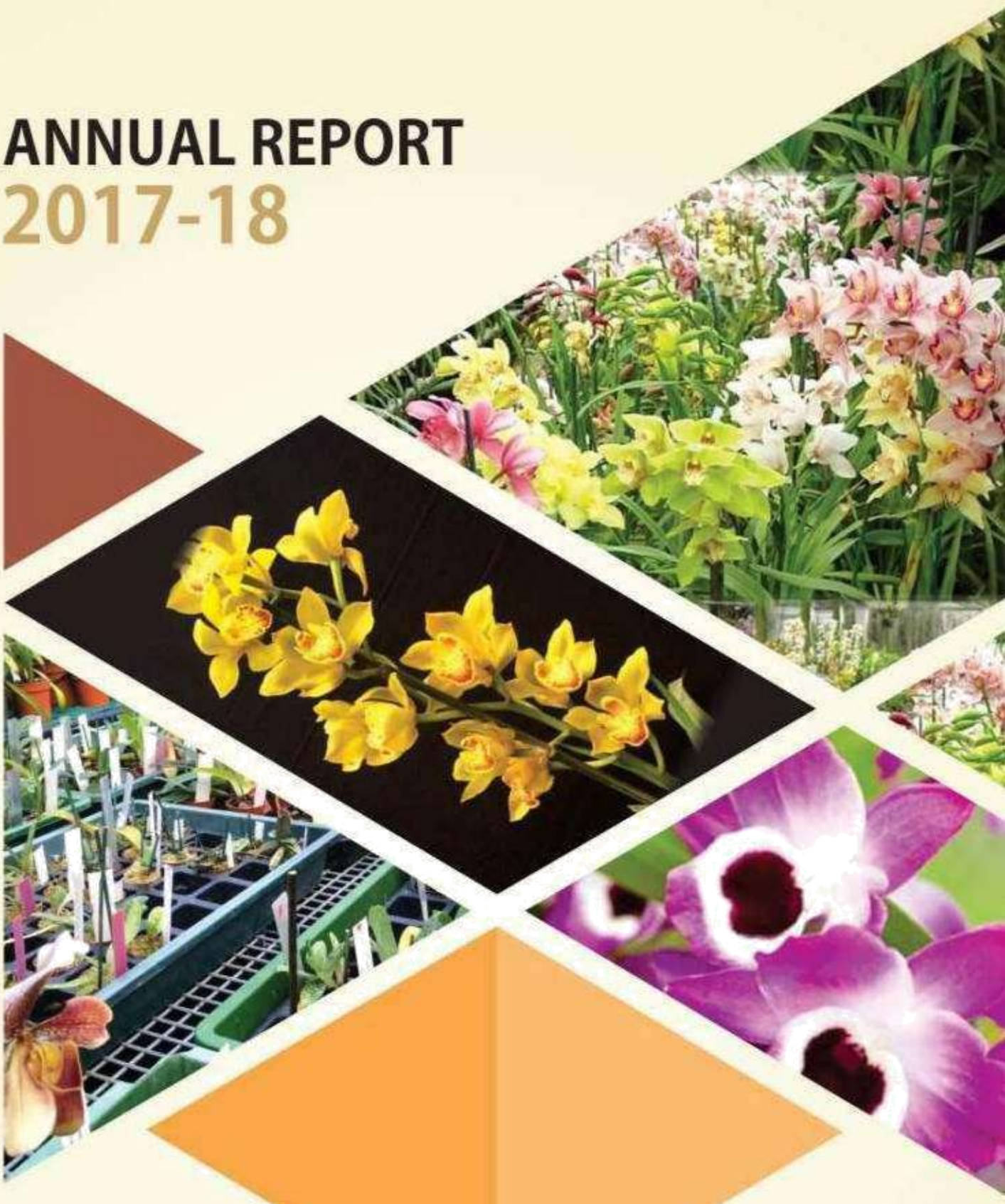
ANNUAL REPORT
2017-18



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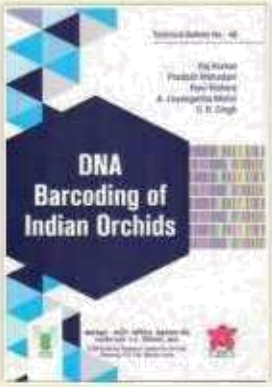

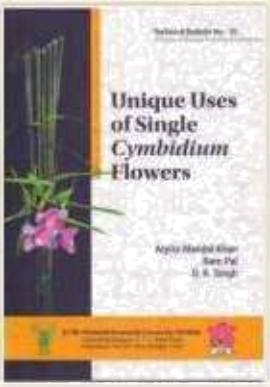

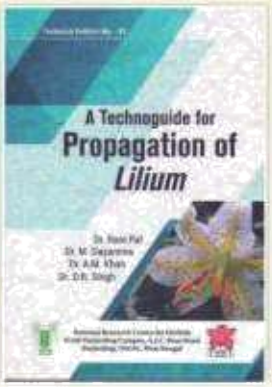

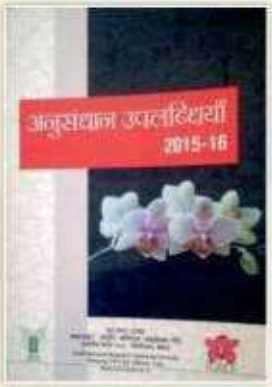

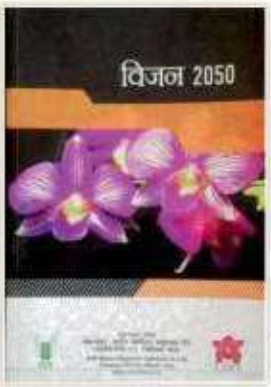

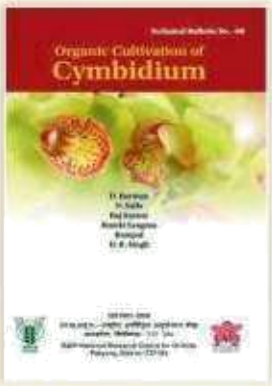

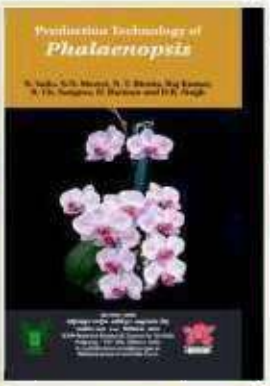

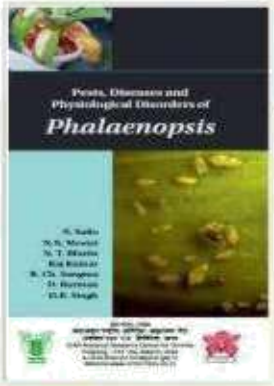

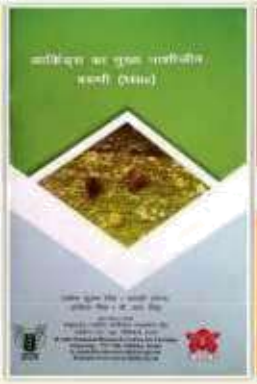

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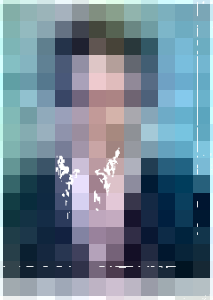

PREFACE

I am delighted to present the Annual Report 2017-18 of ICAR- National Research Centre for Orchids, Pakyong, Sikkim. To meet the requirement of orchid and its products, it is necessary to develop novel technological innovations which are able to engender high quality produce under challenging environment of hill regions. Ever since its inception, ICAR-NRC for Orchids, Sikkim is dedicated to serve the orchid growers by developing innovative technologies and package of practices for communal cultivation of orchids under prevalent conditions, production of quality planting materials and post-harvest management and value addition of the orchids to contain the economic losses. Biological diversity is the variability among all living organisms existing on earth in various ecosystems and ecological complexes. Orchids are one such beautiful creation of nature and represent royalty and aristocracy in loriculture. hey are well known for their uniqueness of shape, size, breath taking colours, and exceptionally long shelf life that surpasses many other loriculture crops. hese qualities have made orchid growing a highly proitable industry all over the world. A large number of species bear attractive lowers and have capacity for interspeciic as well as intergeneric hybridization that has generated tremendous possibilities for producing hybrids of diverse loral characteristics. India is one of the primary/secondary centres of orchid biodiversity and the major regions of diversity are Northeastern Himalayas, Western Ghats and Andaman and Nicobar Islands. Indian orchids have also been used in various indigenous systems of medicines since time immemorial. Whereas, the systematic collection and conservation of orchids for value addition through crossing and selection has started very recently in our country. Today, more than 200,000 hybrids are known globally and cultivated for cut lowers and potted plants and more and more new ones are being registered every month. Orchids have very wide range of distribution in India and have been recorded from low-level plains to an elevation of 4300 m. Orchids are the most evolved family of monocotyledonous plants and is represented by nearly 25,000-35,000 species belonging to 1000 genera. Nearly 1300 species of orchids are found in India distributed in diferent parts of the country.

he present report gives a glance of 4 mega projects and 6 externally funded projects, novel methodologies concept developed viz., orchid conservation through vertical farming, orchid based farming system for optimum utilization of space and getting round the year farm income with vegetable cultivation taken as pilot projects for doubling the farmers' income. Utilization of orchid waste into the value added products were the novel concept popularized during the period 2017-18. Various programme under Tribal Sub Plan, KSHAMATA, Unnat Bharat Abhiyan, Mera Gaon Mera Gaurav, Swachh Bharat Abhiyan and Trainings and Demonstrations to farmers/ oicials were also well adopted. Besides the above, a National Conference on Floriculture for Rural and Urban Prosperity in the Scenario of Climate Change was organized during February, 2018. Transfer of the technologies and scientiic information, human resource development, linkages fostered with various stakeholders of NARS and other

Research organizations. I would like to place on record of my admiration for the eforts of all the members of the Institute Research Committee, Research Advisory Committee who have discussed all the research activities exhaustibly and came forward meticulously formulated plan of action within the stipulated time. During the period, institute faced acute shortage of scientiic manpower due to which many activities were not completed on time.

I am abundantly blessed to have erudite guidance and perpetual support of Dr. Trilochan Mohapatra, Hon'ble Secretary, DARE and Director General, ICAR in accomplishing the mandate and carrying forward the vision of the Institute. I also express my gratitude to Dr. A. K. Singh, Hon'ble Deputy Director General (Horticultural Science) and Dr. T. Janakiram, Assistant Director General (HS-I) for their critical remarks, worthy suggestions, constant encouragement and guidance to meet the research, extension and physical targets of the institute during 2017-18. All the scientists, technical, administrative and other staf of our orchid family, farmers, support from Department of Horticulture, Govt. of Sikkim, Chairman and members of QRT, RAC and IM Care duly acknowledged for their untiring cooperation, coordination, compilation of information and inally bringing out of this document.

Place – Pakyong, Sikkim
Date – 29.06.2018

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

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Executive Summary

- Morphological characterization of 43 rare species was completed, which includes *Dendrobium ruckerii, Dendrobium hookerianum, Bulbophlum gymnopus, Hyrpysma longicaulis, Bulbophyllum paramjitii, Vanda coerulea*, *Renanthera imschootiana* etc.
- Habitat study of *Diplomeris hirsuta* was done at Assam Lingzey, Sikkim and Sevoke, West Bengal.
- Molecular variability for early and late lowering in *Liparis bootanensis* Grif was done by using the ISSR primers.
- Molecular characterization of ×interspeciic hybrids; *Coelogyne corymbosa* × *Coelogyne nitida* and *Coelogyne laccida Coelogyne*
- Characterized promising Vanda breeding lines *viz.*, PBX-12-169/01 and PBX-12-169/02; late lowering Phalaenopsis breeding lines *viz.*, PBX-12-99/6 and PBX-12-99/7 and early breeding line of Cymbidium PBX-05-29/47.
- Paphiopedilum× progenies like Pl × Pw/05, Pl Pw/08, PlxPw/33 and PlxPw/28 for special*cristata*wasdonebyusingISSRprimers.
- Gamma radiated mutant plants generated at lower doses in 'Emma White' (Dendrobium).
- In *Zygopetalum intermedium*, the media comprising of Cocochips + Cocopeat +Brick Pieces +Cowdung found suitable for the vegetative growth.characterscharacterized.
- Spray of liquid manure in the ratio of 1:10 found suitable for vegetative as well as lower characters in Cymbidium.
- he efect of bark of 10 trees studied as potting media for vegetative and lowering parameters in diferent orchids.
- In Chettalli, Karnataka, efect of diferent concentrations of in-organic nutrients studied in Dendrobium cv. 'Singapore White'. Foliar spray of 10:20:10 NPK @ 0.1% at weekly intervals produced the maximum number of spikes/plant (6.22) and the spikes recorded a vase life of ten days in tap water.
- In *Zygopetalum intermedium*, application of half strength of Hoagland Solution improved the spike length (57.56 cm) and spike longevity (51.8 days) of plants grown in perlite medium.
- he application of micro-nutrients in *Dendrobium nobile* studied for lowering and vegetative characters.
- Embedded drying with borax and silica gel at 50-60°C in oven found suitable for drying of orchid species and hybrids.
- Extension activities and on-campus & of-campus training programs were conducted under MGMG program at the adopted villages.

Introduction

The National Research Centre for Orchids was established on 5th October 1996 by the Indian Council of Agricultural Research (ICAR), New Delhi to organize research programme on improvement in productivity, quality and commercialization of orchids. he 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 loriculture in the country, the centre has modiied 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 modiied 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 of ICAR-NRC Orchids

Staff Position (2017-18)

Category Wise

Category	Sanctioned	In position	Vacant
RMP	01	01	00
Scientiic	14	07	07
Technical	07	06	01
Administrative	10	06	03*
Skilled Supporting	07	06	01
Total	**39**	**26**	**12**

(*) 01 AAO post abolished w.e.f. 01/03/2016

Budget (2017-18)

Rs. In Lakh

Head	BE 2017-18	RE 2017-18	Fund Utilized	(%) Fund Utilized
Salary	299.00	268.00	267.78	99.92%
Other than salary	360.00	110.00	95.53	86.85 %
Total	**659.00**	**378.00**	**363.31**	

Detail of Research Projects

Sl. No	Project Name	Funding Agency	PIs & Co-PIs
	Institute Projects		
1	Conservation, characterization and sustainable use of diversity in Orchids	ICAR	Dr. Rampal - PI Dr. D.R. Singh Dr. L. C. De Dr. S. Chakrabarti Dr. R. G. Devadas Dr. N. Sailo Mr. Raj Kumar Mr. R.K. Pamarthi
2	Genetic Improvement of Orchids for Yield, Quality and Resistance to Biotic and Abiotic Stresses	ICAR	Dr. R. G. Devadas - PI Mr. Raj Kumar
3	Development and reinement of production and protection technologies for improved productivity, marketing and utilization of orchids	ICAR	Dr. L. C. De - PI Dr. D.R. Singh Dr. Rampal Dr. N. Sailo Mr. Raj Kumar

Sl. No	Project Name	Funding Agency	PIs & Co-PIs
4	Improvement of knowledge and skill of stakeholders for improving production of orchids	ICAR	Dr. L. C. De -PI Dr. D.R. Singh Dr. Rampal Dr. R. G. Devadas Dr. N. Sailo Mr. Raj Kumar Mr. R.K. Pamarthi
	External Funded Project		
1	Breeding of Selected Orchids for Cut Flower 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. *Cost. of Project : 6.50 Lakhs*	PPV&FRA	Dr. L. C. De - PI Dr. D.R. Singh Dr. R. G. Devadas
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). *Cost. of Project : 28.08 Lakhs*	DBT	Dr. S. Chakrabarti - PI Dr. N. Sailo Dr. A. Mitra
4	National Mission for Himalayan Studies (NMHS). *Cost. of Project : 122.64 Lakhs*	Ministry of Environment & Forest, GOI	Dr. D.R. Singh - PI Dr. Rampal Dr. N. Sailo Mr. Raj Kumar Mr. R.K. Pamarthi
5	Inventorization of gamma radiation irradiation technology for Orchid varietal improvement (BRNS-BARC Project). *Cost. of Project : 17.35 Lakhs*	DAE, BARC, GOI	Dr. R. G. Devadas - PI Mr. R.K. Pamarthi
6	Life cycle cryo-biotechnology of orchids for bio-resources conservation and sustainable development (Collaborative project with NBPGR & IBSD) *Cost. of Project : 20.10 Lakhs*	DBT	Dr. Rampal - PI Dr. Rekha Chaudhary

Research Achievements

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

1.1. Survey and collection of orchid germplasm

Habitat studies of *Diplomeris hirsuta* was conducted at Assam Lingzey, Sikkim and Sevoke, West Bengal. It is typically lithophytic and generally found growing near the sides of running water streams and requires warm humid climate during the active growing stage. However, the rocks where they are growing are diferent from site to site. Sevoke area has sandy rocks while Assam Linzey has crystalline and hard rocks. he population in Sevoke stretch for more than 3 Km however, in Assam Linzey, the population is restricted in a few meters only, where water are directly available. his could be due to the porosity and good capillarity of the rocks in Sevoke area. he plants are *ex-situ* conserved in semi-automated Green House and kept in diferent temperature from warm to hot. However no signiicance diference was seen in it germination time and rate. Time of availability of water to the plant and its efect of its germination time and rate studies is under progress.

1.2 Morphological characterization of orchid germplasm

Characterised the 43 species (including photoplates) available in NAGS and conservation polyhouses which includes rare species like *Dendrobium ruckerii, Dendrobium hookerianum, Bulbophlum gymnopus, Hyrpysma longicaulis, Bulbophyllum paramjitii, Vanda coerulea* Grif. ex Lindl. (Blue vanda) *Renanthera imschootiana* Rolfe (Red Vanda).

1.2.1 Bulbophyllum gymnopus Hook. f.: It is distributed from NE region in India. Pseudobulbs ovoid, scape slender, erect, loosely lowered, dorsal sepal lanceolate, petals spreading, linear to linear-lanceolate, lip lanceolate with cordate base.

Fig. 1. *Bulbophyllum gymnopus*

1.2.2 Bulbophyllum paramjitii Agrawala, M.U. Sharief & B.K. Singh, sp. Nov.: Extremely rare and distributed in NE India. Primrose yellow, strongly fragrant lowers, petals and sepals margins curved backward, lip 1.3-1.6 x 1.2-1.8cm, 3-lobed, deeply concave and much curved from the base, sub-trapezioidly-obovate (when lattened) its base slightly auricled, the lateral lobes large, broad, convolute, with numerous radiating streaks of reddish-brown, the apical lobe sub-orbicular, biid, delexed and crisped, the disc from about the middle with a villous green papillose crest.

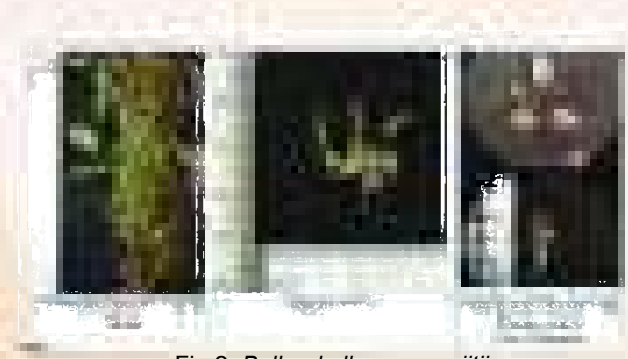


Fig.2. *Bulbophyllum paramjitii*

1.2.3 Dendrobium ruckeri Lindl.: Extremely rare and distributed in NE India. Primrose yellow, strongly fragrant lowers, petals and sepals margins curved backward, lip 1.3-1.6 x 1.2-1.8cm, 3-lobed, deeply concave and much curved from the base, sub-

trapezioidly-obovate (when lattened) its base slightly auricled, the lateral lobes large, broad, convolute, with numerous radiating streaks of reddish-brown, the apical lobe sub-orbicular, biid, delexed and crisped, the disc from about the middle with a villous green papillose crest.

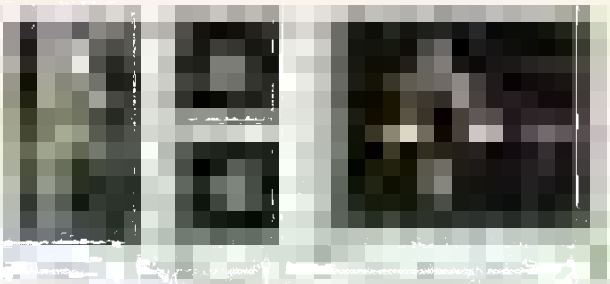


Fig.3. *Dendrobium ruckeri*

1.2.4 Vanda coerulea Grif. ex Lindl.: It is commonly known as Blue vanda. It is high breeding value widely used in production of Vandaceous hybrids.

Fig.4. *Vanda coerulea*

1.2.5 Renanthera imschootiana Rolfe (Red vanda): Extremely rare and distributed in NE India. State lower of Mizoram. Flowers 5- 6 cm axillary, branched or racemose, loosely many lowered inlorescence with semi orbicular loral bracts and long-lasting, slightly fruity scented lowers. Length of the lower is 5.3 cm, Sepals are 3.5x2 cm, lateral petals are 1.2 x 0.4cm, dorsal petal is 2.2x0.6 cm.

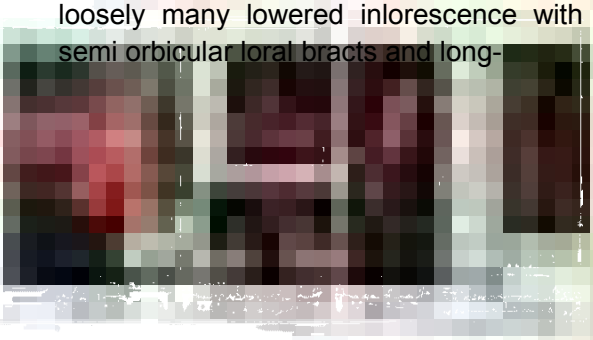


Fig.5. *Renanthera imschootiana*

1.2.6 Eria ferruginea Lindl.: Plants are epiphytic with stem like pseudobulbs, 4-5 internodes. Two leaves are found thick texture, Inlorescence arising from pseudobase, Red purplish spots on white colour lip, trilobed, clawed saccate at base, 1x1.3-1.4 cm, Lateral lobes are short, sub cordate retuse, transversely lobe, crested dentate lamellae.

Fig. 6. *Eria ferruginea*

1.2.7 Anthogonium gracile Lindl.: Plants are 15-35 cm tall. Stem is sheathed at basal region, ovoid pseudobulbs. Leaves are oblong-lanceolate to acuminate ends. Inlorescence 4-9 lowered, lowers are dark pink to white colour.

Fig.7. *Anthogonium gracile*

1.2.8 Herpysma longicaulis Lindl.: Plant is terrestrial, 35 cm tall. Leaf sheaths are pale, pubscent, trucet, membranous. Inlorescence is pubescent, many lowered, lowers are 1cm long, petals having reddish spots. Dorsal sepal is boat shaped, petals are clavate elliptic-lanceolate, acute, 3 veined. Oblong lip found.

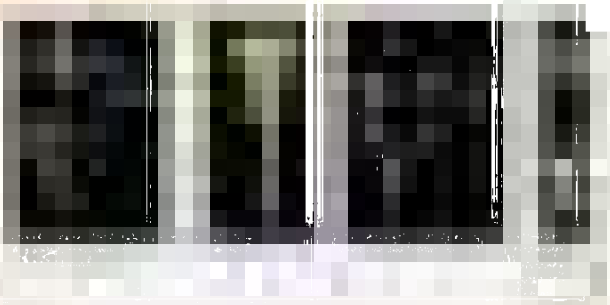


Fig. 8. *Herpysma longicaulis*

1.3 Molecular characterization of orchid germplasm

Molecular characterization of a collection of *Coelogyne nitida* revealed that it natural hybrid between *Coelgyne nitida* and *Coelogyne corymbosa.* Both these species are colowering species and found in Darjeeling district of West Bengal.

Molecular characterization of another collection of *Coelogyne cristata* revealed that it is natural hybrid between *Coelgyne laccida* and *Coelogyne cristata.* Both these species are sympatric and occur in Darjeeling district of West Bengal.

1.4 DNA Bank

DNA isolated from 148 orchid species ater identiication, puriied and stored in DNA Bank. of Genetics section for future research work.

1.5. Molecular characterization of interspecific hybrids between *Coelogyne coryombosa* X *Coelogyne nitida* and *Coelogyne flaccida* X *Coelogyne cristata* using ISSR markers.

he hybridity conirmation was determined in two interspeciic hybrids, *Coelogyne coryombosa* (female)X *Coelogyne nitida* (male) and *Coelogyne laccida* (female) X *Coelogyne cristata* (male) using 19 selected ISSR primers . F1 plant for the cross I was obtained from the cross of *Coelogyne coryombosa* (female) and *Coelogyne nitida* (male) and the F1 plant for cross II was obtained from the cross of *Coelogyne laccida* (female) X *Coelogyne cristata* (male). Among 19 ISSR primers, the primer IG-12 showed convincingly the success of hybridization by producing reproducible polymorphic bands between cross I and cross II and parents. Using DICE similarity coeicient matrix maximum similarity (85.5%) was observed between *C. corymbosa* (female parent) and F_1 hybrid in Cross I. Similarly, 74.8% was observed in case of *C. laccida* (female parent) and hybrid in cross II. Cluster analysis based on DICE similarity coeicient also produced similar results.

