C. (2018). *Growth and Improvement of Horticultural Crops*, pp. 238; Published by Pointer Publisher, Jaipur, Rajasthan.
- Meitei, A.L., P K Babu and DR Singh “Orchids of India: The Silent Treasure (Distribution, Utilization and Conservation)” in *Wild Ornamental Plants of India*. Astral International (P) Ltd. New Delhi.
- Raj Kumar, Lakshman Chandra De, Rakesh Kumar and D R. Singh (2018). *Dendrobium Ka Byabsayik Utpadan*, *Phal Phool*, 39 (3): 3-8.
- Singh D.R. (2019). International Trade in Orchids and potential of increasing India Share in Global market. In *Shaping the future of Horticulture*. Editor by K L Chadha et al. Kruger Brentt Publishers UK Ltd. Pp 855-870.

## Oral/Posters/Lead/Abstract in Seminars/Symposia/Conference

- Bhutia, T.L., S.S. Mali and Anoj Kumar. Crop diversification for improving livelihood of marginal and tenant farmers through improved dry season irrigation in Eastern Gangetic Plains. **In:** “9<sup>th</sup> NEE Congress-2018 on Smart Agriculture Technology Innovations and Intervention” Organized by Society of Extension Education, Agra in collaboration with Central Agricultural University, Imphal, Manipur 15-17 Nov, 2018 at CAEPHT, Ranipool, Sikkim.
- Chaturvedi, P., R.K Pamarthi and D.R. Singh. To develop database of Orchid biodiversity of Sikkim Himalaya. **In:** 2<sup>nd</sup> *Himalayan Researchers Consortium* at Gangtok, Sikkim, 26-27 Nov, 2018.
- Chaudhury R., Rampal, B. Thongam and H.W Prichard. Use of Cryopreservation technology for long-term conservation of Indian orchid species. **In:** National Conference cum Workshop on Current trends in conservation, sustainable development biological and social

- benefit of medicinally and floriculturally significant orchids & orchid show, 16-18 Mar, 2018 Wayanad, Kerala. pp. 34
- Chaudhury, R.M. Shanker, Rampal, B. Thongam S.K Malik, and H.W Pritcard. Cyotechnological approaches for long term cost-effective conservation of Indian orchid species: national and international collaboration (2019) **In:**National Conference cum Workshop on Recent advances in orchidology with special emphasis on biology, climate change, conservation and commercialization of floriculturally and therapeutically important taxa & orchid show, 15-17 Feb, 2019, Port Blair, Andaman and Nicobar Islands
  - De, L.C. Impact of Climate Change on Floriculture and Landscape Gardening. **In:**9th National Extension Education Congress-2018, organized by Society of Extension Education, Agra on “Climate Smart Agricultural Technologies: Innovations and Interventions” held at CAPHET, Ranipool, Sikkim from 15-17 Nov, 2018.
  - De, L.C. Post-harvest management and value addition of flowers & foliage. **In:**9th National Extension Education Congress-2018, organized by Society of Extension Education, Agra on “Climate Smart Agricultural Technologies: Innovations and Interventions” held at CAPHET, Ranipool, Sikkim from 15-17 Nov, 2018.
  - De, L.C., and D.R. Singh. Year round production technology of orchids. **In:** COBACAS 4<sup>th</sup> National Conference on Diversified System: Sustainable Livelihood and Doubling Farmers Income from 17-18 Jan, 2019 at UBKV Campus, Majhian, Dakshin Dinajpur, West Bengal.
  - De, L.C., D.R. Singh and Rakesh Singh. Swachh Bharat Abhiyan- An Overview. **In:**9th National Extension Education Congress-2018, organized by Society of Extension Education, Agra on “Climate Smart Agricultural Technologies: Innovations and Interventions” held at CAPHET, Ranipool, Sikkim from 15-17 Nov, 2018.
  - De, L.C., Rakesh Singh and DR Singh. Preparation of DUS Test Guidelines in Mokara orchids. **In:** Indian Horticulture Congress-2018: Shaping future of Indian Horticulture held at IGKVV, Raipur, Chhattisgarh from 17-21 Jan, 2019.
  - De, L.C., Rakesh Singh, Deepak Rai and D.R Singh. Organic Production of Cymbidium Orchids. **In:** Indian Horticulture Congress-2018: Shaping future of Indian Horticulture held at IGKVV, Raipur, Chhattisgarh from 17- 21 Jan, 2019.
  - Meitei, A.L., R.K. Pamarthi and D.R. Singh. Phytochemical analysis of native *Dendrobium nobile* Lindl. Methonal extract. **In:**2nd Himalayan Researchers Consortium at Gangtok, Sikkim, 26-27 Nov, 2018.
  - P Kiran Babu, R.K Pamarthi, A.L Meitei, Deepak Rai, A.R Ilahi, N.T Bhutia and D.R Singh. Conservation, sustainable use and equitable benefit sharing arising out of use of natural resources (Orchids). **In:**1<sup>st</sup> Himalayan Researchers Consortium at Dehradun, Uttarakhand (25-28 April, 2018).
  - P Kiran Babu, R.K Pamarthi, Deepak Rai, Rampal and D.R Singh. Potential wild orchid resources for diverse end use from Sikkim, India. **In:**National Conference on Intensification and Diversification in Agriculture for Livelihood & Rural Development, 28-31 May, 2018, RPCAU Pusa (Samastipur-848101), Bihar.
  - Rai Deepak, R.K. Pamarthi, K. Babu, Rampal and D.R Singh. RET Orchids species of Sikkim Himalaya-Status and Conservation. **In:**National Conference on Intensification and Diversification in Agriculture for Livelihood & Rural Development, 28-31 May, 2018, RPCAU Pusa, Samastipur, Bihar.
  - Rai Deepak, R.K Pamarthi, N.T Bhutia and D.R Singh. Orchids Species of East Sikkim and their Conservation. **In:**8th Indian Horticulture Congress-2019 Shaping Future of Indian Horticulture, Indra Gandhi Krishi VishwaVidyalaya, Raipur, Chhattisgarh 17-21 Jan, 2019

