



Orchids

Newsletter



राष्ट्रीय आर्किड अनुसंधान केन्द्र

(भारतीय कृषि अनुसंधान परिषद)

पाक्योंग - 737 106, सिक्किम

National Research Centre for Orchids

(Indian Council of Agricultural Research)

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RESEARCH HIGHLIGHTS

Diversity and genetic relationship Analysis of 08 native *Aerides* species using RAPD markers

Eight native *Aerides* species were evaluated to study the diversity and genetic relationship using 65 RAPD primers. A total of 877 bands were obtained of which 99.77% were polymorphic and only one was monomorphic. The binary data obtained from RAPD were analyzed using NTYSYS software, the similarity matrix showed that *Aerides affine* and *Aerides multiforum* are closely related and *Aerides raceniformis* is distant from rest of the species. The maximum dissimilarity was found between *Aerides affine* and *Aerides raceniformis*. The cluster analysis grouped 7 species in 1 major cluster named C1 and one species *Aerides raceniformis* separated from others and formed a separate cluster C2. The major cluster C1 divided into 2 minor clusters named MC1 and MC2 and again one species *Aerides ringens* separated from other 6 species and formed a single cluster MC3. The minor cluster I (MC1) includes 4 species *Aerides affine*, *Aerides*

multiforum, *Aerides fieldingii* and *Aerides williamsonii* whereas the other minor cluster 2 (MC2) includes *Aerides longicornu* and *Aerides odoratum*. The resolving power of the primers were found around 5 – 11.25, the maximum resolving power was found to be 11.25 for the primer OPH C13, the minimum was found to be 5 for the primer OPH D06, the average resolving power was 7.59, the maximum PIC was found to be 0.875, the average PIC was found to be 0.8686. The results showed significant variation among the species under study.

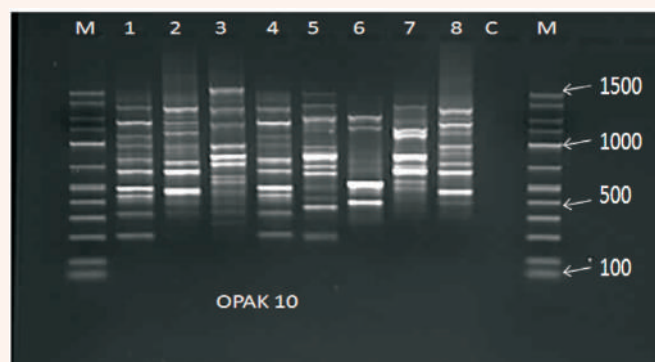


Fig. 1. RAPD Banding pattern of *Aerides* species using primer OPAK-10

A simple modified CTAB method for isolation of high quality genomic DNA

A simple modified CTAB method for isolation of high quality genomic DNA from fresh matured leaves of orchids has been developed. Both the quantity and quality of isolated DNA was higher when compared with the DNA isolated by other methods. This new protocol is highly suitable for various molecular analyses.

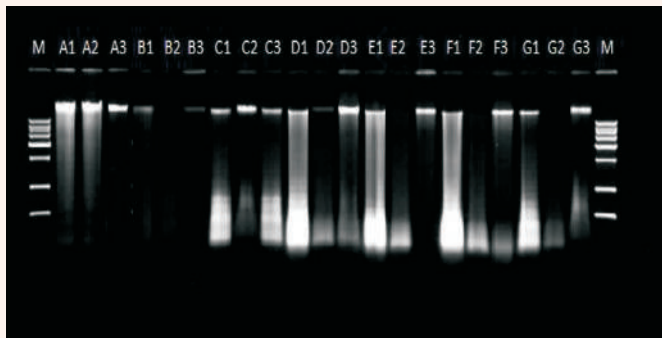


Fig. 2. Quantity and quality assessment of protocols.

Intra specific variability analysis of *Cymbidium whiteae* by using RAPD markers.