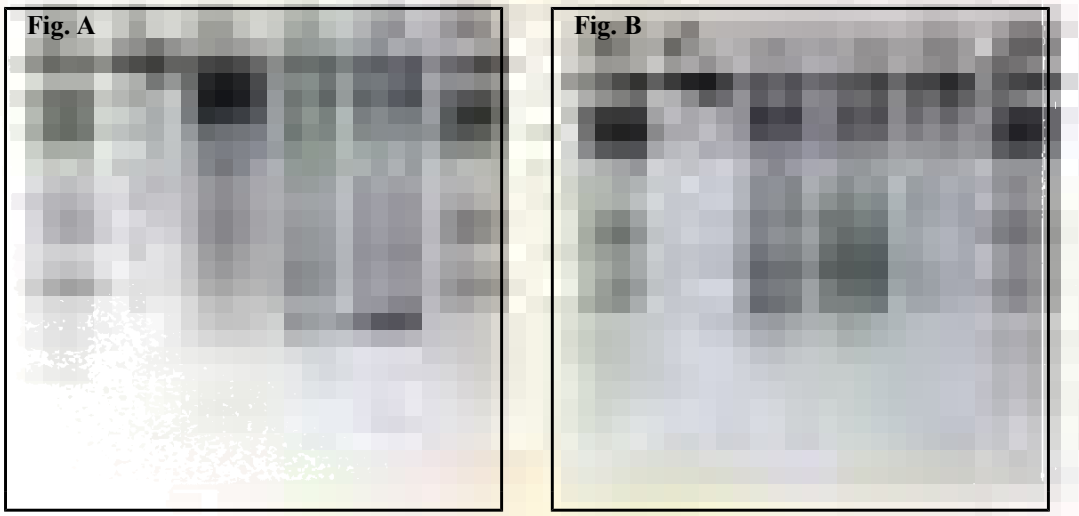


Fig. 9: Ampliication proile of *Coelogyne* parents and their F1 hybrids with ISSR primer (IG-12) resolved on agarose gels
a) ISSR proile generated by IG-12 for C. *corymbosa* (1) Hybrid (2) C. *nitida* (3).
b) ISSR proile generated by IG-12 for C. *laccida* (1) Hybrid (2) C. *cristata* (3) M: DNA ladder, C: control

1.6 Genetic diversity analysis of *Thunia* species using ISSR primers

he genetic diversity analysis was carried out between three species of the genus hunia namely-*hunia alba, hunia bracteata* and *hunia marshiliana* using ISSR primers .14 selected ISSR primers generated 194 bands of which 33 bands were polymorphic. he data obtained were analysed with the NTSYSpc.2.11x sotware and utilized to obtain the genetic similarity matrix using DICE coeicient. he UPGMA clustering method (Unweighted Pair Group Method with Arithmetic Mean) was used to construct a dendrogram to know the relationship among the species.

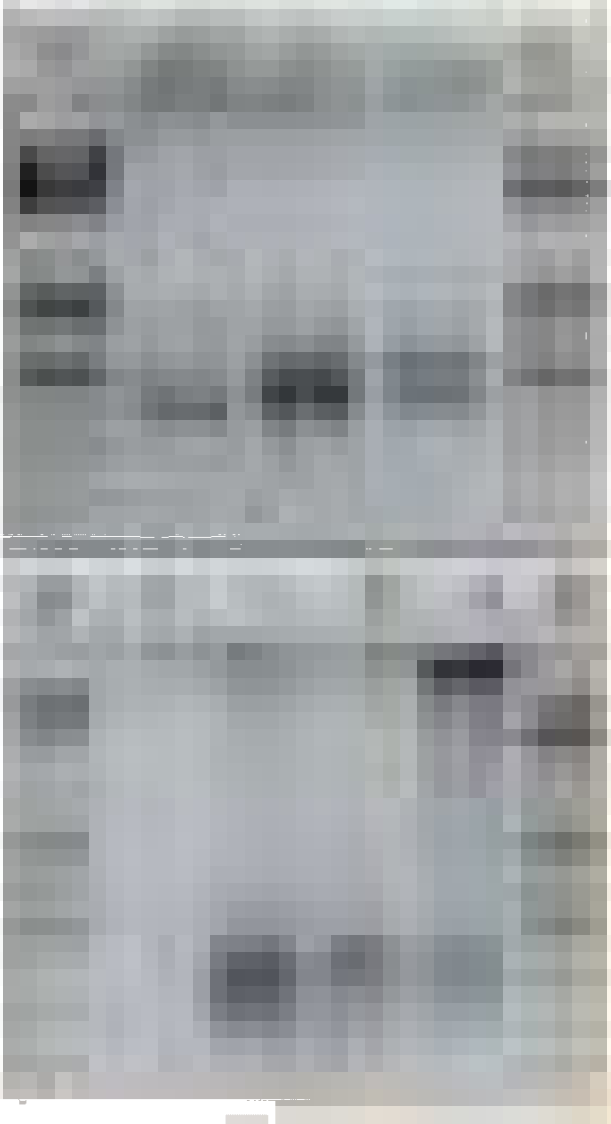


Fig. 10: Ampliication proile of *hunia* species with ISSR primer (IG-12) resolved on agarose gels.

1.7 Molecular variability of early and late flowering samples of *Liparis bootanensis* Griff

Molecular variability of early and late lowering samples of *Liparis bootanensis* Grif was studied using 40 ISSR primers. he bands generated from the primers are all monomorphic indicating that there is no variation of early and late lowering samples at genetic level.

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

2.1 Genetic Enhancement

Documentation and characterization was done for hybrids and parental lines *viz.*, *Phaius tankervilleae*, 'Lervia' (Dendrobium), *Flickingeria fugax*, *Vanda coerulescens*, *Zygopetalum intermedium*, 'Berniece Miller' (Vanda) and 'Airy White' (Dendrobium). Flowering pattern of diferent species, genetic stocks and progeny lines (387 no.) was monitored and status being recorded for maintenance purposes.

2.2 Vanda progeny lines evaluated during current flowering season

1. **PBX-12-169/01:** Early lowering progeny (3rd Wk, Sept) derived from cross {*Vanda* 'Bernice Miller' x (*V.* coerulea x *V. roxburghii*)}. Exotic colour combination with novel lower characters suitable for potted variety. Spike length – > 34.2 cm, thin and slight curvy on top. Flower size – medium, 8.67 cm x 9.47 cm and dominated by medium violet colour (N87B) with visible deeply netted veins in deep violet colour (N87A). Dorsal sepal – 4.87 cm x 3.17 cm, broad & oblong shape and lateral sepals dominating in size with incurved nature. Petals – 4.7 cm x 3.1 cm (R) & 4.8 cm x 3.2 cm (L), broadly oblong to round shape. Lip – 2.7 cm x 0.8 cm, deep violet colour (86A), dented at bottom, mentum present.

2. **PBX-12-169/02:** Late lowering progeny (2nd Wk, Nov) derived from cross {*Vanda* 'Bernice Miller' x (*V. coerulea* x *V. roxburghii*)}. Good colour combination with distinct lower characters suitable for genetic studies. Spike length – 32 cm, thin and slight curvy on top. Flower size – medium, 8.05 cm x 8.35 cm and dominated by medium diluted violet colour (N87C) with visible deeply netted veins in deep violet colour (N87B) and typically out curved margin in sepals. Dorsal sepal – 4 cm x 3.1 cm, broad & oblong shape & convex shaped. Petals – 4.3 cm x 3.2 cm (R) & 4.8 cm x 3.2 cm (L), broadly oblong to round shape. Lip – 2.3 cm x 1 cm, deep violet colour (N87A), dented at bottom, mentum present and tip unequal. Potted vase life 51 days and suitable for genetic stock.

2.3 Cymbidium progeny lines evaluated during current flowering season

1. **PBX-05-57/06**: Very early lowering progeny (2nd Wk, April) with spike length – 44.17 cm, thin (0.51 cm) and multiple spikes. Flower size – medium small, 8 cm x 5.5 cm and dominating in pale yellow-green colour (RHS 153B). Dorsal sepal – 5.3 cm x 1.2 cm with visible veins. Lateral sepals narrow, twisted, pointed tip with visible median vein. Petals – 5 cm x 1.2 (L) & 5 cm x 1.1 cm (R), slightly curved with pointed tip. Potted vase life – 46.33 days and may be useful as potential species hybrid genetic stocks from primary gene pool.

2. **PBX-05-29/47**: Mid early lowering progeny (1st Wk, Oct), medium size with multiple spikes dominating over leaves with medium spike length. Flower colour – attractive colour combination with leaves, dominating shiny yellow-green colour (150D) sepals & petals and red-purple spots on lip (59B). Dorsal sepal – 5.13 cm x 1.67 cm, concave with veins visible. Lateral sepals straight, oriented to frontal projection and upper & lower margin tinged pale purple. Petals – 5.1 cm x 1.9 cm L & R) apprx., broadly ovate shape with pointed tip. Lip – 3.33 cm x 2.2 cm, modern & open type, distinct red-purple spots (59B) on yellow colour (3D) background. Potted vase life > 67.3 days.

3. **PBX-05-772/65**: Mid early lowering scented progeny (1st Wk, Nov) with medium size back bulbs and long peduncle. Bulbs in semi-oval size and laterally compressed with pointed tip portion. Spike – 29.5 cm x 0.57 cm, 6 nodes with inter node length of 5.3 cm. Flower size – 4.5 cm x 9 cm with 6 lorets in dominating greyed-orange colour (RHS 163B). Dorsal sepal – 5.6 cm x 1.65 cm, incurved and aligned over column close, with pointed tip. Lateral sepals are crescent shaped at upper margin with brownish yellow-green colour (RHS 166B) along veins at lower margin as distinct character. Petals – 5.5 cm x 1.2 cm (R & L), 7-8 veins in brownish yellow-green colour (RHS 166B) with pointed tip. Lip – 7 cm x 2 cm, curved backwards with wide open anterior lobe, wavy margin pubescent, irregular shaped marking in greyed purple colour on tip portion. Potted vase life recorded for 65 days.

4. **PBX-05-772/158**: Mid lowering scented progeny (3rd Wk, Nov). Spike – medium size, 77 cm length, with 13 lorets with good internodal length. Flower size – 6.5 x 11 (cm), open type, dominated by medium greyed orange colour (RHS164C) with deep greyed-red colour (RHS/147A) veins as spotted lines on sepals & petals. Dorsal sepal – 6.5 x 1.9 (cm), incurved with pointed tip. Petals partially outcurved, slender, crescent shaped on upper margin. Lip – 6.5 x 1.1 (cm), highly curved back like coil, inside side lobes thick red-purple colour (RHS/59B) base & veins, anterior lobe has diluted greyed-red colour (RHS 45D) in irregular shapes with darker line in middle. Potted vase life recorded for 65 days.

5. **PBX-05-21/01**: Mid-late lowering progeny (3rd Wk, Dec), fragrant moderately & medium size. Spike – 19.5 cm x 0.51 cm, with 3-4 nodes. Flower size – 7.5 x 10.5 (cm), big & modern type dominated by yellow colour (RHS 8B/A). Dorsal sepal – 6.8 x 3.2 (cm),

incurved. Lateral sepals recurved upward at lower margin to best orientation of lower, apart from petals. Lip – 6.4 x 2.2 (cm), modern type & exotic, superior & prominent side lobes with spreading anterior lobes with curvy margin, numerous dark purple spots all over the lip inside on yellow color back ground. Potted vase life recorded for 70 days, has breeding value for distinct lip spots & pattern.

6. **PBX-05-771/05**: Mid-early lowering progeny (4th Wk, Oct) moderately good length of spike (66.4 cm) with 11 nodes. Flower size – 7 x 8 (cm), medium size with strong pubescence nature on lip. Abrupt drying of spike observed ater 82 days of lowering.

7. **PBX-05-21/02**: Mid-late lowering progeny (2nd WK, Jan) with high fragrance & medium size. Spike – 39 cm (original) and top portion dried later. Flower size – 7 x 8.5 (cm), big & modern type dominated by yellow colour (RHS 8B/A). Dorsal sepal – 6.8 x 3.4 (cm), incurved, oblong shape, dominating and central 3 veins translucent as pale red-purple colour (RHS 60B) from bottom to tip. Lateral sepals – broad, incurved pale crimson colored (RHS 48A) on upper & lower margin, lower margin recurved upward. Lip – 6 x 2.7 (cm), modern & exotic and distinct red-purple colour (RHS 60A) at margin with dark red-purple (RHS 59B/A) spots of 3 mm size and typical lines & spots inside lateral lobes. Potted vase life recorded for 53 days, has breeding value for distinct lip spots & pattern.

8. **PNRCO/BxH/28**: Mid-late lowering progeny (4th Wk, Jan) suitable for cut lower variety. Spike – 20.2 cm length & girth 0.64 cm with 10 lorets. Flower – medium size (5.8 x 7.5 cm), non- fragrant dominated by medium greyed-orange colour (RHS 179B) on sepals & petals. Dorsal sepal – 5.1 x 1.6 (cm), straight & narrow spathulate shaped, margin relected. Lateral sepals broadly semi-curved & narrow oblanceolate shaped with narrow blunt tip. Petals – typically distinct with greyed-orange colour with yellow mix at 40% of tip portion & relexed margin. Lip – 4.9 x 1.6 (cm), primitive & narrow type with distinct dark greyed-orange colour (RHS 179A) towards margin.

9. **PBX-05-10/15**: Mid lowering progeny (4th Wk, Dec). Spike – 34 cm & most of the lorets were dropped similar to last year. Flower – medium big size, 7.5 x 8.7 (cm), semi-closed type & modern dominated by pinkish shade of white colour (RHS/N155C) with greyed-purple colour shade (RHS 186B/A) on ventral side of sepals & petals. Dorsal sepal – 6 x 3.45 (cm), broad shaped & incurved with pointed at tip. Median vein of lateral sepals not signiicant inside but prominently visible on ventral side. Petals – 6 x 3.7 cm ® & 5.6 x 2.9 cm (L), broad & oblong-oval shape and relexed. Lip – 5.5 x 2.3 (cm), superior colour combination with regular spots & stripes in medium dark red-purple colour (RHS 59B/A) on whitish pink background (RHS/ N155C). Potted vase life recorded for only 64 days and shall require further evaluation.

10. **PBX-05-34/83**: Mid-late lowering progeny (4th W, Dec) suitable for standard cut lower variety. Spike – 76.5 cm, medium size girth (0.6 cm) with 19 nodes. Flowers – large size, 7.8 x 8.8 (cm), 11 lorets, superior, leshy & bulb shaped, dominated by red-purple colour (RHS 59A) with medium dark purple (RHS 55C/B) veins. Dorsal sepal – 6.7 x 3.5 (cm), broadly oblong oval shaped, incurved with acute pointed tip. Lateral sepals sharp ovate shape, faint red-purple spots at inside bottom and median visible on ventral side with cuspidate nature. Petals – 6.4 x 3.2 cm (R) & 5.8 x 3.5 cm (L), semi-erect with clear entire upper margin with recurved lower margin for orientation & dark red-purple spots (RHS 59A) at bottom inside. Lip – 5.6 x 2.6 (cm), mature & modern type, distinct with dark red-purple colour lines & spots inside side lobes on orange-red colour (RHS 33D) embedded with medium yellow colour and anterior lobe spreading with undulated/ wavy margin. Potted vase life recorded for 87

days and suitable for commercial cultivation.

11. **PBX-05-34/19**: Mid-late lowering progeny (2nd Wk, Jan) suitable for potted variety with exotic colour combination and shape of lowers. Spike – 63.2 cm, strong girth (0.71 cm) with 20 nodes. Flowers – larger size, 8.3 x7.4 cm, 13 lorets, modern & semi-closed type with dominating by whitish-purple colour (RHS 65D) greyed pink-red group (RHS 179C/D) on yellow background. Dorsal sepal – 6.8 cm x 3.35 cm, semi convex, margin slightly curved back & central 3 veins visible as translucent red-purple color (RHS 71A). Lateral sepals are sharp ovate with pointed tip & median vein presence visible on ventral side with presence of darker gradient red-purple colour. Petals – 5.9 x 2.6 cm (R) & 5.6 x 2.6 cm (L), narrow oblong-oval shape with pointed tip, smaller spots in whitish-purple pink spots at bottom inside, median vein visible on ventral side as cuspidate at tip portion. Lip – 5.5 x 2.3 cm, semi-open type, elongated stripes from bottom to tip in medium dark red-purple colour (RHS 60A) inside side lobes. Being proposed for further evaluation to use as genetic stock in breeding programmes.

12. **PBX-05-34/56**: Mid-late lowering progeny (4th Wk, Dec) with short spike and more lorets. Spike – 51 cm, robust girth (0.78 cm) with 19 nodes. Flowers – big size, 9.2 x 10.6 cm, moderately attractive, semi-closed type with 14 lorets with domination of medium purple colour (N77B) on edges of sepals & petals on amber yellow colour (RHS 162D) background. Dorsal sepal – 7 x 3.4 cm, broad oval shape with semi-acute pointed tip with 19-20 visible veins from bottom to tip. Lateral sepals oblong-oval shape, incurved like & lower margin recurved backward at centre with median vein prominent at tip portion. Petals – 6.5 x 3.3 cm (R) & 6.7 x 3.5 cm (L), crescent shaped upper margin & recurved lower margin with medium purple colour (RHS N77B) on dorsal side. Lip – 6.5 x 3.3 cm, grand & bigger size, red-purple colour (RHS 59C) broken lines inside side lobes up to 50% length, anterior lobe big with curvy margin in deep red-purple colour.

13. **PBX-05-21/20**: Mid-late lowering progeny (4th Wk, Jan) with long spike and attractive lorets in shape & spots. Spike – 66 cm, robust girth (0.9 cm) with 17 nodes. Flowers – medium big size, 8.7 x 9 cm, semi-open type with 10 lorets dominated by attractive yellow colour (RHS 11B) with medium purple colour (RHS 60A/B) on sepals & lip. Dorsal sepal – 7.5 x 3.5 cm, broad oval shape with semi-acute pointed tip with 19-20 visible veins from bottom to tip with presence of medium red-purple (RHS 180B) spots on inside bottom. Upper margin of lateral sepals curved downwards with recurved lower margin with red-purple spots at bottom inside. Petals – 7.3 x 2.8 cm (R) & 6.5 x 2.9 cm (L), narrow oblong shape, wavy margin and median vein appears as smear with broken lines & spots at bottom inside. Lip – 4.7 x 2.4 grand & medium bigger size, thick broken lines in greyed-red colour (RHS 59C) inside side lobes on dark yellow back ground (RHS 11B), anterior lobe spreading & semi-lat & ciliated at centre, irregular big with curvy margin in deep red-purple colour.

14. **PBX-05-11/03**:Mid-late lowering progeny (4th Wk, Jan) with 1st year lowering. Spike – 65 cm, medium size girth (0.72 cm) with 8 nodes and moderately attractive with broader spots on lip. Flowers –big size, 9 x 11 cm, moderately fragrant, semi-open type dominated by greyed-yellow (RHS 160D). Dorsal sepal – 7.5 x 4.1 (cm), incurved, broad oval shape, margin slightly curved back & tip blunt.Lateral sepals in oblong oval shape, upper margin translucent with red-purple colour (RHS 58A) on grey-yellow back ground (RHS 160D).Petals – 7 x 3.3 cm (R) & 7 x 3.5 cm (L), slightly curved with wavy on upper & lower margin.Lip – 5.6 x 2.8 cm, grand shape & modern type, broader broken line & spots in dark red-purple colour (RHS 59A) inside side lobes and 43-4 mm size broader painted spots in red-purple colour on anterior lobe.

15. **PBX-05-34/100**: Mid-late lowering progeny (4th Wk, Jan) with exotic colour combination and attractive. Spike – 61 cm, medium girth (0.6 cm) with 17 nodes. Flowers – medium large size, 8 lorets, round type, bulb shaped & semi-closed with highly attractive pale purple colour (RHS 75D) on faint red (RHS 56D) background & lip traits. Dorsal sepal – 7 x 4 cm, broad oval shape, incurved, tip obtuse pointed with light purple shade at bottom. Deeply incurved lateral sepals for best orientation with petals & lip in pale red colour. Petals – 6 x 3.2 cm (R) & 6.3 x 3.5 cm (L) in whitish domination (RHS N155), margin narrow, straight & aligned to dorsal sepal. Lip – 5.2 x 2.8 cm, grand & bigger modern type, with attractive medium red-purple spots, stripes & lines (RHS 61A) on faint red-purple colour background (RHS N57D), central rised ridges in yellowish-pink with numerous red-purple spots (RHS 61A), single line of elongated spots in dark red-purple colour (RHS 61A) present on medium crimson colour background (RHS N57D) as signiicantly distinct character.

16. **PBX-05-34/04**: Mid-late lowering progeny (4th Wk, Jan). Spike – 47 cm, medium girth (0.51 cm) and 12 nodes. Flowers – medium size, open type, dominated by greyed-yellow colour (RHS 160C) with medium red-purple colour on sepals & petals with distinct bigger size of anterior lobe of lip. Dorsal sepal – 7.5 x 2.8 cm, incurved at top with pointed tip. Lateral sepals greyed-yellow colour (RHS 160C) with visible veins from base to tip & lower margin with few purple spots. Petals – 6.6 x 2.4 cm (R) & 6.5 x 2.6 cm (L), slightly curvy margin, medium pink colour (RHS 58A) with dark red-purple spots. Lip – 4.8 x 2.5 cm, dark red-purple dotted lines & stripes inside side lobes, rides in medium yellow colour, tip slightly curved back.

Late lowering Cymbidium progenies (15 no.) *viz.*, PBX-05-46/03, PBX-05-884/02; HxB/02, 20, 21, 22, 31, BxH/02, 12, 14, 18, 20, 24, 35 & 37 are being under evaluation and the stable performing Cymbidium progeny lines for second consecutive year given below for important traits.

Character	PBX-05-34/31	PBX-05-34/84	PBX-05-34/124	ABxSG	'PCMV'
Plant height	56	84	52	73	51
Plant width (cm)	58	86	81	97	89
Bulb size (cm)	5 x 4.6	6 x 4.82	7.5 x 5.9	8 x 3.82	6 x 3.7
Spike length (cm)	75	74.5	73	70	29.5
Florets	10	12	13	12	12
Flower size (cm)	6 x 6.5	6.5 x 7.6	6.5 x 6.2	6 x 8	7 x 6.5
Fragrance	Moderate	High	Moderate	Less	High
Lip size (cm)	4.6 x 2.9	5.6 x 2.7	4.5 x 2.5	4 x 2.2	4.8 x 2.8
DTF	90	131	139	121	70

. Trials of selected Pl x Pw series

he 07 lines of Paphiopedilum progenies (NRCO/PlxPw) are being evaluated for station trail, apart from check and other promising lines.

S. No.	Breeding line	Height (cm)	Width	No. leaves	Fl. Size (cm)	Lip length	DTF	DTW
1	IC 614750	13.9	44.6	5	12.26 x 12.5	5.9	81.2	91.4
2	IC 614751	26.25	47.75	5	12.75 x 11.65	6.95	74.5	91.5
3	IC 614752	10.63	41.42	5.16	9.81 x 10.72	4.6	78.83	74.67

S. No.	Breeding line	Height (cm)	Width	No. leaves	Fl. Size (cm)	Lip length	DTF	DTW
4	Sheetal 1	12.83	24.66	4.83	9.78 x 10.38	5.5	66.5	111.8
5	IC 617522	16.55	31.10	4.25	9.85 x 10.3	5.5	53	86.5
6	IC 617523	19.7	38.9	4.67	9.8 x 10.16	4.84	57.8	80.8
7	IC 617524	15.75	34.97	5	9.52 x 10.6	5	62.25	67.75
8	PlxPw/33	16.38	26.3	5.4	9.36 x 10.68	5.16	60.2	77.8
9	PlxPw/28	16.75	27.42	4.17	11.04 x 12.72	5.32	73.4	134
10	PlxPw/08	22	32	5	11.2 x 10	5	59	115
11	*P. venustum*	13	14	4	7.5 x 7.6	4.5	73	83
12	*P. villosum*	23	38	4	10.3 x 8.5	5.4		111

Project 3: Development and refinement of production and protection technologies for improved productivity, marketing and utilization of orchids

3.1. Identifying suitable location for cultivation of *Cymbidiums*

For identifying suitable production locations an evaluation of three cultivar (Levis Duke 'Bella Vista'; Ruby Anniversary 'Pink Surprise'; and Margaret hatcher) was conducted at four locations in (Gadidhura, 245m alt.; Rohini, 648m alt., Lower Sirubari, 966m alt; and St. Mary's Hill 1553m alt.). he varieties cultivated at lower elevations (L1 and L2) showed early vegetative bud development as compared to plants cultivated at higher elevation. However, no lowering was observed at lower elevations. he lower elevations can be utilised for plantlet development.

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

Vegetative growth of full grown Cymbidium plants had shown variable response with diferent combinations of potting media. Out of nine potting media used, highest number of leaves (5.5) were produced with (Cocochips + cocopeat +brick pieces + dry leaf fern) and Cocochips + cocopeat +brick pieces +cowdung). Longest leaf (75cm) was recorded with Cocochips + cocopeat +brick pieces + coconut husk. Cocochips + cocopeat +brick pieces + leaf mould, Cocochips + cocopeat +brick pieces + vermiculite and Cocochips + cocopeat +brick pieces +cowdung had given out maximum number of bulbs/plant (4.5). Enhanced bulb diameter (4.0cm) was observed with Cocochips + cocopeat +brick pieces + green moss. Highest content of chlorophyll (72mg/100g) was recorded with Cocochips + cocopeat +brick pieces +rice husk.