- Rai Deepak, R.K Pamarthi, N.T Bhutia and D.R Singh. ITK aspects of Farm Produces by Farming Community in Sikkim. **In:** “9<sup>th</sup> NEE Congress-2018 on Smart Agriculture Technology Innovations and Intervention” Organized by Society of Extension Education, Agra in collaboration with Central Agricultural University, Imphal, Manipur 15-17 Nov, 2018 at CAEPHT, Ranipool, Sikkim.
- Rampal. **In:** Orchid Wealth of India: Challenges in conservation and sustainable utilisation National Conference on Ornamental Horticulture to Uplift Rural Economy, 11-13 Jan, 2019 Udaipur, Rajasthan.
- Satpute, G.K., M. Arya, S. Gupta, V.S. Bhatia, R. Devadas, M.B. Ratnaparkhe, G. Kumawat, M. Singh. Root system architecture for improvement of moisture deficit stress tolerance traits in Soybean (*Glycine max* L Merrill.). Extended Summaries, **In:** National Conference on Oilseeds (NCOS2018) - Enhancing Productivity of Oilseeds in Changing Climate Scenario, 7-9 April, 2018, ICAR-DGR, Junagadh 362001, Gujarat, India. pp 8-9.
- Satpute, G.K., S. Gupta, V.S. Bhatia, R. Devadas, G. Kumawat, V.K. Tiwari, J.P. Purwar, A. Agrawal. Multi-Tiered Selection Scheme for Breeding Drought Tolerance in Soybean. **In:** Golden Jubilee Int. Salinity Conf. (GJISC-2019) on Resilient Agriculture in Saline Environments under Changing Climate: Challenges & Opportunities, Organized by ISSSWQ, ICAR-CSSRI, Karnal and ICAR, New Delhi (7-9 Jan, 19) at Karnal, Haryana, India. pp 127
- Satpute, G.K., S. Gupta, V.S. Bhatia, M. Arya, M. Singh, R. Devadas, S. Pandey, S. Nagar, S. Chandra, V.G. Kamble, G. Kumawat, M. Ratnaparkhe. Fine-tuning the average root angle modulating the constitutive root system architecture for improved productivity under drought in Soybean. **In:** 4<sup>th</sup> International Plant Physiology Congress during 2-5 Dec, 2018, CSIR-National Botanical Research Institute, Lucknow, India. pp 160
- Sherpa. R., R. Devadas, P. Suprasanna and P.R. Kishore. Effect of Gamma Radiation on asymbiotic seed germination of scented orchid *Zygopetalum maculatum*. **In:** International Conference on Climate change, biodiversity and sustainable agriculture (ICCBSA-2018) 13-16 Dec, 2018, Jorhat, Assam.

