

वार्षिक प्रतिवेदन  
**ANNUAL REPORT**

**2003-2004**



NRC Orchids

राष्ट्रीय आर्किड अनुसंधान केन्द्र  
भारतीय कृषि अनुसंधान परिषद  
पिकयोंग, सिक्किम 737 106



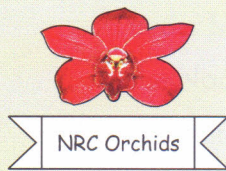
**NATIONAL RESEARCH CENTRE FOR ORCHIDS**

(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)

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ANNUAL REPORT  
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**National Research Centre for Orchids**  
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## Preface

India has unparalleled natural wealth of orchid flora in the world and have good potential for export trade in orchids. Orchid hybrids of export quality are hardly available in India and therefore, it is difficult to compete in the international market for orchid trade. In order to undertake various research and development programme in technology development, the thrust areas like germplasm collection, maintenance, documentation and conservation; development of potential hybrids with high yield, quality and withstand long distance transportation; protocol for mass multiplication of improved varieties/hybrids of orchids; production technology for increasing the productivity of new varieties/hybrids; standardization of pre and post harvest techniques for reducing the storage and transport losses; promotion of integrated disease and pest management programme have been identified. This centre will enable through the implementation of mission oriented research programmes to develop technology for making orchid production viable commercial industry for domestic purpose at initial stage and international trade later. Useful technologies for the commercial production of cut flower of orchids are being developed for entrepreneurship development.

The research activities have been modified with the changing scenario of market demand in the recent past and achievements are expected to report under these broad areas. In addition, two NATP projects and one Central Sponsored Scheme under Mini Mission-I (Research) for the integrated development of horticulture in the North Eastern states including Sikkim are supporting the research activities. I take this opportunity in expressing my gratitude to Dr. Mangala Rai, Secretary, DARE, Government of India and Director General, ICAR, for his support in the development of this Centre. I am extremely thankful to Dr. G. Kalloo, DDG (Hort.), ICAR for his encouragement, technical guidance and help. I will be fail in my duty



unless appreciate the dedicated efforts made by Dr T. K Bag and Dr V. S. Nagrare in bringing out this report in presentable form. I thank all my scientific, administrative, technical and supporting staff for their dedicated hard work and co-operation.

I am presenting with pride the 5th Annual Report 2003-2004 with detailed findings by the scientists and other related information about the Centre.

R.C. UPADHYAYA  
Director

Pakyong  
January 20



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## Summary

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During the year under report, research in three major divisions such as crop improvement, crop production and crop protection was carried out on orchids. In addition, work done at Darjeeling campus and in different externally funded projects is summarized below.

### CROP IMPROVEMENT

Forty-one species of 17 genera and 34 *Cymbidium* hybrids were morphologically characterized using 30 parameters. Total chlorophyll, chlorophyll a, chlorophyll b was studied in 14 species and 38 hybrids of *Cymbidium*. Maximum chlorophyll content was observed in *Cymbidium tigrinum* and minimum in *C. aloifolium*.

Embryos excised from mature green but unburst pods of 20 species and crosses of orchids were cultured on MS, Nitsch, B5 and Knudson's C media supplemented with or without activated charcoal, BAP, NAA, Triacantanol and Paclobutrazol indicated varied response for swelling among the species/crosses from 3 days to over 15 weeks followed by development of protocorm, shoot and root.

The morphogenetic response of *in vitro* regenerated protocorm like bodies of *Cymbidium tracyanum* trilipped was markedly influenced by different media formulations. Among the three basal media viz., MS, Nitsch and B5 containing 1.5g/l AC and 0.25mg/l paclobutrazol, the total plantlet weight

was maximum on MS.

The influence of plant growth substances on morphogenetic response of embryos on half strength MS revealed that seed swelling was early (59.67 days) in half strength MS containing 0.25mg/l PBZ and 0.1mg/l NAA. Nitsch as a basal media was found to be superior compared to MS.

Coco peat in combination with tree fern was the best suitable media for *ex vitro* hardening as it produced maximum shoot length with bigger and wider leaves, followed by coco peat alone.

Better growth of plantlets in respect of plantlet weight, plantlet length, leaf number, leaf length and root number was recorded in the full strength media, however, root growth was better in media diluted to 1/4th strength on *in vitro* hardening of *Dendrobium aphyllum* X *D. primulinum*.

### CROP PRODUCTION

Foliar application of 0.3 % of  $N_{20}P_5K_5$  on *Cymbidium* Show Girl "Cooksbridge" resulted maximum plant height and leaf length. However, leaf number, leaf width and pseudobulb girth was found to be non significant. Plant height and pseudobulb girth was greater when the plants were sprayed with 0.2 % of NPK 20 : 30 : 10.

Organic manure supplied through neem cake was most effective for growth and development as it increased leaf length and girth of pseudobulb to the





maximum of 56.74 cm and 3.77 cm, respectively.

Application of BA at 200 ppm was effective for plant height where as BA at lower concentration of 100 ppm produced longest leaf of 52.07 cm. Further, application of GA<sub>3</sub> also enhanced flowering. It produced a spike of 64.5 cm length containing five florets.

Application of organic nitrogen at 2000 mg/plant resulted in production of longest leaf (40.75 cm), maximum number of leaves/plant (8.30) and number of pseudobulb (4.20) in *Cymbidium*. As far as interval of its application is concerned, 60 days interval was superior over 30 days as higher length of leaves (35.65 cm), number of leaves (7.80) and number of pseudobulb (4.60) were observed in this treatment.

The average N, P and K content of leaf at the flowering stage of *Cymbidium* Japanese YY was in the ratio of 1.03 : 0.1 : 1.08 and the highest content of total N, P and K was 1.82%, 0.1% and 1.20% respectively in the treatment combination: leaf mould + charcoal + coconut husk + sand + saw dust + loam + FYM.

### CROP PROTECTION

Anthraxnose disease was recorded on 4 species of *Liparis*, 9 species of *Coelogyne*, 7 species of *Eria*, 11 species of *Bulbophyllum*, 3 species of *Cirrhopetalum*, 3 species of *Vanda*, 8 species of *Dendrobium*, 2 species of *Aerides*, 3 species of *Agrostophyllum*, 2 species of each *Pholidota*, *Thunia*, *Arachmanthe*, *Paphiopedilum*, *Ascocentrum*, one species of each *Gastrochilus*, *Renanthera*, *Ornithochilus*, *Cryptochilus*, *Oncidium* and *Goodyera*.

Black rot was observed on *Cymbidium aloifolium*, *C. devonianum*, *C. pendulum*, *C.*

*tracyanum*, *C. elegans*, *C. hookerianum* and other unidentified *Cymbidium* species. The disease was also recorded on the many *Cymbidium* hybrids. Out of three growing conditions in low cost polyhouse, highest number of *Cymbidium* (Hybrid: Red Star) shoot rot was recorded in soil grown bed followed by wooden raised bed and pot grown plants.

About 27 species of 14 genera of orchids were found to be susceptible for shoot borer (Black moth) damage. Black thrips were recorded on different orchid species like *Bulbophyllum hirtum*, *Coelogyne cristata*, *Coelogyne* sp., *Dendrobium chrysanthum*, *D. fulconeri*, *D. nobile*, *Epigenium amplum* and *Pholidota articulata* in the germplasm. Grasshopper feeding on petals of *Cymbidium lowianum*, *Cymbidium* hybrids and young *Cymbidium* seedlings was recorded during late winter. Black aphid *Toxoptera aurantii* infested spike of *Oncidium* Gower Ramsay.

Seasonal occurrence of yellow aphid *Macrosiphum* sp. on *Dendrobium nobile* and *Epidendrum* sp. studied. This aphid was also found to infest *Vanda cristata*, *Acampe papillosa*, *Dendrobium nobile*, *Goodyera procera* and *Cymbidium* hybrids viz., Red Star, Hawtescence, San Francisco "Del Rio".

Black weevil larvae entering into the shoot and thereafter into Pseudobulb, feed on plant tissue which resulted into rotting of pseudobulb and thereby further growth arrested. Nearly 20% plants *Cymbidium* of H.C. Aurora were affected by black weevil. This pest has been also seen to damage *Cymbidium* spp., *Coelogyne* spp., *Phaius tankervilleae*, *Storopsis undulata* etc.

Damage caused by snail *Cryptaustenia verrucosa* by feeding on plant parts of *Aerides fieldingii*, *Arachmanthe*





sp. *Calanthe triplicata*, *Coelogyne elata*, *C. flaccida*, *Dendrobium kingianum*, *D. moschatum*, *D. parishii*, *D. primulinum*, *Eria flava*, *E. pubescens*, *E. spicata*, *Goodeyria procera*, *Lycaste schunbrunensis*, *Otochilus* sp., *Paphiopedilum villosum*, *Pholidota imbricata*, etc was recorded.

### Darjeeling campus

Four explorations were conducted to collect the orchids from natural habitat occurring in the Darjeeling district. During explorations one new species of *Calanthe*, one species of *Cymbidium* (*Cymbidium iridoides*) and two species of *Coelogyne* were added to the previous collection thus making total collection of 154 species of native orchids.

Among the ten species of *Cymbidium* conserved at the campus, *C. erythreum*, *C. gammieanum* and *C. elegans* were the first flowering species while *C. lowianum*, *C. devonianum* and *C. tigrinum* were late flowering species. All the conserved species have either been maintained in low cost playhouses or in artificial natural habitat. The artificial natural habitat provided almost similar conditions like in nature.

Four oriental lily cultivars, two Asiatic lily cultivars, two cultivars of tulip and one cultivar of iris have been added to the previous collection. Two cultivars of *Lilium* 'Nove Cento' (Oriental) and 'Star Fighter' (Asiatic) quantity have been planted for evaluation trial.

Among the growth regulators tested for multiplication of *Lilium longiflorum*, ethylene > 500 ppm but below 2000 ppm was found most suitable for propagation of bulbs.

The detached scales of *Lilium longiflorum* bulbs were wounded and planted in leaf mould. The pricking of scales on whole scale resulted in more number of

plantlets while slitting at the basal portion resulted in equal size of bulbs. The scales planted in nine different cutting media. Amongst them saw dust gave maximum (2.29) number of bulblets followed by vermicompost (1.95), perlite + leaf mould (1.94), leaf mould (1.76), sphagnum moss (1.68) compost (1.37), charcoal (1.36) and coco peat (1.28).

The bulbs of daffodils were soaked in different concentrations (500, 1000, 1500 and 2000 ppm) of ethylene (source: ethrel) for different time intervals (24, 48, and 72 hrs) and thereafter planted in beds. The result showed that higher ethylene concentration delayed germination.

### NATP Project: Sustainable management of plant biodiversity

During the year 3 exploration trips were undertaken in collaboration with NBPGR and ICAR Research Complex for NEH region, Barapani in Arunachal Pradesh, Nagaland and Darjeeling hills of West Bengal and collected over 228 accessions of orchids and 9 accessions of bulbous flowers.

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

In Rose cv. First Red, the longest plant was observed from the growing media containing 2 soil : 1 compost : 1 sand supplemented with 150 ppm N + 200 ppm K through fertigation under the irrigation regime of 20 kPa. The growing media comprising of 2 soil : 1 compost : 1 sand (M-4) as well as 2 soil : 1 compost : 1 saw dust fertigated with 150 ppm N + 200 ppm K maintaining the soil moisture at 40 kPa (M-6) induced early bud appearance (60 days). Plants





grown in the media containing 2 soil : 1 compost : 1 coco peat (M-2) pre supplemented with 1 kg CAN + 2 kg SSP + 1/2 kg MOP / 10 m<sup>2</sup> + 150 ppm N and 200 ppm K at 20 kPa irrigation regime resulted in production of longest pedicel (8.61 cm) as well as largest flower (8.86 cm). Highest number of flowers (65.63) with 30–44 cm stem length was recorded from the growing media containing 2 soil : 1 compost : 1 sand supplemented with 150 ppm N + 200 ppm K through fertigation under the irrigation regime of 20 kPa and spraying of polyfeed + micronutrients (2g/l) followed by spray of BAP 50 ppm + GA<sub>3</sub> 50 ppm from September to January (M-9).

The experiment on *Cymbidium* hybrid Soul-Hunt-6 was undertaken with one and half years old tissue cultured plants. Growing media containing leaf mould + FYM + charcoal + coconut husk + brick bits (2 : 1 : 1 : 1 : 1) and spraying with N 300 ppm P 200 ppm K 100 ppm + BA 200 ppm and GA<sub>3</sub> 200 ppm recorded the maximum plant height (70.40 cm). Number of leaves were highest (12.00) in potting mixture having leaf mould + FYM + charcoal + coconut husk + brick bits (2 : 1 : 1 : 1 : 1) and spraying with N 200 ppm P 100 ppm K 100 ppm + BA 100 ppm GA<sub>3</sub> 100 ppm.

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

*Cymbidium* Lunavian Atlas and *Cymbidium* Show Girl “Cooksbridge” multiplied better in Gamborg + 1.5g/l AC, as indicated in higher number of Plbs and differentiated into shoots as indicated by higher number of shoot development and root

formation. Supplementation of 100ml/l coconut water recorded more number of protocorms, while shoot initiation, leaf and root differentiation was better at 200ml/l coconut water.

In case of *Cymbidium* Show Girl “Cooksbridge” MS media supplemented with 1g/l activated charcoal resulted in better multiplication as well as differentiation of Plbs and formed shoots and roots and it also prevented the browning of the media.

In *Cymbidium* Lunavian Atlas, Nitsch media resulted in higher number of Plbs, as well as shoot and root differentiation and in fastest multiplication of Plbs, but the shoot and root initiation was fastest in Gamborg media. BAP at lower concentration (0.25mg/l) in media formed more Plbs, early shoot emergence and maximum number of shoots developed, however early root emergence was recorded on BAP at 0.5mg/l.

For *Cymbidium* Golden Girl and *Cymbidium* Show Girl “Cooksbridge” Gamborg with 1.5g/l AC was better for plantlets development. Murashige and Skoog with 1.5% AC was found better for *Cymbidium* Soul Hunt I where as Nitsch with 1.5g/l AC was for development of *Cymbidium* Lunavian Atlas. Activated charcoal, when incorporated with *in vitro* culture media at a concentration of 1%, resulted in better plantlets of well-developed shoot and root of *Cymbidium* Show Girl “Cooksbridge”

Planting of gladiolus cv. Jester corms at the planting density of 33 corms/m<sup>2</sup> without potash produced maximum length of plant (144.47 cm), leaf length (61.42 cm), spike length (89.56 cm), rachis length (68.57 cm) and maximum number of corms and cormels (1.30 and 35.26), respectively.





## सारांश

रिपोर्ट के अंदर इस वर्ष आर्किड के अनुसंधान कार्य को तीन प्रमुख विभागों जैसे:- फसल सुधार, फसल उत्पादन एवं फसल संरक्षण में विभाजित किया गया। दार्जिलिंग परिसर पर किये गये कार्य एवं विभिन्न बाह्य वित्तपोषित परियोजनाओं का संक्षिप्त विवरण नीचे दिया गया है।

### फसल सुधार

तीस प्रतिरूपों का उपयोग करके 17 वंशों की 41 प्रजातियाँ एवं 34 सिम्बीडियम संकर मारफोलोजिकली वर्गीकृत किये गये। सिम्बीडियम के 38 संकरों एवं 14 प्रजातियों में क्लोरोफिल 'ए' एवं क्लोरोफिल 'बी' का अध्ययन किया गया। क्लोरोफिल का अधिकतम स्तर सिम्बीडियम टिग्रिनम में तथा कम स्तर सिम्बीडियम एलोइफोलियम में पाया गया।

विभिन्न माध्यमों जैसे:- एम.एस. निश्च, बी-5, नडसन सी माध्यम में कल्चर करने पर श्रूणों में प्रभावी वृद्धि पाई गई, यह अध्ययन 20 प्रजातियों के परिपक्व हरी फलियों पर किया गया, इस माध्यम में सक्रिय चारकोल, बी ए पी, एन ए ए, ट्राईकन्टेनाल, पेक्लोब्यूट्राजाल भी प्रयोग किया गया। इसमें फुलाव के लिये कई आर्किड प्रजातियों/संकरों ने 3 दिन से 15 सप्ताह तक का समय लिया एवं इससे प्रोटोफार्म का विकास प्ररोह एवं मूल का विकास भी तीव्र पाया गया।

विभिन्न माध्यम संयोगों से सिम्बीडियम ट्रेसियेनम के पी एल बी निर्माण में तीव्र प्रभाव पाया गया। तीन आधारीय माध्यमों जैसे: एम.एस. निश्च, तथा बी-5 जिसमें 1.5 ग्रा./ली. सक्रिय चारकोल 0.25 मि.ग्रा./ली. पेक्लोब्यूट्राजोल था, से अधिक पौधे भार पाया गया।

पादप वृद्धि नियामकों का अध्ययन प्रभाव की दृष्टि से किया गया, इसमें जब आधी शक्ति का एम एस माध्यम प्रयोग किया गया तब बीज का स्फुटन (अर्लि स्वेलिंग) शीघ्र (59.67 दिन) पाया गया, इस एमएस माध्यम में 0.25 मिग्रा./ली.पी.बी.जेड एवं 0.1 मि.ग्रा./ली.

एन.ए.ए था। निश्च माध्यम एम.एस. माध्यम की तुलना में उत्तम पाया गया।

हार्डनिंग के दृष्टिकोण से, कोकोपीट का ट्री फर्न के साथ संयोग वाला माध्यम उपयोगी पाया गया एवं इससे अधिक लम्बाई वाले प्ररोह एवं लम्बी चौड़ी पत्तियाँ पाई गईं।

पूर्ण शक्ति वाले माध्यम में पौधों की वृद्धि के कई संघटकों जैसे:- पौधों का भार, पौधों की लम्बाई, पत्तियों की संख्या, पत्तियों की लम्बाई एवं मूल संख्या में वांछित वृद्धि पाई गई, जबकि डेन्ड्रोबियम एफिलम × डेन्ड्रोबियम प्राइमूलिनम को एक चौथाई सांद्रता वाले माध्यम से हार्डनिंग करने पर मूलों का विकास उत्तम पाया गया।

### फसल उत्पादन

सिम्बीडियम संकर शोगर्ल 'कुक्सब्रिज' में एन<sub>20</sub>पी<sub>5</sub>के<sub>5</sub> को 0.3 प्रतिशत की सांद्रता पर पर्णाय छिड़काव करने से ऊँचाई एवं पत्तियों की लम्बाई में प्रभावी वृद्धि पाई गई, जबकि पत्तियों की संख्या, पत्तियों की चौड़ाई एवं आभासी कंद की चौड़ाई सार्थक नहीं पाई गई। जब पौधों पर एन.पी.के. को 20 : 30 : 10 के अनुपात में एवं 0.2 प्रतिशत की सांद्रता पर छिड़काव किया, तब पौधों की ऊँचाई एवं आभासीकंद की चौड़ाई में वृद्धि पाई गई।

कार्बनिक खाद को नीम की खली के रूप में प्रयोग करने पर पत्तियों की लम्बाई तथा आभासी कंदों की चौड़ाई में क्रमशः 56.74 से.मी. तथा 3.77 से.मी. की वृद्धि पाई गई।

बीए को 200 पी.पी.एम की सांद्रता पर उपयोग करने पर पौधों की ऊँचाई में प्रभावी वृद्धि पाई गई, जबकि बीए की निम्न सांद्रता 100 पी.पी.एम. प्रयोग करने पर लम्बी पत्तियाँ (52.07 से.मी.) पाई गई। जिब्रेलिक एसिड (जी ए) के उपयोग से पुष्पन में वृद्धि पाई गई एवं इससे 5 पुष्पों वाला लम्बा स्पाइक (64.5 से.मी.) पाया गया।

सिम्बीडियम में कार्बनिक नाइट्रोजन को 2000 मि.ग्रा./पौधा की





## सारांश

रिपोर्ट के अंदर इस वर्ष आर्किड के अनुसंधान कार्य को तीन प्रमुख विभागों जैसे:- फसल सुधार, फसल उत्पादन एवं फसल संरक्षण में विभाजित किया गया। दार्जिलिंग परिसर पर किये गये कार्य एवं विभिन्न बाह्य वित्तपोषित परियोजनाओं का संक्षिप्त विवरण नीचे दिया गया है।

### फसल सुधार

तीस प्रतिरूपों का उपयोग करके 17 वंशों की 41 प्रजातियाँ एवं 34 सिम्बीडियम संकर मारफोलोजिकली वर्गीकृत किये गये। सिम्बीडियम के 38 संकरों एवं 14 प्रजातियों में क्लोरोफिल 'ए' एवं क्लोरोफिल 'बी' का अध्ययन किया गया। क्लोरोफिल का अधिकतम स्तर सिम्बीडियम टिग्रिनम में तथा कम स्तर सिम्बीडियम एलोइफोलियम में पाया गया।

विभिन्न माध्यमों जैसे:- एम.एस. निश्च, बी-5, नडसन सी माध्यम में कल्चर करने पर भ्रूणों में प्रभावी वृद्धि पाई गई, यह अध्ययन 20 प्रजातियों के परिपक्व हरी फलियों पर किया गया, इस माध्यम में सक्रिय चारकोल, बी ए पी, एन ए ए, ट्राईकन्टेनाल, पेक्लोब्यूट्राजाल भी प्रयोग किया गया। इसमें फुलाव के लिये कई आर्किड प्रजातियों/संकरों ने 3 दिन से 15 सप्ताह तक का समय लिया एवं इससे प्रोटोफार्म का विकास प्ररोह एवं मूल का विकास भी तीव्र पाया गया।

विभिन्न माध्यम संयोगों से सिम्बीडियम ट्रेसियेनम के पी एल बी निर्माण में तीव्र प्रभाव पाया गया। तीन आधारीय माध्यमों जैसे: एम एस, निश्च, तथा बी-5 जिसमें 1.5 ग्रा./ली. सक्रिय चारकोल 0.25 मि.ग्रा./ली. पेक्लोब्यूट्राजोल था, से अधिक पौधे भार पाया गया।

पादप वृद्धि नियामकों का अध्ययन प्रभाव की दृष्टि से किया गया, इसमें जब आधी शक्ति का एम एस माध्यम प्रयोग किया गया तब बीज का स्कुटन (अर्लि स्वेलिंग) शीघ्र (59.67 दिन) पाया गया, इस एमएस माध्यम में 0.25 मिग्रा./ली.पी.बी.जेड एवं 0.1 मि.ग्रा./ली.