A small population of *Cymbidium whiteae* – a very rare and endemic species of Sikkim as rediscovered in Rumtek area of East Sikkim. Twenty plant samples of the species were collected from their natural sources to assess the genetic diversity of the population using RAPD polymorphisms. PCR amplification of 65 RAPD primers were done of which 41 primers produced clear and reproducible bands. A total of 340 bands were amplified by 41 primers of which 46 (13.52) were monomorphic and 294 (86.48) were polymorphic in nature. Cluster analysis was done by using Jeccard coefficient and a dendrogram was prepared. All 20 plant samples were clustered in two distinct groups-C1 and C2. Out of 20 only 6 plants were grouped in C1 and rest in C2. The similarity between two clusters was 31% which shows a huge diversity within the small population.

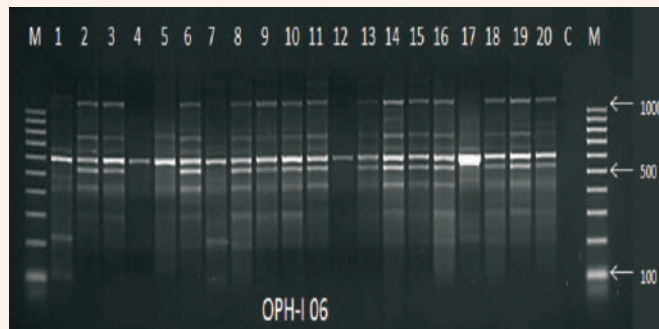


Fig. 3. RAPD Banding pattern of *Cymbidium whiteae* species using primer OPH-I 06

Achievement of first record (In India) on *in-vitro* flowering in *Cymbidium dayanum*

Early flowering was induced in the temperate orchid *Cymbidium dayanum* by *in-vitro* techniques. The *in-vitro* flowering plantlets were about 6-10 cm in height. Each flowering plantlets with 3 to 5 leaves produced one inflorescence stalk with an average of 1-2 flower per stalk with a flower size of 2 x 2.5 cm. Petals and sepals are clear with a reddish purple column and whitish yellow anther. 70% of the flowering plantlets produced a single flower while the remaining produced double flowers. The flowers produced by *in-vitro* techniques were smaller than the normal flowers.



Fig. 4. Conventionally propagated *Cymbidium dayanum*

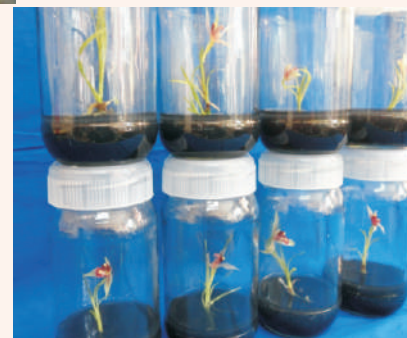


Fig. 5. *In-vitro* flower culture of *Cymbidium dayanum*

Water soluble nutrition increase growth and vigour of *Zygopetalum*

In order to quantify nitrogen requirement for hardening of tissue cultured plants, different concentrations of nitrogen was sprayed at weekly intervals. Higher mortality (47%) was recorded in the plants subjected to without nutrition, however less mortality (25%) was recorded in the plant sprayed with $N_{75}P_{10}K_{10}$.



Fig. 4. Plant growth with no NPK sprayed



Fig. 5. Plant growth when NPK sprayed with $N_{75}P_{10}K_{10}$

Effect of water stress on *Cymbidium* hybrid 'Pine clash moon venus' (PCMV)

Water stress is the single most limiting factor governing the growth and survivability of plants. To study short duration of drought exposure, 2 years old PCMV seedlings were subjected to water stress by

withholding irrigation for 15 days. The growth parameters recorded did not show any significant difference between stressed and non stressed plants (Fig.6: a-c). Drought stress causes physiological changes in short term. Water content of stressed plants leaves were reduced considerably. Decrease of 12% water content in stressed plants as compared to non stressed plants was observed (Fig.6:d).