. . Effect of potting media on growth and development on young plants of *Zygopetalum intermedium.*

In *Zygopetalum intermedium*, out of nine potting mixtures, cocochips + cocopeat +brick pieces +cowdung produced maximum number of leaves (6), longest leaf (75cm), highest number of bulbs (4) per plant. here was no signiicant diferences in bulb sizes with all the treatments. However, chlorophyll content was recorded highest with Cocochips + cocopeat +brick pieces + leaf mould (40.96 mg/100g) followed by Cocochips + cocopeat +brick pieces + Slow release fertilizer (38.8 mg/100g).

3.4. Effect of liquid manure spray on growth, development and flowering in *Cym.*Winter Beach Sea Green'

Spraying of liquid manure in higher dilution (1:30) improved vegetative growth of young plants of Cymbidium orchids. Maximum pseudobulb size (3.0cm), number of leaves (4.5), leaf length (75cm), number of pseudobulb per

plant (3.0) and chlorophyll content (72 mg/100g) were also recorded with this treatment. Out of six treatments, both the sprays of liquid manure (1:30) and (1:20) showed beneicial efect on vegetative growth as compared to NPK sprays.

Maximum leaf length (87cm), spike length (65cm), rachis length (25cm), number of lowers per spike (7), lower longevity (110 days) and chlorophyll content (93mg/100g) were observed with spray of liquid manure in the ratio (1:30) on full grown Cymbidium plants. Spraying with liquid manure in the ratio of 1:10 had broader pseudobulb (8.0cm), number of spikes/plant (2.0) and lower width (11cm).

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

Amongst 10 tree barks used as potting media, highest number of leaves were found with Paiyun barks, *Prunus cerasoides* and Lapsi barks, *Choerospondias axillaris* (5). Maximum leaf length was recorded with Malato barks, *Macaranga pustulata* (75cm). Both Paiyun barks, Prunus cerasoides and Lapsi barks, *Choerospondias axillaris* had produced more number of bulbs/plant (2.5) and bulb size of 3.5 and 4.0 cm, respectively. Highest chlorophyll content was studied in Utis barks, *Alnus nepalensis* (67 mg/100g) followed by Paiyun barks, *Prunus cerasoides.*

3.6. Effect of ionic strength of nutrient solution and medium composition of *Zygopetalum intermedium*

Uniform sizes of plants were planted in 6"size pot in perlite, vermiculite, moss, and cocopeat media. Plants were applied with ¼, ½ and full strength of Hoagland Solution at monthly interval. here were 12 treatment combinations. he experiment was set to identify the medium and nutrition requirement of *Zygopetalum intermedium* grown under semi- hydroponic system. he experimental results revealed that application of half strength of Hoagland Solution in plants grown in moss growing medium increased plant height (72.46cm), no. of leaves (11.6), length of leaves (55.3cm) and no. of shoots/plant (2.8). Application of half strength of Hoagland Solution improved the spike length (57.56 cm) and spike longevity (51.8 days) of plants grown in perlite medium.

3.7. Effect of micronutrients on growth and flowering of *Dendrobium nobile*

Uniform size plants of *Dendrobium nobile* were planted in 8" diameter pots containing a media consisting of cocochips + brick pieces + leaf mould + shredded bark at 1:1:1: 1 ratio. Regular dose of macro nutrients (N: P: K) 30:10:10 @0.1% foliar spray was applied to all the treatments at weekly interval. he micronutrient treatments were applied as foliar spray at 15 days intervals. 1 ppm of the required micronutrient solution was prepared by dissolving the following quantities of chemicals in one litre of water.

Cu-3.93 mg of copper sulphate, Zn-3.42mg of Zinc sulphate, Fe- 7.02 mg of Ferrous ammonium sulphate, Mn- 1.58 mg Manganese sulphate, Bo-5.72 mg of Boric acid, Mo- 1.88 mg of Molybdic acid

Among 13 micronutrient treatments, Mo@0.01 ppm spray increased plant height (63.11 cm), stem girth (0.48cm), leaf area (41.51 cm^2) and number of leaves/cane (15.67) whereas Fe @0.1 ppm spray produced highest number of canes (9.4). Longest internode (3.66cm), maximum number of spikes (3.16) and number of lowers/spike (16.75) was recorded with Mo @0.05 ppm spray. Increased lower size (8.21 cm x 6.67 cm) and pedicel length (5.72 cm) was found with B @0.05 ppm spray.

3.8: Development of Orchid Based Farming System

In view of the doubling farmers' income by 2022, the institute has taken up various experiments and models with orchid cultivation to maximize the production per unit area. In this, farmers can utilize the maximum area of ploy-houses for enhancing the production and increase the output.

Fig. 11: Orchid based farming systems

3.9. Vertical Farming of Orchids

Pilot project was started for conservation of orchid species and production of some commercial orchids.

Fig. 12: Vertical farming in orchids

. . Flower drying in orchids

Sl. No.	Species / varieties of orchids	Suitable Drying method
1.	*Vanda teres*, *Dendrobium moschatum, Arundina graminifolia, Den.* 'Madam Pink', *Den.* 'Lervia', *Den*. 'Abraham', Phal. 'Casa Blanca', Phal. 'Detroit' and Oncidium 'Sweet Sugar'	Embedded drying with borax at 50°C in oven
2.	*Epidendrum* spp., *Cattleya bowringiana* and *Cattleya* hybrids, Phal. 'Ox Plum Rose x Black Jack' and Den. 'Big White', *Vanda coerulea*	Embedded drying with borax at 60°C in oven
3.	*Coelogyne laccida*, *Coelogyne cristata, Dendrobium nobile, Dendrobium williamsonii, Dendrobium aphyllum*, Den, 'Erika', Den. 'Big White 4N', Den. 'Bangkok Blue', Phal.'Nagasaki' and Cym. 'Sungold'.	Embedded drying with borax and silica gel at 55°C in oven
4.	Dendrobium, Phalaenopsis, Cattleya, Cymbidium, Aranda, Mokara hybrids	Perlite, Perlite + borax and Perlite + Silica gel under room condition (24-25°C and 75-79%RH)
5.	Cattleya 'Guanmian City', Dendrobium 'Lervia, Phalanopsis 'Vienna ', Vanda tessellata, Oncidium 'Taka Yellow', Phalanopsis 'Taida S.Red'	Embedded drying with sand at 50°C in oven

Fig. 13: Flower drying in orchids

3.11 Value Addition: Waste to Wealth

Waste dry leave of Cymbidium ater lowering were dried and utilized for making the basket from leaves, which can be utilized for keeping of diferent commodities in the houses and for decorative purposes. his technique was also demonstrated to the women entrepreneurs of diferent self-help groups of nearby areas of Pakyong.

Fig. 14 Value addition in orchids

3.12. Post-harvest Management of Orchids

Orchid species used directly as cut lowers like *Renanthera imschootiana* had vase life of 24 days, *Vanda tessellata* 16 days and *Vanda stangeana* 10 days.

Table 1: Post-Harvest Technology of Dendrobium

Sl. No.	Particulars	Findings
1.	Evaluation of commercial hybrids of Dendrobium for vase life	Triple Pink (40 days), Emma White (37 days), Madam Pompadour (37 days), Erika (34.8 days), Ear Sakul (33.5 days), hongchai Gold (30.4 days), Big White Jumbo (29.5 days), Kating Dang (28 days), Lervia (28 days), Daang Saard (27.5 days), Julie (25 days)
2.	Best harvesting stage of Dendrobium for maximum vase life	50 % opened stage with 60 days of vase life
3.	Best bud opening of Dendrobium for improved vase life	4% Sucrose + 100 ppm Salicylic acid
4.	Best holding solution of Dendrobium for improved vase life	2% sucrose + 200 ppm ASA and 2% glucose + 100 ppm ASA were found as best holding solutions for maximum vase life (80 days) over control (without treatment) (48 days).

3.13. Multiplication of *Phaius tankervilleae* by breaking dormant buds of the spent spike

Flower stalk of *Phaius tankervilleae* were cut ater lowering was over. he tip of the stalk without visible buds were cut of. he stalk was dipped in rain water and keikis emerged from the dormant buds. One stalk produced up to 3 keikis depending on the size of the stalk. he development of keikis was acropetal.

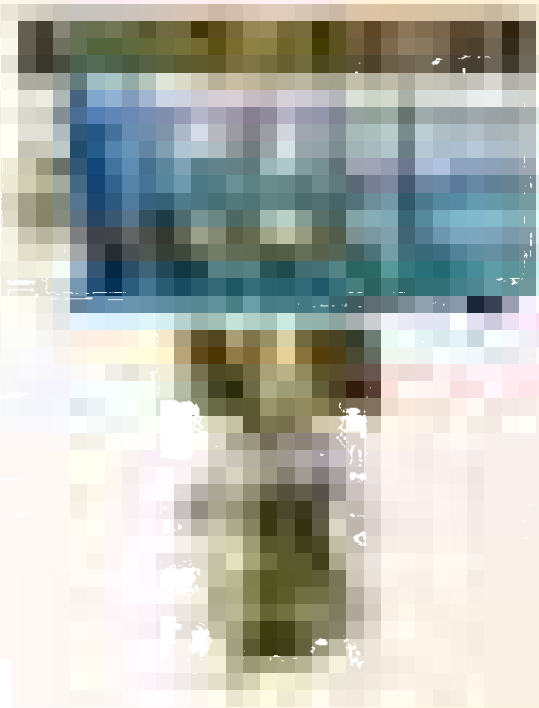


Fig. 15: Flower stalk cutting in *Phaius tankervilleae*

. . Studies seasonal growth, development and flowering in *Dendrobium nobile*

Seasonal growth of Dendrobium was studied. Growth studied in mature shoots, current year shoots and new emerging shoots were conducted. Plants need to reach certain stage of maturity to produc lowers. It have to attain certain growth and age. Flower were produced in matured and 2nd years old cane. Whereas, current year and emerging shoots did not produced lower. he average height which produced lower recorded was 54.21 cm and the average plant height of non-lowering cane recorded was 38.50cm. Leaves width and leaves length almost same in vegetative and lowering shoots. Plant height strong correlation with number of buds/lower produced.

Tropical Orchid Centre, CHES, Chettalli, Karnataka

Effect of inorganic nutrients on growth and flowering of orchids

An experiment was laid out to study the efect of inorganic nutrients on growth and lowering of orchids, *Dendrobium* cv. Singapore White during May, 2017. he experiment comprised of twelve nutrient doses replicated thrice in CRD. Foliar sprays of the nutrients were given at weekly intervals.

hedataonthevegetativeparametershavebeen presented in Table Leaf area varied signiicantly among the treatments. he treatment T_2- NPK @ 10:20:10 @ 0.1% recorded the maximum leaf area of 40.32 cm^2 and was on par with treatments T_9- NPK @ 30:10:10 @ 0.1% (38.22 cm^2) and T_3- NPK @ 10:10:20 @ 0.1% (37.51 cm^2). Minimum leaf area was recorded in treatment T_{12}- NPK @ 30:20:20 @ 0.1% (29.37 cm^2).

Diferent loral traits and the vase life of cut lowers were recorded and have been presented in Table Maximum number of spikes per plant/ year (6.22) was recorded in treatment T_2- NPK @ 10:20:10 @ 0.1% and was on par with T_9- NPK @ 30:10:10 @ 0.1% (6.11), T_{10}: NPK @ 30:20:10 @ 0.1% (5.77). Minimum number of spikes / plant/ year was recorded in treatment T_{12}- NPK @ 30:20:20 @ 0.1% (3.72).

Vase life was recorded under ambient conditions in tap water and was maximum in T_8- NPK @ 20:20:20 @ 0.1% (12.33 days) and was on par with T_9- NPK @ 30:10:10 @ 0.1% ; T_{11}- NPK @ 30:10:20 (11.67 days), T_{10}- NPK @ 30:20:10 @ 0.1% (10.67 days) and T_2- NPK @ 10:20:10 @ 0.1% (10.00 days). Minimum vase life of 10 days was recorded by T_1- NPK @ 10:10:10 @ 0.1%.

Salient finding

Foliar spray of 10:20:10 NPK @ 0.1% at weekly intervals produced maximum number of spikes / plant (6.22) and the spikes recorded a vase life of ten days in tap water.

Table 2: Efect of inorganic nutrients on vegetative characters of Dendrobium cv. Singapore White

Treatments	Plant height (cm)	No. of leaves per plant	Leaf area (cm^2)	No. of pseudo-bulbs per plant	Internodal length (cm)	Girth of pseudobulbs (mm)
T_1	43.37	31.56	30.92	2.73	4.14	13.91
T_2	45.69	35.39	40.32	3.20	3.54	13.87
T_3	45.12	33.47	37.51	3.20	3.61	13.89
T_4	42.30	36.40	31.17	3.07	3.72	13.89
T_5	41.73	39.05	29.79	3.13	3.72	13.93
T_6	41.73	33.01	33.97	2.80	4.01	13.99
T_7	43.70	31.91	35.46	2.73	3.29	13.98
T_8	42.09	39.88	32.86	3.40	3.57	13.95
T_9	47.59	29.92	38.22	2.80	3.51	14.00
T_{10}	44.55	32.79	37.15	2.87	3.53	13.94
T_{11}	43.81	25.95	36.36	2.27	3.70	14.02
T_{12}	50.79	24.48	29.37	2.47	3.83	14.06
CV (%)	10.799	20.825	5.136	14.319	9.073	0.548
SeM(±)	2.767	3.946	1.021	0.239	0.193	0.044
CD (p=0.05)	**NS**	**NS**	**3.00**	**NS**	**NS**	**NS**

Table 3: Efect of inorganic nutrients on loral characters and vase life of Dendrobium cv. Singapore White

Treatments	No. of Spikes / plant	No. of Flowers / spike	Spike length (cm)	Flower size (Length-cm)	Flower size (Breadth - cm)	Pedicel length (cm)	Vase life (days)
T_1	3.84	10.57	34.15	7.27	7.52	6.25	7.00
T_2	6.22	8.83	34.80	7.74	7.33	6.40	10.00
T_3	5.22	9.44	34.69	7.80	7.75	6.19	8.00
T_4	3.89	8.27	34.15	7.71	7.55	6.29	8.33
T_5	3.72	11.27	40.00	7.85	7.62	6.28	8.33
T_6	4.22	9.22	29.27	7.65	7.55	4.91	9.00
T_7	5.22	8.67	36.33	7.29	7.18	6.07	8.33
T_8	3.89	9.78	37.87	7.44	7.24	6.23	12.33
T_9	6.11	9.78	43.76	7.93	7.64	6.45	11.67
T_{10}	5.77	11.67	39.52	8.09	7.74	6.28	10.67
T_{11}	5.00	9.89	36.93	8.05	7.90	6.05	11.67
T_{12}	3.78	8.78	31.51	7.56	7.29	6.35	9.00
CV (%)	10.261	17.86	10.195	4.544	5.127	11.431	18.759
SeM(±)	0.281	0.998	4.207	0.202	0.223	0.406	1.032
CD (p=0.05)	**0.82**	**NS**	**NS**	**NS**	**NS**	**NS**	**3.03**

Treatment details:

T_1: NPK @ 10:10:10@ 0.1% ; T_2: NPK @ 10:20:10@ 0.1% ; T_3: NPK @ 10:10:20@ 0.1%; T_4: NPK @ 10:20:20@ 0.1% ; T_5: NPK @ 20:10:10@ 0.1% ; T_6: NPK @ 20:20:10@ 0.1% ; T_7: NPK @ 20:10:20@ 0.1% ; T_8: NPK @ 20:20:20@ 0.1% ; T_9: NPK @ 30:10:10@ 0.1% ; T_{10}: NPK @ 30:20:10@ 0.1% ; T_{11}: NPK @ 30:10:20@ 0.1% ; T_{12}: NPK @ 30:20:20@ 0.1%

Fig. 16: General view of the experiment

Fig. 17: Vase life studies in Dendrobium

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

Table 4: On and Off Campus training programs:

Sl No.	Date & Duration	Topic and Venue	No. of Beneiciaries
1.	29th June 2017	Prospects of Orchid Cultivation in Tripura, Tripura	25 Oicials (Tripura)
2.	18th July 2017	Value Addition in Orchids, NRCO, Pakyong	10 farmers (Chhalamthang)
3.	18th Sept. 2017	Value Addition in Orchids, NRCO, Pakyong	22 farmers (Haryana)
4.	18th Oct.2017	Central Public Procurement Portal, NRCO, Pakyong	10 staf (NRCO)
5.	15th Nov, 2017	Value Addition in Orchids, NRCO, Pakyong	71 students (KAU, Trichur)
6.	28th Nov.2017	Floriculture in Hill regions, NRCO, pakyong	19 students (College of Hort., Sikkim)
7.	19th Dec. 2017	Orchid cultivation, NRCO, Pakyong	9 Extension Oicers (ATMA, MP)
8.	29th-30th January, 2018	Production Technology & DNA Finger printing in orchids, NRCO, Pakyong	24 students (IITM, UP)
9.	21st Feb. 2018	Floriculture in Hill regions, NRCO, pakyong	20 farmers (Haryana)
10.	13th-17th March, 2018	ICAR Sponsored Training Under Pt. Deen Dayal Upadhyay Unnat Krishi Siksha Yojana, Sikkim Kalyan Asram	30 farmers (East Sikkim)
11.	23rd March, 2018	Vegetative Propagation and rejuvenation	60 farmers (Lossing-Dhakal)
12	26th March, 2018	Floriculture in Hill regions, NRCO, Pakyong	25 farmers (Morigaon, Assam)
13.	28th March 2018	Awareness program on IPR, ICAR-NRCO, Pakyong, Sikkim	Students, staf

Externally Funded Project

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

1.1: Cymbidium crosses taken for hardening: Cronulla 'he Khan' x Cronulla 'he Khan'; (2) Floripink x Valley Vampire; (3) Freestyle No.6 x Freestyle No.6; (4) *Cym eburneum x Cym devonianum*; (5) *Cym lowianum x Cym eburneum*; (6) DLR/16; (7) *Cym lowianum* x *Cym devonianum*; (8) DLR/01/14; (9)Baltic Glacier Mint Ice x *Cym lowianum* (MRK); (10) 75; (13) Valley Zenith x Lovely Bunny; (11) *Cym erythraeum x C. tracyanum*; (12) *Cym erythraeum* x *Cym tracyanum* (12) *Cym erythraeum x Cym elegans* ; (13) *Paphiopedilum insigne* x *Paphiopedilum villosum* (14) *Phaius lavus* x *Phaius tankervilleae.*

1.2: he plantlets of following crosses were lost in tissue culture laboratory due to strike/ bandh in darjeeling (1) *Cym erythraeum x Cym ensifolium*; (2) Pineclash Moon Venus x Valley Inga Tower; (3) A/29; (4) Yellow River Stei x Valley Webster Satsuma; (5) Baltic Glacier x Khan Flame; (6) *Coelogyne elata* x *Coelogyne ocultata.*

1.3: Crosses at seed stage : *Baltic Glacier* x *Cronulla*; (2) *Valley Inga* x *Cronulla* (3) *Cronulla* x *Valley Vampire* (4) *Cronulla* x *Tracy Reddaway* (5) *Cronulla* x *Valley Inga* (6) *Cronulla* x *Kiwi Mint* (7) *Cronulla* x *Arcadian* (8) *Cronulla* x *Valley Chianti* (9)*Valley Zenith* x *Sleeping Nymph* (10) *Baltic Glacier* x *Valley Inga* (11) *Valley Treasure* x *Breakout* (12) *Morning Moon* x *Sleeping Nymph* (13) *Kuralta Park* x *Valley Chianti* (14) *Valley Treasure* x *Rotoura* (15) *Cym eburneum* x *Cym hookerianum* (16) *Lady Leopard* x *Dark red* (116) (17) *Cym tracyanum* x *Cym erythraeum* (18) *Cym tracyanum* x *Cym elegans.*

1.4: Crosses made: he following crosses were made during the year 2017-18

Female parent	Male Parent	Crossing date	Cross Identity	No. lowers pollinated
Valley Zenith Discuss	Ripe Cherry Dazzle	01-04-2017	DLR/01/2018	4
Lerov's Envy Top Brass	Ripe Cherry Dazzle	01-04-2017	DLR/02/2018	4
Baltic Glacier	Ripe Cherry Dazzle	01-04-2017	DLR/03/2018	4
Lunagard	Red Nelly	01-04-2017	DLR/04/2018	4
Valley Champion Georgeous	Red Nelly	01-04-2017	DLR/05/2018	3
Valley Legend Raggie	Valley Vampire Blood Red	01-04-2017	DLR/06/2018	4
Kiwi Magic Sue	Valley Vampire Blood Red	01-04-2017	DLR/07/2018	2
Leroy's Envy Top Brass	Valley Vampire Blood Red	01-04-2018	DLR/08/2018	3
Lunagard	Valley Vampire Blood Red	01-04-2018	DLR/09/2018	3
Lunagard	Valley Zenith Concord	01-04-2018	DLR/10/2018	3
DLR/C/48	Valley Zenith Concord	01-04-2018	DLR/11/2018	4
Valley Legend Raggie	Magic Kiwi Sue	01-04-2018	DLR/12/2018	1

Female parent	Male Parent	Crossing date	Cross Identity	No. lowers pollinated
Sain Doll	Valley Legend Stei	02-04-2018	DLR/13/2018	8
Valley Legend Stei	Satin Doll	02-04-2018	DLR/14/2018	8
Valley Champion Georgeous	Mop down	04-04-2018	DLR/20/2018	3
Margaret hatcher Diplomat	Ruby Lips	04-04-2018	DLR/21/2018	4
Pure Junge Green	Valley Vampire Blood Red	04-04-2018	DLR/22/2018	4
Valley Zenith Discuss	Margaret hatcher Diplomat	04-04-2018	DLR/23/2018	4
Soul Hunt	Kiwi Midnight	04-04-2018	DLR/24/2018	4
Valley Inga Pink tower	Ruby Lips	04-04-2018	DLR/25/2018	3
Valley Legend Raggie	Rocky Creek Pebble	04-04-2018	DLR/26/2018	3
Breakout Flame	Rocky Creek Pebble	04-04-2018	DLR/27/2018	2
Breakout Flame	Ruby Lips	04-04-2018	DLR/28/2018	3
Sleeping Nymph	Valley Zenith Concord	07-04-2018	DLR/29/2018	3
Sleeping Nymph	Mop down	07-04-2018	DLR/30/2018	3
Valley Legend Stei	Morning Moon Great Tiger	07-04-2018	DLR/31/2018	4
Satin Doll	*Cym devonianum*	29-04-2018	DLR/32/2018	2
Sleeping Nymph	*Cym devonianum*	29-04-2018	DLR/33/2018	2
Cym devonianum	*Cym lowianum* (MRK)	29-04-2018	DLR/34/2018	9
Cym devonianum	*Cym eburneum*	29-04-2018	DLR/35/2018	4
Cym eburneum	*Cym lowianum* (MRK)	29-04-2018	DLR/36/2018	2
Valley Zenith	*Cym devonianum*	29-04-2018	DLR/37/2018	3
Baltic Elegans	*Cym devonianum*	29-04-2018	DLR/38/2018	4
Valley regent Raggie	*Cymbidium devonianum*	29-04-2018	DLR/39/2018	4
Madrid Forest King	*Cym devonianum*	29-04-2018	DLR/40/2018	4
Jung Frau Snow Queen	*Cym devonianum*	29-04-2018	DLR/41/2018	4
AX-03 (Kurseong)	*Cym devonianum*	29-04-2018	DLR/42/2018	4

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.
- In *Paphiopedilum*, DUS Test Guidelines with 77 morphological descriptors have been developed and notiied for registration.
- In *Mokara* (*Arachnis* x *Ascocentrum* x *Vanda*), DUS Test guidelines developed.

Grouping characters in Mokara

- Plant: width (cm)
- Inlorescence: number of lowers
- Flower: length (cm)
- Flower: width (cm)
- Dorsal sepal: main colour
- Lateral sepal: main colour
- Petal: main colour
- Lip: apical lobe: main colour
- Lip: colour of throat

Project 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).

Genetic diversity analysis of 11 fragrant *Coelogyne species* with ISSR primers

he genetic diversity analysis was carried out between 11 fragrant species of genus *Coelogyne viz.Coelogyne barbata, Coelogyne corymbosa, Coelogyne cristata, Coelogyne lavida, Coelogyne laccida, Coelogyne mooreana, Coelogyne nitida, Coelogyne ochreacea, Coelogyne ovalis, Coelogyne pantlingii,* and *Coelogyne punculata.* 12 selected ISSR primers used in this study generated 359 distinct bands out of which 287 bands were polymorphic. he UPGMA clustering method (Unweighted Pair Group Method with Arithmetic Mean) was used to construct a dendrogram.

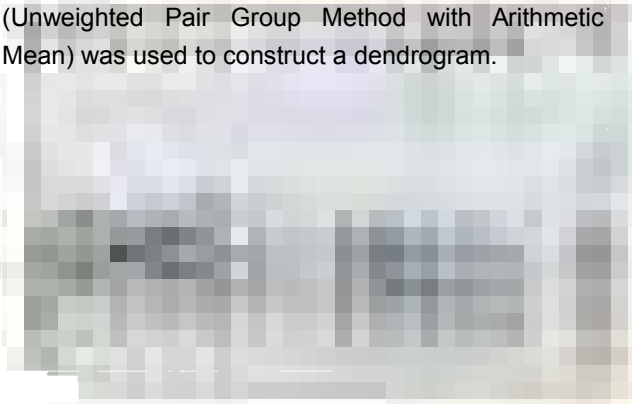


Fig. 18: ISSR A

Fig. 19: ISSR-I-32

Ampliication proile of fragrant *Coelogyne* species with ISSR primers resolved on agarose 2% gels

- ISSR proile generated by ISSR A
- ISSR proile generated by ISSR-I-32 M: DNA ladder, C: control

Assessment of scent volatiles emissions:

Developmental variations in the scent volatiles emissions of some fragrant *Coelogyne* and *Dendrobium* species was studied by Trapping of volatile emissions at diferent stages during lowering and further using Gas chromatography-mass spectrometry for analysis of chemical components.