# Distinguished Visitors

## Visit of Parliament Standing Committee

A twelve member team Parliamentary Standing Committee on Agriculture under the Chairmanship of Shri Hukmdev Narayan Yadav visited ICAR NRC for Orchids, Pakyong on 16<sup>th</sup> April, 2018.



## Visit of Shri Giriraj Singh, Hon'ble Minister of State, MSME, Govt. of India

Shri Giriraj Singh, Hon'ble Minister of State, MSME, Govt. of India visited ICAR NRC for Orchids, Pakyong on 25<sup>th</sup> April, 2018.



## Visit of Shri Pinso Chopel Lepcha, MLA, Gangtok

Shri. Pintso Chopel Lepcha, MLA Gangtok (Govt. of Sikkim) visited ICAR- NRC for Orchids, Pakyong on 25<sup>th</sup> June, 2018.

## Visit of Director Personnel, ICAR, New Delhi

Director Personal Sh. Sujit Kumar Mittra,

ICAR, New Delhi visited ICAR - NRC for Orchids, Pakyong, Sikkim on 20<sup>th</sup> Aug, 2018.

## Visit of Shri Satpal Ji Maharaj, Hon'ble Minister, Watershed, Tourism & Irrigation Govt. of Uttarakhand

Shri Satpal Ji Maharaj, Hon'ble Minister, Watershed, Tourism & Irrigation Govt. of Uttarakhand visited ICAR – NRC for Orchids, Pakyong, Sikkim along with other 14 Officials on 4<sup>th</sup>Sept, 2018.



## Visit of Agriculture Skill Council of India members

Chairman and other 11 members of Agriculture Skill Council of India visited ICAR NRC for Orchids, Pakyong on 1<sup>st</sup> September, 2018.

## Visit of Hon'ble Minister of State for Tribal Affairs, Govt. of India

The Hon'ble Minister of State for Tribal Affairs' Shri Jaswantsinh Bhabor, Government of India visits the ICAR-National Research Centre for Orchids, Pakyong - Sikkim along with officials from the Government of Sikkim on 26<sup>th</sup> October' 2018.

## Visit of Hon'ble Minister of State for Tourism, Govt. of India

The Hon'ble Minister of State for Tourism, Govt. of India, Shri K. J. Alphons visited ICAR

NRC for Orchids, Pakyong on 28<sup>th</sup> January, 2019.

### Visit of Hon'ble Governor of Sikkim, Shri Ganga Prasad

Hon'ble Governor of Sikkim, Shri Ganga Prasad visited ICAR-NRCO, Pakyong on 28<sup>th</sup> March, 2019. On behalf of the Institute, Dr. D. R. Singh, Director ICAR- NRC (O) Pakyong welcomed the Governor of Sikkim, Shri Ganga Prasad and the dignitaries and delegates from various Departments and Institutions by offering khadas, bouquet & Mementos. On this occasion a felicitation programme for progressive farmers and Official Staff was organised by ICAR-NRCO, Pakyong. Hon'ble Governor of Sikkim, Shri Ganga Prasad Ji was the Chief Guest of the function, Sh. Khorlo Bhutia, Secretary (H&CCDD) Govt. of Sikkim as Guest of Honour, Smt. D. Lamu, Pr. Director H & CCDD) Dr. S.K. Sharma, Dean (Hort.) CAEPHT Ranipool and Sh. Ramtanu Saha, Director, Airport Authority of India, Pakyong as Special Guests. Dr. D. R. Singh, Director ICAR- NRC (O) on his welcome speech, highlighted the various achievements and progress work done by the institute in the field of Research and Extension. He also focus light on the opportunities and schemes introduce

and their implementations by ICAR NRC (O) for Doubling Farmers Income and the scope of Organic Agriculture in Sikkim. Sh. Khorlo Bhutia, Secretary (H&CCDD) Govt. of Sikkim appreciated the efforts done by ICAR NRC (O) Pakyong in the field of Research and Extension technologies for doubling farmers income and also explained the Organic mission and horticulture scenario of Sikkim. Dr. S.K. Sharma, Dean (Hort.) CAEPHT Ranipool congratulated for the achievement and success achieved by ICAR-NRC (O) in various intuitional research as well as field activities. Ten (10) Progressive farmers from East and 30 from West Sikkim were also participated on the programme. Five Progressive farmers nominated by State and 5 Progressive farmers nominated by ICAR –NRC (O) from East and West Sikkim were Awarded by Hon'ble Governor of Sikkim, for their outstanding contribution in cultivation Orchid and other Seasonal flowers. Hon'ble Governor of Sikkim also presented the Awards to 4 Staff of ICAR-NRC (O) Pakyong for their outstanding contribution in Research, Technical and Supporting activities of the Institute and also appreciated and congratulate for their efforts. Hon'ble Governor of Sikkim also visited all farms of the institute.