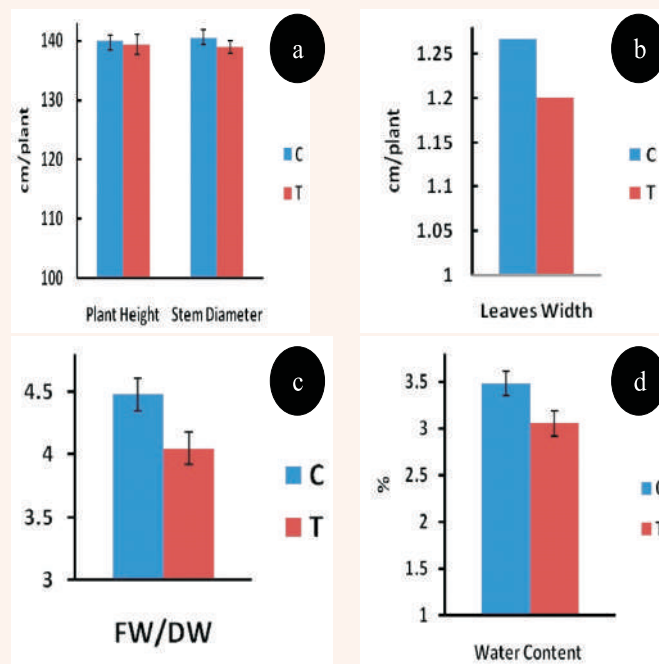


Fig. 6. Effect of water stress on plant growth parameter Plant height, Stem diameter, Leaves width & FW/DW. C; Control, T; water stress treatment (a -c); Effect of water stress on water content (d)

Water stress is also known to induce reactive oxygen species (ROS) in plants. The accumulation of ROS must be prevented by plants as rapidly as possible to maintain growth and productivity. Superoxide radicals (O_2^-) production was comparatively high in stressed plants. Stressed plants produced 25% higher Superoxide radicals (Fig.7:a). O_2^- is relatively less damaging, but it can lead to formation of hydroxyl radicals (OH) that can initiate lipid peroxidation, DNA nicking, amino acid and protein oxidation. Lipid peroxidation was measured in terms of thiobarbituric acid reactive substances (TBARS)

contents. 22.61 n mol of TBARS g^{-1} FW was recorded in stressed plants which showed 25% increased in TBARS content as compared to the non-stressed plants (Fig.7: b).

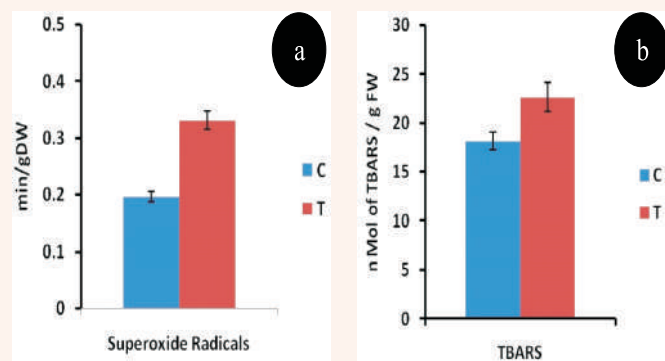


Fig. 7. Effect of water stress on production of superoxide radicals (a); Effect of water stress on production of TBARS(b)

Studies on orchid fleck virus (OFV) on orchids

Orchid fleck virus (OFV) affected samples of *Coelogyne elata*, *C. flaccida*, *Pholidota rubra* and some *Cymbidium* sp. collected from Sikkim and Kalimpong (West Bengal), were maintained in polyhouse at NRC orchids, Pakyong, Sikkim. The infected samples were showing chlorotic and necrotic rings and chlorotic flecks on leaves (Fig 8a & 8b). The symptomatic leaves were processed for electron microscopy (at IARI, New Delhi) to see the virus particles, if any.



Fig. 8a. Orchid fleck virus (OFV) affected *Coelogyne flaccida* showing chlorotic rings and necrosis



Fig. 8b. *Cymbidium* sp. Showing chlorotic flecks due to the infection of OFV

Mechanical transmission of OFV

Mechanical transmission of OFV was carried out by grinding of infected tissue in 0.01M phosphate buffer (pH- 7.6) in 1:1 ratio (w/v). The extract was filtered through cheese cloth and used for sap inoculation. The test plants used in this experiment were *Datura stramonium*, *Chenopodium amaranticolor*, *Nicotiana glutinosa*, *Dianthus* sp., *Gazania* sp. *Antirrhinum* sp. *Aster* sp. etc.

Nicotiana glutinosa showed veinal flecks and necrotic spots after two weeks of inoculation. *Datura stramonium* also developed necrotic spots while *Dianthus* sp. showed chlorotic spots (Fig. 9a, 9b & 9c).