Project 4: National Mission for Himalayan Studies (NMHS).

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

- Studied few RET species – Population, distribution, mapping and conservation status

  – *Cymbidium whiteae*

2. H-RA (002): Long-term Ecological/ Environmental monitoring of orchids & assessment of threats to biodiversity and Extent of IKP documentation & strengthened

A. Identiication of the sites for long-term ecological/environmental monitoring

- Literature survey on target species/long-term monitoring related study.
- Field survey and sites selection (i.e., presence of targeted species). Layout of secure plots (measured 2500 sq. M) for the monitoring activities.
- Benchmark data record.
- Installations of continuous scientiic data recorder in the sites for continuous monitoring activities.

B. To facilitate mainstreaming of long-term monitoring and building scientiic evidence base across the keys sectors

- Continuous data monitor on population behaviours, structures, reproduction and its phenology
- Efects of environmental factors on targeted population
- Substrate analysis for physio-chemical properties of diferent sites
- hreats identiication and management

C. To collect and systematically document the Indigenous Knowledge and Practices (IKP) linked it to scientiic evidence base

- Data collection through questionnaires on indigenous medicinal practices from the locals.
- Comprehensive data analysis.
- Research paper publication.

3. H-JRF-001: Carry out survey, GIS Mapping and collection of orchid populations of Sikkim Himalayas

- 17 distribution maps of Orchids (modiied)
- Compiled Latitudinal and Longitudinal data of 100 species of Orchids.
- GIS sotware based shape ile of India and Sikkim.
- Location map of Sikkim.

Location of Sikkim

Completed the preliminary data of Orchids Species List from Sikkim and Darjeeling Himalaya.

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

Table 5: List of RET species, status and their distribution in Sikkim

Sl. No.	Species	Status	Distribution
1	*Aerides odoratum* Loureiro	Rare and threatened	NE India, NW Himalaya, Sikkim and West Bengal
2	*Agrostophyllum planicaule* (Wall.ex Lindl.) Rchb.f.	Rare and hreatened	NE India
3	*Ascocentrum ampullaceum* (Roxb.) Schltr.	Rare and threatened	NE India, NW India and West Bengal
4	*Bulbophyllum cornucervi* King and Pantl	Very rare	Sikkim and Darjeeling
5	*Bulbophyllum emarginatum* (Finet) J.J.Smith	Very rare	NE India
6	*Bulbophyllum penicillium* Parish and Rchb.f.	Very rare	Meghalaya, Nagaland and Sikkim
7	*Bulbophyllum piluliferum* King and Pantl	Very rare in Sikkim	Meghalaya, Nagaland and Sikkim
8	*Bulbophyllum polyrhizum* Lindl.	Very rare	Sikkim, Darjeeling and Western Himalaya
9	*Bulbophyllum protractum* Hook.f.	Very rare	Sikkim and Darjeeling
10	*Bulbophyllum stenobulbon*	Very rare	Sikkim and Darjeeling
11	*Bulbophyllum trista* Rchb.f.	Very rare	Kumaon, Sikkim, Darjeeling and Orissa
12	*Calanthe anjanii* S.Z.Lucksom	Very rare and endemic	Sikkim and west Bengal
13	*Calanthe yuksomnensis* S.Z.Lucksom	Endemic and rare	Yuksom in South Sikkim
14	*Cephalantheropsis longipes*(Hook.f.) Ormerod	Rare and threatened	NE India and Sikkim
15	*Cheirostylis griithii* Lindl.	Rare and hreatened	N E India
16	*Cheirostylis moniliformis* (Grif.) Seidenfaden	Rare and threatened	E himalaya, Sikkim and West Bengal
17	*Cirrhopetalum andersonii* Hook.f.	Very rare	Sikkim, Darjeeling, Arunachal Pradesh
18	*Cirrohopetalum sikkimense* King and Pantling	Very rare	Sikkim and Darjeeling
19	*Cleisocentron pallens*(Cathcart ex. Lindl.) N. Pearce and P.J.Cribb	Rare and endangered	Sikkim, West Bengal and Arunachal Pradesh
20	*Cleisostoma striatum* (Rchb.f.) N.E.Brown	Very rare	Assam, Sikkim and West Bengal
21	*Cleisostoma subulatum* Bl.	Rare and threatened	Assam, Arunachal Pradesh, Meghalaya, Nagaland and Sikkim

Sl. No.	Species	Status	Distribution
22	*Coelogyne barbata* Lindl.ex.Grif.	Rare and hreatened	North India and Sikkim
23	*Coelogyne hitendrae* Das and Jain	Rare an threatened	NE India
24	*Coelogyne pantlingii* S.Z.Lucksom	Rare and endemic	Sikkim
25	*Crepidium aphyllum*(King and Pantling) A.Nageswara Rao	Very Rare	Arunachal Pradesh,Sikkim and West Bengal
26	*Crepidium saprophyum* (King and Pantling)A.Nageswar Rao	Very Rare	Endemoic to Sikkim
27	*Cymbidium dayanum* Rchb.f.	Very rare	Sikkim
28	*Cymbidium iridoides* D.Don	Rare and threatened	NE India, Sikkim and West Bengal
29	*Cymbidium whiteae* King and Pantling	Very rare	Sikkim
30	*Dendrobium chryseum* Rolfe	Very rare	Meghalaya, Sikkim and Uttar Pradesh
31	*Dendrobium cumulatum* Lindl.	Very rare	NE India and West Bengal
32	*Dendrobium farmeri* Paxton	Very rare	NE India and West Bengal
33	*Dendrobium formosum* Rchb.ex.Lindl.	Very rare	Assam, Meghalaya, Sikkim and West Bengal
34	*Dendrobium jenkinsii* Wall.ex.Lindl.	Very rare	NE India and West Bengal
35	*Dendrobium peguanum* Lindl.	Very rare	West Bengal
36	*Dendrobium pendulum* Roxb	Rare and threatened	Manipur
37	*Dendrobium praecinctum* Rchb.f.	Very rare or in the threshold of extinction	NE India and West Bengal
38	*Dendrobium sulcatum* Lindl.	Very rare	Meghalaya, Sikkim and Uttar Pradesh
39	*Dendrobium terminale* Parish and Rchb.f.	Very rare	Sikkim and West Bengal
40	*Didiciea cunninghamii* King the Prain ex King the Pantling	Very Rare	Endemic to North Sikkim
41	*Diphylax urceolata (*C.B.Clarke)Hook.f.	Rare and threatened	Sikkim and West Bengal
42	*Diplomeris hirsuta* (Lindl.) Lindl.	Very rare	Arunachal Pradesh, Darjeeling and Sikkim
43	*Diploprora championii* (Lindl.ex Bentham) Hook.f.	Very rare	Sikkim and West Bengal
44	*Drymoda gymnopus* (Hook.f.) Garay, Hamer and Seigerist	Endangered	NE India
45	*Epigenium treutleri (*Hook.f.) Omerod	Very rare, may be extinct	Sikkim
46	*Epipactis royleana* Lindl.	Rare and threatened	N. India and Sikkim
47	*Eria clausa* King and Pantling	Rare and threatened	NE India nad West Bengal
48	*Esmeralda cathcartii* (Lindl.) Rchb.f.	Rare and threatened	NE India and West Bengal
49	*Esmeralda clarkei* Rchb.f.	Rare and hreatened	NE India and West Bengal
50	*Eulophia bicallosa* (D.Don)P.F.Hunt		Sikkim and West Bengal
51	*Eulophia densilora* Lindl.	Maybe extinct	not known
52	*Eulophia mannii*(Rchb.f.)Hook.f.	Very rare	NE India and West Bengal

Sl. No.	Species	Status	Distribution
53	*Eulophia promensis* Lindl.	Very rare and threatened	NE India and West Bengal
54	*Eulophia zollingeri* (Rchb.f.)J.J.Smith	Rare and hreatened	Sikkim and West Bengal
55	*Galeola nudilora* Loureiro	Very rare	N. India, W.Bengal
56	*Gastrochilus linearifolius* Z.H.Tsi and Garay	On the verge of extinction	NE India and West Bengal
57	*Habenaria malleifera* Hook.f.	Very rare	NE India nad West Bengal
58	*Habenaria stenopetala* Lindl.	Very rare	NE India
59	*Kingidium deliciosum* (Rchb.f.) Sweet.	Very rare	NE India nad West Bengal
60	*Liparis duthiei* Hook.f.	Very rare	NW India, Sikkim and West Bengal
61	*Liparis glossula* Rchb.f.	Very rare	NW Himalaya and Sikkim
62	*Liparis pygmaea* King and Pantling	Very rare	Sikkim
63	*Liparis somai* Hayata	Very rare	Sikkim
64	*Mastigion appendiculatum* (Rolfe)Garay, Hamer and Seigreist	Very rare	Assam, Madhya Pradesh and Nagaland
65	*Nerevilia crociformis* (Zollinhger & Moritzi) Seidenfaden	Very rare	Sikkim
66	*Nervilia gammiaeana* (Hook.f.) Schltr.	Rare and threatened	NE India, W. Bengal
67	*Nervilia hookeriana* (King and Pantloing) Sentlr.	Very rare	Endemic to Sikkim
68	*Nervilia plicata* (Andrews) Schltr.	Rare and threatened	Sikkim, N. India, Ne India, W. Bengal
69	*Nervilla falcata* (King and Pantling) Schltr.	Very rare	Jaldhaka of W. Bengal
70	*Oberonia angustifolia* Lindl.	Very rare	West Bengal, Meghalaya
71	*Oberonia ensiformis* (J.E.Smith) Lindl.	Very rare	Sikkim and West Bengal
72	*Oberonia jenkinsiana* Grif.ex.Lindl.	Very rare	Sikkim and West Bengal
73	*Oberonia kingii* S.Z.Lucksom	Very rare	Endemic to Sikkim
74	*Oberonia prainiana* King and Pantling	Very rare	W.Bengal
75	*Paphiopedilum fairriewanum (*Lindl.) Stein	Rare and threatened	Arunachal Pradesh, Assam and Sikkim
76	*Paphiopedilum venustum* (Wall.)	Rare and threatened	NE India, Meghalaya
77	*Pecteilis sausanne* (L.) Rainesque	Rare and threatened	NE India and West Bengal
78	*Peristylus goodyeroides* (D.Don) Lindl.	Rare and threatened	NW India , Sikkim and West Bengal
79	*Peristylus parishii* Rchb. F.	Endangered	Sikkim, West Bengal and Andaman island
80	*Phalaenopsis lobbii* (Rchb.f.)H.R.Sweet	Very rare, maybe extinct	NE India and West Bengal
81	*Phalaenopsis mannii* Rchb.f.	Rare or extinct from natural habitat of Sikkim	NE India and West Bengal

Sl. No.	Species	Status	Distribution
82	*Plantlingia paradoxa* Prain	Very rare	Endemic to Sikkim
83	*Pomatocalpa bambusarum* (King and Pantling)Garay	Very rare	NE India and West Bengal
84	*Pteroceras teres* (Bl.) Holttum	endangered	Sikkim and West Bengal
85	*Rhomboda longifolia* Lindl.	Very Rare	Endemic to Sikkim
86	*Rhytionanthos spathulatum*(Rolfe ex Cooper) Garay, Hamer and Seigerist	At the verge of extinction	NE India and West Bengal
87	*Risleya atropurpurea* King and Pantling	Very rare	Sikkim
88	*hrixpermum centipeda* Loureiro	Very rare	W.Bengal
89	*Trichotosia pulvinata* (Lindl.) Kranzlin	Rare and threatened	NE India and West Bengal
90	*Vanda alpina* (Lindl.)Lindl.	Rare and threatened	NE India
91	*Zeuxine lava* (Wall. Ex. Lindl.) Trimen	Very rare	Darjeeling and Sikkim
92	*Zeuxine glandulosa* King and Pantling	Very rare	Sikkim and West Bengal
93	*Zeuxine nervosa* (Wall. Ex. Lindl.) Bentham ex.C.B.Clarke	Rare and threatened	Sikkim and West Bengal
94	*Zeuxine pulchrea* King and Pantling	Rare and threatened	NE India and Sikkim
95	*Zeuxine seidenfadenii* Deva et Naithni	Very rare	Uttar-Khand, Sikkim

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

- Success of *ex-situ* conservation and growing of *Diplomeris hirsuta* in diferent temperature and moisture level in glass house
- Growing of orchid species in alternative temperature under controlled environment conditions and record the morphological character of orchids in diferent temperature in diferent house.
- Growing of *Dendrobium nobile* keikis, *Diplomeris hirsuta* (Lindl.) Lindl, *Ornithochilus diformis* (Wall. ex Lindl.) Schltr, *Herpysma longicaulis* Lindl, *Pleione maculuta*, *Coelogyne fuscescens* etc, plants in diferent temperature
- Pollen viability and germination test is conducted in diferent temperature by using growing media and alternative temperature.
- To simulate the habitat of orchids and study the efect of increasing temperature on its growth and phenology.
- To observe the selected orchid species in controlled environment or alternate habitat. andmoistureconditions.

Efect of temperature and humidity on growth & lowering of orchids during 2017-18

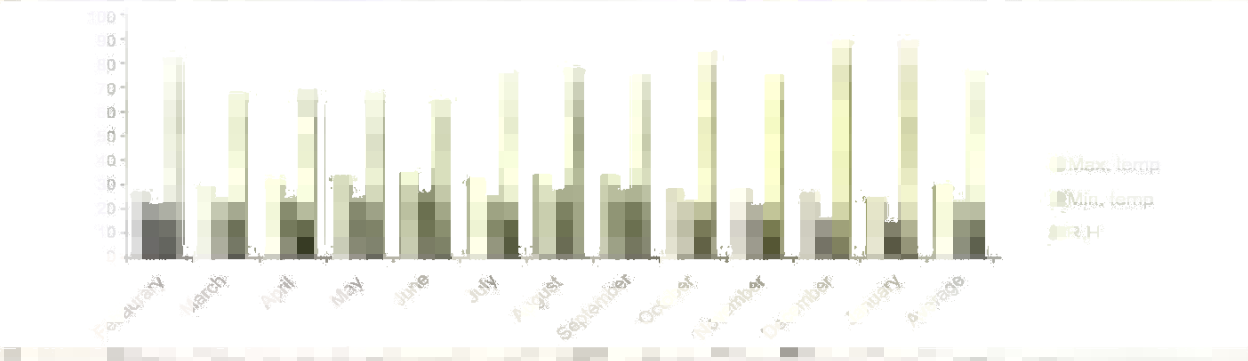


Fig. 20: Glass House-1

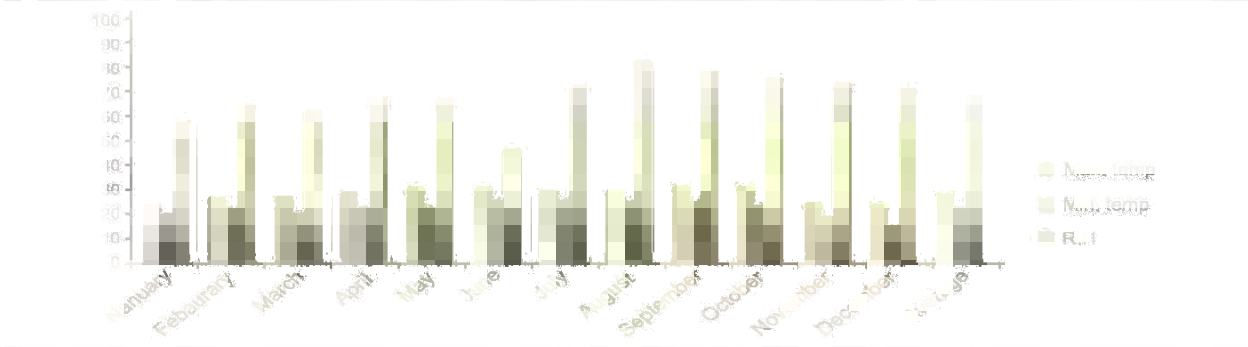


Fig. 21: Glass House-2

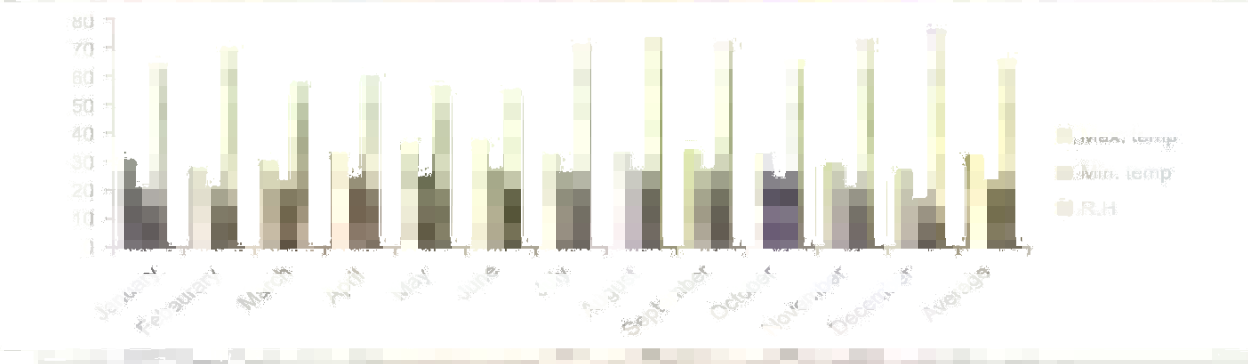


Fig. 22: Glass House-3

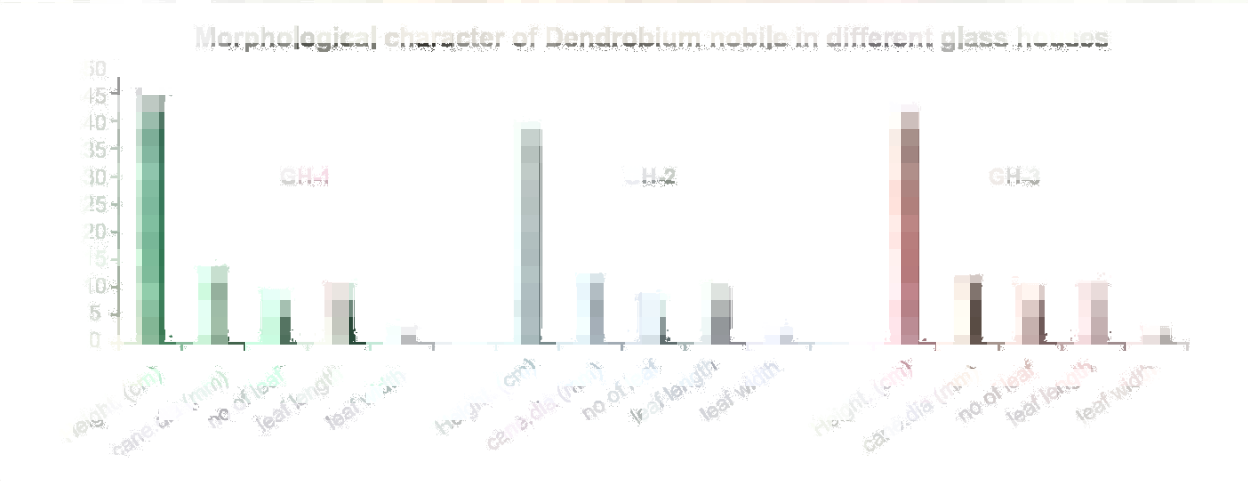


Fig. 23: Glass House-3

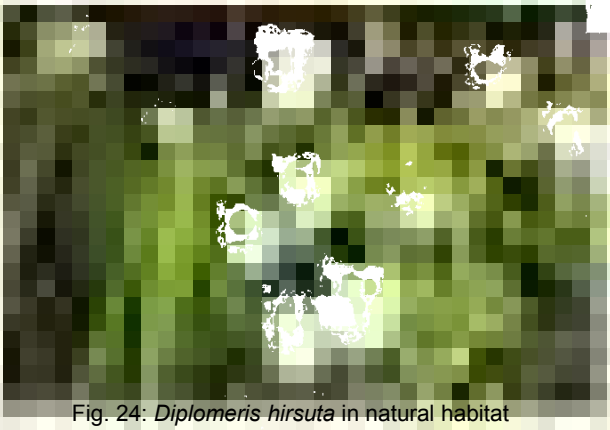


Fig. 24: *Diplomeris hirsuta* in natural habitat

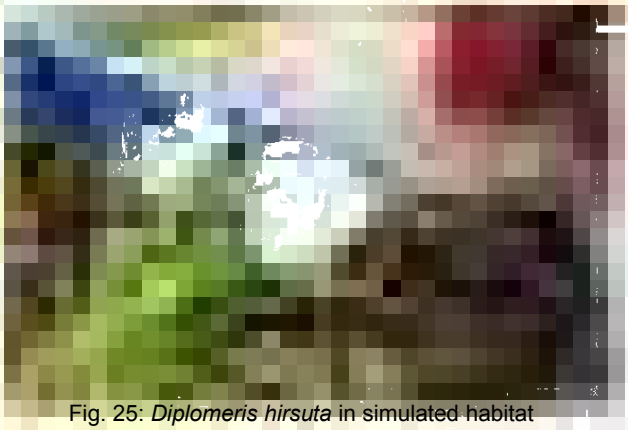


Fig. 25: *Diplomeris hirsuta* in simulated habitat

Fig. 26: *Dendrobium nobile* in simulated habitat

Fig. 27: *Ornithochillus deformis* in simulated habitat

. H-JRF- : Chemical profiling of medicinally important orchids, *in-vitro* multiplication and re-introduction of selected rare orchid species of Sikkim

- Quantitative analysis of medicinal orchids under process.
- Collected and compilation of secondary data of all the reported medicinal orchids of Sikkim Himalaya
- ITK survey for medicinal uses of orchids and conservation.
- Sample preparation of 05 (ive) medicinal orchids have been done for further analytical works.

Himalayas in their Natural Habitat.

Extension activities Under NMHS Project

1. Awareness programme on conservation of orchid biodiversity among orchid growers

he fellows of NMHS were created the awareness programme on Conservation of orchid biodiversity among the orchid growers at Yakten village (East Sikkim Dt.), Sikkim under the leadership of Dr. Rampal, Principal Scientist, ICAR-NRCO, Pakyong, Sikkim on the event of Swatch Bharat pakwada held on 19-10-2016. he fellows were actively done voluntarily job and created the awareness regarding conservation and protection of orchid biodiversity.

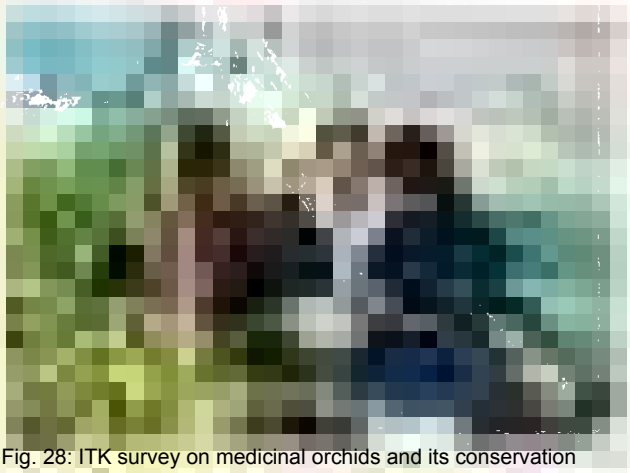


Fig. 28: ITK survey on medicinal orchids and its conservation

Fig. 29: Awareness programme on Conservation of Orchid biodiversity by the fellows of NMHS at Yakten village (East Sikkim) on 19-10-16.

Project 5: Inventorization of gamma radiation irradiation technology for Orchid varietal improvement (BRNS-BARC Project).

5.1 *In-vitro* propagation of irradiated PLBs of 'Emma White' (Dendrobium hybrid)

Following the treatments given to PLBs and small plantlets for its diferentiation into bigger plantlets on responsive media (1st year), good number of plantlets were obtained with healthy shoots and long roots on medium supplemented with IBA (2 mg/l), BAP (0.25 mg/l), and NAA

Fig. 30: Treatments for diferentiation of PLBs into plantlets

Fig. 31: Response of PLBs post gamma irradiation treatment

A. Control ; **B**. Treatment DR (A); **C**. Treatment DR A (I); **D**. Treatment DR (B)

Fig. 32: Rooting Treatment

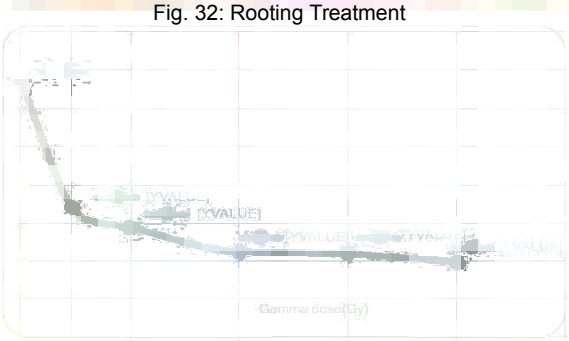


Fig. 33: Average fresh weights of irradiated PLBs decreasing from 10 to 80 Gy

(0.25 mg/l) with addition of stones, bricks and sand [Fig. 32]. PLBs showed good diferentiation response on Gamborg medium supplemented with BAP (1 mg/l) and NAA (0.2 mg/l) [Fig.1]. PLBs at higher doses of gamma i.e. 40, 60 and 80 Gy afected the most in case of growth and development with exceptional reduction in shoot diferentiation as compared to 10 and 20 Gy [Fig. 31]. he average fresh weights of irradiated PLBs recorded ater 60 days of incubation period was found to be decreasing progressively from 10 to 80 Gy as compared to control/untreated PLBs [Fig.].