# Important Programmes organized, attended and facilitated by the Director

- Attended meeting with Secretary, Horticulture, Govt. of Sikkim regarding MoU between ICAR- NRC for Orchids and Dept. of Horticulture, Govt. of Sikkim on 2<sup>nd</sup> April, 2018.
- Facilitated the visit of Hon'ble Parliament Committee on Agriculture at ICAR-NRC for Orchids on 16<sup>th</sup> April, 2018.
- Facilitated & conducted the meeting with MSME, Gangtok at ICAR-NRC for Orchids on 23<sup>rd</sup> April, 2018.
- Facilitated & organized the visit of Hon'ble MoS, MSME at ICAR-NRC for Orchids on 25<sup>th</sup> April, 2018.
- Facilitated the visit of DG, CPWD, New Delhi at ICAR-NRC for Orchids on 27<sup>th</sup> April, 2018.
- As Chief Guest addressed the farmers of South Sikkim for their Doubling the Income by 2022 held on 30<sup>th</sup> April, 2018.
- Facilitated the visit of Students & Faculties of Agriculture Institute, Allahabad and Students from NEHU, Shillong on 3<sup>rd</sup> May, 2018.
- Attended the Meeting with Dept. of Agriculture & Horticulture, Govt. of Sikkim at Gangtok on 7<sup>th</sup> May, 2018.
- Chairman in IRC meeting at ICAR-NRC for Orchids on 08<sup>th</sup> May, 2018.
- Facilitated & conducted the Interview for Project Fellows of NMHS Project at ICAR-NRC for Orchids on 09<sup>th</sup> May, 2018.
- Attended Regional Committee Meeting at Barapani, Shillong on 11<sup>th</sup> May, 2018.
- Facilitated the planting of sampling of Arecanut at farm of Hon'ble Minister of Agriculture, Govt. of Sikkim on 18<sup>th</sup> May, 2018.
- Chief Guest in Valedictory Functions of Training Programs on Orchid Cultivation for Officials of J&K at ICAR-NRC for Orchids on 18<sup>th</sup> May, 2018.
- Facilitated the visit of II<sup>nd</sup> batch of Agriculture Officials of J&K at ICAR-NRC for Orchids on 21<sup>st</sup> May, 2018.
- Co-chairman in Technical Session during National Conference on Intensification and Diversification in Agriculture for Livelihood and Rural Development held during 27-31<sup>st</sup> May, 2018 at RPCAU, Samastipur, Bihar.
- Member in Poster Evaluation Committee during National Conference on Intensification and Diversification in Agriculture for Livelihood and Rural Development held during 27-31<sup>st</sup> May, 2018 at RPCAU, Samastipur, Bihar.
- Delivered a keynote address during National Conference on Intensification and Diversification in Agriculture for Livelihood and Rural Development at RPCAU, Samastipur, Bihar on 29<sup>th</sup> May, 2018.
- Visited ICAR-NRC for Litchi, Muzaffarpur, Bihar on 28<sup>th</sup> May, 2018
- Participated in Kisan Ghosti at National Conference on Intensification and Diversification in Agriculture for Livelihood and Rural Development at RPCAU, Samastipur, Bihar on 30<sup>th</sup> May, 2018.
- Attended the Meeting with Officials of Dept. of Agriculture, Govt. of Sikkim at Gangtok on 2<sup>nd</sup> June, 2018.
- External Expert Member in comprehensive Viva-Voce for PG students of Nagaland University at Medziphema, Nagaland on 4-5<sup>th</sup> June, 2018.