Fig. 9a. Vein flecking and necrotic lesions on *Nicotina glutinosa* on inoculation with OFV



Fig. 9b. Necrotic spots on *Datura stramonium* on inoculation with OFV



Fig. 9c. Chlorotic spots on *Aster* sp

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

Eight bio-pesticidal products were tested for the management of thrips, *Dichromothrips nakahari* on *Cymbidium* 'WBSG' under polyhouse conditions. Amongst, two neem products, i.e. neem oil 0.03% EC @ 5ml/lit. and NSKE (achook) 1500 ppm @ 5ml/lit were found most effective, while one wild botanical plant product (chilaune leaf extract) was found least effective against this insect.

Organic control of pest complex of *Dendrobium*

To evaluate the relative efficacy of botanical products and biopesticides against aphid on *Dendrobium nobile* under polyhouse conditions. Nine treatments (including control) viz., azadirachtin (neem oil) 0.03% EC 5ml/lit., econeem 3000 ppm 2ml/lit., garlic extract 5%, chilaune (*Schima wallichii*) leaf extract 10%, datura leaf extract 10%, titapat (*Artimessia*) leaf extract 10%, tobacco extract 5% and cow urine 50% were applied on 6 years old potted plants at 10 days intervals. The results showed that, all the treatments were found significantly superior over control. The highest mortality (78.06%) in aphid population occurred on the plants treated with econeem 3000 ppm followed by azadirachtin (neem oil) 0.03% EC, whereas, the

minimum per cent mortality (42.13%) was recorded on the plants treated with titapat (*Artimessia*) leaf extract 10%. The remaining treatments were found moderately effective against aphid.

Preparation of DUS Test Guidelines in Commercial Orchids

Ten hybrids of *Oncidium*, 8 hybrids of *Cattleya* and 10 hybrids of *Phalaenopsis* were maintained under DUS project on Orchids. DUS Test guidelines of *Phalaenopsis* and *Cattleya* Orchids (Orchid Task Force, 2011) were submitted to PPV & FRA during 2012 and published in Plant Variety Journal of India. Morphological descriptors of Paphiopedilum (76) and *Oncidium* (60) were also developed.

INSTITUTIONAL ACTIVITIES



Three days training programme on “Commercial production and post harvest management of tropical and temperate Orchids” from 22-24th January 2013



Republic Day Celebration (26th January, 2013)



Hon'ble' Agriculture Minister of Odisha at NRC Orchid pavilion during XIth Indian Agricultural Science Congress from 7th to 9th February, 2013 at OUAT, Bhubaneswar, Odisha

Participation of Scientists in Conference, Meetings, Workshop, Symposia, Seminar etc in India and Abroad.

International Conference on-Bio resource and stress Management Organized by Bose Institute, Kolkata on 7th February, 2013.

S. Chakrabarti

National Dialogue on 'Orchid Conservation & Sustainable Development for Community Livelihood' Organized by National Research Centre for Orchids, Pakyong, Sikkim on 8th March, 2013.

All Scientists

First meeting of Orchid Task Force (3/2012) and one day awareness cum training programme on Protection of Plant Variety and Farmer's Right Act (PPV&FRA) at Sylvan KVK, Hengbung, Manipur from 20-21st March, 2013.

L. C. De

One day National seminar on “Horticultural biotechnology” organized by the society for promotion of Horticulture, IIHR at IIHR, Bangalore on 14th June, 2013.

S. Chakrabarti

National Seminar on “Advances in Protected cultivation” at NASC Complex, New Delhi on 21st March, 2013.

D. Barman

Education and Training

Scientist

Five days training of “Gahan Hindi Karyashala” at Central Hindi Training Institute at New Delhi from



Agribusiness Camp on June 24, 2013 at Chintan Bhawan Gangtok, in association with ICAR Zonal Technology Management – Business Planning and Development Unit of NIRJAFT, Kolkata



Awareness program on “Intellectual Property Rights” on June 25, 2013 at Conference Hall of NRC for Orchids Pakyong

7-11th January, 2013.

Rampal

Five days training of “387th Gahan Hindi Karyashala” conducted by Department of Official Language, Ministry of Home Affairs, and Government of India” at Prithviraj Road, New Delhi from 4 - 8th February, 2013.