. . Cell-based assay screening of first batch *in-vitro* samples (irradiated) of 'Emma White'

he irradiated *in-vitro* samples of 'Emma White' (Dendrobium hybrid) at two diferent stages of PLBs and plantlets were analyzed by high-throughput cell analyzer (TTP Labtech acumen® Cellista) at BARC, Mumbai. Nuclei were isolated from about 25mg of control and treated PLBs and leaves by following basic nuclei isolation protocol (Jaroslav Dolezel *et al.*) with few modiications. he protocol was irst optimized using PLBs and plantlets of Dendrobium hybrid. A total of 108 samples (PLBs-Control, 10, 20, 40, 60, 80 Gy and Plantlets-Control, 10, 20 Gy) with three biological replicates and two technical replicates were then scanned and analyzed using Cellista sotware.

5.3. Preliminary attempt to study genetic variability /mutant identification using molecular technique 'capillary electrophoresis'

Genomic DNA was extracted from about 200 mg of PLBs and leaves of Dendrobium hybrid 'Emma White' using modiied CTAB method. DNA was quantiied using UV- Spectrophotometer (UV-1800 Shimadzu), followed by quality check by Agarose gel electrophoresis of total 25 nos. of samples: PLBs – 01 control and 05 treated; Plantlets (leaf) – 01 plt control, 08 plts (10 Gy), 10 plts (20 Gy). Five reference SSR markers: DO-02, DO-03, DO-07, DO-09 and DO-12 were selected from *Dendrobium oicinale* (S. GU *et al.*) in an attempt to study genetic variation among the irradiated plants. PCR reaction was carried out using 05 SSR markers for one PLB and one plantlet sample with 55º C as annealing temperature *(T_a)*. No bands were observed on 1.2% agarose gel.

Fig. 34: **Agarose Gel Electrophoresis**
(L: Ladder 1 kb; Samples: 1 to 25)

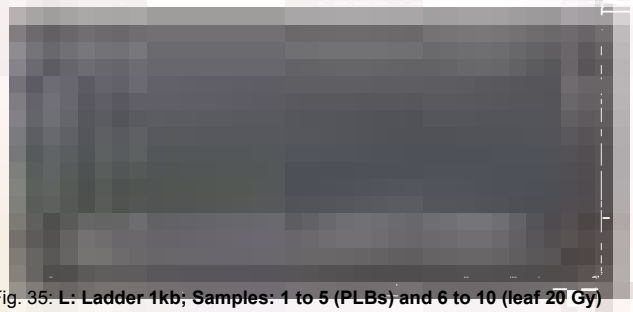


Fig. 35: **L: Ladder 1kb; Samples: 1 to 5 (PLBs) and 6 to 10 (leaf 20 Gy)**

PCR reaction repeated using SSR markers with slight modiication in (T_a) as follows for samples: DO-02 (T_a)at 47ºC, DO-07 and DO-09 *(T_a)*at 55º C, DO-03 and DO-12 (T_a)at 51º C (S. GU *et al.*). PCR product was then run on capillary electrophoresis (Qiagen QIAxcel Advanced) using 25-500 bp marker and 15- 600 bp alignment marker with OM500 method. No bands were ampliied, could be due to lack of locus speciic markers. Gradient PCR reaction was done for optimizing the annealing temperature *(T_a)*of ive SSR marker with temperature (T) 55º C and gradient (G) 10. No bands observed on capillary electrophoresis gel image.

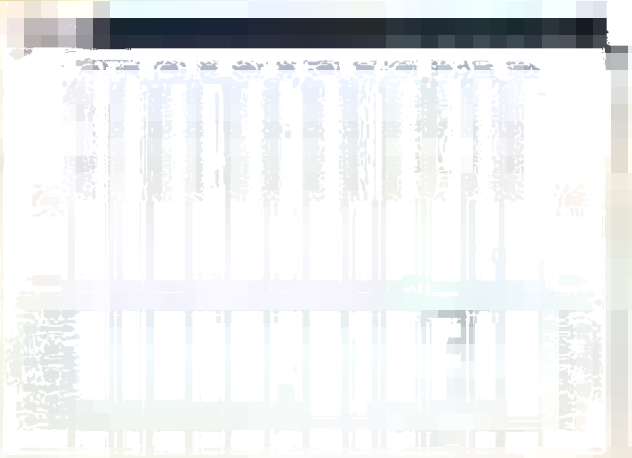


Fig. 36: Capillary Electrophoresis Gel Image

Following irradiation, embryos were immediately sub-cultured into responsive treatment (Treatments GT1, GT2, GT3, and GT4) for their diferentiation into plantlets [Fig].

Fig. 37: Abnormal growth of plantlet in Control, 10 & 20 Gy and 0 % survival in 30, 40 & 50 Gy

5.4. Gamma radiation on 2nd batch samples at BARC:

Apomictic embryos of PBS(X)-17-01 (*Zygopetalum Intermedium*)

Apomictic embryos of PBS(X)-17-01 were sub-cultured in less responsive treatment *i.e.* Treatment 1 (T1): MS+ Sucrose (2%) + BAP (0.2mg) + AC (2g) in order to slow the growth of globules till the irradiation treatment completed.

Gamma Dose (Gy)	Total No.	Exposure Time (min:sec)
10	05	00:20
20	05	00:40
30	04	00:60
40	03	01:21
50	03	01:41

5.5 Seed Capsules

Mature seed capsules of selected orchid species were harvested from the ield and irradiated with gamma rays at two diferent doses of 10 and 25 Gy at BARC.

5.6 Callus culture work: Callus Induction of *Vanda coerulea* (#1090, #1081, #710, #711) with leaf and lower bud stalk as explant was initiated using MS, Nitsh, Gamborg and Mitra Orchid media supplemented with diferent combination of BAP, NAA and TDZ.

No.	Species	10 Gy	25 Gy	Total
1	*Vanda coerulea*	PBS-16-43, 61,	PBS-16-62, PBS(x)-17-02	04
2	*Zygopetalum intermedium*	-	PBS-16-53	01
3	(*V. coerulea* x V. roxburghii)	PBS-16-16, 17	PBS-16-18, 51	04
4	*Arachnis labrosa*	-	PBS(x)-17-48	01
5	*Cymbidium pendulum*	-	PBS(x)-17-25	01
6	*Epidendrum sp.*	PBS(x)-17-36, 37	PBS(x)-17-38, 39	04
7	*Coelogyne laccida*	PBS(x)-17-46	PBS(x)-17-47	02
8	*Dendrobium moschatum*	PBSx-17-43	PBSx-17-44, 45	03
9	*Acampe rigida*	PBSx-17-41	PBSx-17-42	02
10	*Arundina graminifolia*	PBSx-17-49	PBSx-17-50	02
11	*Paphiopedilum venustum*	-	PBSx-17-40	01

Gamma Chamber 5000, BRIT, DAE, Mumbai; Dose Rate: 30.16 Gy/ min; 01.81 KGy / hr

Project 6. Life cycle cryo-biotechnology of orchids for bio-resources conservation and sustainable development

6.1 Effects of pollen age, sucrose concentration, desiccation tolerance, and storage temperature on *in vitro* pollen germination of *Arundina graminifolia* (D. Don) Hochr.

Arundina graminifolia (D. Don) Hochr. popularly called as 'bamboo orchids' because of its tall stem, shape of leaves and their arrangement over reedy stem look like bamboo. his species occur in tropical and subtropical Asia from an elevation ranging from sea level to 1200 meters. his plant grows to a height of about 70 cm to 2 m and lowers through April to October. he lowers are pink or rosy lilac akin to *Cattleya* lowers. his species is useful for landscaping because of sequential opening lower buds that impart long display life. Dwarf sized plants of this species can also be grown as potted plants for decorating homes and oices. *A. graminifolia* var. revoluta is dwarf but shy in lowering. he intraspeciic hybridization can result in varieties suitable for pot culture. Further, hybridization with *Spathoglottis plicata* have shown the way for devising novel varieties suitable for landscaping and pot culture. his study was undertaken to optimize pollen age, develop procedure for determination of *A. graminifolia* pollen viability, and to deine the conditions for short term pollen storage for cross pollination and hybridization. he study showed that pollen collected on third day of anthesis had highest germination and pollen tube length. he optimum sucrose concentration for germination of *A. graminifolia* pollen was 6 per cent. he pollens of *A. graminifolia* are desiccation tolerant and recorded the highest germination percentage and longest pollen tube length when the pollens were rehydrated at 90 per cent RH for two days. Dehydrated pollens could be stored in viable condition for 15 days at room temperature but storing pollens at low temperature (4 ^{0}C or -80 ^{0}C) enhances longevity. Storing pollens at -80 ^{0}C was found better than 4^0 C.

6.2 Pollen germination and pollen tube growth in subfamily Epidendroidea

he family Orchidaceae comprises of ive subfamilies. Among them, Epidendroideae is the largest and consists of 21160 species constituting 76 % of the family. Most of the species of this subfamily grow in tropical and subtropical vegetation. Majority of the species have adapted to the epiphytic mode of living. However, some are also found as terrestrial and mycoheterotrophs. In the present study, we investigated the pollen germination and pollen tube growth of 23 species belonging to *Dendrobieae (5), Arethuseae (3), Vandeae (3), Epidendroieae (3), Collabieae (1), Malaxideae (1), Podochileae (2), Cymbidieae* (4) and Cymbidium hybrid on Brewbacker and Kwack's, 1963 medium. he pollens were excised from the fresh lowers with the help of toothpicks and cultured on freshly prepared media in Petri plates and incubated at 22^{0}C. he germination and pollen tube length was assessed ater 24 h of cultured. One way ANOVA was used for data analysis with Statistical sotware and the means were separated by Duncan's Multiple Test Range at 95 % Conidence Interval. he germination percent and pollen tube growth varied from 31.55-89.62 percent and 38.04-240.17 µm, respectively. he lowest germination percent was recorded in *Dendrobium longicornu* Lindl. (31.55%) whereas it was the highest in *Epidendrum xanthinum*Lindl. (89.62). he lengthiest pollen tube was observed in *Calanthe masuca* D. Don (240.17 µm) but the shortest was in *Phalaenopsis deliciosum* Rchb. f. (38.04 µm). No correlation with germination percentage or pollen tube growth was found among the tribes.

Technology Assessed & Transfer

Sl No.	Date & duration	Topic and Venue	No. of Beneiciaries
1.	29th June 2017	Prospects of Orchid Cultivation in Tripura, Tripura	25 oicials (Tripura)
2.	18th July 2017	Value Addition in Orchids, NRCO, Pakyong	10 farmers (Chhalamthang)
3.	18th Sept. 2017	Value Addition in Orchids, NRCO, Pakyong	22 farmers (Haryana)
4.	18th Oct.2017	Central Public Procurement Portal, NRCO, Pakyong	10 staf (NRCO)
5.	15th Nov, 2017	Value Addition in Orchids, NRCO, Pakyong	71 students (KAU, Trichur)
6.	28th Nov.2017	Floriculture in Hill regions, NRCO, pakyong	19 students (College of Hort., Sikkim)
7.	19th Dec. 2017	Orchid cultivation, NRCO, Pakyong	9 extension oicers (ATMA, MP)
8.	29th-30th January, 2018	Production Technology & DNA Finger printing in orchids, NRCO, Pakyong	24 students (IITM, UP)
9.	21st Feb. 2018	Floriculture in Hill regions, NRCO, pakyong	20 farmers (Haryana)
10.	13th-17th March, 2018	ICAR Sponsored Training Under Pt. Deen Dayal Upadhyay Unnat Krishi Siksha Yojana, Sikkim Kalyan Asram	30 farmers (East Sikkim)
11.	23rd March, 2018	Vegetative Propagation and rejuvenation	60 farmers (Lossing-Dhakal)
12	26th March, 2018	Floriculture in Hill regions, NRCO, Pakyong	25 farmers (Morigaon, Assam)
13.	28th March 2018	Awareness program on IPR, ICAR-NRCO, Pakyong, staf Sikkim	students,

Organised the National Seminar on Floriculture for Rural and Urban Prosperity in the Scenario of Climate Change in collaboration with Indian Society of Ornamental Horticulture, IARI- Pusa Campus, New Delhi

Fig. 38: National Seminar on Floriculture for Rural and Urban Prosperity in the Scenario of Climate Change

ICAR NRC for Orchids, Pakyong Showcased the technologies developed by the institute at Sikkim Organic Day Mela at Saramsa, Ranipool

Fig. 39: Shri Pawan Kumar Chamling, Hon'ble Chief Mminister of Sikkim and Acharya Shri Bal Krishna from Patanjali visited ICAR-NRCO Stall during the Organic Day Mela at Saramsa, Ranipool.

Interface Meeting between A Team of RIGSS officials of Royal Government of Bhutan and Scientists, ICAR-NRC for Orchids, Pakyong

A team of RIGSS oicials from Royal Government of Bhutan visited ICAR-NRC for Orchids, Pakyong, Sikkim on 1st April, 2017. he Director welcomed Ms. Siporah, Nodal oicer and all oicial delegates of Bhutan and gave power point presentation above the role of institute research activities and farmers centric program. He also explained the role of ICAR in Indian agricultural system and latest farmers programs which were introduced by ICAR & Govt. of India. Scientiic staf of ICAR-NRCO was interacted with a team of RIGSS oicials and visited experimental farm of the institute. RIGSS oicials appreciated the farmer's programmes conducted by ICAR, and various schemes of Govt. of India and team efort of ICAR-NRCO for research and extension activities.

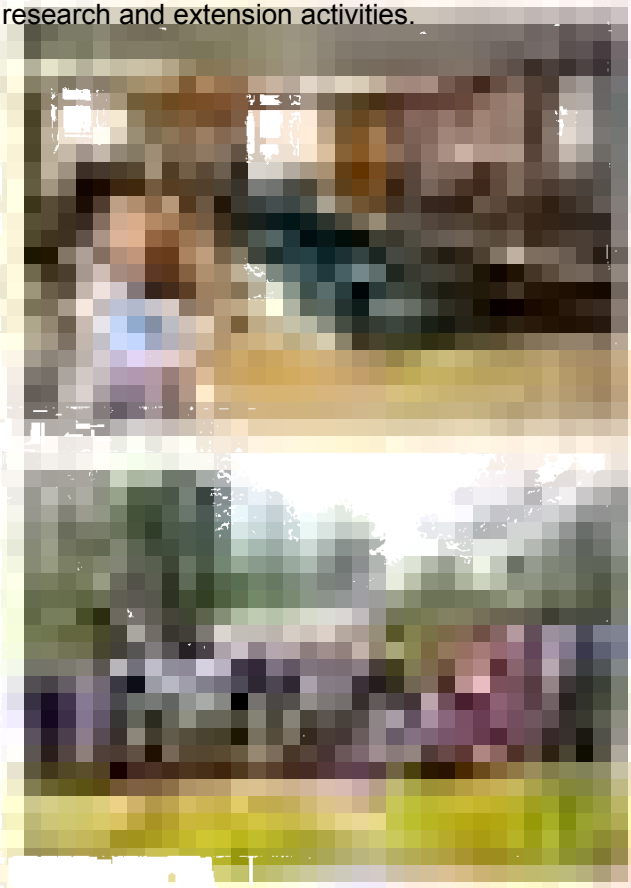


Fig. 40: Interface Meeting between A Team of RIGSS oicials of Royal Government of Bhutan and Scientists, ICAR-NRC for Orchids, Pakyong

Awareness programme on *"Prospects of Orchid cultivation in Tripura"* on 29th June, 2017 at ICAR-Research Complex, Lembucherru Centre, Tripura

Organized the Awareness programme on "*Prospects of Orchid cultivation in Tripura*" under the chairmanship of Shri.Arun Debbarma, Director of Agriculture, Tripura at conference hall of the centre. he programme was Co-chaired by Dr. Khandpal, J.D. ICAR-RC, Lembucherra centre. During the programme, Dr. M. Dutta, Principal, College of Agriculture, Agartala, State agricultural department oicials and scientiic staf of Lembucherra centre were actively participated and interacted in the programme. he programme was completed in forenoon with fruitful discussions for conservation, documentation of orchid diversity in Tripura and prospects and identiication of potential orchids for commercial cultivation in Tripura. During the part of the programme, a ield visit was conducted at (polyhouses of four progressive farmers) Ranirkhamar and Maheshkhola of Dukli area, Agartala.

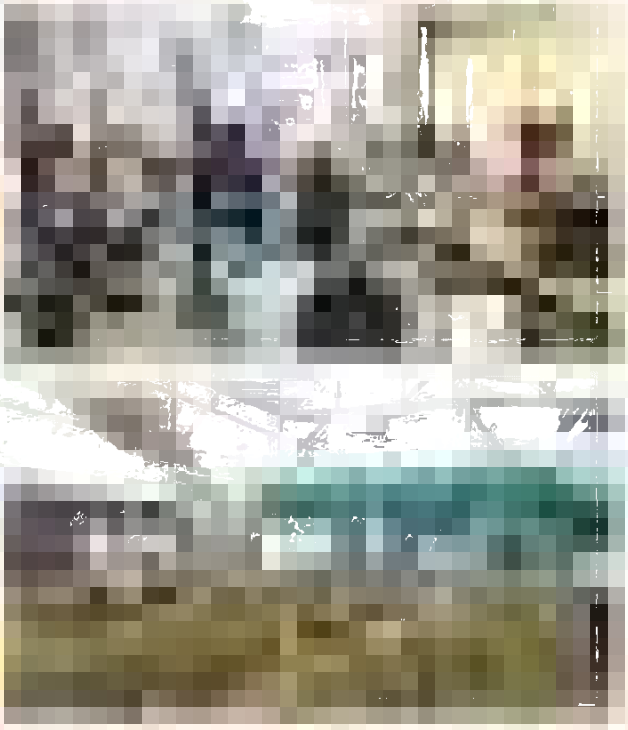


Fig. 41: Awareness programme on "Prospects of Orchid cultivation in Tripura

ICAR Sponsored Training Under Pt. Deen Dayal Upadhyay Unnat Krishi Siksha Yojana

ICAR Sponsored Training Under Pt. Deen Dayal Upadhya Unnat Krishi Siksha Yojna was organised by ICAR NRC for Orchids, Pakyong Sikkim at Sikkim Kalyan Ashram, Ranipool from 13th to 17th March, 2018

First Day Inaugural program was initiated with 45 participants including 30 farmers from Sikkim. Inauguration Program was started with lighting of lamp by Dr. P.P. Dabral, Dean, CAE&PHT, Ranipool , Chief Guest followed by introductory & welcome remarks by Dr. L.C. De, Principal Scientist & Nodal Oicer, ICAR-NRCO, and remarks by Shri Ram Pada Paira, i/c Kalyan Asram, and address by Dr. P.P. Dabral , Chief Guest. Ater that, three practical sessions by farmers on Farmers inventory, Farmer's Practice and Farmers list of challenges on organic/ natural farming was held.

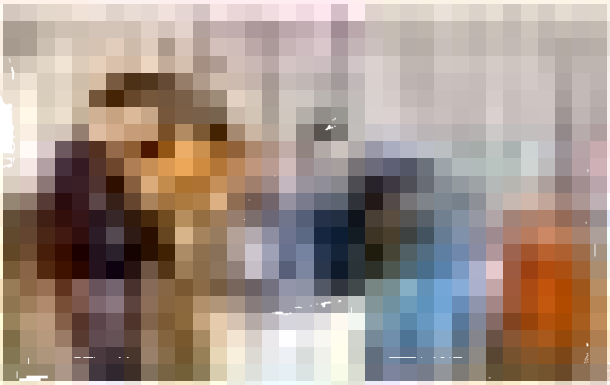


Fig. 42: Lighting of Lamp by Dr. P.P. Dabral Dean, CAE& PHT, Ranipool, Chief Guest

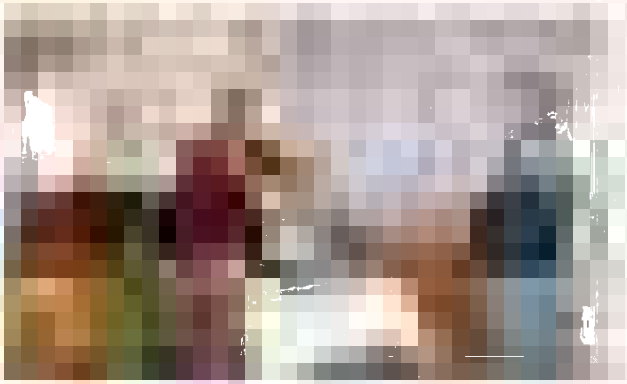


Fig. 43: Lighting of Lamp by Dr. L.C. De, Nodal Oicer

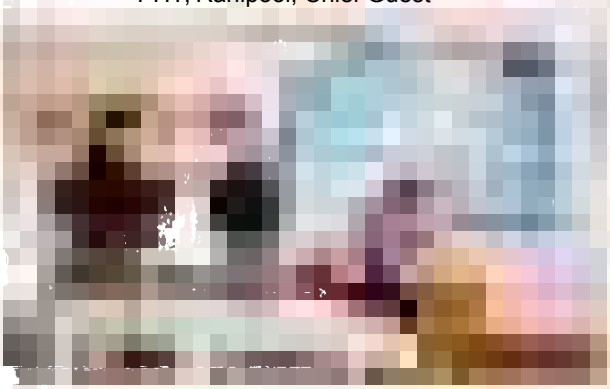


Fig. 44: Honoring to Dr. P.P. Dabral, Dean, CAE & PHT, Chief Guest by Dr.L.C. De, Nodal Oicer, ICAR – NRCO, Pakyong

Fig. 45: Remarks by Shri Rampada Paira, i/c Sikkim Kalyan Asram, Marchak, Ranippol

Fig. 46: Address by Dr. P.P. Dabral, Chief Guest

Fig. 47: Practical sessions class on Farmers inventory, Farmer's Practice and Farmers list of challenges on organic/ natural farming

Second day program was completed by three lectures based on the following topics:

1. Principles of nutrient management through processes of nature, Zebu Cattle (Nitrate formation by lightning, plant waste recycling), Principles of nutrients management by role of micro-organisms, Mulching and Green manuring by **Dr.A.B Sherpa, Assistant Professor, CAE & PHT Ranipool.**
2. Understanding the role and importance of earthworm (endogenous – belonging to the village ecosystem), Production of enriched compost and vermi-composting, Production of bio-control agents-(Neemastra, Brahmastra, Agnestra, Dasparni ark etc.) **by Shri Rakesh Singh, SRF, ICAR NRCO Pakyong.**
3. Sampling and testing of Soil for base line data of the ield and for monitoring by **Dr. Ch. Birendrajit, Assistant Professor, CAE & PHT, Ranipool.**

hird Day program was completed by three lectures based on the following topics:

1. Water management through planning of optimized mix of crops and Advanced method of water management such as drip, sprinkler, micro-sprinkler. Other Water conservation techniques (emphasizing Per Drop, More Crop) – farm pond, check dam, bunding, land shaping for slope management; Raised – bed mulching and laser leveling; Irrigation scheduling and water budgeting, by **Dr. G.T. Patle, Assistant Professor, CAE & PHT, Ranipool.**
2. Emphasis on alternative source of Energy shall be clariied as judicious mix of solar, wind, bio gas and bullock – power, could be done, in diferent ways, at diferent location, **By Dr. M.S. Seveda, Associate Professor, CAE & PHT, Ranipool.**
3. Protected Cultivation Options, by **Dr. L.C. De, Pr. Scientist (Floriculture) ICAR-NRCO, Pakyong.**

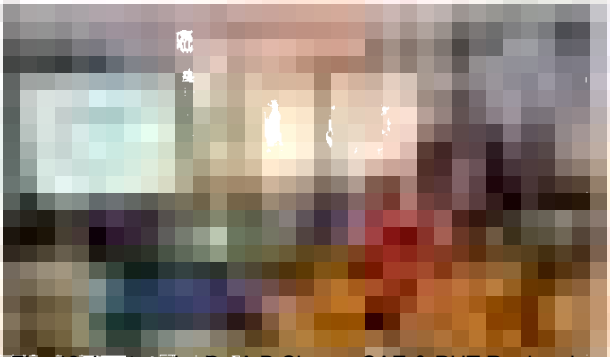


Fig. 48: Lecture by Dr. A.B Sherpa CAE & PHT Ranipool

Fig. 49: Lecture by Dr. G.T. Patle, CAE & PHT, Ranipool

Fig. 50: Lecture by Dr. Ch. Birendrajit, CAE & PHT, Ranipool.