एन.ए.ए था। निश्च माध्यम एम.एस. माध्यम की तुलना में उत्तम पाया गया।

हार्डनिंग के दृष्टिकोण से, कोकोपीट का ट्री फर्न के साथ संयोग वाला माध्यम उपयोगी पाया गया एवं इससे अधिक लम्बाई वाले प्ररोह एवं लम्बी चौड़ी पत्तियाँ पाई गईं।

पूर्ण शक्ति वाले माध्यम में पौधों की वृद्धि के कई संघटकों जैसे:- पौधों का भार, पौधों की लम्बाई, पत्तियों की संख्या, पत्तियों की लम्बाई एवं मूल संख्या में वांछित वृद्धि पाई गई, जबकि डेन्ड्रोबियम एफिलम × डेन्ड्रोबियम प्राइमूलिनम को एक चौथाई सांद्रता वाले माध्यम से हार्डनिंग करने पर मूलों का विकास उत्तम पाया गया।

### फसल उत्पादन

सिम्बीडियम संकर शोगर्ल 'कुक्सब्रिज' में एन<sub>20</sub>पी<sub>5</sub>के<sub>5</sub> को 0.3 प्रतिशत की सांद्रता पर पर्णाय छिड़काव करने से ऊँचाई एवं पत्तियों की लम्बाई में प्रभावी वृद्धि पाई गई, जबकि पत्तियों की संख्या, पत्तियों की चौड़ाई एवं आभासी कंद की चौड़ाई सार्थक नहीं पाई गई। जब पौधों पर एन.पी.के. को 20 : 30 : 10 के अनुपात में एवं 0.2 प्रतिशत की सांद्रता पर छिड़काव किया, तब पौधों की ऊँचाई एवं आभासीकंद की चौड़ाई में वृद्धि पाई गई।

कार्बनिक खाद को नीम की खली के रूप में प्रयोग करने पर पत्तियों की लम्बाई तथा आभासी कंदों की चौड़ाई में क्रमशः 56.74 से.मी. तथा 3.77 से.मी. की वृद्धि पाई गई।

बीए को 200 पी.पी.एम की सांद्रता पर उपयोग करने पर पौधों की ऊँचाई में प्रभावी वृद्धि पाई गई, जबकि बीए की निम्न सांद्रता 100 पी.पी.एम. प्रयोग करने पर लम्बी पत्तियाँ (52.07 से.मी.) पाई गई। जिब्रेलिक एसिड (जी ए) के उपयोग से पुष्पन में वृद्धि पाई गई एवं इससे 5 पुष्पों वाला लम्बा स्पाइक (64.5 से.मी.) पाया गया।

सिम्बीडियम में कार्बनिक नाइट्रोजन को 2000 मि.ग्रा./पौधा की





दर से प्रयोग करने पर पत्तियों की लम्बाई, (40.75 से.मी.), प्रति पौधा अधिक पत्तियों की संख्या (8.30) एवं आभासी कंदो की संख्या (4.20) में प्रभावी वृद्धि पाई गई। कार्बनिक नाइट्रोजन के उपयोग के अंतराल का प्रभाव भी देखा गया। जिसमें 60 दिन का अंतराल, 30 दिन के अंतराल की अपेक्षा, उत्तम पाया गया इसमें पत्तियों की लम्बाई (35.65 से.मी.), पत्तियों की संख्या (7.80) एवं आभासी कंदो की संख्या (4.60) पाई गई।

सिम्बीडियम जापानीज 'वाई वाई' में पुष्पन की अवस्था पर पत्तियों का औसत एन पी के स्तर 1.03 : 0.1 : 1.08 के अनुपात में पाया गया। अधिकतम पत्तियों का एन पी के स्तर- 1.82 प्रतिशत, 0.1 प्रतिशत एवं 1.20 प्रतिशत एक उपचार संयोग (लीफ मोल्ड+चारकोल+कोकोनट हस्क+सेन्ड+साडस्ट+लोम+गोबर की खाद) में पाया गया।

#### फसल संरक्षण

लाइपेरिस की 4 प्रजातियाँ, सीलोगाइनी की 9 प्रजातियाँ, इरिया की 7 प्रजातियाँ, बल्बोफिलम की 11 प्रजातियाँ, सिरापेटेलम की 3 प्रजातियाँ, वेन्डा की 3 प्रजातियाँ, डेन्ड्रोबियम की 89 प्रजातियाँ, एरीड्स की 2 प्रजातियाँ, एग्रोस्टोफिलम की 3 प्रजातियाँ, फोलीडोटा, थूनिया, ऐरेक्नेन्थे, पेफियोपेडीलम, एस्कोसेन्ट्रम की 2 प्रजातियाँ एवं गेस्ट्रोचिलस, रिनेन्थेरा, ओरिन्थोचिलस, क्रिप्टोचिलस, ओन्सीडियम, गुडयेरा की एक-एक प्रजाति ऐन्थ्रेकनोज रोग से संक्रमित पाई गई।

सिम्बीडियम एलोइफोलियम, सिम्बीडियम डेबोनियेनम, सि. पेन्डुलम, सि. ट्रेसियेनम, सि. एलिगेन्स, सि. हुकेरियेनम और अन्य जानी गई सिम्बीडियम प्रजातियों पर ब्लैक राट की उपस्थिति पाई गई। सिम्बीडियम के संकरों पर भी यह रोग पाया गया। तीन उगाने की परिस्थितियों में से, कम लागत पौली हाऊस में भूमि क्यारियों में अधिक सिम्बीडियम प्ररोह संक्रमित पाये गये।

लगभग 14 वंशों की 27 प्रजातियों पर तना छेदक (ब्लैक मॉथ) की क्षति का आंकलन किया गया। जीव द्रव्य कक्ष में कई आर्किड प्रजातियों जैसे:- वल्बोफिलम हिरटम, सीलोगाइनी क्रिस्टाटा, सीलोगाइनी स्पीसीज, डेन्ड्रोबियम क्राइजेन्थम, डेन्ड्रोबियम फुल्कोनेरी, आर्सिकुलेटा पर ब्लैक थ्रिप्स पाया गया।

सर्दियों में देर से, पेरल्स पर ग्रासहोपर की उपस्थिति कई आर्किड

प्रजातियों जैसे:- सिम्बीडियम लोविएनम, सिम्बीडियम संकरों एवं नये सिम्बीडियम पौधे पर पाई गई। ब्लैक एफिड प्रजाति, टोक्सोपेटेरा औरन्टी ने ओन्सीडियम ग्रोवर रेम्से की स्याइक को संक्रमित किया।

डेन्ड्रोबियम नोविली एवं इपीडेन्ड्रम प्रजातियों पर यलो एफिड मेक्रोसिफम प्रजाति की मौसमीय उपस्थिति का अध्ययन किया गया। वेन्डा क्रिस्टाटा, एकेम्पे पेपिलोसा, डेन्ड्रोबियम नोविली, गुडयेरा प्रोसेरा एवं सिम्बीडियम संकरों जैसे:- रेड स्टार, हाटेसेन्स एवं सेन फ्रांसिस्को 'डेलरियो' पर भी यलो एफिड पाया गया।

ब्लैक वीविल लार्वा के प्ररोह एवं आभासी कंद में संक्रमण से, आभासी कंदों में सड़न पाई गई एवं पौधों की वृद्धि रुकी हुई पाई गई। लगभग 20 प्रतिशत पौधों (एच.सी. औरोरा) ब्लैक वीविल से संक्रमित पाये गये। इस कीट से कई अन्य प्रजातियों जैसे:- सिम्बीडियम प्रजाति, सीलोगाइनी प्रजाति, फायस टेकरविलि, स्टोरोपसिस अन्दुलाटा में भी क्षति पाई गई।

स्नेल क्रिप्टोस्टेनिया वेरूकोसा द्वारा क्षति कई प्रजातियों जैसे:- एरीड्स, ऐरेक्नेन्थे, केलेन्थे ट्रिपलिकेटा, सीलोगाइनी एलाटा, सीलोगाइनी फ्लेसिडा, डेन्ड्रोबियम किंगिऐनम, डेन्ड्रोबियम मोस्चेटम, डेन्ड्रोबियम पेरिसी, डेन्ड्रोबियम प्राइमयूलियम, इरिया फ्लेवा, इरिया प्यूबेसेन्स, इरिया स्पीकेटा, गुडयेरा प्रोसेरा, लिकास्टी, ओटोचिलस स्पि; पेफियोपेडीलम विलोसम, फोलीडोटा इम्ब्रीकेटा में पाई गई।

#### दार्जिलिंग परिसर

दार्जिलिंग जिले में पाये जाने वाले आर्किड प्रजातियों को एकत्रित करने के लिये चार प्रयास किये गये। प्रयासों के दौरान कैलेन्थे की एक नई प्रजाति, सिम्बीडियम इरीडोइड्स की एक नई प्रजाति, सीलोगाइनी की दो प्रजातियाँ, प्रारंभिक संग्रहण में सम्मिलित की गई, जिससे आर्किड्स की कुल प्रजातियों की संख्या 154 हो गई।

परिसर पर संरक्षित की गई 10 सिम्बीडियम प्रजातियों में से, सिम्बीडियम इरिथ्रेयम, सिम्बीडियम गेम्मियेनम, सिम्बीडियम ऐलीगेन्स आदि प्रजातियों में पुष्पन पहले पाया गया जबकि सिम्बीडियम लोवियेनम, सिम्बीडियम डेबोनियेनम एवं सिम्बीडियम टिग्रिनम में पुष्पन देर से पाया गया। सभी संरक्षित प्रजातियाँ या तो कम लागत पालीहाऊस में संरक्षित की गई है या इन्हें कृत्रिम प्राकृतिक वास स्थान में रखा गया है। कृत्रिम प्राकृतिक कुस स्थान, प्रकृति की तरह ही सभी पर्यावरणीय





स्थितियां रखते हैं।

चार ओरियेन्टल लिली की प्रजातियों, दो एशियाटिक लिली की प्रजातियां, ट्यूलिप की दो प्रजातियों एवं आइरिस की एक प्रजाति को प्रारंभिक संग्रहण में सम्मिलित किया गया। लिलियम की दो प्रजातियों नोवे सेन्टो (ओरियेन्टल) एवं स्टार फाइटर (एशियाटिक) को मूल्यांकन परीक्षण के लिये प्रयोग किया गया।

लिलियम लोंगीफ्लोरम के बहुगुणन के लिये इथाइलीन 500 पी पी एम से ज्यादा लेकिन 2000 पी पी एम से कम, कंदों के प्रजनन के लिये उपयुक्त पाया गया।

लिलियम लोंगीफ्लोरम के कंदों को पृथक कर, उन्हें लीफ मोल्ड में रोपित किया गया। पूर्णरूपेण शल्कपत्रों को प्रतिस्थापित करने पर पौधों की संख्या अधिक पाई गई जबकि आधारीय भाग का उपयोग करने पर एक समान कंद प्राप्त हुये। शल्क पत्रों को विभिन्न 9 माध्यमों में रोपित किया गया जिसमें से साडस्ट युक्त माध्यम से अधिकतम कंदिकायें (2.29) उत्पन्न की जबकि वर्मीकम्पोस्ट (1.95), परलाइट+लीफमोल्ड (1.94), लीफ मोल्ड (1.76), स्फेगनम मास (1.68), कम्पोस्ट (1.37), चारकोल (1.36) एवं कोकोपीट (1.28) आदि ने कंदिकायें उत्पन्न की डेफोडिल के कंदों को जब विभिन्न सांद्रताओं के विलयनों (500, 1000, 1500 एवं 2000 पी पी एम) इथाइलीन से विभिन्न समय अंतरालों (24.48 एवं 72 घंटे) में उपचारित किया गया एवं क्यारियों में रोपित किया गया। परिणाम स्वरूप, इथाइलीन की अधिक सांद्रताओं से अंकुरण देर से हुआ।

### राष्ट्रीय कृषि तकनीकी परियोजना के अन्तर्गत पादप-विविधता का प्रबंधन

इस वर्ष में एन.बी.पी.जी.आर. एवं आई.सी.ए.आर. रिसर्च काम्प्लेक्स फार एन ई एच रीजन, बारापानी के सहयोग से अरुणाचल प्रदेश, नागालैण्ड एवं पश्चिमी बंगाल की दार्जिलिंग पहाड़ियों से प्रजातियाँ एकत्रित करने के लिये तीन प्रयास किये गये। इन प्रयासों से आर्किड्स की 228 एकत्रण एवं कंदीय पुष्पों के 9 संग्रहण एकत्रित किये जा चुके हैं।

### राष्ट्रीय कृषि तकनीकी परियोजना के अन्तर्गत पहाड़ी तथा मैदानी क्षेत्रों में पुष्पों एवं सब्जियों की संरक्षित खेती

गुलाब की जाति 'फस्ट रेड' के पौधों की ऊँचाई तब अधिक पाई

गई जब माध्यम 2 भाग मृदा:1 भाग गोबर की खाद:1 भाग रेत जोकि 150 पी पी एम नाइट्रोजन+200 पी पी एम पोटाश युक्त था, इस माध्यम के साथ ही 200 कि.ग्रा. फास्फोरस भी प्रयोग किया गया। माध्यम (2 भाग मृदा: 1 भाग कम्पोस्ट: 1 भाग रेत (मॉडुल-4) के समान एक अन्य माध्यम (2 भाग मृदा: 1 भाग कम्पोस्ट: 1 भाग साडस्ट) को 150 पी पी एम नाइट्रोजन+200 पी पी एम पोटाश से आपूर्ति करने पर, जिसमें मृदा नमी 40 के पी ए थी (मॉडुल-6), कलिकाओं की उपस्थिति (60 दिन) शीघ्रता से पाई गई। एक अन्य माध्यम (2 भाग मृदा: 1 भाग कम्पोस्ट: 1 भाग कोकोपीट (मॉडुल-2) को 1 कि.ग्रा. सी ए एन+2 कि.ग्रा. एस एस पी+½ कि.ग्रा. एम ओ पी/10 वर्ग मी.+150 पी पी एम नाइट्रोजन एवं 200 पी पी एम पोटाश को 20 के पी ए की सिंचाई दक्षता पर प्रयोग करने से वृन्त की अधिक लम्बाई (8.61 से.मी.) एवं बड़ा पुष्प (8.86 से.मी.) प्राप्त हुआ। पुष्पों की अधिक संख्या (65.63) जोकि 30-40 से.मी. तना युक्त था, की प्राप्ति हुई, माध्यम (2 भाग मृदा: 1 भाग कम्पोस्ट: 1 भाग रेत) जिसको 150 पी पी एम नाइट्रोजन+200 पी पी एम पोटाश से पूरित किया गया था। सितम्बर से जनवरी के मध्य में पोलीफीड+सूक्ष्म तत्वों (2 ग्रा./ली.) के छिड़काव से प्रभावी वृद्धि भी पाई गई (मॉडुल-9)।

सिम्बीडियम संकर 'सोल-हन्ट-6' के 1.5 वर्ष पुराने टिशू कल्चर पौधों पर एक प्रयोग किया गया। माध्यम (लीफ मोल्ड+गोबर की खाद+चारकोल+कोकोनट हस्क+त्रिक्स टुकड़ों, (2 : 1 : 1 : 1 : 1 के अनुपात में) एवं नाइट्रोजन-300 पी पी एम, फास्फोरस-200 पी पी एम एवं जिब्रेलिक एसिड-200 पी पी एम के छिड़काव से पौधों की ऊँचाई अधिक (70.40 से.मी.) पाई गई। मिश्रण (लीफ मोल्ड+गोबर की खाद+चारकोल+कोकोनट हस्क+त्रिक्स के टुकड़े (2 : 1 : 1 : 1 : 1) को नाइट्रोजन 200 पी पी एम, फास्फोरस 100 पी पी एम एवं पोटाश-100 पी पी एम+बी ए-100 पी पी एम एवं जिब्रेलिक एसिड-100 पी पी एम को साथ मिलाकर छिड़काव करने से पत्तियों की संख्या (12.00) अधिक पाई गई।

### सिक्किम सहित उत्तरी-पूर्वी राज्यों में उद्यानिकी का एकीकृत विकास (मिनी मिशन-1)

सिम्बीडियम ल्यूनेवियन एटलस एवं सिम्बीडियम शोगर्ल 'कुक्सब्रिज' को जब गेम्बर्ग+1.5 ग्रा./ली. सक्रिय चारकोल माध्यम में





बहुगुणित किया गया, तब पी एल बी की संख्या अधिक पाई गई एवं प्ररोह एवं मूल का निर्माण भी शीघ्रता से हुआ। माध्यम को 100 मि.ली./ली. नारियल पानी से पूरित करने पर प्रोटोकॉर्म की संख्या में वृद्धि पाई गई, जबकि प्ररोह का उद्भव, पत्ती एवं जड़ का प्रादुर्भाव 200 मि.ली./ली. नारियल पानी की पूर्ति से प्रभावी पाया गया।

सिम्बीडियम शोगर्ल 'कुक्सब्रिज' में एम एस माध्यम जो कि 1 ग्रा./ली. सक्रिय चारकोल से पूरित था, में पी एल बी का बहुगुणन अच्छा पाया गया एवं प्ररोह एवं मूल के निर्माण में वृद्धि पाई गई तथा साथ ही माध्यम को भूरेपन से भी बचाया।

सिम्बीडियम 'लूनेवियन एटलस' में निश्च माध्यम के उपयोग से पी.एल.बी. की संख्या में वृद्धि पाई गई साथ ही प्ररोह एवं मूलन से भी प्रभावी वृद्धि पाई गई, गैमबर्ग माध्यम में पी.एल.बी., प्ररोह एवं मूलन शीघ्रता से हुआ। माध्यम में बी.ए.पी. (निम्न स्तर 0.25 मि.ग्रा./ली.) की आपूर्ति से अधिक पी.एल.बी., शीघ्र तना की उपस्थिति, तथा अधिक प्ररोह पाये गये। माध्यम में जब बी ए पी को 0.5 मि.ग्रा./ली.