N. K. Meena

Administrative

Five days training of “387th Gahan Hindi Karyashala” conducted by Department of Official Language, Ministry of Home Affairs, and Government of India” at Prithviraj Road, New Delhi from 4 - 8th February, 2013.

Rishi Kant Singh

Five days training of “Gahan Hindi Karyashala” conducted by Department of Official Language, Ministry of Home Affairs, and Government of India” at Prithviraj Road, New Delhi from 20 - 24th May, 2013.

Ajen Lama & Arvind Chauhaan

Eleven days training programme for newly recruited Assistant at ISTM, New Delhi from 27th May to 7th June, 2013.

Arvind Chauhaan

Distinguished Visitors:

1. Shri. Bharat S. Bhajane, General Manager (Business developer), Rise & Shine Biotech Pvt. Ltd., Pune, Maharashtra.
- 23/02/2012

2. Shri. Keeratikal Sophunsin, Kultan Orchids,

Bangkok - 23/02/2013

3. Shri. Yoshi Kazu Moriyama, Managing Director, M. Kat Bio Co. Ltd., Japan
- 23/02/2013

4. Dr. K. R. Dhiman, VC, UHF Nauni, Solan, H.P.
- 24/02/2013

5. Dr. N. K. Krishna Kumar, DDG (Hort.), ICAR, New Delhi
- 09/03/2013

6. Dr. S. M. Virmani (Retd.) Scientist ICRISAT, 811A, Road 41, Jubilee Hills, Hyderabad
- 12/03/2013

7. Mr. Lawsence Hislop, UNEP/GRID-Asendal, Norway
- 26/03/2013

8. Mr. Simon Pugh Jones, Writhlington School Orchid Project, Radstak, England
- 28/03/2013

9. Dr. Lawren Gwduis, Royal Botanical Garden, Kew, England
- 28/03/2013

10. Dr. K. K. Jindal, Director of Research (Retd.), UHF Solan / CAU Imphal, Jindal Niwas, Surya Vihar, Rajgarh Road, Solan – 173212 (H.P.)
- 29/05/2013

11. Dr. Moa Walling, DHO & PD, ATMA, Phek District, Nagaland
- 05/06/2013

12. Dr. S. Sarkar, Asst. Professor, College of Home Science, CAU, Tura, Meghalaya
- 12/06/2013

13. Dr. Ramesh Kumar, Director, Directorate of Floriculture Research, Pusa Campus, New Delhi-110012
- 20/06/2013

Publications

Book Chapters

1. Meena., N. K., D. Barman and R. P. Medhi. 2013. Impact of abiotic factors on incidence of mite in orchids and its potential impact on flower production. *Agroforestry and Climate Change Management*. Pointer Publishers, Jaipur (Rajasthan), Pp. 116-121.

Research Papers:

1. Naik., S. K., D. Barman and N. Pathak. 2013. Response of graded levels of calcium and magnesium on growth and flowering of *Cymbidium* hybrid 'Mint Ice Glacier'. *African J. of Agricultural Research*, 8(17): 1767-1778.
2. Meena., N. K., Rampal, D. Barman and R. P. Medhi. 2013. Biology and seasonal abundance of the two-spotted spider mite, *Tetranychus urticae*, on orchids and rose. *Phytoparasitica*, DOI 10.1007/s 12600-013-0320-2.

Bulletin

1. Pant., R. P., N. K. Meena and R. P. Medhi. 2013. *Important diseases of Orchids and their Management*. NRC for Orchids, Pakyong, Sikkim. Pp. 1-40. (Technical Bulletin No.09)
2. Pant., R. P., N. K. Meena and R. P. Medhi. 2013. *Virus diseases of Orchids and their Management*. NRC for Orchids, Pakyong, Sikkim. Pp. 1-34. (Technical Bulletin No.10)
3. Rampal., M. Dayamma and R. P. Medhi. 2013. *Manual for Acclimatization of Micro propagated Cymbidiums*. NRC for Orchids, Pakyong, Sikkim. Pp. 1-33. (Technical Bulletin No.11)
4. Rampal., R. P. Medhi, M. Dayamma and Parvati