- Attended meeting with Chief Secretary, Govt. of Sikkim regarding the proposed visit of Hon'ble Vice-President of India at Secretariat, Gangtok on 7<sup>th</sup> June, 2018.
- Attended meeting with Hon'ble Governor of Sikkim regarding the proposed visit of Hon'ble Vice-President of India at Raj Bhawan on 9<sup>th</sup> June, 2018.
- Facilitated the visit of CVO, ICAR on 15<sup>th</sup> June, 2018.
- Facilitated the visit of MLA, Gangtok on 25<sup>th</sup> June, 2018.
- Attended the meeting with Secretary, DoPT, Govt. of India and Chief-Secretary, Govt. of Sikkim at Gangtok on 27<sup>th</sup> June 2018.
- Chairman in IRC meeting at ICAR-NRC for Orchids for new projects on 1<sup>st</sup> July, 2018.
- Facilitated the visit of Chairman, PPVV&FRA, New Delhi at ICAR-NRC for Orchids on 05<sup>th</sup> July, 2018.
- Attended Director's Conference at NASC, New Delhi on 16<sup>th</sup> July, 2018.
- Attended the Meeting with DG (ICAR) & DDG(HS) at NASC, New Delhi on 17<sup>th</sup> July, 2018.
- Attended the Meeting in SMD, Horticulture at KAB-II, Pusa, New Delhi on 18<sup>th</sup> July, 2018.
- Attended the Meeting with DG, ICAR at Krishi Bhawan, New Delhi on 19<sup>th</sup> July, 2018.
- Attended the Meeting with Director, ICAR-IIHR, Bengaluru at ICAR-IIHR, Hessargatta, Bengaluru on 21-22<sup>nd</sup> July 2018.
- Guest of Honour in the meeting on the occasion of Guru Purnima at Kalyan Asharam, Ranipool, Sikkim on 27<sup>th</sup> July, 2018.
- Facilitated the Visit of Agricultural Officials, ATMA, Nagaland at ICAR-NRC for Orchids on 1<sup>st</sup> August, 2018.
- Attended National Conference on Indian Science History & Historiography at Sikkim University, Tadong, Sikkim on 2<sup>nd</sup> August, 2018.
- Attended Gyan Bharati Program at Regional Station, AYUSH, Tadong on 2<sup>nd</sup> August, 2018.
- Chief Guest in Meeting with Orchid Growers Associations at Mirik, Darjeeling, W.B. on 06<sup>th</sup> August, 2018.
- Attended the Meeting with Secretary, Horticulture, Govt. of Sikkim to Finalize the MoU on 07<sup>th</sup> August, 2018.
- MoU Signed with Dept. of Horticulture, Govt. of Sikkim on 16<sup>th</sup> August, 2018.
- Facilitated the visit of Director (P), ICAR, New Delhi at ICAR-NRC for Orchids on 20<sup>th</sup> August, 2018.
- Facilitated the visit of Officials, ASCI & CII, New Delhi at ICAR-NRC for Orchids on 01<sup>st</sup> September, 2018.
- Attended Program at ICAR-NAARM, Hyderabad on 03-05<sup>th</sup> September, 2018.
- Attended the Meeting with Hon'ble Governor, Govt. of Sikkim at Raj Bhawan, Gangtok, Sikkim on 07<sup>th</sup> September, 2018.
- Facilitated the visit of Farmers & Officials of KVK, Bharuch, Gujarat at ICAR-NRC for Orchids, on 19<sup>th</sup> September, 2018.
- Organized the Coverage of our Institute activities by Door Darshan, New Delhi on 23<sup>rd</sup> September, 2018.
- Attended Inaugural Function of Greenfield Airport, Pakyong by Hon'ble Prime Minister of India on 24<sup>th</sup> September, 2018.
- Facilitated & Conducted the Interview for Project Fellows of NMHS Project at ICAR-NRC for Orchids on 25<sup>th</sup> September, 2018.
- Organized Swachhta Program at ICAR-NRC for Orchids on 02<sup>nd</sup> October, 2018.
- Facilitated the visit of Students from Allahabad and farmers from Karnataka at ICAR-NRC for Orchids on 03<sup>rd</sup> October, 2018.
- Facilitated the visit of Farmers from Andhra Pradesh at ICAR-NRC for Orchids on 12<sup>th</sup> October, 2018.