की दर से प्रयोग किया गया तो मूल की उपस्थिति शीघ्रता से हुई।

सिम्बीडियम 'गोल्डन गर्ल' एवं सिम्बीडियम शोगर्ल 'कुक्स ब्रिज' के लिये गेम्बर्ग माध्यम, जो कि 115 ग्रा./ली. सक्रिय चारकोल युक्त था, पादप वृद्धि के लिये प्रभावी पाया गया। मुराशिगे एवं स्कूग माध्यम, जो कि 1.5 प्रतिशत सक्रिय चारकोल से पूरित था सिम्बीडियम सोल हन्ट-1 के लिये उपयोगी पाया गया, जबकि निश्च माध्यम जोकि 1.5 ग्रा./ली. सक्रिय चारकोल से पूरित था, सिम्बीडियम 'लूनेवियन एटलस' के लिये उपयोगी पाया गया। सक्रिय चारकोल को 1 प्रतिशत की दर से प्रयोगशाला के माध्यम में प्रयोग करने से, सिम्बीडियम शोगर्ल 'कुक्सब्रिज' में प्ररोह एवं मूल का निर्माण तीव्रता से हुआ।

ग्लेडियोलस प्रजाति-जेस्टर को जब 33 बल्ब प्रति वर्ग मीटर की दर से रोपित किया गया, जिसमें पोटेश नहीं था, से पौधों की अधिक लम्बाई (144.47 से.मी.), पत्तियों की लम्बाई (61.42 से.मी.), स्पाइक की लम्बाई (89.56 से.मी.), रेचिस की लम्बाई (68.57 से.मी.) एवं कंद एवं कंदिकाओं की अधिक संख्या (1.30 एवं 35.26) पाई गई।





# 1

## Introduction

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### Background

The flower qualities of orchids like uniqueness in shape, size, color, scent, exquisitely attractive, long vase life in comparison to other flowers have made orchid growing a highly profitable industry all-over the world. However experience showed gaps left in orchid commercialization in India. Modern farms requires not only entrepreneurial skills coupled with knowledge to manage and operate a disease and pest free farms and production of quality flowers acceptable in international markets, but it is also vitally important to achieve global production standards in order to become price competitive. Therefore at this centre

studies have been undertaken on biodiversity with their morphology, genetics, breeding for developing desired hybrids, testing the suitability of substrate for growing of orchids, nutritional requirements, etc. Keeping in pace with world research attempts are also being made to generate large number of plants through tissue culture. For sustainable commercialization the research areas like production technology, plant protection, green house management, post harvest technology etc are being studied at this centre. The extension activities like training and entrepreneur development for floriculture growth are provided in north east hill region.

### Mandate

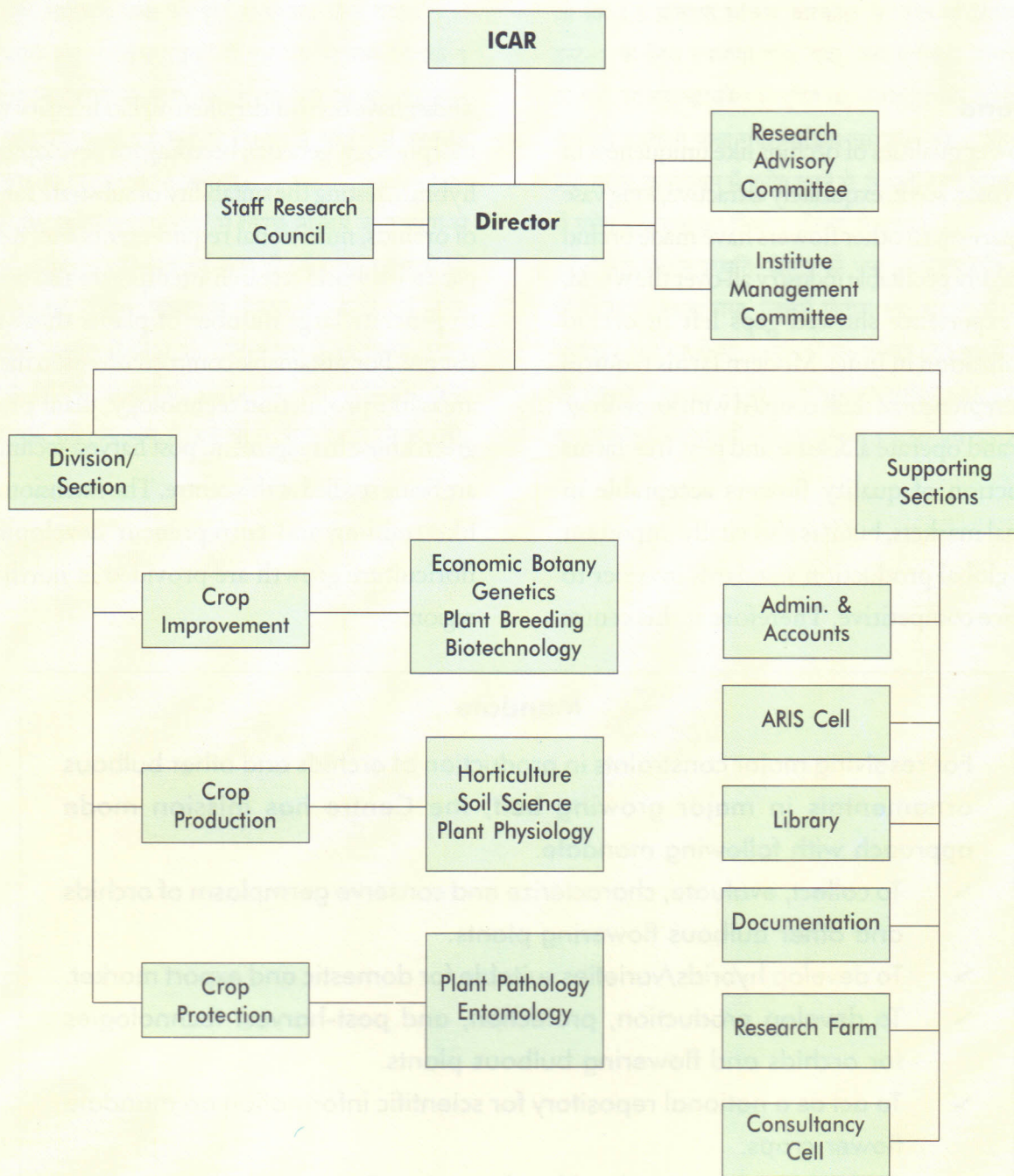
For resolving major constraints in production of orchids and other bulbous ornamentals in major growing belt, the Centre has mission mode approach with following mandate.

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





### ORGANOGRAM





## Introduction



### Staff strength as on 31.03.2004

Staff	Sanctioned	Filled
Scientific	11	9
Technical	6	3
Administrative	9	5
Supporting	8	7
Total	34	24

### Budget for 2003-04

(Rupees)

Head	Plan		Non Plan	
	Sanctioned	Utilized	Sanctioned	Utilized
Establishment charges	-	-	43,00,000	42,39,966
Wages	6,30,000	6,26,416	-	-
T.A.	3,00,000	2,99,446	80,000	80,163
Other charges including equipment	17,65,000	17,44,380	9,52,000	9,49,251
Work	1,09,00,000	1,09,00,000	20,000	14,900
Other charges including I.T	3,00,000	3,18,907	-	-
Land development	85,000	90,650	-	-
Human resources development	20000	20,000	-	-
Total	1,40,00,000	1,39,99,799	53,32,000	52,84,280

□





## Research Achievements

2

### CROP IMPROVEMENT

Project: Cytogenetical Research on Orchids

S. Chakrabarti

#### Morphological characterization of orchids

Forty-one species of 17 genera and 34 *Cymbidium* hybrids were morphologically characterized using the

30 parameters. The species and hybrids studied are presented (Table 1).

#### Biochemical analysis of orchids

Total chlorophyll, chlorophyll a, chlorophyll b was studied in 14 species and 38 hybrids of the genus *Cymbidium*. The results (Table 2) revealed that the

Table 1. Morphological characterization of orchid species and hybrids

Genera	Species/hybrids
<i>Arachnis</i>	<i>rubra</i>
<i>Bulbophyllum</i>	<i>odoratissimum</i>
<i>Calanthe</i>	<i>masuca</i>
<i>Coelogyne</i>	<i>flaccida, fuscescens, ovalis,</i>
<i>Cymbidium</i> species	<i>eburneum, ensifolium, elegans, erythraeum, gammieanum, longifolium</i>
Hybrids	Bertha, Orkney, Arunta lovely lips, Madrid "Forest king", Luna guard, Burgundian Sydney, Angel bird, Soul hunt VI, Narella "Jennifer Gail", Lavis Duke "Butterball", Tahiti, Platinum bird, Valley zenith "Green orb", May fair, Miss sanders, Red beauty "Carmen", Lillian Stewart "Coronation", Concerto, Black flame "Starburst", The Chester, Canine, Rievaulx "Cooksbridge", Arabian night "glacier", Golden elf "Sundust", Oriental legend., Amesbury "lime light", Agnes Norton "show off", Drake, Sarah jean "Ice cascade", Golden girl, Highland fair "Cooksbridge", Rose queen, Red star, Takarazuka
<i>Dendrobium</i>	<i>anceps, aggregatum, candidum, hookerianum, longicornu, primulianum, ochreatum, transparens</i>
<i>Diplomaris</i>	<i>hirsuta</i>
<i>Doritis</i>	<i>humilitus</i>
<i>Eria</i>	<i>coronaria, javanica, pubescens, rufinula, spictata, vittata</i>
<i>Epigeneium</i>	<i>amplum</i>
<i>Gastrochilus</i>	<i>calceolaris</i>
<i>Luisia</i>	<i>volucris</i>
<i>Lycaste</i>	<i>aromatica</i>
<i>Micropera</i>	<i>rostratum</i>
<i>Philodata</i>	<i>imbricata</i>
<i>Paphiopedilum</i>	<i>insigne, villosum, venustum, hirsutissimum, spicerianum,</i>
<i>Pleione</i>	<i>hookeriana, praecox</i>



## Research Achievements

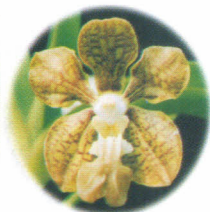


Table 2. Chlorophyll content of *Cymbidium* species and hybrids

<i>Cymbidium</i> species/ hybrids	Total chlorophyll (mg/g fresh wt.)	Chlorophyll a (mg/g fresh wt.)	Chlorophyll b (mg/g fresh wt.)
<b>Species</b>			
<i>C. aloifolium</i>	0.381	0.232	0.149
<i>C. devonianum</i>	1.232	0.866	0.367
<i>C. eburneum</i>	0.802	0.519	0.287
<i>C. elegans</i>	1.113	0.841	0.271
<i>C. ensifolium</i>	0.869	0.624	0.245
<i>C. erythraeum</i>	1.707	1.241	0.466
<i>C. gammieanum</i>	1.175	0.887	0.288
<i>C. hookerianum</i>	0.837	0.580	0.247
<i>C. indioides</i>	1.972	1.346	0.626
<i>C. longifolium</i>	1.504	1.133	0.371
<i>C. lowianum</i>	1.198	0.866	0.333
<i>C. pendulum</i>	0.506	0.369	0.137
<i>C. tigrinum</i>	2.289	1.676	0.614
<i>C. tracyanum</i>	1.601	1.185	0.417
<b>Hybrids</b>			
Agnes Norton "Show off"	0.674	0.505	0.169
Angel bird	1.279	0.897	0.382
Arabian Night "glacier"	0.858	0.463	0.395
Arundo lovely lips	1.003	0.697	0.306
Bertha	0.841	0.590	0.251
Black flame "Starburst"	1.385	0.946	0.437
Burgundian "Sydney"	0.896	0.653	0.241
Canine 1	1.396	1.038	0.361
Canine 2	1.057	0.655	0.372
Concerto	0.662	0.446	0.216
Drake	1.212	0.804	0.408
Golden elf "Sundust"	1.498	1.036	0.463
Golden Girl	1.849	1.312	0.537
Helly's Comet "Aurora"	1.094	0.742	0.352
Highland Fair "Cooksbridge"	1.033	0.754	0.280
Levis duke "butterball"	0.641	0.426	0.216
Lillian Stewart "Coronation"	0.928	0.649	0.280
Luna guard	1.158	0.829	0.403
Madrid "Forest king"	1.289	0.877	0.412
Mayfair	1.426	0.941	0.485

(Contd...)



*(concluded)*

Cymbidium species/ hybrids	Total chlorophyll (mg/g fresh wt.)	Chlorophyll a (mg/g fresh wt.)	Chlorophyll b (mg/g fresh wt.)
Miss sanders	0.863	0.547	0.316
Narella "Jennifer Gail"	1.120	0.733	0.388
Orkney	1.150	0.811	0.339
Oriental legend	1.223	0.886	0.328
Pearl balkis	0.787	0.568	0.219
Platinum bird	0.986	0.690	0.287
Red beauty "Carmen" 1	0.538	0.402	0.137
Red beauty "Carmen" 2	1.089	0.651	0.402
Red star	1.105	0.780	0.315
Rievaux "Cooksbridge"	0.820	0.555	0.266
Rose queen	0.780	0.535	0.257
Sarah jean "Ice cascade"	0.902	0.684	0.218
Show Girl "Cooksbridge"	1.539	1.085	0.471
Soul hunt VI	0.845	0.605	0.240
Tahiti	0.680	0.481	0.190
Takarazuka	0.936	0.604	0.332
The Chester	0.809	0.519	0.284
Valley zenith "green orb"	0.819	0.582	0.239

*Cymbidium* species and hybrids studied exhibit variations in chlorophyll content. In all the species and hybrids chlorophyll a was higher than chlorophyll b. Maximum chlorophyll content was observed in the species *Cymbidium tigrinum* (2.289 mg/g fresh wt.) and the minimum content in *C. aloifolium* (0.381 mg/g fresh wt.). The data will be taken for further statistical analysis to study the relationship of this biochemical tool with other morphological characters.

**Project: *In vitro* propagation of orchid: *Cymbidium* and important, rare and endangered species**

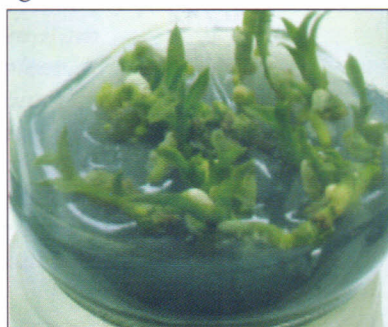
V. Nagaraju, S. Chakrabarti and S. P. Das

**Protocorm regeneration using embryos of orchid species and hybrids**

V. Nagaraju

Embryos excised from mature green but unburst pods of 20 species and crosses of orchids

Proliferation of Plbs



Plantlet differentiation

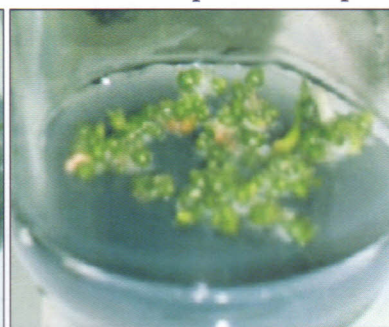






Table 3. Morphogenetic response of embryos of various orchid species *in vitro*

Species/hybrid	Days taken for					One
	Swelling formation	Globule formation	PLB greening	1st emergence	Shoot leaf	
V. Rosburry × <i>Renanthera imschootiana</i>	9	24				
<i>D. leutifolium</i> × <i>D. chrysenthemum</i>	9	15	35	54	62	74
<i>D. aphyllum</i> × <i>D. primulinum</i>	5	11	19	32	38	46
	6	14	27	33	37	48
<i>V. praviflora</i> × <i>Renanthera imschootiana</i>	3	8	18	26		
<i>Cymbidium pendulum</i> × <i>C. aloifolium</i>	3	14	24	36	46	
	3	9	14	19	26	
<i>D. wardianum</i> × <i>D. crepidatum</i>	11	19	34	50	70	85
PBS 8 × PBS 9	101	129	157			
PBS 13 × 3	16	29				

were cultured on MS, Nitsch, B5 and Knudson's C media supplemented with or without activated charcoal, BAP, NAA, Triacantanol and Paclobutrazol. Among the species/crosses/hybrids, protocorms followed by plantlets were regenerated from 11 crosses/species (Table 3). The results indicated that the response for swelling among the species/crosses varied from 3 days to over 15 weeks followed by development of protocorm, shoot and root. Addition of activated charcoal in the media resulted in better growth of plantlet.

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

V. Nagaraju

The meristem excised from field grown plants of *Cymbidium* Soul Hunt 3 and *Cymbidium* Burgundiun "Sydney" were cultured *in vitro* on Murashige and

Skoog (MS) and Nitsch media supplemented with plant growth substances. Protocorms were regenerated successfully from these cultures *in vitro* on MS media supplemented with BAP 1 mg/l + 2,4-D 0.5 mg/l, BAP 1mg/l+ NAA 0.5 mg/l, Zeatin 0.25mg/l+ NAA 0.5 mg/l and Zeatin 0.25 mg/l+ 2,4-D 0.5 mg/l. The plbs were further separated for proliferation and differentiation. The shoot tip and root tip excised from *Dendrobium* hybrids were cultured on MS and Nitsch media containing BAP, NAA, Zeatin and 2,4-D resulted in production of shoot from axillary bud explant.

**Influence of media and growth substances on *in vitro* multiplication and *ex vitro* survival of *Cymbidium tracyanum***

V. Nagaraju

**Multiplication:** The morphogenetic response of *in vitro* regenerated protocorm like bodies of *Cymbidium*





*tracyanum* trilipped was markedly influenced by different media formulations (Fig. 1 and 2). Among the three basal media viz., MS, Nitsch and B5 containing 1.5g/l AC and 0.25mg/l paclobutrazol, the total plantlet weight was maximum on MS, but it was very poor on NB media. Similarly, the shoot length, root number and percent dry matter content were also significantly higher on MS. Leaf number, leaf length, leaf width and root length were maximum on MS medium.

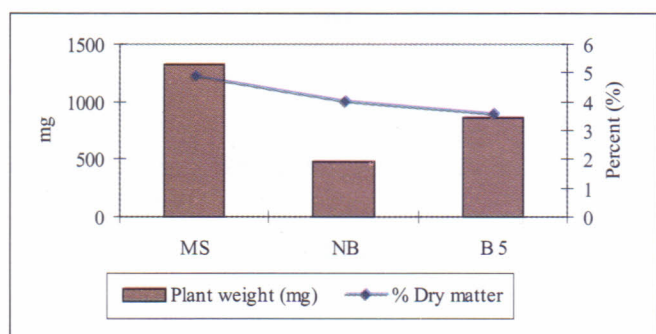


Fig. 1. Plantlet growth as affected by basal media

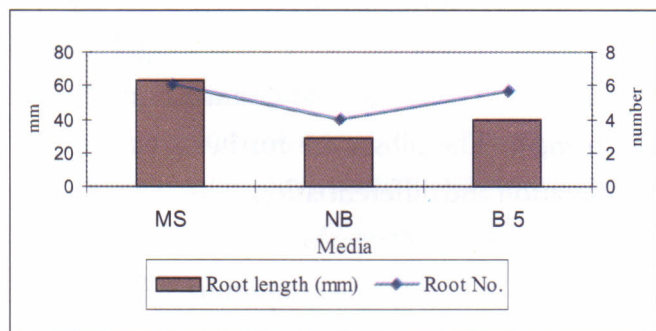


Fig.2. Influence of media on growth

**Differentiation:** The result on *in vitro* preconditioning with PBZ and Tria showed significant for shoot length, leaf length, root number and percent dry matter accumulation. Among the treatments, maximum plantlet weight was recorded in MS supplemented with 0.25mg/l Tria and 0.25mg/l PBZ. Longest plant was recorded on MS with 0.5mg/l Tria and 0.5mg/l PBZ.