Khatiwara. 2013. *Commercialization of Cymbidiums in Sikkim; NRCO turning a dreams into reality*. NRC for Orchids, Pakyong, Sikkim. Pp. 1-33. (Technical Bulletin No.12)

5. Barman., D., H. Pokhrel, P. Mohanty, Rampal, M. Adhikari, L. C. De, N. K. Meena, N. Sailo and R. P. Medhi. 2013. *Production Technology of Aerides odoratum, Coelogyne nitida and Zygopetalum intermedium*. NRC for Orchids, Pakyong, Sikkim. Pp: 1-48. (Technical Bulletin No. 1(NAIP))
6. De., L. C., D. Barman, R. P. Medhi, Geetamani Chhetri and H. Pokhrel.2013. *Production Technology of Dendrobium*. NRC for Orchids, Pakyong, Sikkim. Pp: 1-30. (Technical Bulletin No. 13)
7. De., L. C., D. Barman, R. P. Medhi, Geetamani Chhetri and H. Pokhrel. 2013. *Production Technology of Phaleonopsis*. NRC for Orchids, Pakyong, Sikkim. Pp: 1-26. (Technical Bulletin No. 15)

Paper presented in Seminars/Symposia:

1. Barman., D., H. Pokhrel and R. P. Medhi. 2013. Effect of inorganic nutrient and growth regulators on reducing pre-blooming in *Cymbidium* hybrid 'Black Magic'. Pp: 167. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
2. Barman., D., H. Pokhrel and R. P. Medhi. 2013. Optimisation of nutrient requirement for *Cymbidium* plants (6 months old) under hardening. Pp: 168. In: *Abstract cum Souvenir -*

- National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
3. Chakrabarti, Syamali, S. Jain, D. Sinha and R. P. Medhi. 2013. Diversity and Genetic Relationship Analysis of native species using RAPD markers. Pp: 150. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
 4. Chakrabarti., Syamali. 2013. Traditional Knowledge of NE People for Conservation and Utilisation of Orchids. In: *International Conference on- Bio resource and Stress Management* organised by Bose Institute, Kolkata from 6 - 9th February, 2013.
 5. Chakrabarti., Syamali. 2013. DNA barcoding for Intellectual Protection. Pp: 32-36. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
 6. Chakraborti., Mridul., Rampal, Syamali Chakrabarti, Sudeep. K. Jain and R. P. Medhi. 2013. Study of variability among Cymbidium tracyanum accessions collected from Darjeeling using RAPD markers. Pp: 152. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
 7. Chhetri., Geetamani, L.C. De and R. P. Medhi. 2013. *Studies on morphological characters of Paphiopedilum species of North East India*. Pp: 125. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
 8. Chhetri., Geetamani, L. C. De and R. P. Medhi. 2013. *Notes on colour analysis in flowers of Dendrobium species of North East India*. Pp: 125-126. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
 9. De., L. C., S. P. Vij, H. Pohkrel and R. P. Medhi. 2013. *Priorities in post-harvest management and value addition in orchids*. Pp: 50-60. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
 10. De., L. C., A. N. Rao, P. K. Rajeevan, S. R. Dhiman, Manoj Srivastava and Geetamani Chhetri. 2013. *DUS Test Guidelines in Cattleya orchids*. Pp: 119. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with

TOSI, Chandigarh.

11. De., L. C., S. P. Vij, R. P. Medhi and Geetamani Chhetri. 2013. *Round the year production of commercial orchids*. Pp: 166. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
12. De., L. C., V. Arunachalam, S. P. Vij, N. P. Singh and R. P. Medhi. 2013. *Survey and collection of tropical orchids from Goa*. Pp: 119-120. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
13. Devadas., R., S. Pattanayak and N. Sailo. 2013. *Induction of protocorm like bodies (plbs) from different explants of seven hybrids of Cymbidium*. Pp: 149. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
14. Devadas., R., P. Khatiwara, S. Pattanayak and L. C. De. 2013. Genetic Control of floral traits in *Cymbidium* hybrids (F₁ progenies). Pp: 150-151. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
15. Devadas., R., P. Khatiwara, S. Pattanayak and R. P. Medhi. 2013. New *Cymbidium* Hybrids (2013) of NRCO for Commercialization & Re-invention of Breeding Cycle. Pp: 188-189. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
16. Gogoi., J., N. K. Meena, B. Hakmaosa, N. Sailo and R. P. Medhi. 2013. Medicinal use of orchids. Pp: 178-179. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
17. Hakmoasa., B., R. P. Pant, Jaya Gogoi, N. Sailo and R. P. Medhi, 2013. Vanilla- a commercially important orchid. Pp: 188. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
18. Meena., N. K., Rampal., R. P. Pant, Jaya Gogoi, and R. P. Medhi. 2013. *Pests associated with Dendrobium orchid and possible control measures*. Pp: 178. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.