- Facilitated the visits of Scientist from ICAR-NBAIR, Bangalore at ICAR-NRC for Orchids on 23<sup>rd</sup> October, 2018.
- Facilitated the visit of Hon'ble MoS, Tribal Affairs, Govt. of India at ICAR-NRC for Orchids on 26<sup>th</sup> October, 2018.
- Received Fellow Award, 2017, Society for Upliftment of Rural Economy, at BIT Patna, Bihar on 30<sup>th</sup> October, 2018.
- Chairman in Technical Session on Horticulture during International Conference on Rural livelihood improvement for enhancing farmers' income through sustainable Innovative Agri and allied enterprises at BIT Patna, Bihar on 30<sup>th</sup> Oct, 2018 to 01<sup>st</sup> Nov, 2018
- Guest of Honour in the Inaugural Function of 9<sup>th</sup> National Extension *Education Congress-2018* on Climate Smart Agricultural Technologies: Innovations and Interventions at CAU, Gangtok, Sikkim on 16<sup>th</sup> November, 2018.
- Chairman in Technical Session during 9<sup>th</sup> National Extension *Education Congress - 2018* on Climate Smart Agricultural Technologies: Innovations and Interventions held on 16<sup>th</sup> November, 2018 at CAU, Gangtok, Sikkim.
- Co-Chairman of the National Organizing Committee of the 9<sup>th</sup> National Extension *Education Congress-2018* on Climate Smart Agricultural Technologies: Innovations and Interventions at College of Agricultural Engineering and Post Harvest Technology, CAU, Ranipool, Sikkim. on 15-17<sup>th</sup> November, 2018
- Guest of Honour in the Valedictory Function of 9<sup>th</sup> National Extension *Education Congress-2018* on Climate Smart Agricultural Technologies: Innovations and Interventions at CAU, Gangtok, Sikkim on 17<sup>th</sup> November, 2018.
- Received SEE Fellow Award by Hon'ble Governor of Sikkim in the Valedictory Function of 9<sup>th</sup> National Extension *Education Congress - 2018* on Climate Smart Agricultural Technologies: Innovations and Interventions at CAU, Gangtok, Sikkim on 17<sup>th</sup> November, 2018.
- Facilitated the visit of Students from BCKV, Kalyani, Kolkata and Farmers from Haryana at ICAR-NRC for Orchids on 17<sup>th</sup> November, 2018.
- Organized One Day Computer Training Program to Supporting Staff at ICAR-NRC for Orchids on 19<sup>th</sup> November, 2018.
- Attended & Presented the Activities of ICAR-NRC for Orchids at Parliament Committee on Commerce held at May-Fair Hotel, Gangtok on 20<sup>th</sup> November, 2018.
- Co-chairman in Technical Session during National Conference on "Revisiting agricultural research and monitoring system for developing innovations: To meet the newer challenges" at ICAR-Central Institute of Women in Agriculture, Bhubaneswar, Odisha on 24<sup>th</sup> November, 2018
- Conducted DPC for four of our Employees at ICAR-NRC for Orchids on 01<sup>st</sup> December, 2018.
- Organized Agricultural Education Day at ICAR-NRC for Orchids on 03<sup>rd</sup> December, 2018.
- Organized World Soil Health Day at ICAR-NRC for Orchids on 05<sup>th</sup> December, 2018.
- Attended Training Program at NID, Bangalore on 12-15<sup>th</sup> December, 2018.
- Attended Meeting at Krishi Bhawan, Gangtok on 21<sup>st</sup> December, 2018.
- Attended function at Kalyan Asharm, Ranipool, Sikkim on 27<sup>th</sup> December, 2018.
- Organized Swachta Pakhwada at ICAR-NRC for Orchids from 16-31<sup>st</sup> December, 2018.
- Attended the Meeting with Secretary, Agriculture & Secretary Horticulture at Krishi Bhawan on 02<sup>nd</sup> January, 2019.