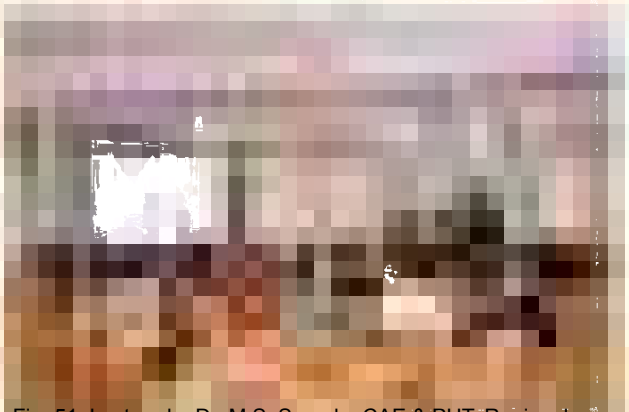


Fig. 51: Lecture by Dr. M.S. Seveda, CAE & PHT, Ranipool

Fourth Day program was completed by three lectures and one practical based on the following topics:

1. Identiication of appropriate and locale speciic variety of crops, vegetables, horticulture; focus on production of its seeds and provisioning of quality planting materials useful for the area, and post-harvest management , processing, value addition, storage, marketing by **Dr. S. Manivannan (Sikkim University), Gangtok.**
2. Important Varieties of lower Crops and their package of practice -Rose, Gladiolus, Chrysanthemum, Marigold, Rajnigandha, China Aster, Orchid, Anthurium, Gerbera by **Dr. L.C. De, Pr. Scientist, ICAR – NRCO Pakyong.**
3. Latest marketing tools- Digital and Internet-based cashless system of transactions by **Shri Rajat Das**, AFA &O, NRCO, Pakyong, Sikkim

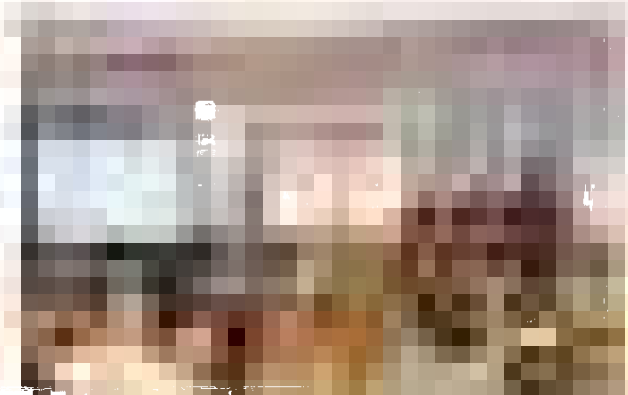


Fig. 52: Lecture by Dr. S. Manivannan (Sikkim University), Gangtok

Fig. 54: Lecture by Dr. L.C. De, Principal Scientist, ICAR-NRCO

he 5th Day (17.03.2018) program was completed by three lectures and one practical based on the following topics:

1. GAU KRISHI ADHIRAKSHINI SIDHANT (Zebu cattle based conservational agriculture), including focus on its breed conservation; understanding the issue of A1-A2 milk with production methods of other Panchgavya products including proper method of cow urine collection and treatments of cattle diseases By **Dr. Raiqul Islam, Principal Scientist, Animal Science, NOFRI, Tadong, Gangtok**
2. Introduction to relevant farm implements, tools and their usages in diferent farming operations with demonstration By **Dr. S.N. Yadav, Professor, CAE& PHT, Ranipool, Sikkim**
3. Organic/ZB natural farming-based integrated farming systems (Crops, fruits, vegetables, lowers, ish, poultry, duck rearing), **by L.C. De, Principal Scientist, ICAR-NRCO, Pakyong, Sikkim.**
4. Practical on Farmers Feedback on Training under PDDUUKSY on Natural Farmring/ Cow based Economy

Fig. 53: Lecture by Dr. S.N. Yadav, Professor, CAE&PHT, Ranipool, Sikkim

Fig. 55: Lecture by Dr. Raiqul Islam, Principal Scientist, Animal Science, NOFRI, Gangtok

Fig. 56: Lecture by Dr. L.C. De, Principal Scientist, ICAR-NRCO, Pakyong

Fig. 57: Group photo of Framers Participants

Awareness cum Training Programme on Intellectual Property Rights"

ICAR-NRCO organized "Awareness cum Training Programmeon Intellectual Property Rights"at the institute training hall on 28th March, 2018. here were 35 participants (students and research fellows) in the training programme.

Fig. 58: Awareness cum Training Programme on Intellectual Property Rights

Demonstrations

Demonstrations on orchid media preparation, re-potting of plants and disease control measures were presented before farmers as per request received from UFS members. An interaction session was also organized with the KVK staf, UFS organizers and farmers. Forest permits, CITES permits, cost of cultivation, planting material availability and TSP status was surfaced for discussions with farmers. Mr. Artex Simray, Advisor, Ukhrul Flower Society (UFS) requested for conducting 'On campus training programmes and Exposure visit' for Ukhrul farmers in near future at ICAR-NRCO, Sikkim and also for participating in forthcoming Ukhrul Flower Festival. TSP planting material *viz.*, Zygopetalum plants and Cymbidium hybrids were distributed to participants. he programme ended with vote of thanks from Ms. Khanimphi Luikham, Member, UFS.

Fig. 59: Demonstration on orchid media preparation, re-potting of plants and disease control

Tribal Sub-Plan Scheme

Capacity building programme at Manipur:

'Capacity building training programme on Orchids' was conducted at Ukhrul, Manipur jointly by ICAR-NRC on Orchids, Sikkim and Krishi Vigyan Kendra, Ukhrul on 18th July, 2017. he training was conducted in collaboration with Ukhrul Flower Society (UFL) at Earl E. Brock Training Centre, TBCA, Ukhrul. Nearly 80 participants attended the programme, followed by interaction session and planting material distribution. he programme was inaugurated with introductory welcome by Mr. Artex Simray, Advisor, UFS. He requested ICAR-NRCO to assist the orchid growers from Ukhrul. Elderly person and sponsor to the venue, and Mr. Ningshian Shaiza, Chairperson of 'Ukhrul Flower Society' also attended the day length event and expressed his full cooperation for conducting training programmes. Dr. Y. Rama Krishna, Head & Senior Scientist (Agronomy), KVK (Ukhrul) gave brief welcome to participants and introduced speakers of the training. Introductory lecture on ICAR-NRCO and 'Propagation techniques of Orchids' by Dr. R. Devadas, Principal Scientist (Plant Breeding) and Mr. A. L. Meitei, Young Professional-II (Plant Breeding) presented two lectures on '*Year round cultivation of Orchids*' and '*Value addition of Orchids*' on behalf presentations from Dr. L. C. De, Principal Scientist (Horticulture) & PME Cell i/c. He presented the lectures in both English and vernacular *Meitei* language for the beneit of local farmers.

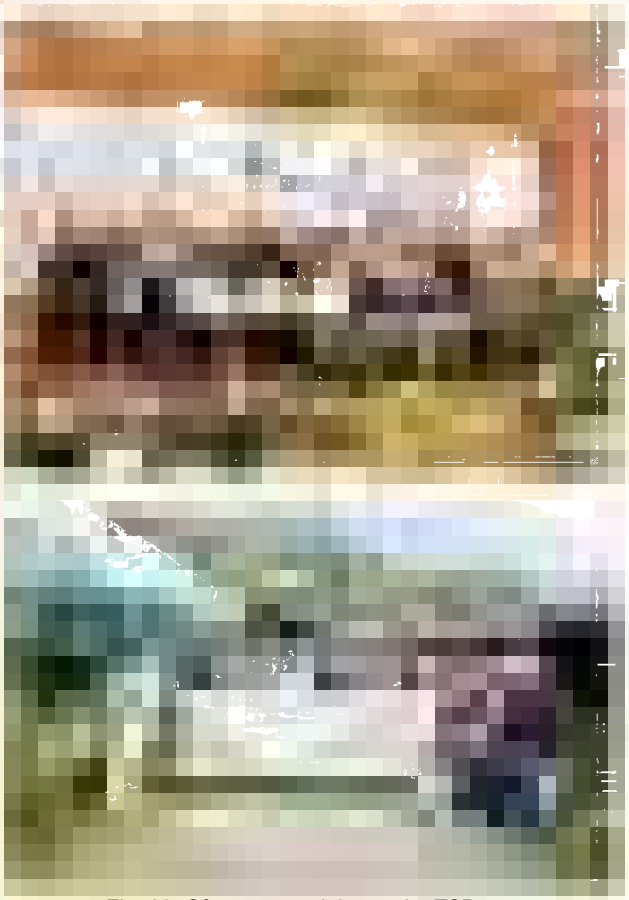


Fig. 60: Of campus training under TSP

Training program at Sikkim

ICAR-National Research Centre for Orchids Pakyong conducted of-campus Training and demonstration cum interactive meeting under **TSP** (Tribal Sub Plan scheme) on 23rd March, 2018 at Dzongu (Sangdong Village) North Sikkim. Dr. N. Sailo (Scientist), ICAR-NRC for Orchids briefed the gathering regarding TSP, Orchids cultivation and Orchids biodiversity, while Shri. Deepak Rai (JRF), ICAR-NRC for Orchids explained the importance of conservation of local orchid's species and Bio-piracy. Zilla Adaksha Mr. Samru Ugen Lepcha graced the training cum interaction programme. He highlighted the present condition of the farmers at Sangdong and the needs in the near future. he interaction programme brings out the future prospect and possibility of joint venture of the locality and the research institute in orchids cultivation and conservation. he training programme was attended by more than 25 farmers and farming kits were also distributed to the farmers.

Central Government Schemes

MERA GAON MERA GAURAV

Adopted Villages: Raigaon, Namcheypong and Kartok in East Sikkim

Events	Total activities	No. of Beneiciaries
Visit to village	63	156
Gosthis/ Meetings conducted	30	1000
Mobile based Advisory	28	65
Linkages created with other Departments/ Organizations	30	420
Literature Support Provided	8	185

SWACHH BHARAT ABHIYAN

Under the program Swachh Bharat Abhiyan the ICAR N-NRC for Orchids organised the following activities within and of campus:

- Cleanliness Drive under Swachh Bharat Abhiyan at Institute campus
- Cleaning and Awareness Programme at Rai Gaon , Kartok Village
- Cleanness Drive and Plantation of Ornamental Saplings at Bhanu Bhakta Vatika, Pakyong
- Cleaning and Awareness programme in EL-Bethel School, Pakyong
- Cleanness Drive at Sai Mandir at Tsalumthang area
- Sapath Taking Ceremony & Launching of Swatch Monitoring System
- Celebration of Shramdan Diwas
- Essay writing and Painting competition on “Swachh Bharat Abhiyan
- Celebration of Sewa Diwas
- Celebration of Sarwatra Swachhta Diwas at EL-Bethal School

Fig. 61: Cleanliness Drive under Swachh Bharat Abhiyan at Institute campus

Fig. 62: Cleaning and Awareness Programme in Rai Gaon, Kartok Village

Fig. 63: Cleanliness Drive and Planting of Ornamental Saplings in the Bhanu Bhakta Vatika

Fig. 64: Cleaning and Awareness Programme in El Bethel School

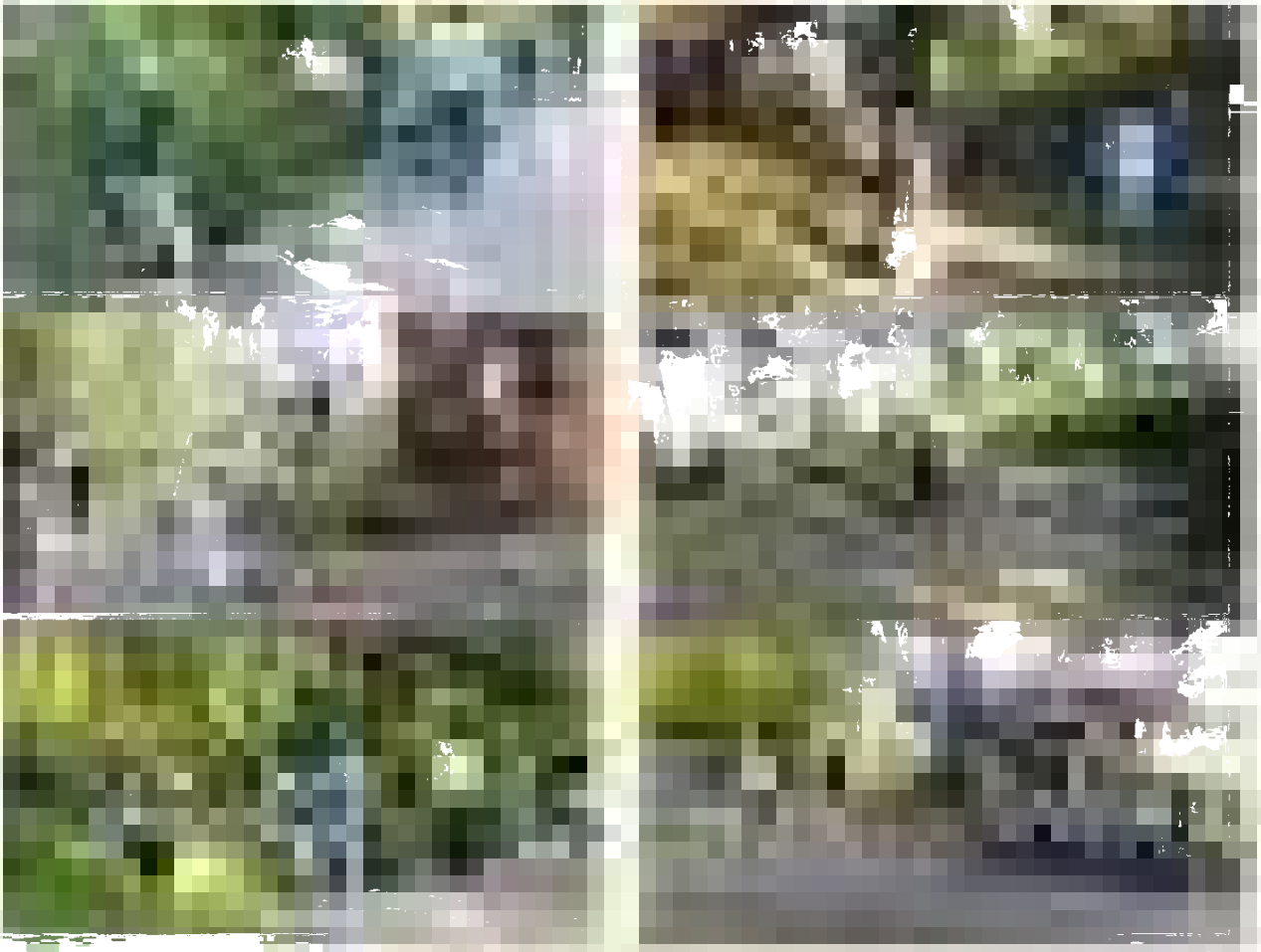


Fig. 65: Cleanliness Drive in Sai Mandir, Tsalumhang Area

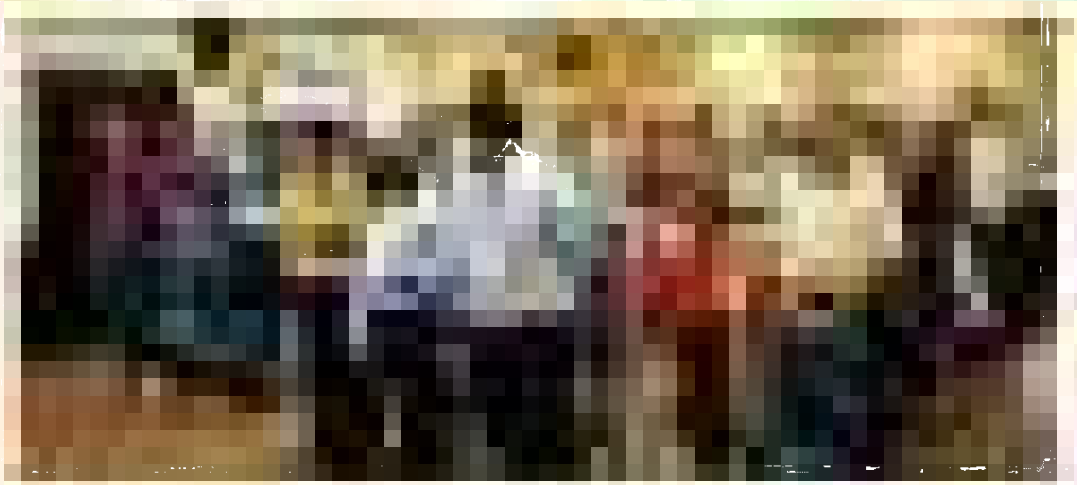


Fig. 66: Sapath Taking Ceremony & Launching of Swatch Monitoring System

Fig. 67: Celebration of Shramdan Diwas

Fig. 68: Essay writing and Painting competition on “Swachh Bharat Abhiyan

Fig. 69: Celebration of Sewa Diwas

Fig. 70: A Celebration of Sarwatra Swachhta Diwas at EL-Bethal School

Other Institute Activities

World Soil Health Day

World Soil Day was organized on the eve of he International Union of Soil Sciences (IUSS), in 2002, made a resolution proposing the 5th of December as World Soil Day to celebrate the importance of soil as a critical component of the natural system and as a vital contributor to human wellbeing and the Day was celebrated at Training Hall, ICAR-NRC for Orchids, Pakyong, Sikkim on 5th December, 2017 at 11.00 AM. On this occasion, importance of soils w.r.t. 'Healthy Soils for Healthy Life' & **Soul Of Ininite Life' (SOIL)** was narrated by Dr. L.C. De, Principal Scientist (Hort) & HRD Nodal Oicer to 20 students of Dickling Senior Secondary School, Sikkim, 9 farmers under MGMG village Kartok-Upper Namcheypong, Sikkim and Staf viz. Scientists, Administrative Staf, Technical Staf, Supporting Staf, Project Staf, TSM and contractual Staf of this institute both in English and Hindi. In addition, an exhibition was organized for showing live orchids, dry lowers, value added products and publications to students and farmers on that day.

National Science Day celebration

National Science Day was celebrated on 28th February, 2018 at ICAR-NRCO Pakyong. Dr. P.P Dabral, Dean, CAE & PHT, CAU, was the Chief Guest of the function. On behalf of institute, Dr. D.R. Singh, Director briely explained the mandate and activities going in ICAR-NRCO. Dr. P.P. Dabral appreciated the eforts of Dr. D. R. Singh for the improvement of the institute and also launched the new website of ICAR-NRCO, Pakyong, Sikkim.

Fig. 71: Celebration of World Soil Health Day 2017

Fig. 72: National Science Day celebration 2018

Republic Day Celebration

Republic day was celebrated on 26th January, 2018 at the campus. he National Flag hoisting followed by address by the Director was done in oice premises.

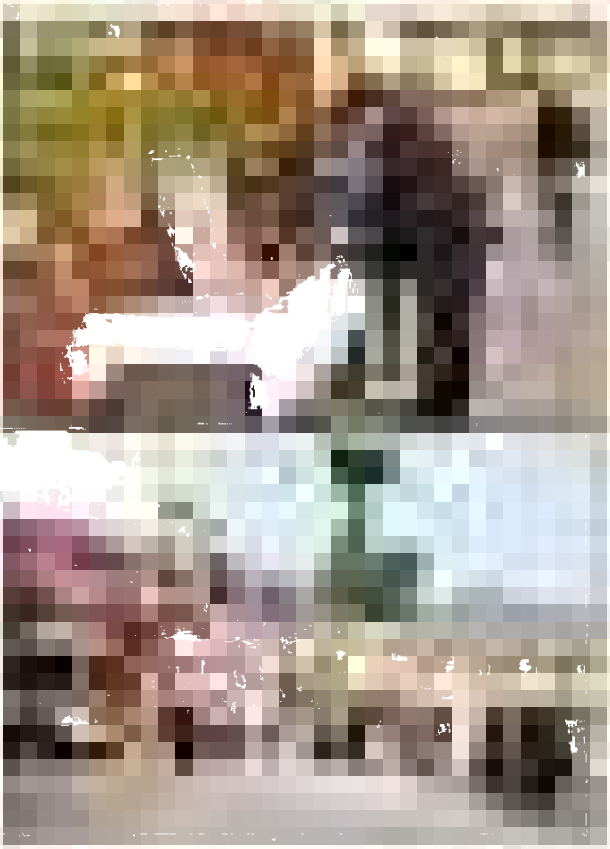
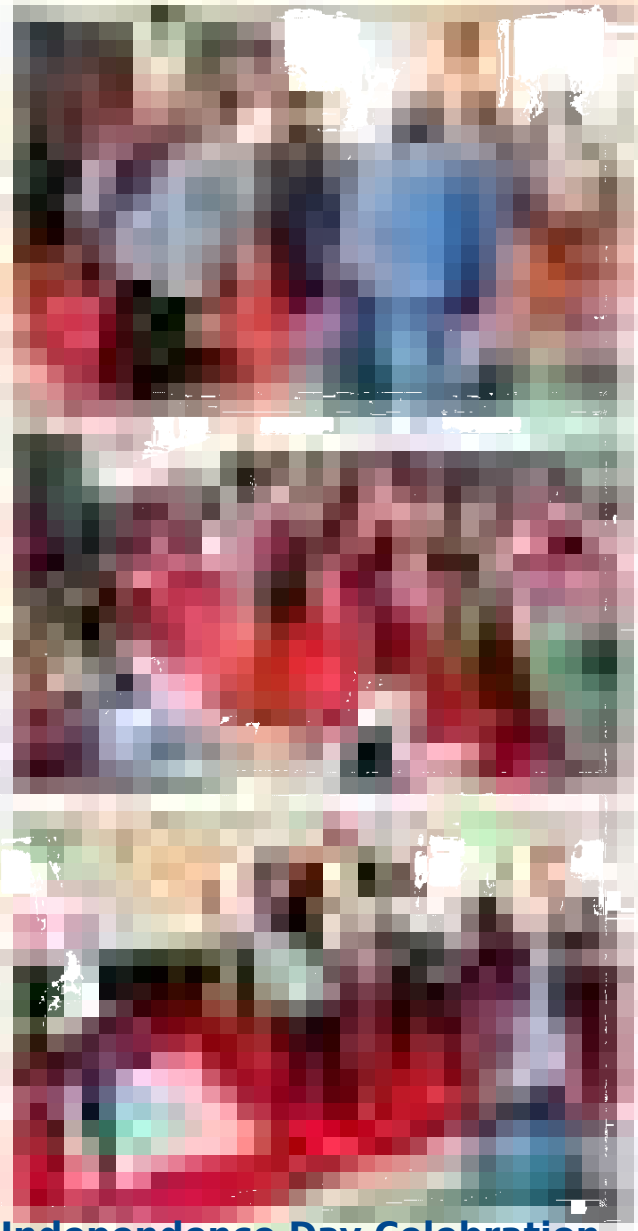


Fig. 73: Republic Day Celebration 2018

3rd International Day of Yoga

ICAR – NRCO Pakyong, Sikkim Celebrated "*3rd International Day of Yoga*" 21st June, 2017. Sh.Tushar Kanti Mandal from AYUS was Guest of Honour and also demonstrated the diferent posture (Yoga-Ashans).



Independence Day Celebration

Independence Day was celebrated on 15th Aug, 2017 at the campus. he National Flag hoisting followed by the address by the Director was done at oice premises.

Fig. 74: Independence Day Celebration 2017

21st Foundation Day Celebration

21st Foundation Day of ICAR-NRC for Orchids was celebrated on 5th October, 2017 at Pakyong, Sikkim. On the onset of the program, Dr. D.R. Singh, Director, ICAR-NRC for Orchids did welcome the Chief Guest, Shri Khorlo Bhutia, Secretary (Horticulture), Government of Sikkim and Guests of Honour viz. Dr. D.K. Agrawal, Head, BSI, Gangtok; Shri R. Manjunatha, Airport Director, Pakyong; Dr. S. Manivannan, Dean, Sikkim University; Dr. R.P. Misra, Dean, CAE & PHT, CAU, ranipool and other dignitaries from Sikkim University, CAE & PHT, Ranipool, Sikkim; RC-IBSD, Gangtok; GBPNIHESD, Gangtok; Local Heads of Bank and Schools; Scientists and other Staf, ICAR-NRC for Orchids and Farmers participants from Sikkim state. In introductory speech Dr. D.R. Singh, Director, ICAR-NRC for Orchids highlighted the importance of orchids in human life, export and import scenario, hybrid development, technology development and germplasm conservation on focused orchid species and strategies for doubling of farmers income by 2022 in a model state like Sikkim. Dr. D.K. Agrawal, Head, BSI, Gangtok narrated the impact of climate change on orchid diversity, habitat shiting and distribution pattern of species complex. Shri Khorlo Bhutia, Secretary (Horticulture), Government of Sikkim pointed out the importance of organizational linkages for transfer of technology, genesis of varietal development and strategies such as organic cultivation, drying, processing, packaging, branding and marketing of the organically grown healthy and safe foods from Agricultural and Horticultural Crops based upon consumer preferences for doubling the farmers income in the state. In this graceful occasion, 22 adopted Farmers under MGMG, 15 Central Government Oicials involved in Doubling of Farmers income, 3 local Heads and 14 Staf of ICAR-NRC for Orchids were awarded. Director, and Other Staf of ICAR-NRC for Orchids were pleased to confer Leadership Award to Shri Khorlo Bhutia, Secretary (Horticulture), on " Sustainable Development of Organic Horticulture in Sikkim State".