19. Meena., N. K and R. P. Medhi. 2013. Pest's scenario on orchids and their management. Pp: 72-79. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
20. Mohanty., P., D. Barman, J. Das, S. Thapa and R. P. Medhi. 2013. Antioxidant activities of two selected aromatic orchids of India. Pp: 167. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
21. Pattanayak., S., R. Devadas and J. Gagoi. 2013. New innovations: *In-vitro* flowering of *Cymbidiums* for promotion/commercialization. Pp: 187. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
22. Pant., R. P., Smita Gupta, B. Hakmoasa, N. K. Meena, S. P. Vij and R. P. Medhi. 2013. Status of orchid virus diagnostics and their application in production of virus free planting material. Pp:61-71. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
23. Pant., R. P., B. Hakmoasa, N. K. Meena, Pramila Devi, T. Mathur, Nita and R. P. Medhi 2013. *Studies on leaf spot disease of Aranda and Mokara hybrids and their management*. Pp.178. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
24. Pant., R. P., P. Chowdappa, Smita Gupta, B. Hakmoasa, N. K. Meena, and R. P. Medhi. 2013. *Molecular characterization and management of orchid anthracnose caused by Colletotrichum gloeosporioides in India*. Pp. 180. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
25. Ram Pal, R. P. Medhi and M. Dayamma 2013. Protocol for mass multiplication of *Paphiopedilum villosum* (Lindl.) Pfitz. through seeds: An approach for conservation through commercialization. Pp: 153-154. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
26. Ram Pal., D. Barman, M. Dayamma and R. P. Medhi. 2013. A symbiotic seed germination, seedling growth and acclimation of *Zygopetalum intermedium* for commercial cultivation. Pp: 154. In: *Abstract cum Souvenir -*

National Dialogue on orchid conservation and sustainable development for community livelihood at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.

27. Sailo., N., D. Barman., B. Hakmoasa, , Jaya Gogoi, and R. P. Pant. 2013. Effect of water stress on *Cymbidium* hybrid 'Pine clash moon venus' (PCMV). Pp: 180. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.
28. Srivastava., M., V. Chaudhary, R. C. Agrawal , D. S. Pilania and L. C. De. 2013. Role of PPV & FRA for IPR protection of orchids. Pp: 24-31. In: *Abstract cum Souvenir - National Dialogue on orchid conservation and sustainable development for community livelihood* at Gangtok from 8-9th March, 2013 organized by NRC (O) in collaboration with TOSI, Chandigarh.

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

1. NRC for Orchids, Pakyong received the award of 'Best Orchid Research Centre' for the year 2012-13 from Ministry of Home Affairs, Rajbhasha, New Delhi on 29th January, 2013.

2. Participated in the Sikkim International Flower Show, 2013 from 23-27th February, 2013 and bagged 3rd prize in National Stall Competition.

Appointments

Scientific

- ? Mrs. Arpita Mandal Khan joined as Scientist (Horticulture) on 11th April, 2013.
- ? Ms. Rumki Heloise Ch. Sangma joined as Scientist (Agril. Entomology) on 12th April, 2013.

Technical

- ? Ms. Tshering Chomu Bhutia joined as Horticulture Assistant (T-II-3) on 28th February, 2013.

Transfer

Scientific

- ? Dr. Narottam Kumar Meena, Scientist (Agril. Entomology) transferred to NRC on Seed Spices, Ajmer (Rajasthan) on 10th May, 2013.
- ? Dr. Rajendra Prasad Pant, Sr. Scientist (Plant Pathology) transferred to CPRS, Modipuram, Meerut (U.P.) on 18th May, 2013.

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