With regard to leaf length, greater leaf length was recorded in MS with PBZ at 0.25mg/l. Number of roots produced was maximum on MS supplemented with Tria at 0.5mg/l and PBZ at 0.25mg/l. Percent dry matter content was also maximum in MS supplemented with 0.25mg/l of PBZ. Thus it clearly showed that MS media supplemented with Tria at 0.5mg/l and PBZ 0.5mg/l was the best suitable for quality plantlets production.

**In vitro hardening:** The influence of *in vitro* preconditioning in MS medium containing AC supplemented with plant growth substances (PBZ and Tria) showed significant variation in respect of quality of established plants for all the morphological characters. The percent increase in shoot length was maximum in MS with 0.5mg/l of PBZ, while the percent increase in new leaves was highest in MS containing 0.5mg/l PBZ and Tria. Plant growth analysis, revealed that the inclusion of PBZ in the pre hardening media containing AC and Tria improved the leaf size.

**Ex vitro survival:** Maximum survival (87.7%) was recorded when plantlets were pre hardened on MS media incorporated with 1.5g/l AC with 0.5mg/l of Tria and 0.5mg/l of PBZ (Fig 3). Murashige and

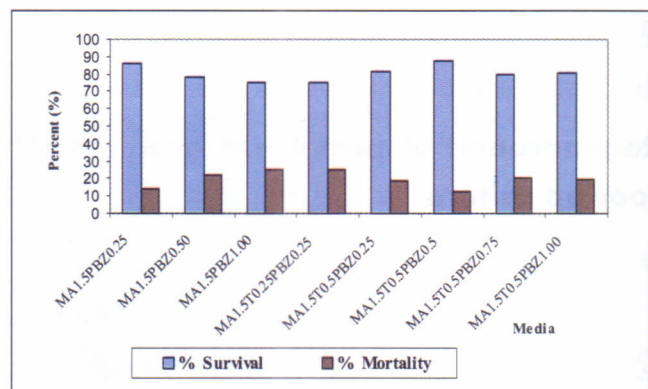


Fig. 3. Influence of *in vitro* media on *ex vitro* survival





Skoog media supplemented with 1.5g/l AC and 0.25mg/l PBZ resulted in better multiplication. MS media supplemented with AC and 0.5 mg/l each of PBZ and Tria improved plantlet differentiation, growth of plantlets and maximum survival *ex vitro*. Further plantlets growth was also quite encouraging in *ex vitro* hardening stage.

**Protocol for rapid *in vitro* propagation of *Zygopetalum intermedium***

V.Nagaraju

**Embryogenesis:** The influence of plant growth substances on morphogenetic response of embryos on half strength MS revealed (Table 4) that seed swelling was early (59.67 days) in half strength MS containing 0.25mg/l PBZ and 0.1mg/l NAA. Rapid globule formation (64 days) was recorded in half strength MS media supplemented with 0.5mg/l of BAP and 0.1mg/l of NAA. Further, formation of protocorm like bodies (Plbs) was also rapid in half strength MS media containing 0.5mg/l of BAP and 0.1mg/l of NAA (70.67 days), which resulted in

quickest greening of the culture too. Shoot emergence and days taken for one and two leaf stage was also found to be earliest in half strength MS media in combination with 0.5mg/l of BAP and 0.1mg/l of NAA (88 days, 92 days and 104.3 days respectively). Thus BAP 0.5mg/l in combination with NAA 0.1mg/l was the most effective in germination and differentiation.

**Protocorm proliferation, differentiation and plantlet growth:** Nitsch as a basal media is found to be superior compared to MS for all the characters, however statistically it was not significant, while the response was poor in B5 media (Fig.4). BAP 0.5mg/l

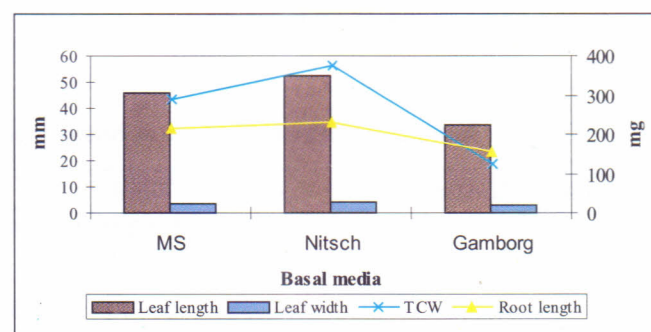


Fig.4. Influence of media on proliferation

Table 4. Influence of different media on seed germination

Media	Days taken for						
	Seed swelling	Globulization of seeds	Plbs formation	First greening	Shoot emergence	One leaf	Two leaf
½ MA1.5B0.25N0.1	61.00	70.67	78.67	85.00	94.00	112.67	126.33
½ MA1.5B0.5N0.1	60.00	64.00	70.67	81.00	88.00	92.00	104.33
½ MA1.5P0.25N0.1	59.67	64.67	82.00	86.33	89.33	92.00	122.00
½MA1.5P0.25B0.25	62.00	64.67	81.00	85.67	91.00	95.00	123.00
Sem±	0.47*	0.44**	0.38**	0.43**	0.55**	0.33**	0.54**
CD at 5%	1.63	1.52	1.33	1.49	1.91	1.15	1.85





in combination with 0.25mg/l of Tria was the most effective in Plbs proliferation. Maximum culture weight (489.88mg), longest shoot (74.26mm), maximum leaf number (5.22), increased leaf size (60.4 × 4.22mm), more number (4.22) of longest (49.11mm) and thickest (1.7mm) roots were developed in plantlets cultured in BAP 0.5mg/l in association with Tria 0.25mg/l. Nitsch with BAP 0.5mg/l and Tria 0.25mg/l was the best, which recorded maximum culture weight (844.33mg); longest leaf (81.67mm) and well developed root system (67.0mm length and 2.03mm diameter). MS media supplemented with 0.5mg/l of BAP and 0.25mg/l of Tria produced maximum culture weight (493.07mg), leaf length (65.0mm) and root length (58.67mm) and diameter (1.53mm).

The BAP at 0.5mg/l in combination with Tria 0.5mg/l resulted in maximum plantlet growth (85.83mm). However, maximum number of leaves (6.3) was recorded in half strength 0.5mg/l PBZ in combination with Tria 0.25mg/l. Longest leaf (81.83mm) was observed in Plbs cultured in BAP at 0.5mg/l in combination with Tria 0.5mg/l, which was followed by half strength media with Tria 0.5mg/l and PBZ 0.5mg/l (72.83mm). However, leaf width was maximum in PBZ 0.5mg/l + Tria 0.5mg/l. The plantlets produced in BAP 0.5mg/l with Tria 0.25mg/l resulted in better root development (5.17) and longest (57.67mm) and thicker (2mm) root. Nitsch media in combination with BAP 0.5mg/l and Tria 0.25mg/l was the best (Table 5) which recorded maximum

Table 5. Interaction effect of basal media and growth hormone on Plbs proliferation

Media	Hormone	Culture weight (mg)	Plant height (mm)	Leaf			Root		
				No.	Length (mm)	Width (mm)	No.	Length (mm)	Diameter (mm)
MS	½	253.63	59.00	4.33	57.00	2.83	3.67	41.67	1.43
	B0.5	115.20	35.17	3.67	33.00	2.67	3.33	26.67	1.33
	T0.25B0.5	168.10	42.00	5.00	40.00	4.00	2.33	50.67	1.33
	½ B0.5T0.5	590.67	80.67	5.00	73.66	4.33	5.00	51.67	1.67
	½ T0.5N0.1	151.06	38.00	4.33	36.67	2.00	2.33	16.67	1.40
	½ T0.25P0.5	565.40	66.67	5.00	66.67	5.00	3.67	20.67	2.03
	½ T0.5P0.5	493.07	67.33	6.00	65.17	5.17	5.33	58.67	1.53
Nitsch	½	112.45	38.00	4.33	36.00	3.00	2.33	17.33	1.33
	B0.5	242.17	53.00	5.00	48.67	3.17	3.33	33.00	1.40
	T0.25B0.5	935.20	91.00	6.33	90.00	5.17	5.33	67.00	2.33
	½ B0.5T0.5	462.63	56.33	4.33	55.67	4.33	4.33	43.00	1.53
	½ T0.5N0.1	349.13	64.00	5.67	60.00	3.83	4.00	50.67	1.40
	½ T0.25P0.5	844.33	83.67	5.67	81.67	5.67	4.67	63.67	2.03
	½ T0.5P0.5	398.20	79.00	6.00	79.00	5.33	3.00	31.67	1.63
Sem ±		69.77**	4.25**	0.41	4.21**	0.39**	0.36**	4.29**	0.37**
CD at 5%		214.97	13.09	NS	12.97	1.20	1.11	13.24	0.33





culture weight (935.20mg); longest leaf (91mm) and well developed root system (67.0mm length and 2.35 mm diameter).

### **Ex vitro hardening of in vitro regenerated plantlets**

Coco peat in combination with tree fern was the best suitable media for *ex vitro* hardening as it produced maximum shoot length with more number of bigger and wider leaves, followed by coco peat alone. Perlite as the *ex vitro* hardening media showed poor growth and gradually plantlets turned brown followed by death of plantlets. In organic fertilizer in the form of nitrophos (19N : 19P : 19K) at 1mg/l was the best suitable nutrient. Organic fertilizer (Biospark) at 1mg/ml found to be suitable for *ex vitro* growth. Spraying of paclobutrazol at 5mg/l and Triacantanol at 10mg/l to hardening plants improved the *ex vitro* growth.

### **Response of plantlets of Cymbidium PB 8 to basal media and hormone**

V.Nagaraju

The effect of different concentration of triacantanol and paclobutrazol in MS on plantlet growth *in vitro* shows significant. Maximum plantlet weight (694.6mg), plantlet length (212mm), leaf number (6.33), leaf length (151mm), leaf width (5mm), root number (4.33) was recorded in MS supplemented with 0.25mg/l of Tria and 0.25mg/l of PBZ. Thus MS media along with 0.25mg/l of Tria and 0.25mg/l of PBZ resulted in healthy plantlets with well-developed shoot and root system.

### **Influence of triacantanol and paclobutrazol on in vitro hardening of Dendrobium aphyllum × D. primulinum**

V.Nagaraju

Better growth of plantlets in respect of plantlet weight, plantlet length, leaf number, leaf length and root number was recorded in the full strength media, however, root growth was better in media diluted to 1/4th strength. The better growth of plantlets was recorded in media containing Murashige and Skoog supplemented with activated charcoal 1.5g/l, 0.5mg/l each of triacantanol and paclobutrazol. The shoot growth and development of new shoot developed on old pseudobulb of *Dendrobium aphyllum* × *Dendrobium primulinum* *in vitro*, was better in full strength MS media supplemented with 1.5g/l of activated charcoal and 0.5mg/l each of triacantanol and paclobutrazol. Root development was better in one-fourth strength media of MS with 1.5g/l of AC and 0.5mg/l each of triacantanol and paclobutrazol.

### **Response of media on growth and development of Dendrobium aphyllum × Dendrobium primulinum.**

V.Nagaraju

Full strength media was better for the growth and development of pseudobulb of *Dendrobium aphyllum* × *Dendrobium primulinum* *in vitro*. Plantlets with highest weight, longest shoot, maximum leaf number, leaf length was reported from pseudobulbs cultured in media containing MS supplemented with 1.5g/l of AC, 0.5mg/l of Tria and 0.25mg/l of PBZ. The growth and development of old pseudobulb of





*Dendrobium aphyllum* × *Dendrobium primulinum* *in vitro* was better in full strength MS media incorporated with 0.5mg/l of Tria and 0.25mg/l of PBZ along with 1.5g/l of AC.

### CROP PRODUCTION

**Project: Development of agro techniques for commercial scale production of orchids in open and protected condition**

D. Barman, S. K. Naik and R.C. Upadhyaya

**Effect of nutrients spray on growth and pre-blooming period of *Cymbidium* Show Girl “Cooksbridge”.**

D. Barman

The study was carried out on four years old plant to know the influence of foliar application of NPK on growth and pre-blooming period of *Cymbidium* Show Girl “Cooksbridge”. The different nutrient

combinations- T<sub>1</sub>-N<sub>5</sub>P<sub>5</sub>K<sub>5</sub>-0.1%, T<sub>2</sub>-N<sub>5</sub>P<sub>5</sub>K<sub>5</sub>-0.2%, T<sub>3</sub>-N<sub>5</sub>P<sub>5</sub>K<sub>5</sub>-0.3%, T<sub>4</sub>-N<sub>10</sub>P<sub>5</sub>K<sub>5</sub>-0.1%, T<sub>5</sub>-N<sub>10</sub>P<sub>5</sub>K<sub>5</sub>-0.2%, T<sub>6</sub>-N<sub>10</sub>P<sub>5</sub>K<sub>5</sub>-0.3%, T<sub>7</sub>-N<sub>15</sub>P<sub>5</sub>K<sub>5</sub>-0.1%, T<sub>8</sub>-N<sub>15</sub>P<sub>5</sub>K<sub>5</sub>-0.2%, T<sub>9</sub>-N<sub>15</sub>P<sub>5</sub>K<sub>5</sub>-0.3%, T<sub>10</sub>-N<sub>20</sub>P<sub>5</sub>K<sub>5</sub>-0.1%, T<sub>11</sub>-N<sub>20</sub>P<sub>5</sub>K<sub>5</sub>-0.2%, T<sub>12</sub>-N<sub>20</sub>P<sub>5</sub>K<sub>5</sub>-0.3% and T<sub>13</sub>-control were sprayed at fortnightly interval.

The results (Table 6) revealed that plant height and leaf length was maximum (85.00 cm and 56.61 cm respectively) in T<sub>12</sub> where plants were sprayed with 0.3 % of N<sub>20</sub>P<sub>5</sub>K<sub>5</sub>. However, leaf number, leaf width and pseudobulb girth was found to be non significant. Pseudobulb length was significantly influenced by the various treatments recording maximum (5.01 cm) in T<sub>3</sub> (N<sub>5</sub>P<sub>5</sub>K<sub>5</sub> at 0.3 %).

**Effect of NPK on growth and flowering of *Cymbidium* Show Girl “Cooksbridge”**

D. Barman

The experiment was laid with the objective to study the vegetative and flowering attributes. The NPK

Table 6. Effect of NPK on growth and flowering of *Cymbidium* Show Girl “Cooksbridge”.

Treatment	Plant height (cm)	Leaf number (cm)	Pseudobulb length (cm)	Pseudobulb girth
T <sub>1</sub>	79.00	4.94	3.86	2.91
T <sub>2</sub>	77.50	5.50	3.64	3.29
T <sub>3</sub>	75.50	5.44	5.01	3.22
T <sub>4</sub>	77.10	5.62	4.52	3.36
T <sub>5</sub>	64.50	5.44	3.48	2.71
T <sub>6</sub>	74.50	5.85	4.69	3.26
T <sub>7</sub>	76.80	6.38	4.20	3.00
T <sub>8</sub>	77.50	4.50	4.30	3.20
T <sub>9</sub>	68.20	5.00	3.69	2.87
T <sub>10</sub>	79.50	6.69	4.09	2.87
T <sub>11</sub>	80.70	4.75	2.51	3.01
T <sub>12</sub>	85.00	6.00	2.12	2.80
T <sub>13</sub>	69.50	5.15	3.46	2.82
CD(0.05)	6.50	N.S.	1.05	N.S.





nutrients at different concentrations were sprayed at fortnightly interval. The treatment combinations were- T<sub>1</sub>-NPK 10 : 10 : 10-0.1%, T<sub>2</sub>-NPK 10 : 10 : 10-0.2%, T<sub>3</sub>-NPK 10 : 20 : 10-0.1%, T<sub>4</sub>-NPK 10 : 20 : 10-0.2%, T<sub>5</sub>-NPK 10 : 30 : 10-0.1%, T<sub>6</sub>-NPK 10 : 30 : 10-0.2%, T<sub>7</sub>-NPK 20 : 10 : 10-0.1%, T<sub>8</sub>-NPK 20 : 10 : 10-0.2%, T<sub>9</sub>-NPK 10 : 20 : 10-0.1%, T<sub>10</sub>-NPK 20 : 20 : 10-0.1%, T<sub>11</sub>-NPK 20 : 30 : 10-0.1%, T<sub>12</sub>-NPK 20 : 30 : 10-0.2%, T<sub>13</sub>-NPK 30 : 10 : 10-0.1%, T<sub>14</sub>-NPK 30 : 10 : 10-0.2%, T<sub>15</sub>-NPK 30 : 20 : 10-0.1%, T<sub>16</sub>-NPK 30 : 20 : 10-0.2%, T<sub>17</sub>-NPK 30 : 30 : 10-0.1%, T<sub>18</sub>-NPK 30 : 30 : 10-0.2% and T<sub>19</sub>-Control.

It was observed (Fig. 5) that plant height and pseudobulb girth was maximum (93.40 cm and 6.31 cm respectively) in T<sub>12</sub> when the plants were sprayed with 0.2% of NPK 20: 30: 10. While leaf length and width was maximum in T<sub>14</sub> (NPK 30: 10: 10-0.2%), (60.89 cm) and T<sub>2</sub> (NPK 20: 30: 10-0.2%) (2.20 cm), respectively.

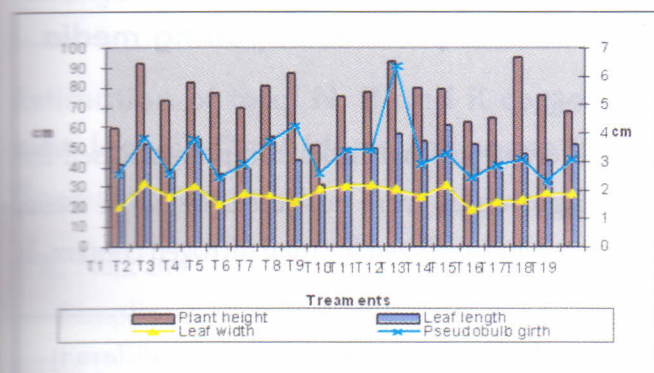


Fig. 5. Effect of NPK in growth of *Cym. Show Girl "Cooksbridge"*

**Effect of growth regulators on growth and pre-blooming period of *Cymbidium Show Girl "Cooksbridge"***

D. Barman and R.C. Upadhyaya

The investigation was undertaken to study the

effect of organic manures on growth and development of *Cymbidium Show Girl "Cooksbridge"*. The treatments consisted of poultry manure, goat manure, mustard cake, fish meal, neem cake and control. The supernatant solution (1 : 25 dilution) was sprayed at fortnightly interval.

It was observed (Fig. 6) that organic manure supplied through neem cake was most effective for the growth and development of the *Cymbidium Show Girl "Cooksbridge"* as it increased the leaf length and girth of pseudobulb to the maximum of 56.74 and 3.77 cm, respectively. A maximum number of leaves (6.87) were found in the application of mustard cake.

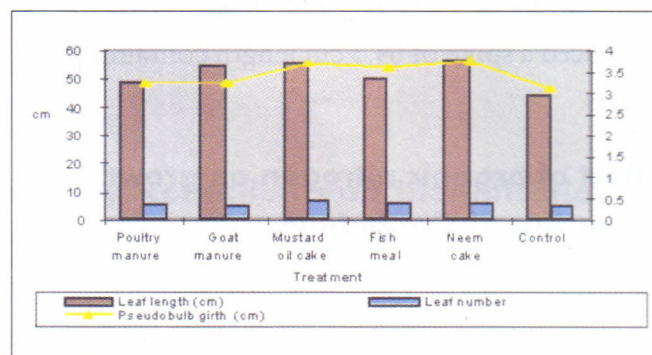


Fig. 6. Effect of organic manures on growth of *Cym. Show Girl "Cooksbridge"*

**Effect of growth regulators on growth and pre-blooming period of *Cymbidium Show Girl "Cooksbridge"***

D. Barman

The experiment was laid out using various concentrations of BA (100, 200 and 300 ppm), GA<sub>3</sub> (100, 200 and 300 ppm) and IAA (250, 500 and 750 ppm) to study the effect on growth and flowering of *Cymbidium Show Girl "Cooksbridge"*.