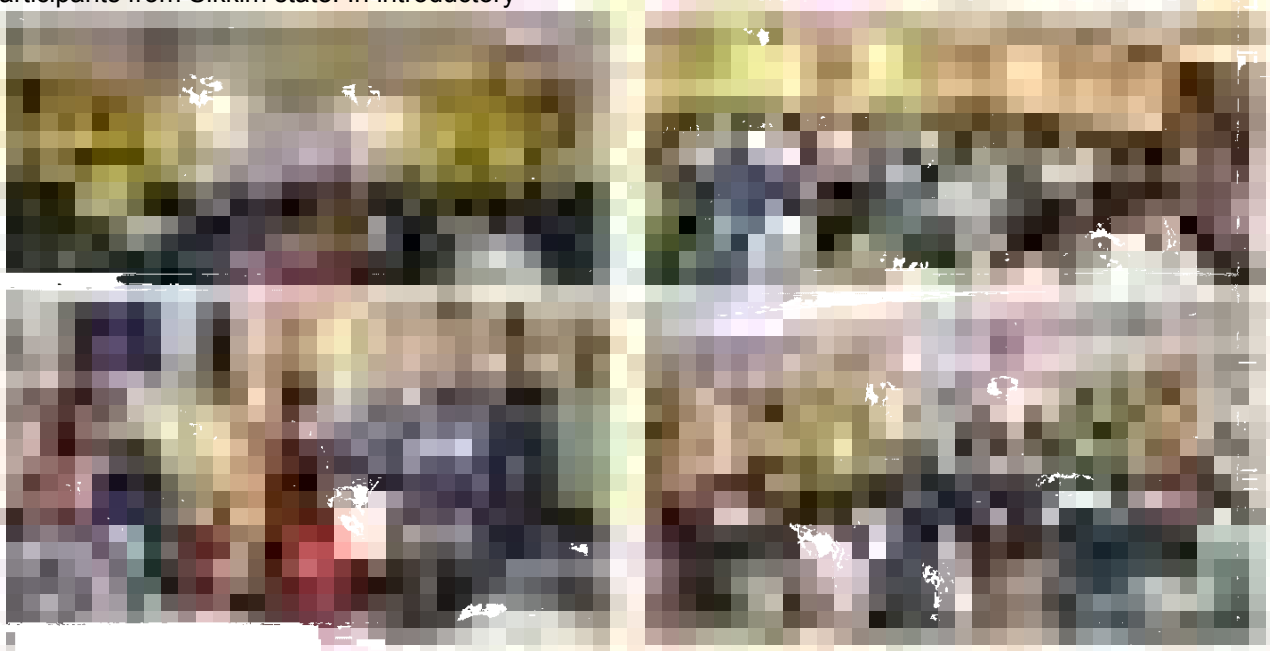


Fig. 75: Celebration of 21st foundation Day of ICAR – NRCO, Pakyong Sikkim

Agriculture Education Day

It was organized on the eve of 'Birth Day of the irst Union Minister of Agriculture of India and irst President of Independent India, Dr. Rajendra Prasad' at Training Hall, ICAR-NRC for Orchids, Pakyong, Sikkim on 4th December, 2017. On this occasion, Agriculture Education System of ICAR was narrated by Dr. L.C. De, Principal Scientist (Hort) & HRD Nodal Oicer to 20 students of Dickling Senior Secondary School, Sikkim, 9 Farmers under MGMG village Kartok Namcheypong and Staf viz. Scientists, Administrative Staf, Technical Staf, Supporting Staf, Project Staf, TSM and contractual Staf of this institute both in English and Hindi. In addition, an exhibition was organized for showing live orchids, dry lowers; value added products and publications to students and farmers on that day.

Fig. 76: Celebration of Agriculture Education Day

Vigilance Week

Before the commencement of Vigilance Awareness Week-2017, all the stafs of ICAR- NRC for Orchids was circulated integrity e-pledge help tips so that all the employees can take e-pledge on CVC portal. he response was tremendous and all most all the employees took the Integrity e-pledge. he Vigilance Awareness Week was inaugurated by Director, NRC for Orchids on 30th October, 1997. It was followed by taking on Integrity Pledge by all the employees of ICAR-NRCO. he two lectures on Importance of Transparency and Integrity in Public Life by Director and Vigilance in Our Daily Life by Vigilance Oicer were delivered . On 31st, the school children of three schools namely, Govt. Senior Secondary School, Dikling, St. Xavier's School and Jawahar Navodaya Vidyalaya (JNV), East Sikkim participated in group discussion on 'My Vision: Corruption Free India'. hree member Committee judged the performance and the Schools were awarded with the Certiicates by Director, ICAR-NRC for Orhids, Sikkim. he teachers and students took Integrity Pledge. On 31st of October, 2017, evening (3:30-4:30 PM) two lectures on 'Financial Procedures in Procurements of Goods, Services and Work Contracts and Preventive Vigilance: Role of Oicial Procedures were organised. On 2nd November, 2017, the programme was organised in village adopted under *Mera Gaon Mera Gaurav* where the participants discussed on My Vision: Corruption Free *Panchayats*. All the participants took the Integrity Pledge. Dr. S. Chakraborti, Principal Scientist (Genetics) delivered a lecture on Orchid Smuggling: A controversial Issue. A documentary 'Boya ped babul ka.....' produced by Central Vigilance Commission also shown to the participants. On 2nd November, 2017 Sri S C Sharma, OSD, College of Agriculture Engineering & Post Harvest technology, CAU, Ranipool, Sikkim delivered a talk on 'Transparency and RTI in Public Oices". On 3rd of November, no programme could be conducted due to *Panchayat* Elections in Sikkim as the attendance was very thin. Being holiday on 4th& 5th November, no programmes could be conducted. he Valedictory Function of Vigilance Awareness Week-2017 was organised on 6th November, 2017 where all the staf of NRC for Orchids, 33 students of Pushpanjali School, 10 students from Govt. Senior Secondary School, Dickling and 10 Students from Javahar Navodaya Vidyalaya and 10 farmers from adopted village participated in the event. he Additional Director General of Police (Law and Order), Sri, Akshay Sachdeva was the Chief Guest of the function. Shri Sachdeva also had been Director Vigilance in Govt. of Sikkim and known for his integrity and hard decisions. In his address Sri Sachdeva stressed on Value Education in Schools, strict vigilance and punishment.

Fig. 77: Innaugration of Vigilance Awareness Week - 2017

Fig. 78: NRCO Family taking Integrity Pledge

Fig. 79: Director & VO delivering lectures on 30th October, 2017

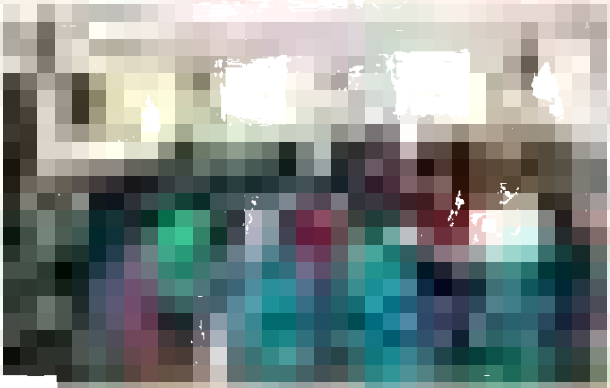


Fig. 80: Group discussion among the student

Fig. 81: Student presenting their view, Govt. SSS, Dickling

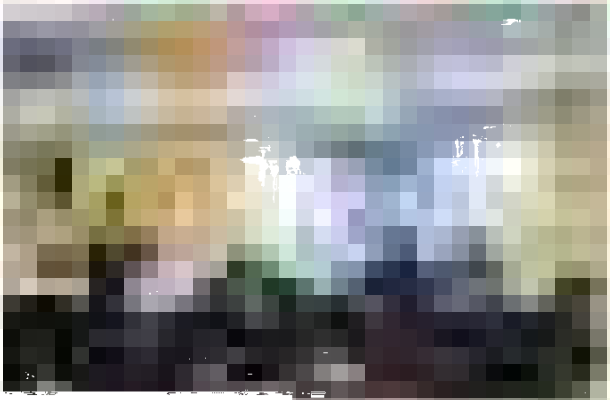


Fig. 82: Student presenting their view, St. Xavier's School

Fig. 83: Winners receiving certiicate from Director, NARCO

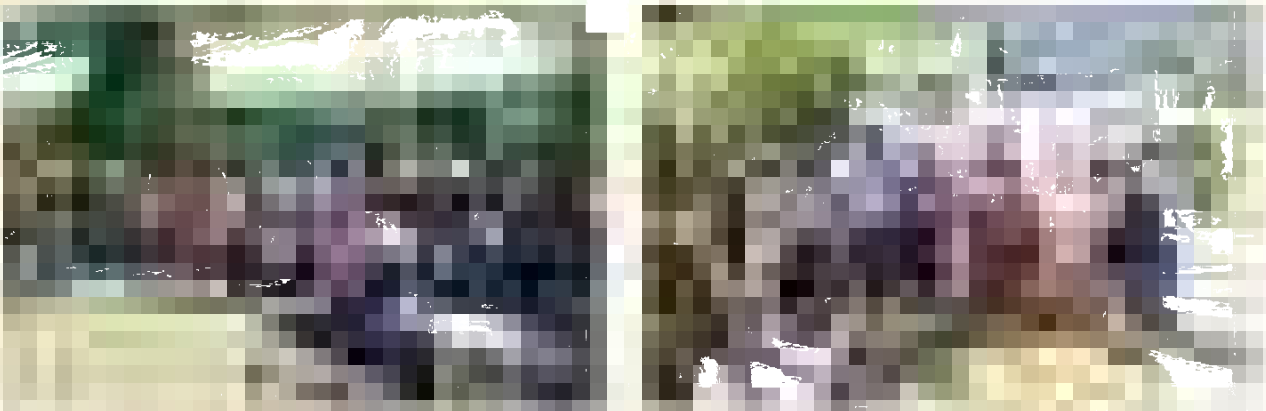


Fig. 84: Discussion and Integrity Pledge by farmer of MGMG Village

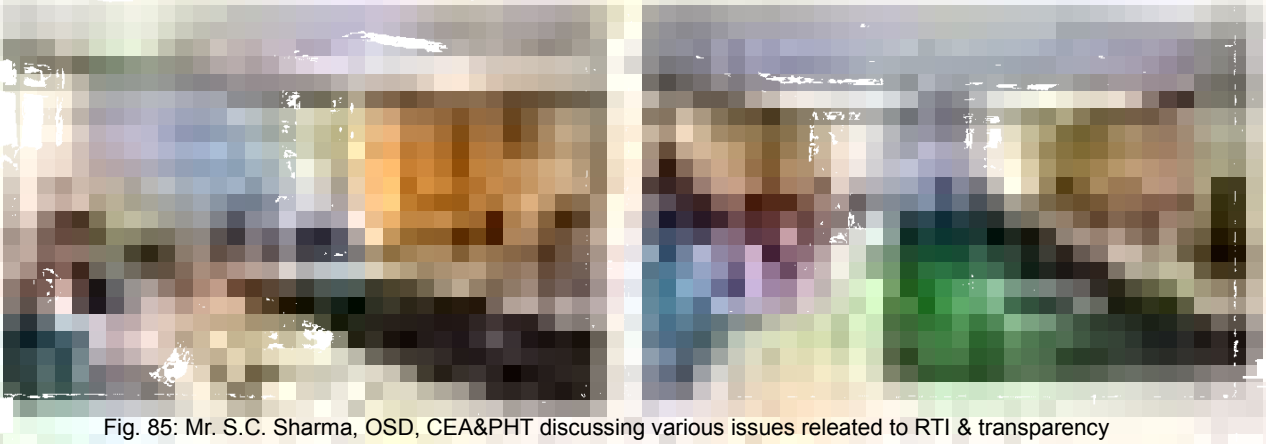


Fig. 85: Mr. S.C. Sharma, OSD, CEA&PHT discussing various issues releated to RTI & transparency

Fig. 86: Sh. Akshay Sachdeva ADGP (Law & Order), Sikkim, Police as Chief Guest Addressing the Gathering

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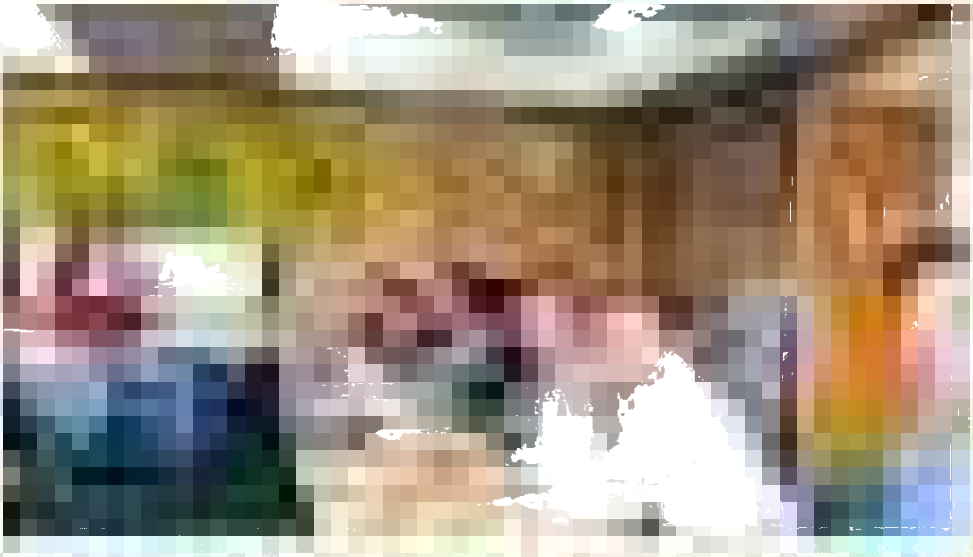


Training and Capacity Building

(A) Physical targets and achievements in training

S. No.	Category	Total No. of Employees	No. of trainings planned for 2017-18 as per ATP	No. of employees undergone training during April' 17-Mar' 18	% realization of trainings planned during 2017-18
1	2	3	4	5	5/4x100=6
1	Scientist	7	3	2	67
2	Technical	6	2	1	50
3	Administrative & Finance	6	3	4	133
4	SSS	6	1	0	0
Total		**25**	**9**	**7**	

(A) Financial targets and achievements under HRD program (All employees)

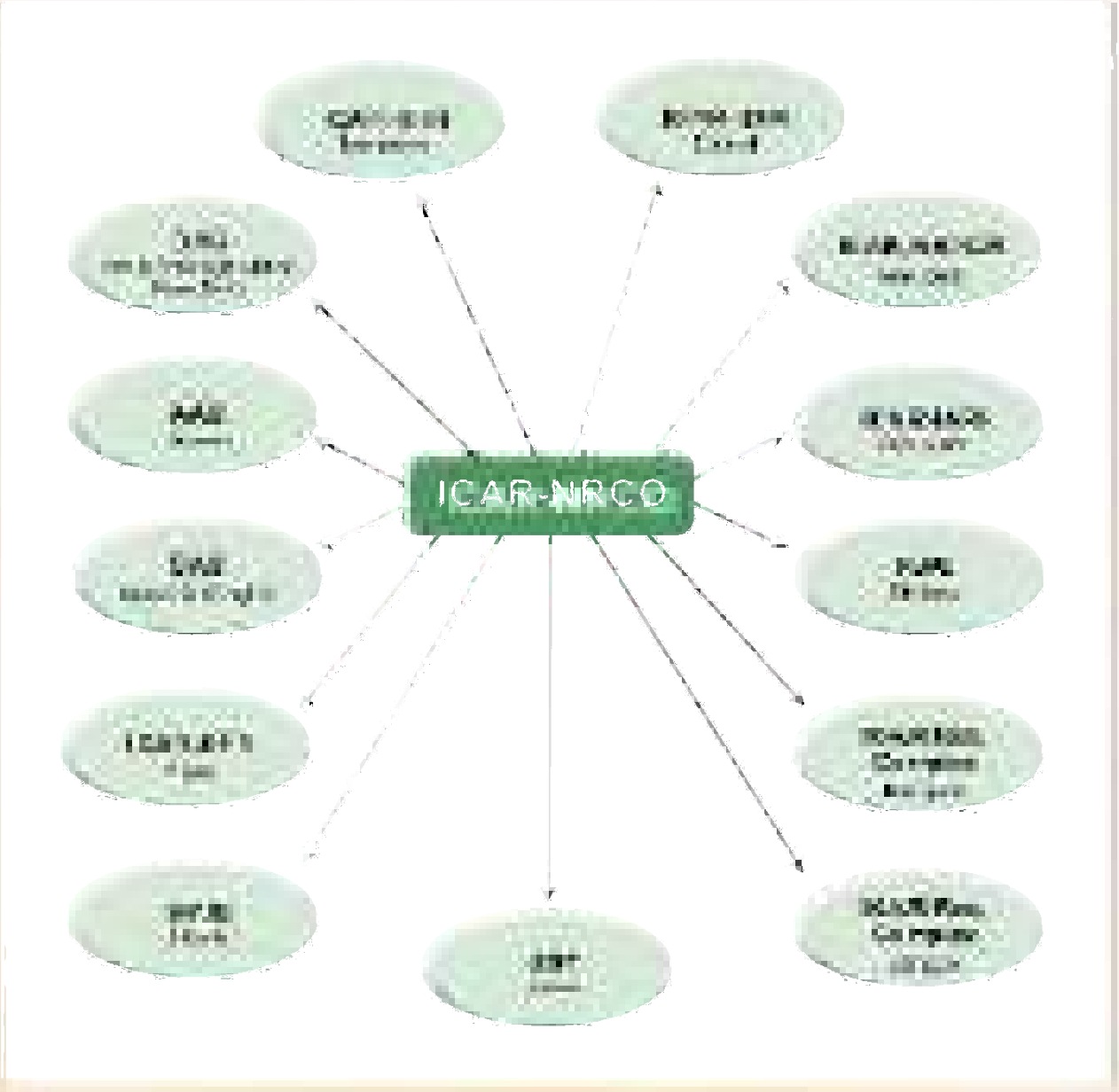
Actual Expenditure with efect from 01/04/2017 - 31/03/2018 for HRD			% Utilization of allotted budget
Plan	**Non-plan**	**Actual Expenditure**	
(Lakh Rs.)	**(Lakh Rs.)**	**(Lakh Rs.)**	**2017-18**
1.50	Nil	100682	67.12

(C) Training programmes attended by staff

Name of Employee	Designation	Programme attended
Mr. P. R. Kishore	Scientist	Experimental approaches in utilization of genomic resources for the improvement of horticultural crops Revisiting Foundation Course for Agricultural Research Service (FOCARS): Relections and feedback of Trained Scientists
Mr. R. K. Das	AF & AO	GFR 17 & PFMS
Mr. R.C. Gurung	T4	Automobile Maintenance Road Safety & Behavioural skill Development of drivers of ICAR
Mrs Stella Sasa	Steno Gr. III	Enhancing Eiciency and Behavioural Skills
Mrs Sangita Lepcha	LDC	PFMS

Linkages and Collaboration

he center has linkages with several universities, research institute and developmental agencies for collaborative research and developmental activities in orchids and other mandate loriculture crops.



Memorandum of Understanding Signed:

1. ICAR-NRCO , Pakyong, Sikkim and Sikkim University, Gangtok, Sikkim
2. ICAR-NRCO, Pakyong, Sikkim and Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh.

NRCO in Media

SIKKIM EXPRESS

National conference on floriculture for rural and urban prosperity in the scenario of and climate change

Sat, Feb 17, 2018

Publications

Research Papers

- D. R. Singh, V. Baskaran, K. Abirami and P. Simhachalan. (2016). *In vitro* micropropagation of *Eulophia andamanensis* – A tropical orchid. *International Journal of Tropical Agriculture*, Vol. **34(7):** 2173-2177.
- Shrawan Singh, K. Kartikeyan, D. R. Singh, P. Sihmachalam N. K. Biansla and I. Jaisankar. (2017). Genetic Diversity in Drumstick of Andaman Islands and heir Relatedness with Probable Introduction Sites from Mainland India. *Proceedings of the National Academy of Sciences, India Section B: Biological Sciences,* pp. 1–11.
- Vishal Kumar, G.T. Patle, D. R. Singh and Rajshree Chand. (2017). Trend of Area, Production and Productivity of Major Cereal Crops in Context of Food Security: Sikkim, India. *International Journal of Engineering Technology Science and Research*, Vol. **4(9):**523-529.
- Devadas, R., S. L. Pattanayak, M. Adhikari, D. R. Singh (2017) Morphological description of selected breeding line of Paphiopedilum: NRCO-*P. lawrenceanum* x P. 'Winston Churchill'/2013/29 (IC-0614750). *Indian Journal of Hill Farming* 30 (1): 125-128.
- De, L.C. and D.R. Singh (2017). Natural Resources in North East Regions of India. *International Journal of Agricultural Science and Research*, 7(5): 51-66.
- De, L.C. (2017). Improvement of ornamental plants-a review. *International Journal of Horticulture*, 7 (22): 180- 205.
- De, L.C. and R.P. Medhi (2017). Orchid- A diversiied lower crop. *Acta Horticulturae, 1181*ISHS 2017. DOI 10.17660/ ActaHortic.2017.1181.14.
- De, L.C., D.R. Singh & Suman hapa (2017). Drying Technologies in orchids. *International Journal of Environmental Sciences & Natural Resources,* 5(1): 1-5.
- De, L.C. and D.R.Singh (2017). Yoga for healthy and quality life. *International Journal of Research in Applied, Natural and Social Sciences*, 5(9): 87-99.
- Meena, NK, Ram Pal, D. Barman, and R. P. Pant (2018). Indigenous approaches of orchid pest management in North East India, *Indian Journal of Traditional Knowledge*, 17 (1): 209-214.
- Raj Kumar, Mridul Chakraborti, Ngursanzuala Sailo, Tshering Chomu Bhutia, D R Singh (2017).Asymbiotic seed germination and in vitro seedling development of *Paphiopedilum villosum* (Lindl.) Stein: A Valuable and Vulnerable Lady's Slipper Orchid from India. *Current Science*, 114 (02): 266-269.
- Ram Pal, R. B Ram, M. Dayamma, D. Barman, D. R. Singh1 and Pushkar Sharma (2016). Response of culture media on PLB (protocorm like bodies) multiplication and organogenesis of four Cymbidium hybrids cultured i*n vitro, J. Ornamental Hort 19: 119-124*

Books/ Book Chapters/Compendium/ Technical Reports

- L.C. De (2017).*'Lawn Development and Management'*, p. 148 ,published by Aavishkar Publishers & Distributors, Jaipur, Rajasthan
- L.C. De (2017). *'Cultivation and Breeding of Medicinal and Aromatic Plants'*, p. 432 Published by Pointer Publisher, Jaipur, Rajasthan(ISBN: 978-81-7132-866-6).
- Ram Pal, M. Dayamma and D. R. Singh (2017). Advances in Propagation of Cymbidiums (Book edited by Dr. K V Peter, accepted)
- Meena, N. K. and Ram Pal (2017) Pests of Orchids (Book edited by Dr. K V Peter, accepted)
- Singh, D.R., Laxuman Sharma, L.C. De and A. Loyanganba Meitei (2018). "Souvenir-cum-Abstract", National Conference on (ISBN:978-81-7910-550-4).

Floriculture for Rural and Urban Prosperity in the Scenario of Climate Change, from 16th-18th February, 2018 organized by ICAR-NRCO, Pakyong, Sikkim at CAE & PHT (CAU), Ranipool, Sikkim, pp. 259.

Research/Posters/ Abstract in Seminar/ Symposia/Conference

- De, L.C. and D.R. Singh 2017. Year Round Production Technology of Tropical and Subtropical Orchids. In: IJTA 6th International Conference on Recent advances in Agriculture and Horticultural Sciences at New Delhi from 16th -17th December, 2017.
- De, L.C. and D.R. Singh 2017. Floriculture in Hill regions. In: National Symposium on Climate Smart Agriculture-A Key to Livelihood Security at Institute of Agricultural Sciences, University of Kolkata from 9th -11 the December, 2017.
- R.K. Pamarthi, D.Rai, S. Chakrabarti, R. Devadas, R. Kumar, Rampal, L.C. De, N. Sailo, D. Barman & D.R. Singh 2018. Collection, Characterization and conservation status of orchids at ICAR-NRCO, Pakyong, Sikkim. In : National Conference on Floriculture for Rural and Urban Prosperity in the Scenario of Climate Change, CAE & PHT (CAU), Ranipool, Sikkim, 16th to 18th February, 2018.
- Rampal (2017) Harnessing the potential of medicinal orchids in India In: 4th International Symposium on Minor Fruits, Medicinal & Aromatic plants (ISMF, M & AP, 5-6 December, 2017 at College of Horticulture & Forestry , Pasighat, Arunachal Pradesh (Lead Paper)
- Rampaland D R Singh (2018) Pollination Biology of Orchids: An unexplored area of research in IndiaIn: Natioanl Conference on Floriculture for Rural and urban prosperity in the Scenario of climate change, 16-18 Feb, 2018, Sikkim.
- Chaudhury, R., Rampal, hongam, B., Malik, SK, Pritchard, HW (2018). Life cycle cryobiotechnology of orchids : collaborative research between NBPGR, NRC Orchids and IBSD, Imphal. ICAR News (in press).
- Chaudhury, R., Rampal, hongam, B., Malik, SK, Pritchard, HW, Awasthi, M. and Priyanka (2018). Attempts to cryostore Indian orchid species. Oral presentation accepted for "National Conference on Floriculture for Rural and Urban Prosperity in the Scenario of Climate Change", 16-18h Feb, 2018, Gangtok.
- Chaudhury, R., Awasthi, M., Priyanka, Rampal and hongam, B. (2018). Post-harvest handling of pods, seeds and pollinia of selected orchid species. Poster presentation accepted for "National Conference on Floriculture for Rural and Urban Prosperity in the Scenario of Climate Change", 16-18h Feb, 2018, Gangtok.
- Rampal, Chaudhury, R., Malik, S. K., Chhetri, K and Gangmaei P.K. (2018). Efects of pollen age, sucrose concentration, desiccation tolerance, and storage temperature on *in vitro* pollen germination of *Arundina graminifolia* (D. Don) Hochr. Oral presentation accepted for "National Conference on Floriculture for Rural and Urban Prosperity in the Scenario of Climate Change", 16-18h Feb, 2018, Gangtok.
- Rampal, Chaudhury, R., Chhetri, K and Gangmei,PK (2018) Pollen germination and pollen tube growth in subfamily *Epidendroidea.* Oral presentation accepted for "National Conference on Floriculture for Rural and Urban Prosperity in the Scenario of Climate Change", 16-18h Feb, 2018, Gangtok.
- R. Sherpa, R. Devadas, P. Suprasanna, R. K. Pamarthi (2018) Efect of gamma irradiation on PLBs of Dendrobium. National Conference on Floriculture for Rural and Urban Prosperity in the Scenario of Climate Change, held at CAE & PHT, CAU, Ranipool, Sikkim on Feb 16-18, 2018.
- N.T. Bhutia, Rampal, N. Sailo, A.L. Meitei, D. Rai, RK Pamarthi & DR Singh (2018). Monitoring of two orchids diversity in rich patches of Sikkim. In : National Conference on Floriculture for Rural and Urban Prosperity in the Scenario of Climate Change, CAE & PHT (CAU), Ranipool, Sikkim, 16th to 18th February, 2018.