- Visited ICAR-CPCRI, Mohitnagar, Jalpaiguri, West Bengal on 05<sup>th</sup> January, 2019
- Visited Farmers Field, Geyzing, West Sikkim on 10<sup>th</sup> January, 2019
- Attended Horticulture Congress at IGAU, Raipur, Chhattisgarh, from 16-17<sup>th</sup> January, 2019.
- Organized Orchids Exhibition at Secretariat, Manan Bhawan, Gangtok on 18<sup>th</sup> January, 2019.
- Facilitated Trainees from CAEPHT, Ranipool, Sikkim at ICAR-NRC for Orchids on 22<sup>nd</sup> January, 2019.
- Visited Orchid Growers, Pokhriabong Darjeeling on 24<sup>th</sup> January, 2019.
- Facilitated the Visit of Hon'ble MoS, Tourism, Govt. of India at ICAR-NRC for Orchids on 28<sup>th</sup> January, 2019.
- Attended Director's Conference at NASC, New Delhi from 31<sup>st</sup> January to 01<sup>st</sup> February, 2019.
- Attended Meeting with Chief Secretary, Govt. of Sikkim at Gangtok on 13<sup>th</sup> February, 2019.
- Attended the Meeting with Hon'ble Governor at Raj Bhawan, Gangtok on 14<sup>th</sup> February, 2019.
- Organized Orchid Exhibition Inaugurated by DDG (HS), ICAR, New Delhi at ICAR-NRC for Orchids on 25<sup>th</sup> February, 2019.
- Organized Workshop on Biodiversity & Sustainable Agriculture for Doubling Farmers Income by 2022 Inaugurated by Chief Secretary, Govt. of Sikkim at ICAR-NRC for Orchids on 25<sup>th</sup> February, 2019.
- Visited Farmer's Field at Somaria, Darjeeling, West Bengal on 28<sup>th</sup> February 2019.
- Attended Meeting with Hon'ble Governor of Sikkim at Raj Bhawan, Gangtok on 07<sup>th</sup> March, 2019.
- Facilitated Women's Day Celebration at ICAR-NRC for Orchids on 08<sup>th</sup> March, 2019.
- Facilitated the visit of Farmers and Officials from Andaman & Nicobar Islands at ICAR-NRC for Orchids on 14<sup>th</sup> March, 2019.
- Guest of Honour in IRC, Indian Cardamom Research Centre, Tadong at Hotel Mount Siniolchu, VIP Road Gangtok on 20<sup>th</sup> March, 2019.
- Co-chairman in Technical Session during National Seminar - cum -Interactive Workshop on Noni and Medicinal Plants in Human Wellness on 22<sup>nd</sup> March, 2019 at University of Madras, Chennai, Tamil Nadu.
- Facilitated the visit of Farmers from Kalimpong, West Bengal at ICAR-NRC for Orchids on 26<sup>th</sup> March, 2019.
- Chief Guest in Hindi Program at Regional Station, AYUSH, Tadong on 26<sup>th</sup> March, 2019.
- Organized & Facilitated the Visit of Hon'ble Governor of Sikkim at ICAR-NRC for Orchids on 28<sup>th</sup> March, 2019.

# Personalia

## **Director**

Dr. D. R. Singh

## **Scientific Staff**

Dr. L. C. De, Principal Scientist (Horticulture)

Dr. Ram Pal, Principal Scientist (Horticulture)

Dr. R. Devadas, Principal Scientist (Plant Breeding)

Dr. T. L. Bhutia, Scientist (Vegetable Science)

Sh. R. K. Pamarthi, Scientist (Economic Botany & Plant Genetic Resources)

Dr. B. P. Mallikarjuna, Scientist (Genetics & Plant Breeding)

Sh. S. S. Biswas, Scientist (Soil Science)

## **Technical Staff**

Ms. T.C. Bhutia, Sr. Technical Assistant (Horticulture)

Sh. Ankur Tomar, Technical Assistant (Computers)

Sh. Ajay Bushal, Sr. Technician (Farm)

Sh. Manoj Adhikari, Sr. Technician (Farm)

Ms. Meena Kumari Chettri, Sr. Technician

## **Workshop Staff**

Sh. Ram Chandra Gurung, Sr. Technical Assistant

Sh. Deepak Khattri, Sr. Technician

## **Administrative Staff**

Sh. Rajat Das, Assistant Finance and Account's Officer

Sh. Arvind Chauhaan, Assistant

Mrs. Diki Bhutia, Assistant

Sh. Phigu Tshering Bhutia, Jr. Clerk

Mrs. Sangeeta Lepcha, Jr. Clerk

## **Personal Assistant to Director**

Mrs. W. Stella Sasa

**Skilled Support Staff**

Sh. Dawa Bhutia  
 Sh. Tularam Dulal  
 Sh. Trilok Singh Balmiki  
 Sh. Arjun Gurung  
 Mrs. Rabin Kala Subba  
 Sh. Rabin Raj Subba

**New Joining/Transfers/Promotion/Study leave/Retirement****New Joining****Scientist**

Dr. T.L. Bhutia (Vegetable Science) w.e.f 27.06.2018  
 Dr. B.P. Mallikarjuna (Genetics & Plant Breeding) w.e.f 10.10.2018  
 Sh. S.S. Biswas (Soil Science) w.e.f. 10.10.2018