The results (Fig.7) showed that performance of BA was superior over other plant growth regulators



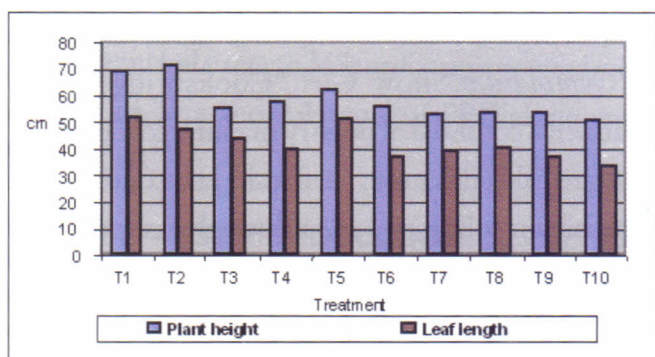


Fig. 7. Effect of growth regulators on growth of Cym. Show Girl "Cooksbridge"

for growth and development of the plants. Application of BA at 200 ppm was effective for the plant height (71.25 cm) where as BA at lower concentration of 100 ppm produced longest leaf of 52.07 cm. Further, application of GA<sub>3</sub> also enhanced flowering. It produced a spike of 64.5 cm length containing five florets.

**Effect of organic nitrogen on growth and flowering of Cymbidium**

D. Barman and R.C. Upadhyaya

To supply organic nitrogen, a commercial product- 'Gold-N' (12 % N, 0.3 % each of P and K) was used at five levels (0, 500, 1000, 1500, 2000 mg/plant) at two intervals (30 and 60 days). The experiment was conducted on two years old plants. Intercultural operations were done as and when required.

The data (Table 7.) showed that application of organic nitrogen at 2000 mg/plant resulted in production of longest leaf (40.75 cm), maximum number of leaves/plant (8.30) and number of pseudobulb (4.20). The mean values for all the characters increased with increasing dose of organic nitrogen. As far as interval of its application is concerned, 60 days interval was superior over 30 days

Table 7. Effect of organic nitrogen and its interval of application on growth of Cymbidium

Doses of 'Gold-N' mg/plant	Leaf length (cm)	No. of leaves/plant	No. of pseudobulb
0	33.85	4.20	2.60
500	34.60	5.30	2.80
1000	37.75	6.30	3.40
1500	38.25	7.10	3.60
2000	40.75	7.30	4.20
CD (0.05)	3.56	1.30	0.66
<b>Interval of application</b>			
30 days	30.72	6.40	3.50
60 days	35.65	7.80	4.60
CD (0.05)	2.95	1.10	0.58

as higher length of leaves (35.65 cm), number of leaves (7.80) and number of pseudobulb (4.60) were observed in this treatment.

**Estimation of total nitrogen content in different components of potting media**

S. K. Naik

Different potting media components used for growing orchids were collected, dried in oven, powdered and analyzed for total nitrogen content. It

Table 8. Total nitrogen content in different components of potting media

Media components	Total Nitrogen content (%)
FYM	0.87
Tree fern	0.22
Coco peat	0.17
Perlite	0.12
Coconut husk	0.05



## Research Achievements



was found that, the highest total N content in FYM (0.87%) and the lowest in coconut husk (0.05%) (Table 8).

### Studies on bark leachate of different trees

S. K. Naik

Bark leachates of different trees were collected periodically for a period of one month during rainy season. The pH and Electrical Conductivity (EC) of leachates was measured. The average pH and EC of different bark leachates is given in Table 9.

Table 9. pH and EC of different bark leachates.

Name of tree	pH	EC (dSm <sup>-1</sup> )
Thuja ( <i>Thuja plicata</i> )	6.85	0.02
Plum ( <i>Prunus americana</i> )	7.13	0.08
Peach ( <i>Prunus persica</i> )	7.20	0.06
Bottle brush ( <i>Aesculus parviflora</i> )	6.46	0.06
Mango ( <i>Mangifera indica</i> )	6.72	0.02

### Estimation of total N, P, and K content in new leaf of *Cymbidium* Japanese YY at flowering stage

S. K. Naik and D. Barman

Sampling of fully developed new leaf was done for the *Cymbidium* Japanese YY. Samples were collected from 9 treatment combinations, dried in oven, powdered and analyzed for total N, P and K content at the flowering stage of the crop. The average N, P and K content of leaf was in the ratio of 1.23 : 0.1 : 1.08 and the highest content of total N, P and K was 1.82%, 0.1% and 1.20% respectively in T<sub>1</sub> leaf mould + charcoal + coco nut husk + sand +

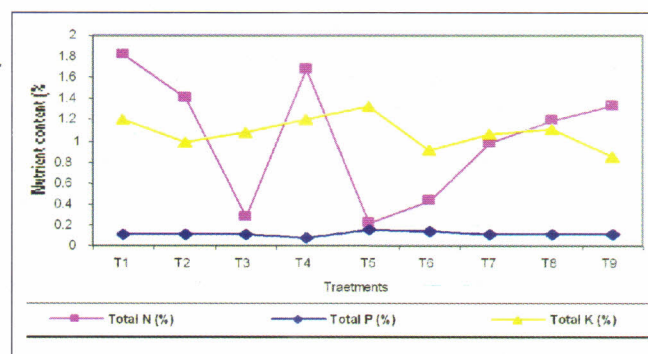


Fig. 8. Total N, P and K content in leaf of *Cymbidium* Japanese "YY"

saw dust + loam + FYM). (Fig 8).

### CROP PROTECTION

Project: Investigation on fungal diseases of orchids

T.K. Bag

#### Survey, collection and identification of different orchid diseases

Survey and collection of disease samples on different orchids was done from growers' field of Namchi, South Sikkim. Besides, regular monitoring of orchid diseases was done at the orchid houses of the centre. Isolation, purification and identification of the disease causing pathogens was done on PDA from collected disease samples (Table 10 & 11).

#### Monitoring the host range of anthracnose in orchids

Anthracnose was monitored regularly on different orchid species in the germplasm house of the centre. The disease was recorded on 4 species of *Liparis*, 9 species of *Coelogyne*, 7 species of *Eria*, 11 species of *Bulbophyllum*, 3 species of *Cirrhopetalum*, 3 species of





## Annual Report 2003–2004

Table 10. Diseases on orchids and their causal organism as identified

Disease	Name of the host	Pathogen identified
Bulb rot	<i>Pleione praecox</i>	<i>Sclerotium rolfsii</i>
Leaf spot	<i>Eria spicata</i>	<i>Collectotrichum gloeosporioides</i>
Stalk rot of flower	<i>Phaius tankervilleae</i>	<i>Fusarium oxysporum</i>
Wilt		<i>Sclerotium rolfsii</i>
New shoot rot		<i>Fusarium oxysporum</i>
Wilt	<i>Paphiopedilum hirsutissimum</i>	<i>Sclerotium rolfsii</i>
Blight of new shoot and inflorescence	<i>Coelogyne dayana</i>	<i>Fusarium oxysporum</i>
Anthraxnose	<i>Dendrobium densiflorum</i>	<i>Colletotrichum gloeosporioides</i>
Black rot/New shoot rot	<i>Cymbidium</i> sp.	<i>Phytophthora</i> sp.
Mosaic	<i>Cymbidium</i> hybrid	CyMV

Table 11. Important diseases of Orchids and their seasonal incidence

Disease	Pathogen	Plant parts infected	Time of occurrence
Black rot	<i>Phytophthora</i> and <i>phythium</i>	Leaves, pseudobulb, new shoots	May to August
Anthraxnose	<i>Colletotrichum gloeosporioides</i>	Leaves, stems	April–October
Orchid wilt	<i>Sclerotium rolfsii</i>	Pseudobulb, crown, stem and roots	June–August
Rust	<i>Uredo</i> sp.	Leaf, inflorescence, aerial portion of pseudobulb and stems	Throughout the year
Petal blight	<i>Botrytis cinerea</i>	Flower spikes and flower petal, aerial portion of pseudobulb and leaf	February–June
Web Blight of <i>Pleione humilis</i>	<i>Rhizoctonia solani</i>	Leaf and stem	June–July
Leaf blight of <i>Thunia bensoni</i>	<i>Rhizoctonia solani</i>	Leaf and stem	June–July
Stalk rot <i>Phaius tankervilleae</i>	<i>Fusarium oxysporum</i>	Flower spike	April–August
Blight of <i>Bullya yunanensis</i>	<i>Fusarium oxysporum</i>	New shoot and inflorescence	April–August
Cymbidium Mosaic	<i>Cymbidium mosaic virus</i>	Newly emerged leaves	Throughout the year





*Vanda*, 8 species of *Dendrobium*, 2 species of *Aerides*, 3 species of *Agrostophyllum*, 2 species of each of *Pholidota*, *Thunia*, *Arachmanthe*, *Paphiopedilum*, *Ascocentrum*, one species of each of *Gastrochilus*, *Renanthera*, *Ornithochilus*, *Cyrtochilus*, *Oncidium* and *Goodyera grandis*.

### Observation on the occurrence of black rot on different orchid species and hybrids

Black rot was observed on *Cymbidium aloifolium*, *C. alexonianum*, *C. pendulum*, *C. tracyanum*, *C. elegans*, *C. hookerianum* and other unidentified *Cymbidium* species in the orchid house. The disease was also recorded on the *Cymbidium* hybrids: Red Star, Arabian Night, Bertha Petershot, Hawtescens, Oklahama tetraploid, Sarah Jean "Ice cascade", Amesbury, San Francisco 'Del Rio', Ann green, High Lander 'Cooksbridge', Yankalila, Soul Hunt 3, Luna Emperium, Brass Bottom, Pesibi Rose Queen and *Oncidium* Gower Ramsey.

### Study on the epidemiology of black rot

Out of three growing conditions (pot grown, wooden raised bed and soil bed) in low cost polyhouse, highest number of *Cymbidium* Red Star shoot rot was recorded in soil grown bed followed by wooden raised bed and pot grown plants. Out of four categories of shoots (less than 6 months age, 6 months age, 12 months age and greater than 12 months age) largest number of new shoot infection occurred in < 6 months old shoots followed by 6 months old shoots, 12 months old shoots and > 12 month old shoots. Rotten old pseudobulb (> 12 month old) needed force to separate them from the rest of the healthy plant

whereas 1–12 month old rotten shoots could easily be pulled out with rotted slimy moist base of shoots, which often emitted foul/fishy smell.

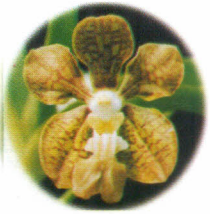
Rotting occurred mostly on the *Cymbidium* plants grown in clayee soil beds which were practically observed lower in elevation and easily get moistened with excessive water by rain or over head irrigation.

At this centre *Cymbidiums* were grown in soil beds in low cost polyhouse where black rot appeared in severe form during June to August in 2003, specially on those beds which were wet and water leached to the low laying beds from the side stonewall during heavy shower in rainy season. Testing of soil samples taken from the diseased plots revealed that pH was in the acidic range (pH ranged from 5.75 to 6.5). Soil of the bed was over saturated. Rainwater was continuously dropping on the plants making the plant surface wet for longer period. Temperature prevailed comparatively in the higher range of 24–30°C and Relative Humidity ranged from 80–95% for majority of the days and continuous rainfall for maximum days coupled with mist like foggy weather.

### Observation on the occurrence of orchid wilt on different orchid species and hybrids

Occurrence of orchid wilt was regularly monitored in the germplasm house. The disease was repeatedly observed in the reported year on the following orchid species: *Tainia minor*, *T. latifolia*, *Pleione praecox*, *Bulbophyllum* sp., *Phaius Tankervilleae*, *Lycaste crueata*, *Calanthe masuca*, *Robiquetia spathulata*, *Vanda coerulea*, *Vanda stangeana*, *Luisia* sp., *Acampe* sp. and *Paphiopedilum*





*hirsutissimum*. Even the disease was also recorded on the *Vanda* Hybrid: *Vanda coerulea* × *Vanda roxburghii*.

### Study of blight of *Coelogyne dayana*

New shoot arising from the previous years old bulb appeared watery, soft at the base and later turned brownish to black, which easily could be pulled out from the rest of the plant. Later stage this type of blight was also appeared on the inflorescence starting from its stalk. No flower opened on the inflorescence. Light brown/orange coloured powdery spores were visible on the blighted inflorescence. The fungus was identified as *Fusarium oxysporum*.

### Study of flower blight of *Dendrobium moschatum*

The disease caused inflorescence blight including individual floret. Individual floret did not open. Tip of the inflorescence later turned black. Rachis and infected individual floret covered with light brown fungal mass. Infected floret dropped off before opening. Fungus has been identified with this disease as *Fusarium oxysporum*.

### Study of inflorescence rot of *Phaius tankervilleae*

Base of the individual floret rotten and turned black. Infected individual florets toppled and hang down. Infected individual floret partially opened. Light brown fungal spore mass was also visible on the infected parts. Fungus has been identified as *Fusarium oxysporum*.

### Project: Pest management in orchids and bulbous flowering plants

V.S. Nagrare

### Survey on insects/pests of orchids

Survey was carried out in Namchi, South Sikkim for insects/pests occurring on orchids during rainy season. It was observed that snail and mite were the pests of *Cymbidium* hybrids in South Sikkim.

### Observations on host range of shoot borer (Black moth)

About 27 species of 14 genera of orchids were found to be susceptible for shoot borer damage, which are listed below.

- Acampe rigida*
- Aerides catbcartii*
- Aerides odoratum*
- Agrostophyllum callosum*
- Arachmanthe catbcartii*
- Ascocentrum ampullaceum*
- Dendrobium anceps*
- Dendrobium aphyllum*
- Dendrobium chrysotoxum*
- Dendrobium devonianum*
- Dendrobium nobile*
- Dendrobium* sp.
- Epidendrum* sp.
- Eria graminifolia*
- Eria pubescens*
- Eria spicata*
- Liparis grandiflora*
- Liparis plantaginea*
- Liparis viridiflora*





*Saccolobium intermedium*

*Sarcanthus insectifera*

*Smitinandia*

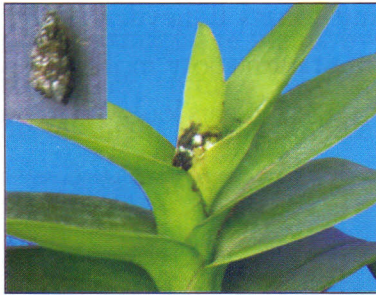
*Vanda cristata*

*Vanda coerulescense*

*Vanda coerulea*

*Vanda pumila*

*Vanda stangeana*



Shoot borer damage on *Vanda stangeana* (inset adult moth)

### Observations on black aphids

Black aphid *Toxoptera aurantii* trigger infestation on *Oncidium* Gower Ramsay on spike starting from bud stage and remained till the flowers wither.



Black aphids on *Oncidium* Gower Ramsay

### Monitoring black thrips infestation

Black thrips were recorded on different orchid species like *Bulbophyllum hirtum*, *Coelogyne cristata*, *Coelogyne* sp., *Dendrobium chrysanthum*, *D. fulconeri*, *D. mobile*, *Epigenium amplum* and *Pholidota articulata* in the germplasm of the centre.

### Observations on the grasshopper damage

Grasshopper feeding on petals of *Cymbidium lozianum*, *Cymbidium* hybrids and young *Cymbidium* seedlings was recorded during late winter.



Grasshopper damage on *Cymbidium* hybrid

Infestation started from cold months of January to moderately hot mid June under polyhouse conditions. Aphid suck the juice from bud as well as from open flowers and simultaneously excrete honey dew which support the growth of black sooty mould an unsightly fungus that mars the beauty of flower. Honeydew secretion also invite black ants, which clearly indicate aphid infestation. Aphids are winged or wingless and formed small colonies. This aphid also get attracted to the inflorescence of *Dendrobium densiflorum* in the month of May. They formed colony on the flowers and sucked the sap from the petals and thus caused discoloring. As the flower lasted for only few days (5-7), they were unable to establish for a long and as soon as flowering over they disappeared. However, it is likely to be a first observation that *T. aurantii* occurred on hosts *Oncidium* Gower Ramsey and *Dendrobium densiflorum* in India. During the year black





aphid infestation was also recorded on *Dendrobium* hybrid.

**Seasonal occurrence of yellow aphid *Macrosiphum* sp. on *Dendrobium nobile* and *Epidendrum* sp.**

Aphid *Macrosiphum* sp. is pale yellowish green to bright greenish yellow colour. Adults are winged or wingless. The wingless form has a brownish patch on the top of the abdomen. Both the nymph and adults suck the sap from new shoot, flower bud and opened flower. They excrete honeydew on which sooty mold attracted. High humidity and cloudy weather fasten the population build up. Affected plants retards growth and flower quality affected. However, except host *Epidendrum*, the occurrence of *Macrosiphum* sp. on *Vanda cristata*, *Acampe papillosa*, *Dendrobium nobile*, *Goodyera procera*, *Cymbidium* hybrids- Red Star, Hawtescence, San Francisco “Del Rio” seems to be new hosts of *Macrosiphum* sp. They remain on plant round the year but their number remained low in winter season. Yellow Aphid counts on *Dendrobium nobile* and *Epidendrum* sp. was taken on weekly interval for two years.

**Observations on rose aphid *Macrosiphum rosae* on *Cymbidium***

Rose aphid *Macrosiphum rosae* are green in colour. Infestation seen to occur on buds. Both nymph and adult suck the cell sap, which resulted into abortive opening of flower of *Cymbidium* hybrid.

**Infestation of mealybug *Pseudococcus maritimus***

Mealybug is soft filamentous pink or yellow bodied

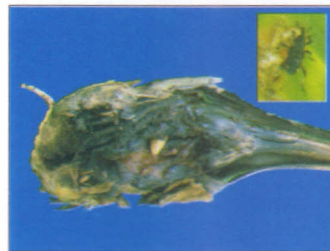
insects covered with powdery wax. Both young and adult suck the sap from leaves and petioles, flowers and secretes honeydew that attracts ants. In sever infestation sooty mold may develop on the leaves. Attacked plants look wilted and growth arrested.



Mealybug on *Phaius tankervilleae*

**Observations on black weevil damage**

Adult black weevil *Sipalinus* sp. was observed to cause serious damage by feeding on plant parts. Larvae after hatching was found to feed on leaves, exudates come out from the puncture on which *Fusarium* fungus grow. Fungus helps in deceasing adjacent portion. Larvae enter into the shoot and thereafter pseudobulb and feed on plant tissue resulted into rotting of pseudobulb and thereby further growth arrested. On single *Cymbidium* H. C. Aurora, nearly 20% plants were affected by black weevil. This pest has been also seen to damage *Cymbidium* spp., *Coelogyne* spp., *Phaius tankervilleae*, *Storopsis undulata*. Further observations are continuing.



Black weevil grub feed inside pseudobulb of *Cymbidium*, inset adult





**Studies on host range of snail *Cryptaustenia verrucosa***

*Cryptaustenia verrucosa* damage the plants by gnawing pseudobulbs, leaves, stem as well as inflorescence (spike) during night hours and hide under dark during daylight. By touching, it rolled and become movementless. Snail was more prevalent in moist and moderate temperature of rainy season. It measures about 10–15 mm long, gradually tapering at the end. Shell was small, hemispherical, thin walled approximately 5mm across, uniformly pale-honey coloured but variable in different hues of yellow colour. Damage caused by snail by feeding on plant parts of *Aerides fieldingii*, *Arachmanthe* sp. *Calanthe* *implicata*, *Coelogyne* *elata*, *C. flaccida*, *Dendrobium kingianum*, *D. meschatum*, *D. parishii*, *D. primulinum*, *Eria flava*, *E. pulchra*, *E. spicata*, *Goodeyia procera*, *Lycaste schunbrunensis*,

*Otochilus* sp., *Paphiopedilum villosum*, *Pholidota imbricata*, etc was recorded.

**Insect identification**

Out of 9 insect specimens sent for its identification, 4 specimen viz., beetles *Sipalinus* sp., *Papillia* sp., *Phytoscaphus* sp. and snail *Cryptaustenia heteroconcha* were identified from Zoological Survey of India during the year.