- Deepak Rai, RK Pamarthi, P. KiranBabu, AL Meitei, Rampal and DR Singh (2018). Occurence and conservation status of *Cymbidium whiteae* an endangered and endemic orchid from Sikkim, India. National Conference on Floriculture for Rural and Urban Prosperity in the Scenario of Climate Change, held at CAE & PHT, CAU, Ranipool, Sikkim on Feb 16-18, 2018
- P. KiranBabu, Rampal, RK Pamarthi, Deepak Rai, AL Meitei, NT Bhutia and DR Singh (2018). Status and conservation strategies for orchids at Sikkim Himalaya. National Conference on Floriculture for Rural and Urban Prosperity in the Scenario of Climate Change, held at CAE & PHT, CAU, Ranipool, Sikkim on Feb 16-18, 2018
- A.L. Meitei, A.Singh, R. Kumar, RK Pamarthi, Rampal, D. Rai, NT Bhutia and DR Singh (2018). Preliminary phytochemicals screening of medicinal orchid. National Conference on Floriculture for Rural and Urban Prosperity in the Scenario of Climate Change, held at CAE & PHT, CAU, Ranipool, Sikkim on Feb 16-18, 2018

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

- Pollination biology of orchids: An unexplored area of research in India in National Conference on Floriculture for Rural and Urban Prosperity in the scenario of Climate Change, 16th-18th Feb, 2018, Sikkim (Dr. D. R. Singh)
- 23rd meeting of ICAR Zone-III Regional Committee Meeting at ICAR Research Complex for NEH Region, Manipur Centre, Imphal held from 30-31 May, 2017. (Dr. D. R. Singh)
- Meeting with Chief Secretary, Govt. of Arunachal Pradesh, PCCF and other state oicials of State Forest Research Institute, Itanagar, visited and surveyed Orchid Research Centre, Tippi and Sessa Orchid Orchid Nursery, Sessa, Arunachal Pradesh
- ICAR Foundation Day, Award Ceremony 2017 and Directors Conference to held on 16.7.2017 (Sunday) at AP Shinde Auditorium, NASC Complex, Pusa, New Delhi. (Dr. D. R. Singh)
- XXVI AICRP on Floriculture Meet held from 3-5 August, 2017 at ICAR- IIHR, Bengaluru. (Dr. D. R. Singh)
- 10th Global Agriculture Leadership Summit, 2017 at New Delhi held on 5th & 6th September, 2017 at New Delhi. (Dr. D. R. Singh)
- Strategy Meeting on Doubling of Farmers' Income by 2022 at Krishi Bhavan, New Delhi held on 10th & 11th October, 2017. (Dr. D. R.Singh)
- National Symposium on Recent Advances on Floriculture and Urban Horticulture in Global Perspective at BCKV, Kalyani, Mohanpur on 04.01.2018. (Dr. D. R. Singh)
- Conference on Linking Startups and SMEs in Food Processing with Government Schemes & Markets on 18.01.2018 at Summit Denzong Renaissance, Gangtok by ASSOCHAM (he Associated Chambers of Commerce and Industry of India). (Dr. D. R. Singh)
- Consultative Meeting of North Eastern Council on Agriculture and Horticulture held on 20-21 February, 2018 at State Convention Centre, Pine Wood Hotel, Shillong. (Dr. D. R.Singh)
- National Symposium on Climate Smart Agriculture, Institute of Agriculture Sciences, University of Kolkata 10th December' 2017 (Dr. L. C. De).
- 4th International Symposium on Minor Fruits, Medicinal & Aromatic plants (ISMF, M & AP, 5-6 December, 2017 at College of Horticulture & Forestry, Pasighat, Arunachal Pradesh(Dr. Rampal).from12-17 June, 2017. (Dr. D. R. Singh)

Awards/ Rewards/ Recognition/ Bodies acquired during the year

- Lotus Award, 2017 conferred by the Indian Society of Ornamental Horticulture.
- Vice President - Indian Society of Ornamental Horticulture (ISOH)
- External Examiner for Ph.D. hesis evaluation at BCKV, West Bengal.
- External Examiner for Ph.D. hesis evaluation at Nagaland University.

Dr.D.R.Singh

- As External Examiner for Ph.D. hesis evaluation for Department of Floriculture and Landscaping, UBKV, Pundibari, Coochbehar and BCKV, Mohanpur, West Bengal
- As Reviewer of Asian Journal of Advances in Agricultural Research, International Journal of Plants and Soil Science, Asian Journal of Agricultural Extension, Sociology and Economics, Journal of Tropical Agriculture, Biotechnology Journal International

Dr.L.C.De

Dr. S. Chakrabarti

As Reviewer of Indian Journal of Agricultural Sciences

Mr. Deepak Rai

"Best Poster Award" in the theme of **"Bio-resources Conservation, management and Utilization"** at National Conference on Floriculture for Rural and Urban Prosperity in the Scenario of Climate Change on February 16 – 18th 2018 at CAU-CAE & PHT, Ranipool, Sikkim.

Ms. Geetanjali Pradhan

"Best Poster Award" in the theme of **"Post-harvest management and marketing of loriculture products"** at National Conference on Floriculture for Rural and Urban Prosperity in the Scenario of Climate Change on February 16 – 18th 2018 at CAU-CAE & PHT, Ranipool, Sikkim.

Mr. Rakesh Kumar Singh

"Best Poster Award" in the theme of **"Doubling Framers income "** at National Conference on Floriculture for Rural and Urban Prosperity in the Scenario of Climate Change on February 16 – 18th 2018 at CAU-CAE & PHT, Ranipool, Sikkim.

Sikkim Farmer Sh. Kapil Chettri received prestigious National Award Of Indian Agricultural Research Institute (IARI), New Delhi for integrated Orchid Farming

A progressive Farmer Shri. Kapil Chettri a resident of Upper Namcheybong, Pakyong, East Sikkim, selected for Innovative Farmer Award, from prestigious Institute IARI, New Delhi for growing orchids and other horticultural crops. He received award from Shri Parshottam Rupala Hon'ble Minister of State (Agriculture and Farmers Welfare and Panchayati Raj) at National Level Agriculture fair-cum-Exhibition " Krishi Unati Mela (KUM) - 2018" held at ICAR-IARI Mela Ground, Pusa, New Delhi from March 16 to 18th , 2018.

Fig. 89: Sh. Kapil Chettri receiving 'IARI Innovative Farmer Award'

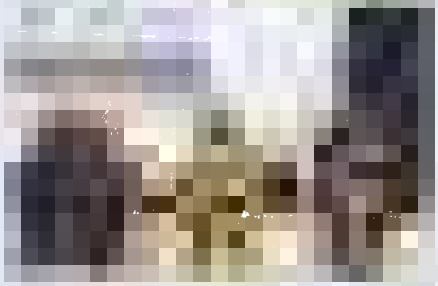
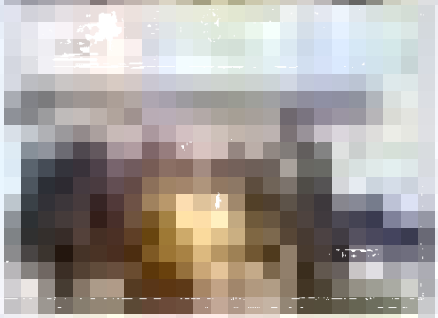
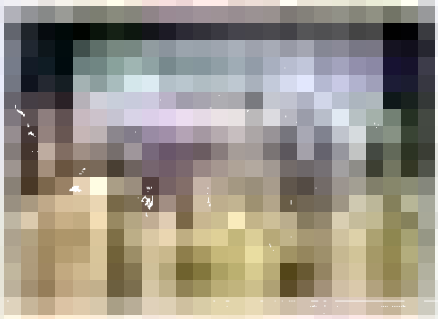
"IARI Innovative Farmer Award" from Honourable Minister Shri Parshottam Rupala Hon'ble Minister of State (Agriculture and Farmers Welfare and Panchayati Raj) & Dr. T. Mahapatra, (DG, ICAR, New Delhi)

National Conference

On

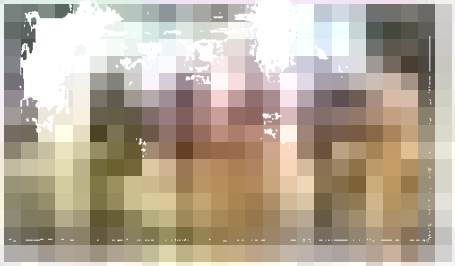
Floriculture for Rural and Urban Prosperity in the Scenario of Climate Change

List of Awards

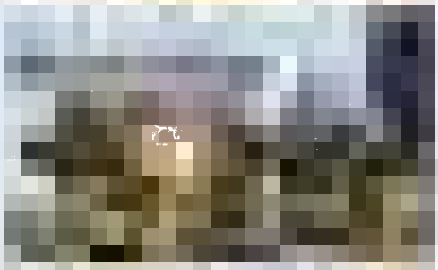
Lifetime Achievement	1. Dr. R. C. Upadhyaya (Ex-Director, ICAR-NRCO) – Orchids (Fig. 90)	
	2. Dr. R. L. Mishra (Ex-PC, AICRP, Floriculture)- Floriculture (Fig. 91)	
Lotus Award	Dr. D. R. Singh (Director, ICAR - NRCO) (Fig. 92)	
Farmer Awards	1. Best Senior Citizenship Award in Orchid Farming Shri Kumar Yanzon (Fig. 93)	

Orchid Display Awards

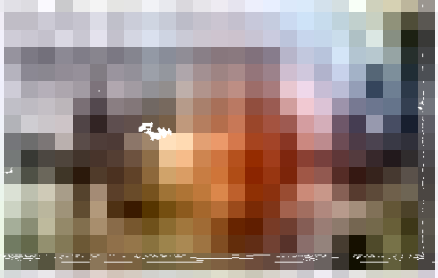
2. Best Orchid Grower Award
Shri Samten Dorjee Gurung (Fig. 94)



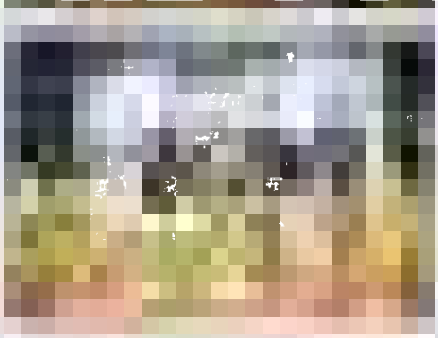
1. Mr. B. B. Gurung and Mr. Gyan Bahadur Subba (Fig. 95)



2. Mrs. Anuradha Chettri and Mrs. Aruna Devi Neopaney (Fig. 96)



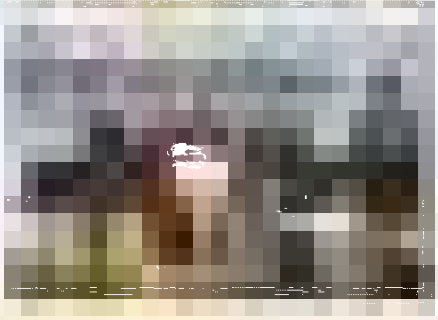
3. Mr. Subash Subba and Mr. Bhim Bahadur Subba (Fig. 97)



Consolation

4. Mr. Kumar Chettri and Mr. Kapil Chettri (Fig. 98)

5. Umanga Group (Fig. 99)



Distinguished Visitors

Fig. 100: 1st Lady of Sikkim State

Fig. 101: 6th RAC Team

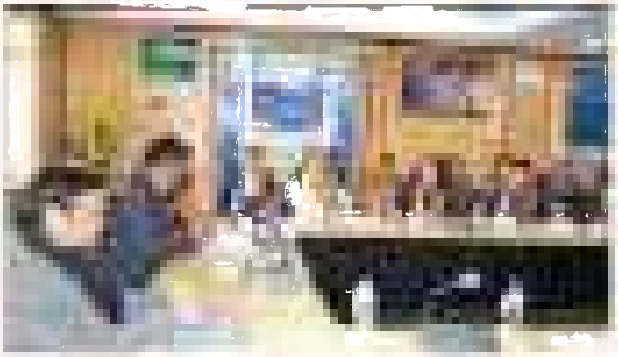


Fig. 102: Team of RIGSS oicials of Royal Government of Bhutan

Fig. 103: Chief Justice of Sikkim High Court

Fig. 104: Prof. K.V. homas, Chairman, PAC

Fig. 105: QRT Team

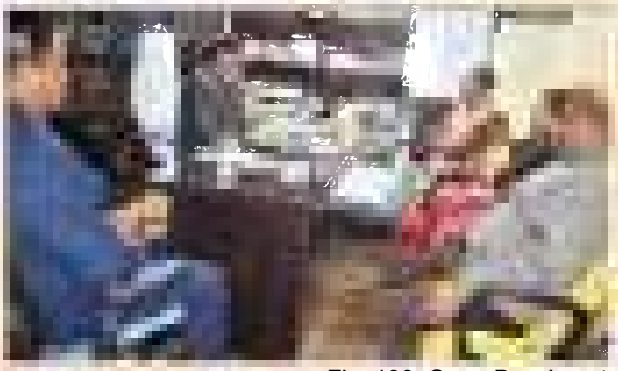


Fig. 106: Gram Panchayats

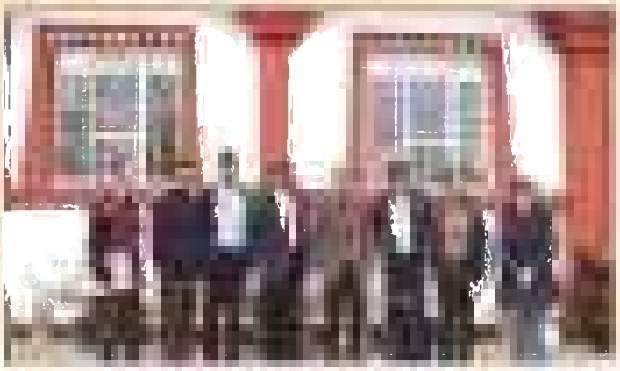


Fig. 107: Dr. T. Janakiram, ADG (Hort Sci-1)

Peer Recognitions to Director

- Chairman in Technical Session on Germplasm Conservation during XXVI AICRP on Floriculture Meet held from 3-5 August, 2017 at ICAR- IIHR, Bengaluru.
- As a Convener, published strategy document of Doubling Farmer's Income by 2022 of Sikkim state.
- Delivered hematic address on Startup in agriculture, organized by ASSCHOAM Gangtok on 18th January 2018.
- Delivered a lecture on scenario of Horticulture/ Floriculture in NE region on 20th February 2018 organized by, ASSCHOAM, Shillong.
- Attended 23rd meeting of ICAR Zone-III Regional Committee Meeting at ICAR Research Complex for NEH Region, Manipur Centre, Imphal held from 30-31 May, 2017.
- Attended meeting with Chief Secretary, Govt. of Arunachal Pradesh, PCCF and other state oicials of State Forest Research Institute, Itanagar, visited and surveyed Orchid Research Centre, Tippi and Sessa Orchid Orchid Nursery, Sessa, Arunachal Pradesh from 12-17 June, 2017.
- Attended ICAR Foundation Day, Award Ceremony 2017 and Directors Conference to held on 16.7.2017 (Sunday) at AP Shinde Auditorium, NASC Complex, Pusa, New Delhi
- Attended various department meeting for Doubling of Farmers' Income by March, 2022 through Horticulture at Krishi Bhawan, Tadong, Gangtok on 27.06.2017
- Attended XXVI AICRP on Floriculture Meet held from 3-5 August, 2017 at ICAR- IIHR, Bengaluru as Guest of Honour.
- Attended New India Mantahn Sankalp Se Sidhi on the Topic "Floriculture for Poverty Elevation in Sikkim" on 24th August, 2017 at CAE&PHT, CAU, Ranipool as Guest of Honour.
- Attended 10th Global Agriculture Leadership Summit, 2017 at New Delhi held on 5th& 6th September, 2017 at New Delhi.
- Attended EFC Meeting at SMD, ICAR, New Delhi held on 18th September, 2017.
- Attended meeting with ADG (HS), ICAR, New Delhi on 19th September, 2017
- Attended Strategy Meeting on Doubling of Farmers' Income by 2022 at Krishi Bhavan, New Delhi held on 10th& 11th October, 2017.
- Attended Strategy Meeting on Doubling of Farmers' Income by 2022 at NASC Complex, New Delhi held on 3rd November, 2017.
- Attended Mid-Term Review Meeting of ICAR-Regional Committee-II at ICAR-CIFRI, Barrackpore, Kolkata held on 13.11.2017.
- Attended XXV ARC meeting on Large Cardamom at Gangtok held on 17.11.2017 organized by Indian Cardamom Research Institute, Regional Research Station Spices Board, Gangtok.
- Attended a function as Chief Guest at Sikkim Kalyan Ashram, Ranipool, Gangtok on 16th December, 2017
- Attended AIR program on 11th December, 2017
- Attended Meeting at oice of the Dean, CAE&PHT, Ranipool, Sikkim on 28.12.2017
- Attended a guest of honour at National Symposium on Recent Advances on Floriculture and Urban Horticulture in Global Perspective at BCKV, Kalyani, Mohanpur on 04.01.2018.
- Attended Sikkim Organic Day at Saramsa on 17 & 18 January, 2018 by displaying a stall and showcasing technologies of orchids in the presence of Shri Acharya Balkrishna, Patanjali, India as the Chief Guest.
- Attended Conference on Linking Startups and SMEs in Food Processing with Government

Schemes & Markets on 18.01.2018 at Summit Denzong Renaissance, Gangtok by ASSOCHAM (he Associated Chambers of

- Meeting with the Hon'ble Chief Minister of Sikkim on 10.02.2018 regarding National Conference.
- Meeting with the Hon'ble Minister for Agriculture (FSAD & HCCDD), Govt. of Sikkim on 14.02.2018 regarding National Conference.
- Attended Consultative Meeting of North Eastern Council on Agriculture and Horticulture held on 20-21 February, 2018 at State Convention Centre, Pine Wood Hotel, Shillong as an Expert.
- Attended Annual Conference of ICAR Director's and Vice Chancellors of Universities

held from 07-09 March, 2018 at NASC Complex, Pusa, New Delhi.CommerceandIndustryof India).

- Attended Noni Search - 2018 held from 24-25 March, 2018 at College of Agriculture, Pune, Maharashtra.
- Organized training on 26/03/2018 for Floriculture in hill region for 25 farmers of Morigaon, Assam
- Delivered a hematic Address on Startup Agriculture and Government Schemes on 18.01.2018 organized by ASSOCHAM, India at Denzong Regency, Gangtok.
- Presented paper on "Production technology for Noni cultivation in challenged lands" on 24.03.2018 during Noni Search-2018 at College of Agriculture, Pune.
- Presented paper on "Potential phytochemicals in diferent parts of Morinda citrifolia" on 25.03.2018 during Noni Search-2018 at College of Agriculture, Pune.
- Presented paper on "Harnessing the economic potential of medicinal orchids in India" on 25.03.2018 during Noni Search-2018 at College of Agriculture, Pune.

Personalia

Director

Dr. D. R. Singh

Scientific Staff

Principal Scientist

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

Dr. Syamali Chakrabarti, Principal Scientist (Genetics)

Dr. Ram Pal, Principal Scientist (Horticulture)

Dr. Ramgopal Devadas, Senior Scientist (Plant Breeding)

Scientist

Dr. N. Sailo, Scientist (Plant Physiology)

Sh. Raj Kumar, Scientist (Floriculture & Landscaping)

Sh. Ravi KishorePamarthi (Economic Botany & Plant Genetic Resources)

Technical Staff

Ms. Tshering Chomu Butia, Technical Assistant (Horticulture Assistant) Sh. Ajay Bushal, Sr. Technician (Farm) Sh. Manoj Adhikari, Sr. Technician (Farm) Ms. Meena Kumari Chettri, Sr. Technician

Workshop Staff

Shri. Ram Chandra Gurung, Sr. Technical Assistant

Shri. Deepak Khattri, Sr. Technician

Administrative Staff

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

Sh. Arvind Chauhaan, Assistant

Mrs. Diki Bhutia, Sr. Clerk

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

Promotions

Mrs. Diki Bhutia, UDC through MACP w.e.f. 05.05.2017

Sh. Arjun Gurung, SSS through MACP w.e.f. 13.09.2017

Mrs. rabin Kala Subba through MACP w.e.f. 17.09.2017

Transfers

Mrs. Rumki H. Ch. Sangma, Scientist (Entomology) transferred to ICAR Research Complex for NEH Region, Umiam, Meghalaya on 30/06/2017.

Mr. Parimal Ghosh, AO transferred to ICAR Research Complex for NEH Region, Umiam, Meghalaya on 20/06/2017.

Mr. Ajay Bhusal, Sr. Technician transferred from ICAR-NRCO Darjeeling Campus to ICAR-NRCO, Pakyong on 21/06/2017.

Study Leave

Shri Raj Kumar, Scientist (Floriculture) was relieved for study leave w.e.f. 24.06.2017 at Dr. YS Parmar University of Horticulture & Forestry, Solan, Himachal Pradesh.

Research Advisories and Institute Committees

QRT Committee

Name	Designation	Assignment
Dr. K. R. Dhiman	Former VC, YSPUH&F, Soaln, H.P.	Chairman
Dr. A. N. Rao	Director, Centre for Gene Conservation for Eastern Himalaya, Hengbung, Manipur	Member
Dr. S. Ramani	Ex - Project Cordinator, UAS, Bangalore, Karnataka	Member
Dr. Promila Pathak	Professor of Botany, Orchid laboratory, Punjab University	Member
Dr. P. C. Panda	Regional Plant Genetic Resource Centre, Bhubaneswar	Member
Dr. D. R. Singh	Director, ICAR-NRC for Orchids	Member
Dr. Ram Pal	Sr. Scientist (Hort.), ICAR - NRC for Orchids, Darjeeling Campus	Member Secretary

RAC, Committee

Name	Designation	Assignment
Dr. V. A. Parthasarathy	Former Director, IISR, Kozhikode, Kerala	Chairman
Dr. T. Janakiram	ADG (HS-I), ICAR, New Delhi	Member
Dr. A. N. Rao	Director, Centre for Gene Conservation for Eastern Himalaya, Hengbung, Manipur	Member
Sh. S. Z. Lucksom	Director (R&D), Orchidologist & Former Director, Himalayan Zoological Park, Gangtok	Member
Dr. V. V. Belvadi	Prof & Head, Department of Entomolgy, UAS, GKVK, Bangalore	Member
Dr. Bikash Mandal	Principal Scientist, Division of Plant Pathology, IARI, New Delhi	Member
Dr. D. R. Singh	Director, ICAR-NRC for Orchids	Member
Sh. Izmir Tikhak	Changlang District, Arunachal Pradesh	Member
Sh. Pempa Sherpa	Kartok, Pakyong, Sikkim	Member
Dr. Ram Pal	Principal Scientist (Hort.), ICAR - NRC for Orchids, Darjeeling Campus	Member Secretary

ISO : Certification Committee

Name	Designation	Assignment
Dr. L. C. De	Pr. Scientist, Horticulture	Chairman
Dr. S. Chakrabarti,	Pr. Scientist (Genetics)	Member
Dr. R. Devadas,	Senior Scientist (Plant Breeding)	Member
Dr. N. Sailo,	In-charge AAO	Member
Sh. Raj Kumar	Scientist (Floriculture)	Member
Mrs. Rumki Sangma	Scientist (Agril. Entomology)	Member
Sh. A. Chauhaan	Assistant	Member
Mrs. D. Bhutia	UDC	Member
Sh. M. Adhikari	Technical (Field)	Member

Official Language Committee

Name	Designation	Assignment
Dr. D. R. Singh	Director, ICAR-NRC for Orchids	Chairman
Dr. Ram Pal	Sr. Scientist (Hort.)	Member
Dr. R. Devadas	Senior Scientist (Plant Breeding)	Member
Dr. N. Sailo	Scientist (Plant Physiology)	Member
Sh. Raj Kumar	Scientist (Floriculture)	Member
Mrs. Rumki Sangma	Scientist (Agril. Entomology)	Member
Sh. A. Chauhaan	Assistant	Member
Mrs. D. Bhutia	UDC	Member
Sh. M. Adhikari	Technical (Field)	Member

PME Cell

Name	Designation	Assignment
Dr. D. R. Singh	Director, ICAR-NRC for Orchids	Chairman
Dr. D. Barman	Pr. Scientist (Horticulture)	Member
Dr. L. C. De	Pr. Scientist (Horticulture)	Member
Dr. S. Chakrabarti	Pr. Scientist (Genetics)	Member
Dr. Ram Pal	Pr. Scientist (Horticulture)	Member
Dr. R. Devadas	Senior Scientist (Plant Breeding)	Member
Dr. N. Sailo	Scientist Plant Physiology	Member

Vigilance Officer

Dr. D. Barman	upto 31/03/2017
Dr. Rampal	19/09/2017 to till date

NOTE

NOTE

हर कदम, हर डगर
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