**Technical**

Sh. Ankur Tomar, Technical Assistant (Computer) w.e.f 26.09.2018

**Promotions****Technical**

Sh Deepak Khattri, Sr. Technician to Technical Assistant w.e.f. 27.11.2017  
 Sh R C Gurung, Sr. Technical Assistant to Technical Officer w.e.f 05.05.2018  
 Ms. T.C. Bhutia, Technical Assistant to Sr. Technical Assistant w.e.f 28.02.2019

**Administration**

Mrs. Diki Bhutia, UDC to Assistant w.e.f 02.12.2018

**Transfers**

Sh. Raj Kumar, Scientist (Floriculture & Landscaping) transferred to ICAR-CPRI, Shimla w.e.f 30.06.2018  
 Dr. N. Sailo, Scientist (Plant Physiology) transferred to ICAR-CPRI, Shimla RS Shillong w.e.f 06.07.2018

**Study Leave**

Ms. T.C. Bhutia, Sr Technical Assistant for six month PhD programme at Sikkim University, Sikkim w.e.f 02.09.2018.

**Retirements**

Dr. Syamali Chakrabarti, Principal Scientist (Genetics) w.e.f 30.09.2018  
 Smt. Sita Devi Chettri, TSM w.e.f 31.08.2018

# Research Advisories and Institute Committees

## Research Advisory Committee

Name	Designation	Assignment
Dr. Brahma Singh	Ex-Director, DRDO, New Delhi	Chairman
Dr Janaki Ram	ADG, Horticulture Sci.-I, ICAR, New Delhi	Member
Dr S Rama Rao	Professor, NEHU, Shillong	Member
Dr A N Maurya	Ex-Director/IAS, BHU, Varanasi	Member
Dr S N Hegde	Ex-Director, SFRI, Tappi, Arunachal Pradesh	Member
Dr D K Agarwal	Head, BSI, Gangtok	Member
Shri Pempa Sherpa	Progressive farmer (Nominated by IMC)	Member
Dr D R Singh	Director, ICAR NRCO, Pakyong	Member
Dr Ram Pal	Principal Scientist, Hort. ICAR NRCO, Darjeeling Campus	Member Secretary

## Women Welfare Committee

Name	Designation	Assignment
Dr. T.L. Bhutia	Scientist (Vegetable Science)	Chairman
Mrs. W. Stella Sasa	Personal Assistant	Member
Mrs Diki Bhutia	UDC	Member
Ms. T. Chomu Bhutia	Tech. Assistant	Member
Ms. Meena K. Chettri	Sr. Technician	Member
Mrs. Sangita Lepcha	LDC	Member
Mrs Rabin Kala Subba	SSS	Member Secretary

## Works Committee

Name	Designation	Assignment
Dr. L C De	Principal Scientist, Horti.	Chairman
Sh. Kailash Sharma	Engineer, Building & Housing Dept., Govt of Sikkim	Member
Sh. Ravi Kishore Pamarthi	Scientist (Economic Botany & PGR)	Member
Estate Officer	-	Member
Mr. Rajat Kumar Das	AF & AO	Member
Mr. Ajay Bhusal	Sr. Technician (Farm/Field)	Member
Administrative Officer I/c	-	Member Secretary

### Vigilance Officer

Name	Designation	Assignment
Dr. Ram Pal	Principal Scientist, Horti.	Incharge

### Official Language Committee

Name	Designation	Assignment
Dr. D.R. Singh	Director ICAR-NR C for Orchids, Pakyong	Chairman
Dr. L C De	Principal Scientist, Horti.	Member
Sh. Ravi Kishore Pamarthi	Scientist (Economic Botany & PGR)	Member
Mr. Rajat Kumar Das	AF & AO	Member
Ms T.Chomu Bhutia	Tech Assistant	Member
Sh. Arvind Chauhaan	Assistant	Member Secretary

### Purchase Advisory Committee

Name	Designation	Assignment
Dr. L C De	Principal Scientist, Horti.	Chairman
Dr. S. Manivannan	Associate Professor, Sikkim University	Member (Outside)
Sh. Ravi Kishore Pamarthi	Scientist (Economic Botany & PGR)	Member
Mr. Rajat Kumar Das	AF & AO	Member
Administrative Officer I/c	-	Member Secretary







**Digital India**  
Power To Empower



भारत  
ICAR



हर कदम, हर डगर  
किसानों का हमसफर  
भारतीय कृषि अनुसंधान परिषद

*AgriSearch with a human touch*