**Darjeeling campus**

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

Rampal

**Collection**

Four explorations were conducted to collect the

Table 12. Month wise occurrence of pest on orchids

Sl. No	Name of pest	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.	Aphid <i>Toxoptera aurantii</i>												
	<i>Macrosiphum</i> sp.												
	<i>Macrosiphum rosae</i>												
2.	Scales <i>Pinnaspis buxi</i>												
	<i>Coccus hesperidum</i>												
	<i>Lecanium</i> sp												
3.	Shoot borer <i>Peridaedala</i> sp.												
4.	Black weevil <i>Sipalinus</i> sp.												
5.	Mealy bug <i>Pseudococcus maritimus</i>												
6.	Mite <i>Tetranychus urticae</i>												
7.	Yellow beetle <i>Anomala</i> sp.												
8.	Grass hopper												
9.	Black thrips												
10.	Snail <i>Cryptaustenia verrucosa</i>												
	<i>Cryptaustenia heteroconcha</i>												





orchids from natural habitat occurring in the Darjeeling district. During explorations one new species of *Calanthe* (not identified), *Cymbidium iridoides* and two species of *Coelogyne* (not identified) added to the previous collection thus making total collection of 154 species of native orchids. Apart from wild species, 7 new *Cymbidium* hybrids were collected, thus total 42 *Cymbidium* hybrids available at the campus.

### Evaluation

Among the ten species of *Cymbidium* conserved at the campus, *C. erythraeum*, *C. gammieanum* and *C. elegans* were the first flowering species while *C. lowianum*, *C. devonianum* and *C. tigrinum* were late flowering species. The flowering season of these species extended from September to the end of May or even up to first fortnight of June. The number of lead shoots produced from mature pseudobulb varied with species to species. *Cymbidium erythraeum*, *C. elegans*, *C. gammieanum* *C. ensifolium* were free growing species produce average 3.26, 2.68, 2.48 2.28 lead shoots per year, respectively. While *C. tigrinum*, *C. hookerianum* *C. lowianum* and *C. tracyanum* were found to be slow growing species and produced average 1.48, 1.64, 1.08, 1.00 lead shoots per year. The slowest growing species was found to be *C. tracyanum* while *C. erythraeum* was found to be fast growing species. Each species produced one flower spike from mature pseudobulb. *Cymbidium iridoides* was found to be susceptible to high light intensity which developed burn injury symptoms if exposed to full sunlight. Among all *Cymbidium* species *C. ensifolium* was found to be susceptible to mite attack, in contrary *C. hookerianum* was found to be least

susceptible. Similarly, other important genera like *Pleione*, *Calanthe*, *Coelogyne*, *Liparis* etc. are being evaluated.

### Maintenance

All the conserved species have either been maintained in low cost playhouses or in artificial natural habitat. The artificial natural habitat provided almost similar conditions like in nature. Epiphytes are tied on the tree trunks while terrestrials are grown on ground under the shady locations. The artificial natural habitat method for conservation of orchids reduced the cost of maintenance.

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

Ram Pal

### Collection

During the year four oriental lily cultivars (Star Fighter, Mero Star, Lereve Joy and unnamed), and two Asiatic lily cultivars (Nove Cento and unnamed), two cultivars of tulips (unnamed) and one cultivar of iris (unnamed) have been added to the previous collection.

### Evaluation

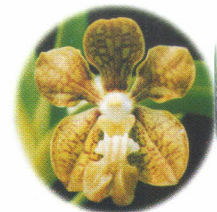
The two cultivars of *Lilium* (one each of Oriental and Asiatic lily) 'Nove Cento' and 'Star Fighter' have been planted for evaluation trial.

### Multiplication

#### Effect of growth regulators on multiplication of *Lilium longiflorum*

Among the growth regulators tested for multiplication of *Lilium longiflorum*, ethylene > 500 ppm





but below 2000 ppm was found most suitable for propagation of bulbs.

For studying the after effects (side effects) of ethylene treatments, the bulbs obtained from each treatment were planted in March 2004. The bulbs treated with less than 500 ppm ethylene showed no adverse effect on germination and have formed the flower buds. While bulbs obtained from the treatment higher than 500 ppm delayed the germination and showed no sign of flower bud formation.

### Effects of wounding of scales on propagation of *Lilium longiflorum*

The detached scales of *Lilium longiflorum* bulbs were wounded (i. slated at all sides, ii. slated at base, iii. streaked longitudinally at middle, iv. transversal streaking v. pricking at all places, vi. pricking at base vii. longitudinal streaking at base viii. pricking at base, ix. no wounding) and planted in leaf mould in September 2003. The bulblets were removed from the scales and planted in beds in March 2004. The pricking of scales on whole scale resulted in more number of plantlets while slitting at the basal portion resulted in equal size of bulbs.



Bulblets formation from wounded bulb scales of *Lilium longiflorum* (A) control, (B) cuts at all sides, (C) cuts at basal portion, (D) pricking, (G) streaking (transversal) and (H) streaking (longitudinal)

### Standardization of cutting media on formation of bulblets from the bulb scales of *Lilium longiflorum*

The detached scales of *Lilium longiflorum* were planted in nine different cutting media viz. (i) sand, (ii) charcoal (iii) saw dust, (iv) perlite + leaf mould (1:2 v/v), (v) coco peat, (vi) sphagnum moss, (vii) compost, (viii) vermicompost and (ix) leaf mould. The experiment was replicated thrice. Scales were planted in September 2003 and plantlets were removed and planted in beds in March 2004. Saw dust gave maximum (2.29) number of bulblets followed by vermicompost (1.95), perlite + leaf mould (1.94), leaf mould (1.76), sphagnum moss (1.68) compost (1.37), charcoal (1.36) and coco peat (1.28). The least number (1.2) of bulblets per scale were formed in sand.

### Effects of Ethylene on growth and yield of daffodils bulbs

The bulbs of daffodils were soaked in different concentrations (500, 1000, 1500 and 2000 ppm) of ethylene (source: ethrel) for different time intervals (24, 48, and 72 hrs) and thereafter planted in beds. The treatments were replicated thrice. The flower buds were removed before opening. It was observed that higher ethylene concentration delayed germination.

### Standardization of fertilizer dose for *Lilium longiflorum* bulb production

An experiment to determine fertilizer dose for production of *Lilium longiflorum* bulbs has been laid out with three replications. The fertilizer study include DAP (18 : 36) 0, 50, 100 and 200 g per m<sup>2</sup>. and NPK (8 : 8 : 8) 0, 50, 100, 200g/m<sup>2</sup>. and their





combinations. Fertilizers were applied as basal dressing.

**Project: Studies on bulb production of Liliums**

Ram Pal

**(A) Propagation of liliums by whole bulb treatment**

**Effects of ethylene concentration and soaking time on multiplication of Oriental lily**

The bulbs of oriental lily were soaked in different concentrations (0, 500, 1000, 1500 and 2000 ppm) of ethylene (source: Ethrel) for different time intervals (24, 48 and 72 hrs) and were planted in raised beds in March 2004. The treatments were replicated thrice. The data on bulb yield, no. of bulbs formed, bulb size etc would be recorded after digging of bulbs.

**Effects of ethylene concentration and soaking time on multiplication of Asiatic lily**

The bulbs of oriental lily were soaked in different concentrations (0, 500, 1000, 1500 and 2000ppm) of ethylene (source: Ethrel) for different time intervals (24, 48 and 72 hrs) and were planted in raised beds in March 2004. The data on bulb yield, no. of bulbs

formed, bulb size etc would be recorded after harvesting of bulbs.

**Effects of ethylene concentrations and soaking time on multiplication of Asiatic lily cultivar 'Nove Cento'**

An experiment to study the effects of ethylene on multiplication of Asiatic lily cultivar 'Nove Cento' was set up in Hilley, West Sikkim at an altitude of 2700 m(MSL).The bulbs were soaked in different concentrations of ethylene (0, 500, 1000, 1500, 2000 ppm) for 12, 24 and 36 hrs before planting. The bulbs were planted in raised beds in April in open fields.

**(B) Propagation of liliums by bulb-scales**

**Effects of auxins on propagation of oriental lily cultivar 'Star Fighter'**

An experiment was laid out to study the effects of auxins (IAA, IBA, NAA, 2-4, D) and their concentrations (0, 100, 200, 400 and 500 ppm) on bulblet formation in oriental lily cultivar 'Star Fighter' in March 2004. The outermost detached bulb-scales were soaked in different concentrations of auxins for 24 hrs and then planted in square shaped earthen pots containing leaf mould as potting media. The data would be recorded after harvesting of bulblets.

□





# 3

## NATP Projects

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

V. Nagaraju, R. C. Upadhyaya, S. P. Das, D. Barman, T. K. Bag, Ram Pal and V.S. Nagrare

#### Exploration and collection

V. Nagaraju and Ram Pal

During the year 3 exploration trips were undertaken in collaboration with NBPGR and ICAR Research Complex for NEH region, Barapani in Arunachal Pradesh and Nagaland respectively and one trip in Darjeeling hills and collected over 228 accessions of orchids and 9 accessions of bulbous flowers (Table 13). The accessions collected during April-May from Dibang valley of Arunachal Pradesh were: *Dendrobium* (12), *Pleione* (3), *Oberonia* (3), *Pholidota* (5), *Bulbophyllum* (5), *Epigeneium* (2), *Eria* (19), *Calanthe* (4), *Habenaria* and *Luisia* (6) and *Anoectochilus* (1). These

were collected from different altitudes, soils, forest types and topography. The wild ornamentals were mainly *Arisema*. Accessions collected from the Zunhebato and Mokokchung Districts of Nagaland during December belonged to 16 genera and 89 accessions. Specieswise distribution of accessions was -*Aerides* (4), *Bulbophyllum* (1), *Calanthe* (4), *Coelogyne* (5), *Cymbidium* (4), *Dendrobium* (38), *Epidendrum* (3), *Epigeneium* (1), *Eria* (5), *Gastrochilus* (1), *Liparis* (3), *Ornithochilus* (1), *Otochilus* (5), *Pholidota* (2), *Thunia* (1) and *Vanda* (6). From Darjeeling hills the species of *Aerides*, *Bulbophyllum*, *Calanthe*, *Coelogyne*, *Cymbidium*, *Dendrobium*, *Eria*, *Liparis* and *Anoectochilus* were collected.

#### Morphological characterization

V. Nagaraju

The germplasm accessions collected are being maintained in the National Active Germplasm Site for Orchids at National Research Centre for Orchids. Proper conditions for tropical, sub tropical and

Table 13. The detail programmes, collaborator and accessions collected

Sl. No	Collaborator	Areas explored	No. of Accessions	Orchids	Other ornamentals
1	NRCO+NBPGRSL	Changlang	93	84	9
2	NRCO+ICARRC	Zunhebato and Mokokchung	89	89	-
3	NRCO	Darjeeling Hills	55	55	-
	Total accessions collected		237	228	9





temperate orchids have been created for their maintenance and growth. The materials that have flowered were characterized for eighteen important morphological characters and in case of bulbous flowers it was characterized for 10 morphological characters. Altogether 174 accessions of orchids and 29 accessions of bulbous flowers have been characterized. Many species were identified suitable as potted plant, cut flower and parents for hybridization programme. Though a number of characters were studied for all the species, a brief notes with respect to important characters like-flowering time, number of flower(s) / spike, flower size, number of spike(s) / plant, flowering duration and shelf life were described as follows.

### Flowering time

It was found that different species of orchids flowered during different month. However, few species flowered at several times in a year. About 60% of the total species flowered during April to July. May-June was the peak flowering time. After July, very few species have been seen to flower and categorically cold winter deter the flowering.

### Flower number(s)/ spike

Flower number per spike varied from 1 (e.g. *Lycaste cruenta*, *Arachnis rubra*, *Paphiopedilum insigne*, etc.) to over 80 (e.g. *Liparis longipes*- 88, *Rhynchostylis primosa*- 105 and *Rhynchostylis retusa*- 84). Some other species like *Goodyera procera* have very minute flowers that were difficult to count.

### Flower size (cm)

The flower diameter varied from 0.2 cm (eg.

*Cleisostoma williamsonii*) to above 8 cm. For example, *Lycaste cruenta* (9 cm), *Dendrobium formosum* (9cm), *Paphiopedilum insigne* (8.8 cm). These large sized flowers were very showy and have long shelf life. Thus these are considered very important from commercial point of view especially as cut flower or potted plant.

### Spike(s) number /plant

Most of the species usually have 1–3 spikes per plant but some species have over 6–8 spikes per plant (e. g. *Bulbophyllum achrochane*, *Bulbophyllum hirtum*, *Dendrobium ochreatum*, *Eria paniculata*, *Liparis viridifolia* and *Pholidata imbricata*).

### Flowering duration

The days taken from first flower opening to last flower opening in a spike, or in a plant varied. In some species it was found to be single day as it produced only one flower (*Flickingeria fugax*, *Bulbophyllum protractum*) with multiple flowers per plant; but in many species complete flowering took more than 10 days and even up to 90 days, (e. g. *Anoetochillus* sp., *Phaius tankervilleae*, *Liparis* sp., *Oncidium* Gower Ramsey, *Vanda stangeana*).

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

D. Barman

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

The experiment was carried out in the polyhouse where budded plants of rose cv. First Red were planted





in the month of March 2002. Plants were subjected strictly to the prescribed technical programme. The treatments (Module 1–13) were distributed in the randomized block design with three replications. Data on characters attributing growth, flowering, yield and quality were recorded.

### Growth and fowering

The longest plant was observed from (M-1) the growing media containing 2 soil: 1 compost: 1 sand supplemented with 150 ppm N + 200 ppm K through fertigation under the irrigation regime of 20 kPa. The growing media comprising of 2 soil: 1 compost: 1 sand (M-4) as well as 2 soil: 1 compost: 1 saw dust fertigated with 150 ppm N + 200 ppm K maintaining the soil moisture at 40 kPa (M-6) induced early bud appearance (60 days).

Plants grown in (M-2) the media containing 2 soil: 1 compost: 1coco peat presupplemented with 1 kg CAN+2 kg SSP + 1/2 kg MOP /10 m<sup>2</sup> + 150 ppm N & 200 ppm K at 20 kPa irrigation regime resulted in production of longest pedicel (8.61 cm) as well as largest flower (8.86 cm)

Highest number of flowers (65.63) with 30–44 cm stem length was recorded from the growing media containing 2 soil: 1 compost: 1 sand supplemented with 150 ppm N + 200 ppm K through fertigation under the irrigation regime of 20 kPa and spraying of polyfeed + micronutrients (2g/l) followed by spray of BAP 50 ppm + GA<sub>3</sub> 50 ppm from September to January (M-9). Maximum number of flower with stem length of 45–59 cm and 60–89 cm (75.25 and 40.48 respectively) were harvested from the plants grown in the media containing 2 soil: 1 compost: 1 coco peat

presupplied with 1 kg CAN+2 kg SSP + 1/2 kg MOP/ 10 m<sup>2</sup> + 150 ppm N & 200 ppm K at 40 kPa irrigation regime (M-5). A maximum number of flowers (8.12) with 90 cm and above were recorded from the growing media containing 2 soil: 1 compost: 1 sand supplemented with 150 ppm N + 200 ppm K through fertigation under the irrigation regime of 20 kPa (M-1). Total number of flowers /m<sup>2</sup>/month was observed maximum (7.72) in the media containing 2 soil: 1 compost: 1 coco peat presupplied with 1 kg CAN+2 kg SSP + 1/2 kg MOP /10 m<sup>2</sup> + 150 ppm N & 200 ppm K at 40 kPa irrigation regime (M-5). Same module also recorded the maximum (92.65) number of flowers /m<sup>2</sup>/year.

### Vase-life

The perusal of data indicated that vase life of rose was significantly influenced by different modules during June to September and February to March. It was observed that vase-life during June-September recorded minimum days. However, it was noted that during February to March the keeping quality was more and it was doubled during this period as compared to June to September period. The longest vase-life was recorded when media 2soil: 1compost: 1sand were supplemented with 1 kg CAN+2 kg SSP + 1/2 kg MOP /10 m<sup>2</sup> + 150 ppm N & 200 ppm K at 20 kPa irrigation regime and spraying of polyfeed + micronutrients (2g/l) at monthly intervals from September to January, keeping moisture regime at 20 kPa (M-13) (15.95 days).

### Nutrient status of leaves

The data indicated that nitrogen content of leaves





increased during March and thereafter tended to decrease in June and September irrespective of different treatments. Same pattern of phosphorus content was also observed during this period. However, potassium content of leaves decreased in most of the Modules during the period of March and then increased during June. Again the nutrient content decreased in September irrespective of various Modules.

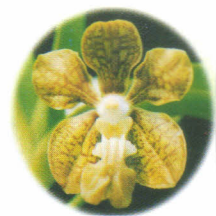
### **Effect of various growing media, nutrients and plant growth regulators on growth and flowering of *Cymbidium* Soul-Hunt-6**

An experiment on *Cymbidium* hybrid Soul-Hunt-6 was undertaken with one and half years old tissue cultured plants. Treatments (Modules 1–11) were replicated five times in completely randomized block design. Regular crop management practices were carried out for proper growth.

The perusal of data indicated that treatments under different modules significantly influenced *Cymbidium* Soul Hunt-6 in terms of plant height,

number of leaves and length of leaves whereas number of shoot per pot, leaf width and pseudobulb girth were found to be non significant. Module 4 which comprised of growing media containing Leaf mould + FYM + Charcoal + Coconut husk + Brick Bits (2: 1: 1: 1) and spraying with N 300 ppm P 200 ppm K 100 ppm + BA 200 ppm & GA<sub>3</sub> 200 ppm recorded the maximum plant height (70.40 cm). Number of leaves were highest (12.00) in potting mixture having Leaf mould + FYM + Charcoal + Coconut husk + Brick Bits (2: 1: 1: 1) and spraying with N 200 ppm P 100 ppm K 100 ppm + BA 100 ppm GA<sub>3</sub> 100 ppm (Module 7). Longest leaf (64.53 cm) was observed from the potting mixture having Leaf mould + FYM + Charcoal + Coconut husk + Brick Bits (2: 1: 1: 1) and spraying with N 200 ppm P 100 ppm K 100 ppm + BA 100 ppm, GA<sub>3</sub> 100 ppm (Module 8). Potting mixture having Leaf mould + FYM + Charcoal + Coconut husk + Brick Bits (2: 1: 1: 1) and spraying with N 200 ppm P 100 ppm K 100 ppm + BA 100 ppm GA<sub>3</sub> 100 ppm (Module 6) produced more number of shoots (3.50).





# 4

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

**Project: Development of conventional and micro propagation techniques**

V. Nagaraju, D. Barman and S. P. Das

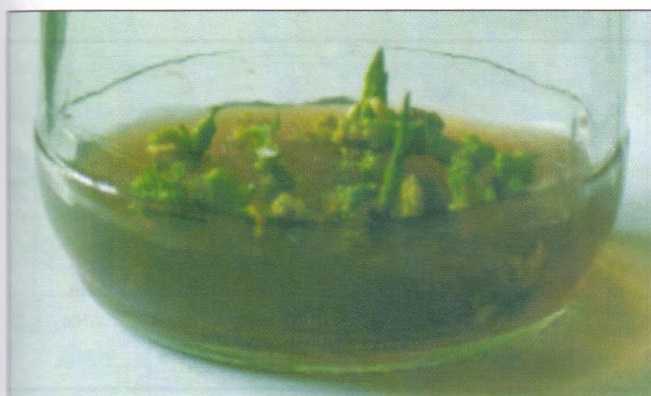
### Effect of activated charcoal on proliferation and growth of *Cymbidium* hybrids

V. Nagaraju

Investigations were carried out using 6 commonly used basal media and 4 *Cymbidium* hybrids to find out the influence of AC on proliferation and differentiation. The results showed that Lunavian Atlas and Showgirl "Cooksbridge" multiplied better in Gamborg + 1.5g/l AC, by producing maximum number of Plbs as well as higher number of shoot development and root formation. With regard to Soul Hunt I, Nitsch media containing 0.15% AC is most

ideal for proliferation, as it produced maximum number of protocorms, besides shoot and root development, where as MS with 1.5g/l AC is most suitable for *Cymbidium* Golden Girl. Among the hybrids, rapid proliferation rate was observed in Golden Girl, while for differentiation, the response was superior in Showgirl "Cooksbridge" (Fig. 9).

Better plantlets development was recorded for Golden Girl and Showgirl "Cooksbridge", in Gamborg with 1.5g/l AC, as it produced plantlets with better leaf and root growth. However, Murashige and Skoog with 0.15% AC is found better for Soul Hunt I with regard to maximum shoot, leaf and root length, where as Nitsch with 1.5g/l AC is most suitable for development of Lunavian Atlas, giving rise to plantlets with bigger shoot, leaf and root size (Fig. 10).



Plbs multiplication with the application of activated charcoal

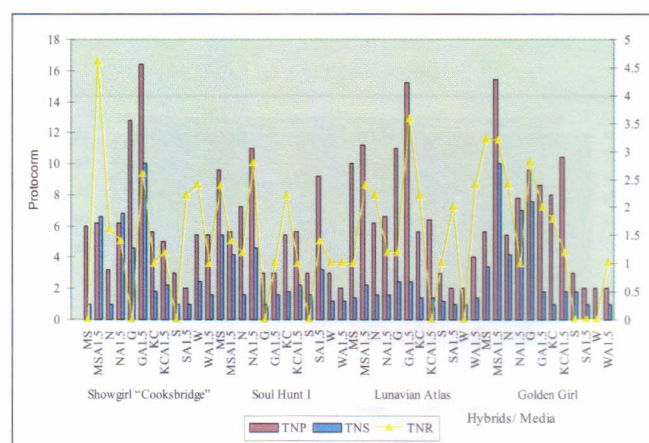


Fig. 9. Influence of media and AC on multiplication of *Cymbidium* hybrids



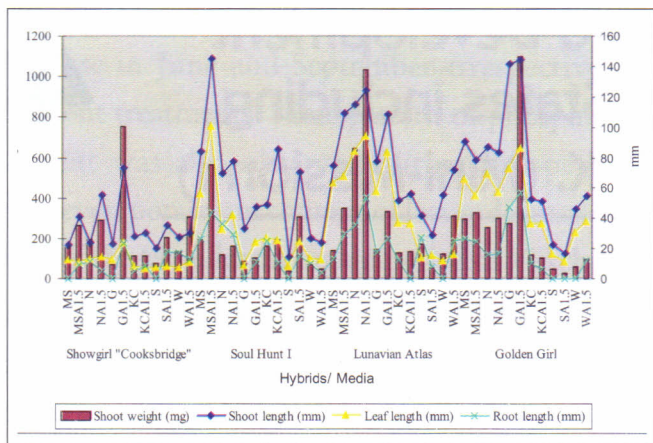


Fig. 10. Influence of media and AC on growth of *Cymbidium* hybrids

### Effect of AC on proliferation and differentiation of *Cymbidium* Showgirl "Cooksbridge"

V. Nagaraju

Study was undertaken to find out the optimum concentration of activated charcoal in the culture media for better proliferation of Plbs and in controlling the browning in *Cymbidium* Showgirl "Cooksbridge". Among the various treatments MS media supplemented with 1g/l activated charcoal resulted in better multiplication as well as

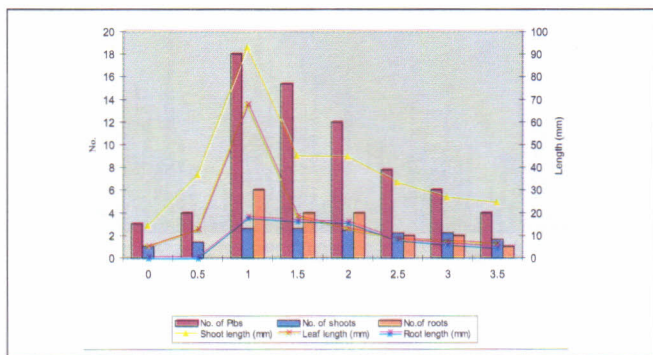


Fig. 11. Influence of activated charcoal on plbs multiplication and growth

differentiation of Plbs and formed shoots and roots and it also prevented the browning of the media (Fig. 11). AC below 1 g/l had no influence on growth and development; where as increasing the concentration beyond 1 g/l has significant reduction in protocorm proliferation.

Incorporation of 1% Activated charcoal with *in vitro* culture media resulted in formation of better plantlets with well-developed shoot and root.

### Response of plbs of *Cymbidium* Showgirl "Cooksbridge" to coconut water

V. Nagaraju

In a study to find out the efficacy of coconut water in six different basal media for protocorm proliferation and differentiation found that, protocorm proliferation was rapid in Street followed by White's media, however; leaf and root differentiation was early in Knudson C followed by Gamborg. More number of Plbs and maximum number of shoot and root were formed in Knudson C followed by Gamborg (Fig. 12). Supplementation of 100ml/l coconut water recorded more number of protocorms, while at 200ml/l; shoot initiation, leaf and root differentiation was better

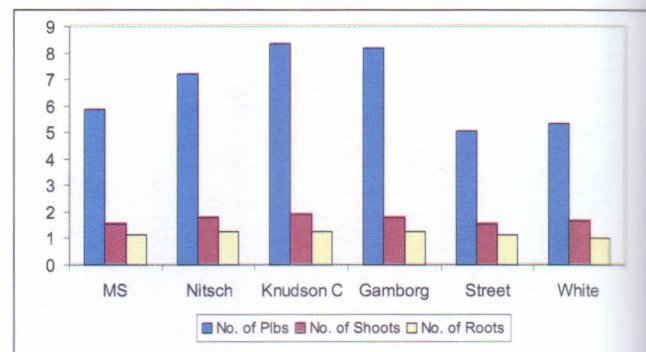


Fig. 12. Influence of media on Plbs proliferation



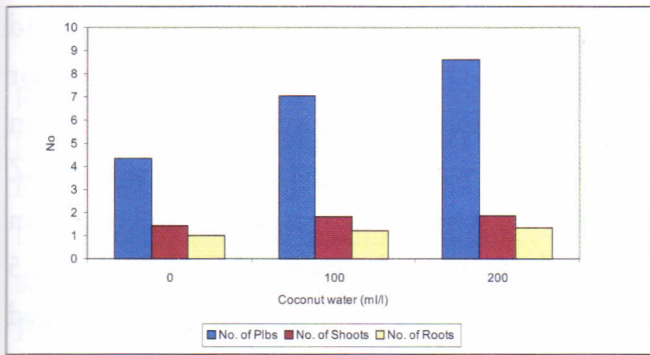


Fig. 13. Influence of coconut water on plb proliferation

(Fig. 13). In White's media with 100ml/l coconut water, Plbs multiplication was rapid, MS with 200ml/l responded better for shoot initiation and root initiation was better in Street media incorporated with 200ml/l of coconut water.

### Influence of AgNO<sub>3</sub> and BAP on plbs multiplication and plantlet growth of *Cymbidium Lunavian Atlas*

V. Nagaraju

In study to find out the alternative source for growth hormone for Plb multiplication, it was observed that, Nitsch media resulted in higher number of Plbs, as well as shoot and root differentiation and in fastest multiplication of Plbs, but the shoot and root initiation was fastest in Gamborg media. Better growth of plantlets in respect of plantlet weight, height

and leaf length was recorded in Nitsch media (Fig. 14). BAP at lower concentration (0.25mg/l) in media formed more Plbs, early shoot emergence and maximum number of shoots developed, however early root emergence was recorded on BAP at 0.5mg/l. BAP @ 0.25mg/l is better for growth and development of plantlets (Fig. 15). Silver nitrate at 0.5mg/l showed rapid differentiation and maximum no. of shoots formed and also resulted in early root emergence. In Silver nitrate @ 0.5mg/l recorded better growth and development (Fig. 16). Maximum number of protocorm formed in Nitsch media incorporated with 1.5g/l AC + 0.25mg/l BAP and 0.5 mg/l AgNO<sub>3</sub>. Early emergence of shoot, leaf and root reported in B5 media supplemented with 1.5g/l activated charcoal, 0.25mg/l of BAP and 0.5mg/l of AgNO<sub>3</sub>.

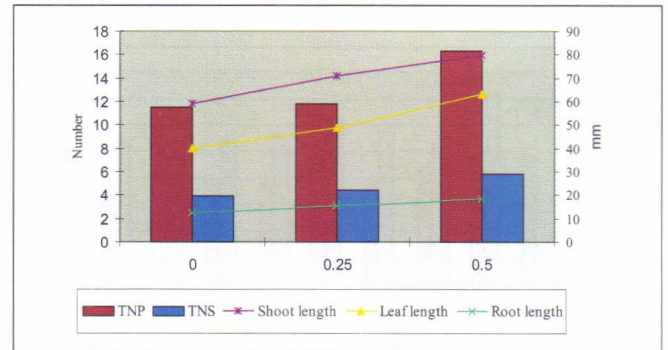


Fig. 15. Influence of BAP on multiplication and growth in vitro

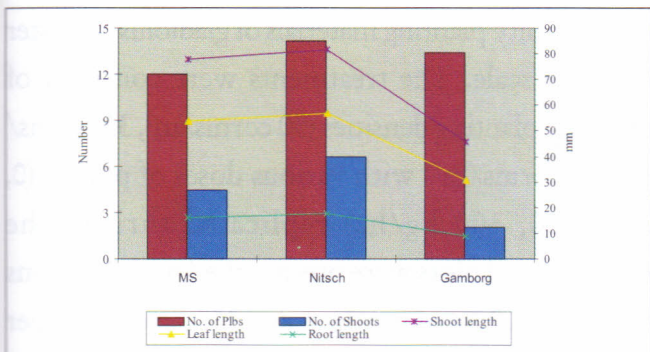


Fig. 14. Response of Plbs to basal media in vitro

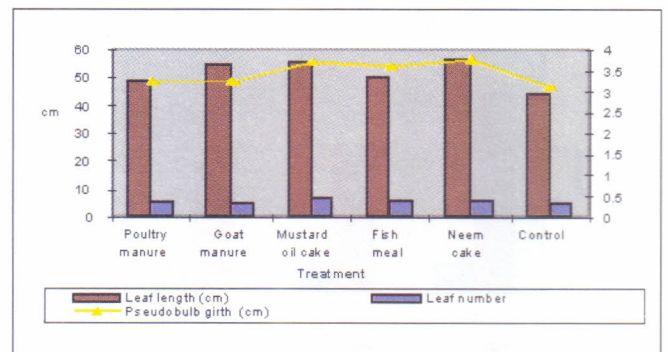


Fig. 16. Influence of AgNO<sub>3</sub> on Plbs multiplication and growth in vitro





The growth and development of plantlets in respects of shoot, leaf and root was better in Nitsch along with 1.5g/l activated charcoal, 0.25mg/l of BAP and 0.5mg/l of AgNO<sub>3</sub>.

### Influence of triacontanol and paclobutrazol on proliferation and differentiation of *Cymbidium Golden Girl*

V. Nagaraju

In a study to find out the effect of triacontanol and paclobutrazol on Plbs proliferation and plantlet growth, it was observed that, MS was better for multiplication and Nitsch found superior for shoot and root differentiation (Fig. 17). Among various levels of triacontanol, Tria at 0.5mg/l found best for Plbs multiplication whereas, differentiation of shoot and root Tria at 0.25mg/l (Fig. 18) found better.

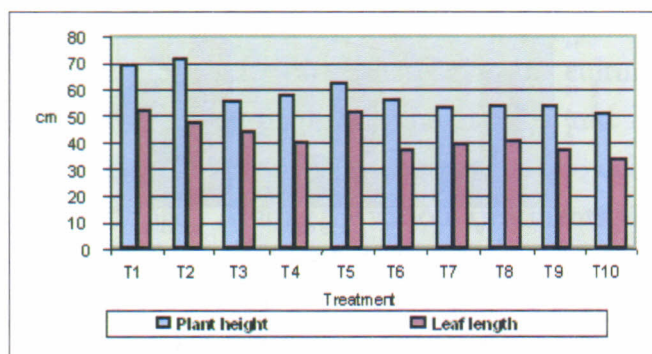


Fig. 17. Response of Plbs to basal media

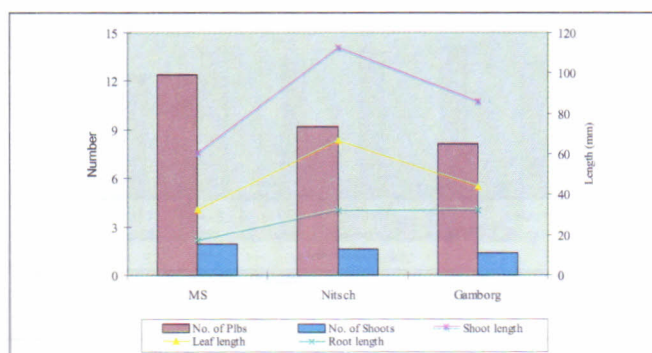


Fig. 18. Response of Plbs to basal media

Supplementation of both triacontanol and paclobutrazol showed that at 0.5mg/l was best for Plb proliferation, with regard to differentiation, in Nitsch media with 0.25mg/l each of Tria and PBZ found better where as increasing the concentration of both the growth substances in Nitsch media at 0.5 mg/l each produced plantlets with well developed leaves and roots, which is a prerequisite for *ex vitro* survival of the plants (Fig 19).

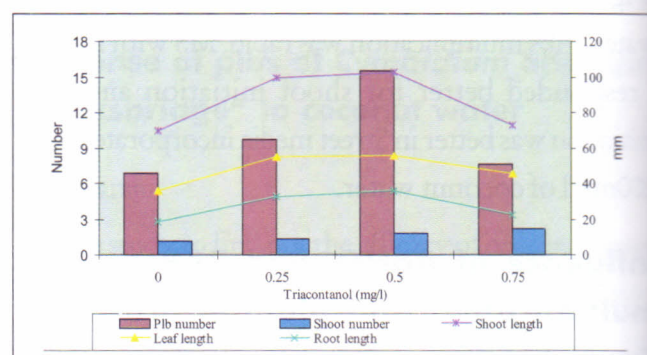


Fig. 19. Response of Plbs to basal media

### Project: Production of planting material under low cost poly house

D. Barman

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

An experiment was conducted with the intention to get quality planting materials of gladiolus cv. Jester on large scale. The treatments were consisted of different planting densities (50 corms/m<sup>2</sup>, 33 corms/m<sup>2</sup>, 25 corms/m<sup>2</sup>) with various doses of potash (0, 100, 200, 300 kg/ha) replicated thrice. The experimental plots were pre-supplied with 1.25 tons of FYM, 200 kg of nitrogen and 100 kg of P<sub>2</sub>O<sub>5</sub> per hectare.



## Technology Mission



The results showed that planting of corms at the planting density of 33 corms/m<sup>2</sup> without potash produced maximum length of plant (144.47 cm), leaf length (61.42 cm), spike length (89.56 cm), rachis length (68.57 cm) and maximum number of corms and cormels (1.30 and 35.26, respectively).

**Freesia:** A trial was undertaken on Freesia with an

objective to optimize the dose of NPK for the production of corm and cormel. The treatments were consisted of three doses (50, 100 and 150 kg/ha) each of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O with five replications. Application of 100 N: 50 P: 100 K was found to be optimum for maximum production of freesia corm and cormels. □





## Training

# 5

Name of training	Period	Participants	Venue
Production of Orchids, Rose & Gerbera organized by WBCADC	24.11.2003	Farmers of Kalimpong	Kalimpong
Production and protection of orchids and rose	27.11.2003	45 farmers	NRC Orchids, Pakyong
On farm demonstration on cultivation of flowers	14.12.2003 to 16.12.2003	14 farmers of Meghalaya	NRC Orchids, Pakyong
Cultivation of orchids	15.12.2003 to 16.12.2003	14 Farmers	NRC Orchids, Pakyong
Development of greenhouse	16.12.2003 to 17.12.2003	Horticulture Officers, Govt. of Nagaland	Kohima, Nagaland
Production and protection of orchids and rose	18.12.2003	47 farmers	NRC Orchids, Pakyong
On farm demonstration on cultivation of flowers	27.12.2003 to 28.12.2003	14 farmers of Meghalaya	NRC Orchids Pakyong
Orchid management in NEH region	28.12.2004 to 30.01.2004	17 Extension officers from Meghalaya	ICAR Research Complex, Barapani, Meghalaya
Production and protection of orchids and rose	19.03.2004	55 farmers	NRC Orchids Pakyong



On farm training to the farmers of Kalimpong





# 6

## Awards and Recognition

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Dr S.P. Das, Scientist (Plant Breeding) was awarded Lal Bahadur Shastri Young Scientist Award 2001–2002 for

his contribution in the field of collection, characterization, evaluation and improvement of orchids.



**Dr S.P. Das receiving award from Shri Rajnath Singh,  
Union Agriculture Minister**





## Linkages and collaboration

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# 7

The centre remained constant in touch with the State Horticultural and Agricultural Departments of North Eastern states for building strong linkage. Apart from the state departments the Centre has also developed specific collaboration with the following research organizations.

### Local institutions

The centre has build up strong linkages with the **Botanical Survey of India**, Gangtok for survey, exploration and the expertise available with them were utilized for identification and taxonomical work. Active collaboration was made with **G. B. Pant Institute of Himalayan Ecology and Environment** for biochemical analysis.

### National Research Institutions

1. **National Bureau of Plant Genetic Resources, New Delhi:** Active collaboration built up for collection, characterization and management of orchid biodiversity. The centre acting a the National Active Germplasm Site for Orchids. Collection explorations were organized by active collaboration with NBPGR regional station, Barapani.
2. **NRC on DNA finger printing, National Bureau of Plant Genetic Resources, New Delhi:** Active collaboration built up for DNA fingerprinting of orchid germplasm.
3. **Kerala Agricultural University, Trissur, Kerala:** Active support and collaboration was received from the Floriculture department of the University for conducting survey on pre and post harvest management of orchids.
4. **Tropical Botanical Garden and Research Institute, Palode, Kerala:** Collaboration was made for collection of orchid germplasm from South India. Assistance was also taken for identification of collected germplasm.
5. **Institute of Himalayan Bioresource Technology, Palampur:** The centre was in the process of developing linkage with the institute for diagnostic test facilities for orchid viruses in the planting material.
6. **State Forest Research Institute, Itanagar, Govt. of Arunachal Pradesh:** The centre developed active linkages for germplasm collection and identification of Orchids. □





# 8

## List of Publications

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### Research articles

Bag, T. K. (2003). Two New Orchid Hosts of *Sclerotium rolfsii* Sacc. from India. *New Disease Reports* (<http://www.bspp.org.uk/ndr/>). 8: Aug.2003-Jan.2004

Bag, T. K. (2003). *Sclerotinia sclerotiorum* on Butterfly flower- a new record. *Indian Phytopatho.* 56: 121-122

Bag, T. K. and Das, S. P. (2003). Rust of *Phaius maculatus* -A new Report in India. *Orchid News* 19: 17

Barman, D. and Rajni, K. (2003). Studies on rooting in the keikis of bamboo orchid (*A. grammifolia* L.) *J. Ornament. Hort.* 6(3): 165-171

Barman, D., Rajni, K., Das, S. P., Nagaraju, V. and Upadhyaya, R. C. (2004). Response of auxins to rooting and shoot growth in back bulbs of *Cymbidium* hybrid Show Girl "Cooksbridge". *J. Ornament. Hort.* 7: 118-120

Mani, S. K. and Nagaraju, V. (2004). Influence of potting media on acclimatization and growth of *in vitro* plantlets of *Cymbidium* hybrids. *J. Ornament. Hort.* 7: 31-37.

Nagaraju V., Das, S. P., Bhutia, P. C. and Upadhyaya, R. C. (2003). *In vitro* multiplication of *Cymbidium* hybrids. *J. Orchid Soc. India* 16: 25-28

Nagaraju, V. and Das, S. P. (2003). *In vitro* morphogenetic response of orchid species to triacontanol. *J. Ornament. Hort.* 6: 25-28

Nagaraju, V. and Mani, S. K. (2003). Influence of mercuric chloride and growth substances on culture initiation and multiplication of *Gladiolus* cv. Ice Gold *in vitro*. *J. Hill Res.* 16: 45-49

Nagaraju, V. and Mani, S. K. (2003). The effect of benzylaminopurine and triacontanol on mericlone of *Cymbidium* Soul Hunt I. In: One hundred Research Papers in Floriculture Eds. Rajeevan, P. K., Valsalakumari, P. K. and Misra, R. L. Indian Society of Ornamental Horticulture, KAU, Kerala.

Nagaraju, V., Das, S. P., Bhutia, P. C. and Upadhyaya, R. C. (2003). Effect of media and BAP on protocorms of *Cymbidium* and *Cattleya*. *J. Orchid Soc. India* 17: 67-71

Nagaraju, V., Das, S. P., Bhutia, P. C. and Upadhyaya, R. C. (2003). Response of protocorms of





*Cymbidium* Lunavian Atlas to Benzyl Amino Purine. *Indian J. Hort.* 60 (1): 98–103

Nagrare, V. S. (2003). Occurrence of aphid *Toxoptera aurantii* on orchid *Dendrobium densiflorum*- A new report. *Ann. Pl. Protec. Sci.* 11(2): 379

### Popular articles

Das, S. P. and Dubey, S. K. (2003). Orchid ek upyog anek. *Samanya Gyan Darpan.* 15(8): 1201–02 (in Hindi)

Das, S. P. and Dubey, S. K. (2003). Orchids in Human Affair. *Employment News*, 28 Dec. 2002- 3 Jan. 2003, 27 (39): 32

Mani S. K. and Nagaraju, V. (2003). Dry flowers – Value for product diversification. *The Botanica.* 53: 135–142

Nagrare, V. S. (2003). Insect pollination of orchids. *Sci. Cult.* 69(1–2): 77–79

Upadhyaya, R. C. and Das, S. P. (2003). Prospects and potential of orchid export from India. *Indian Hort.* 48(3): 22–27

Upadhyaya, R. C., Das, S. P., and Dubey, S. K. (2003). Jaruri Hai Turai Uparant Orchid Kee Dekhbhal. *Raj Bhasha Aalok* 2003: 9–11 (in Hindi)

Upadhyaya, R. C., Das, S. P. and Dubey, S. K. (2003). Uttar Purvi Pradesh Mein Orchid. *Falful* 26 (3):

3–5 (in Hindi)

### Paper presented in seminar/symposia

Barman, D., Rajni, K. and Upadhyaya R. C. Standardization of production technology of rose under partially protected condition. National Symposium on Recent advances in Indian floriculture, November 12–14, 2003, KAU, Trichur.

Das, S. P. and Nagaraju, V. Evaluation of Eastern Himalayan orchids for product diversification. National Symposium on Recent advances in Indian floriculture, November 12–14, 2003, KAU, Trichur (Awarded best paper).

Mani, S. K. and Nagaraju, V. Influence of potting media on acclimatization and growth of *in vitro* plantlets of *Cymbidium* hybrids. National Symposium on Recent advances in Indian floriculture, November, 12–14, 2003, KAU, Trichur.

Nagaraju, V and Mani, S. K. Effect of benzylaminopurine and silver nitrate on proliferation of *Cymbidium* Lunavian Atlas. National Seminar on Horticulture for sustainable income and environmental protection, February 24–26, 2004, Nagaland University, Nagaland.

Nagaraju, V and Mani, S. K. Influence of potting media, nutrients and hormonal spray on establishment of *in vitro* regenerated plantlets of



## List of Publications



*Zygopetalum intermedium* National Seminar on Horticulture for sustainable income and environmental protection, February, 24–26, 2004, Nagaland University, Nagaland.

Nagaraju, V and S. K. Mani. 2003. Micropropagation of *Cymbidium* Soul Hunt I: The effect of BAP and triacontanol. National Symposium on Recent advances in Indian floriculture, November, 12–14, 2003, KAU, Trichur.

Nagaraju, V. Effect of Sucrose on proliferation and conservation of orchids *in vitro*. National Symposium on Recent advances in Indian floriculture, November 12–14, 2003, KAU, Trichur.

Nagaraju, V. and Upadhyaya, R.C. Sucrose mediated proliferation and short- term conservation of *Cymbidium* Lunavian Atlas *in vitro*. 90th Session of Indian Science Congress, January 3–7, 2003, Bangalore University, Bangalore.

Nagrare, V. S. Pest complex of orchids. National Symposium on Frontier Areas of Entomological Research, November 5–7, 2003, New Delhi.

Nagrare, V. S. Needs of Orchid industry in India. National Symposium on Recent advances in Indian floriculture, November 12–14, 2003, KAU, Vellanikkara, Trichur.

Upadhyaya, R. C., Nagaraju, V., Das, S. P., Das, G., Barman, D., Ram Pal, Nagrare, V. S., Bag, T. K.

and Chakrabarti. S. Exploration, characterization and conservation of ornamental orchids. National Symposium on Recent advances in Indian floriculture, November 12–14, 2003, KAU, Trichur.

Upadhyaya, R. C. Nagaraju, V. 2003. Genetic resources of Orchids in NEH Region- Potentials and prospects. Seminar cum workshop on Entrepreneurship development for floriculture in Meghalaya, May 14–15, 2003, ICAR Res. Complex, Barapani, Meghalaya.

### Technical publications

Das, S. P., Nagaraju V. and Barman, D. (2003). Gladiolus: Tips for cultivation.

Das, S. P. and Upadhyaya, R. C. (2003). Growing orchids in North Eastern Region: understanding the critical factors.

### Book chapter

Das, S. P. (2003). Micropropagation of Orchids. *In: Orchids Biodiversity and Conservation- A tissue culture approach* (ed. S. J. Britto). Institute of Natural Resources, Tiruchirappalli.

Das, S. P. (2003). Orchid Seed Culture-raising progeny asymbiotically from embryo. *In: Orchids Biodiversity and Conservation – A tissue culture approach* (ed. S. J. Britto). Institute of Natural Resources, Tiruchivappalli.





## Annual Report 2003–2004

Das, S. P. and Upadhyaya, R. C. (2003). Orchids in Hill Floriculture: Critical Considerations. In: Sustainable Mountain Agriculture (eds. R. Sharma *et al.*). Centre for Development Studies, Uttarakhand Academy of Administration, Nainital.

Nagaraju, V. and Das, S. P. (2003). Micropropagation of Orchids: A success story *In: Comprehensive Micropropagation Of Horticultural Crops* (eds. R. Chandra and M. Mishra). International Book Distributing Co., Lucknow. Pp. 270–307.







## List of ongoing Projects

Institute projects	PI	CoPI
Development of agro – techniques for commercial scale production of orchids in open and protected condition.	D. Barman	S. K. Naik & R.C. Upadhyaya
<i>In vitro</i> propagation of Orchid: <i>Cymbidium</i> and important, rare and endangered species	V. Nagaraju	S. Chakrabarti & S. P. Das
Cytogenetical research on orchids	S. Chakrabarti	
Breeding superior hybrids in <i>Cymbidium</i> and other important orchids	S.P. Das	V. Nagaraju & S. Chakrabarti
Collection, conservation, characterization, evaluation and maintenance high altitude orchid germplasm	Ram Pal	
Collection, conservation, evaluation and multiplication of bulbous ornamental crops	Ram pal	
Sudies on bulb production of <i>Lilium</i>	Ram pal	
Pest management in orchids and bulbous flowering plants	V. S. Nagrare	
Investigations on fungal diseases of orchids	T. K. Bag	
<b>NATP Projects</b>		
Sustainable management of plant bio-diversity “Collection, evaluation, maintenance of Orchids and ornamental plants germplasm From NEH Region”.	CCPI V. Nagaraju	CoCCPI R.C. Upadhyaya, S. Chakrabarti, D. Barman, T. K. Bag, Rampal, S. P. Das & V. S. Nagrare
Protected cultivation of vegetables and flowers in plains and hills	D. Barman	
Strengthening of library improvement and networking	T.K.Bag	
<b>Technology Mission on Integrated Development of Horticulture in North Eastern States including Sikkim, Uttranchal, H. P. and J. &amp; K. (Mini-Mission I) PI : R. C. Upadhyaya</b>		
• Development of conventional and micro-propagation techniques	V. Nagaraju	D. Barman & S. P. Das
• Production of planting material under low cost poly-houses.	D. Barman	
• Refinement and transfer of production technologies for commercial prodcuton of ornamentals	T.K.Bag	V.Nagaraju, S. Chakrabarti, Ram Pal, D. Barman, S.P. Das V.S. Nagrare
<b>A.P. Cess fund</b>		
Standardization of protocol for raising progeny from immature crossed embryo of <i>Cymbidium</i> orchid <i>in vitro</i>	PI : S. P. Das	





## SRC, RAC, IMC, QRT meetings with recommendations

# 10

### SRC

The Staff Research Council (SRC) meeting was held on 15.9.2003 under the chairmanship of Shri. G. K. Gurung, Secretary, Horticulture, Govt. of Sikkim.

The following persons were participated the meeting.

1. Shri. J. R. Subba, Director, Horticulture, Govt. of Sikkim
2. Dr. A. S. Chauhan, Joint Director, B.S.I., Gangtok
3. Shri. D. K. Bhandari, Floriculturist, Govt. of Sikkim
4. Shri. Padam Subba, Tissue culturist, Govt. of Sikkim
5. Dr. K.K. Singh, Scientist (Biotechnology), G. B. Pant Institute of Himalayan Environment and Development, Gangtok

Dr. R. C. Upadhyaya, Director, Dr. V. Nagaraju, Sr. Scientist (Biotechnology), Dr. S. Chakrabarti Sr. Scientist (Genetics), Dr. D. Barman Sr. Scientist (Horticulture), Shri Ram Pal Scientist (Horticulture), Dr. T. K. Bag Scientist, Sr. Scale (Plant pathology), Dr. V. S. Nagrare Scientist (Entomology) and Shri S. K. Naik Scientist (Soil Science) of the Centre attended the meeting.

### Recommendations

1. Effects of light on the *in vitro* germination of orchid seeds in tissue culture media should be

studied.

2. Requirement of light, temperature, relative humidity of micro propagated/seed germinated plantlet at hardening stage may be studied separately species wise.
3. Effect of GA in tissue culture medium for enhancing growth of roots and shoots may be studied.
4. Experiments may be revised as per quality of potting media for growing orchids, which may be recommended to the farmers.
5. Studies may be undertaken to know the number of Cymbidium plants, which could be accommodated per unit area (number of plant/m<sup>2</sup>).
6. To carry out study in the suitable substitute for charcoal.
7. To set up experiments for the control measures of different orchid pests and diseases.
8. publication of bulletin on control measures of pests and diseases with available information on control measures.

### RAC

Fourth Research Advisory Committee (RAC) meeting was held on 24.09.2003 under the Chairmanship of Dr. G. L. Kaul, Vice Chancellor, Assam Agricultural University, Jorhat, Assam in the





presence of the following members.

- |   |                  |
|---|------------------|
| 1. Dr. S. N. Hegde, Director,<br>Forest Research Institute, Itanagar  | Member           |
| 2. Dr. P. K. Hazra, Former Director,<br>BSI, Dehradun   | Member           |
| 3. Dr. Manmohan Attavar,<br>Indo American Hybrid Seeds,<br>Banglore   | Member           |
| 4. Dr. A. A. Zaidi, Head,<br>Division of Floriculture, IHBT,<br>Palampur  | Member           |
| 5. Dr. B. N. Choudhary, 154,<br>Keshav Kunj, Plot No. 15-A,<br>Sector 22, Dwarka, New Delhi   | Member           |
| 6. Shri. G. K. Gurung,<br>Secretary Horticulture,<br>Govt. of Sikkim, Tadong  | Member           |
| 7. Dr. Amor Roy,<br>Professor (Horticulture), In Charge<br>RRS, Hill Zone,<br>Uttar Banga Krishi Viswavidyalaya,<br>Kalimpong, W.B. | Member           |
| 8. Dr. R.C. Upadhyaya,<br>Director, NRC for Orchids, Pakyong,<br>East Sikkim  | Member           |
| 9. Dr. T. K. Bag, Scientist,<br>Sr. Scale (Plant Pathology),<br>NRC for Orchids, Pakyong,<br>Sikkim                                 | Member Secretary |

Dr. K. C. Garg, ADG (VC), ICAR, New Delhi could not attend the meeting due to some unavoidable circumstances. Dr. V. Nagaraju Sr. Scientist (Biotechnology), Dr. S. Chakrabarti Sr. Scientist (Genetics), Dr. D. Barman Sr. Scientist (Horticulture),

Shri Ram Pal Scientist (Horticulture), Dr. S. P. Das Scientist (Plant Breeding), Dr. V. S. Nagrare Scientist (Entomology) and Shri S. K. Naik Scientist (Soil Science) attended the meeting.

### **Recommendations**

1. The NRC should undertake surveys for identifying problems being faced by the orchid growers and exporters, using PRA techniques, prioritize them based on their economic importance, and develop short and long term research plans accordingly.
2. All research activities of the Centre should be reorganized on programme-mode basis. The projects should be grouped under major relevant programme in each major areas of work such as crop improvement, crop production, crop protection, post harvest management etc. In future the progress of research should be presented programme wise.
3. The Centre should confine its activities to *Cymbidium* orchids for the present till the strength of the scientists improves. Crop improvement work on *Gladiolus* and *Freesia* should be phased out.
4. The activities of germplasm collection, evaluation and conservation should be taken up under the institute programme and such activities being taken up under Bio diversity project NATP should be put as one major programme and the areas of work should be properly delineated.
5. The centre should develop a systematic plan for carrying out survey of different territories for collection of germplasm, and put up the same in the next meeting of the RAC.





6. Based on the published information on characterization of Indian Orchids at morphological, biochemical, molecular and chromosomal level, identify the gaps in the descriptions and the work should be confined to filling these gaps.
7. The NRC should have a taxonomist for identification and characterization of the germplasm being collected.
8. The work on plant protection aspect should be taken up only on those pests and diseases, which cause heavy economic losses.
9. Projects on agro-techniques should include the growers' practices as one of the treatments and results of different treatments should be interpreted as percentage improvement over the growers' practice.
10. The Centre should standardize protocols for micropropagation of different species/hybrids of *Cymbidium*. Further research should be taken up to improve the technique and bring down the cost of micropropagated plants. At the same time, work on identifying somaclonal variants among tissue cultured plants should also be taken up for ensuring clonal fidelity.
11. Authentic planting material of nationally and internationally important hybrids which are ruling the trade should be procured and multiplied through tissue culture for distribution to the growers and their use in breeding work or for other experimental purposes.
12. Testing of plant material for virus infections and identifying the specific virus should receive high priority, which is essential for the multiplication

of planting material for the growers.

13. The Centre should isolate and characterize mycorrhizal fungi of orchids and try to use it for hardening of orchid plantlets.
14. The NRC should work out package of practices for cost effective growing of orchids based on the work done so far and provide the entire know-how through technical bulletins, electronic media etc.
15. The NRC should develop strong collaborative programmes with the relevant institutions within the region and also from outside, and place specific proposals in next meeting of the RAC. In no case the NRC should duplicate the work done earlier at any other station in the country, unless fully justified.

#### IMC

Fourth Institute Management Committee (IMC) meeting was held on 16.01.2004 under the chairmanship of Dr. R. C. Upadhyaya, Director, The following members attended the meeting.

- |  |        |
|--|--------|
| 1. Dr. Amar Roy, Incharge,<br>RRS, Hill Zone, UBKV,<br>Kalimpong         | Member |
| 2. Sh. A.C. Deb, FAO,<br>ICAR Res. Complex for NEH Region,<br>Meghalaya. | Member |
| 3. Dr. T. K. Bag, Scientist,<br>Sr. Scale (Pl. Patho),<br>NRCO, Pakyong  | Member |
| 4. Shri. Rampal, Scientist (Hort),<br>NRCO, Darjeeling                   | Member |





5. Dr. V.S. Nagrare, Member Secretary  
Scientist (Entomology),  
NRCO, Pakyong  
Dr. K.C. Garg, ADG (VC), ICAR, New Delhi,  
Shri. G. K. Gurung, Secretary (Hort), Govt. of Sikkim,  
Gangtok; Dr. H. Barooah, Joint Director, Horticulture,  
Govt. of Assam and Dr. V. Nagaraju, Sr. Scientist  
(Biotechnology) NRC Orchids, Pakyong could not  
attend the meeting.

### **Recommendations**

1. Approval of the scientific instruments of approx.  
cost Rs.20, 00,000.
2. Approval of works (a) Residential Quarters Type  
III & Type IV (b) Approach road of approx. cost  
Rs 70,39,320.
3. Security of main campus and Darjeeling Campus  
up to December 2005 of approx. cost Rs 6,00,000.
4. Furniture & Fixtures in building under  
construction of approx. cost Rs.20,00,000.

### **QRT**

The Quinquennial Review Team (QRT) reviewed the work done during 1996–2003 at National Research Centre for Orchids, Pakyong, Sikkim.

### **Constitution of QRT**

1. Dr. S. P. Ghosh, Ex-DDG (Hort), Chairman  
ICAR
2. Dr. P. K. Rajeevan Head, Member  
Div. of Pomology & Floriculture,  
Kerala Agricultural University,  
Trissur

3. Dr. S. Chaudhuri, Member  
Ex-Director Research and  
Prof. of Plant Pathology, BCKV,  
Mohanpur, West Bengal
4. Dr. (Mrs.). Vibha Dhawan, Member  
Dean, TERI, Indian Habitat Centre,  
New Delhi
5. Mr. Udai C. Pradhan, Chair, Member  
ISROSG /IUCN /SSC,  
Kalimpong, (WB)
6. Dr. T. K. Bag, Member Secretary  
Scientist (Senior Scale),  
Plant Pathology,  
NRC for Orchids,  
Pakyong, Sikkim

The preliminary meeting of QRT of National Research Centre for Orchids about the work plan/strategy for review and finalization of visit schedule was held at the chamber of DDG (H), KAB-II, ICAR, New Delhi on 13th February 2004. All members of QRT except Mr. Udai C. Pradhan participated. DDG (Hort) chaired the meeting. On 20th February 2004 Chairman visited to the research centre discussed with Director and the scientists about the review work. On 21st February 2004 Chairman and other two members visited experimental farm and laboratories. Also visited private commercial units of floriculture and had discussion with progressive growers and entrepreneur. Reviewed work, progress report, discussion and meeting with Director and Scientists. On 22nd February 2004 QRT discussed with IMC members. On 23rd February 2004 QRT discussed among them and drafted report and same day visited Darjeeling campus of the centre. On 25th February 2004 Meeting was held with DDG (Hort.), ICAR, New Delhi by





the Chairman of the QRT for discussion on review findings.

### Recommendations of QRT

#### 1. Shortage of manpower

Shortage of manpower both in scientific and other categories at this stage is viewed as most critical. A few critical areas viz. physiology, taxonomy, floriculture and social science need additional research staff to address the identified priority research areas. There is acute shortage of technical staff to cater the needs of the laboratory, germplasm conservation and protected cultivation of orchids. Keeping in view of the workload, filling up of the existing vacant positions of the centre through redeployment/ transfer and creation of new positions as proposed in Xth Plan proposal are strongly recommended.

#### 2. Planting material production

Keeping in view the demand of planting materials of Orchids, *Cymbidium* in particular, both for research and commerce, NRC needs to undertake programme of mass production of planting materials. The entire operation of developing modern micro propagation facility at Pakyong should be completed within 15 months times.

#### 3. Development of a Pack House for cut flowers

A pack house with facilities for grading, sorting, precooling, storing and packaging of orchids and other bulbous flowers need to be established both for refining the technology as well as for hands-on training of the beneficiaries. Such facility should preferably be located in Darjeeling campus for the NRC. The post harvest infrastructure in Darjeeling campus has to be established within 12 months of time.

#### 4. Renaming of the NRC

The hill floriculture is gaining momentum in the national floricultural scenario. The QRT recommends the NRC for Orchids may be renamed as “NRC for Temperate Floriculture” with major R and D programme remains on orchids. In the 69th Meeting of the “Senior Officers Committee” of the ICAR held in 1998 it was decided that the change of the name of the NRC for Orchids can be considered at a later stage and mandate of the NRC may cover other temperate flower crops like *Iris*, *Lilium*, *Gladiolus* etc.

#### 5. Crop Improvement

5.1 Research programmes on germplasm collection, characterization and evaluation; genetic studies, breeding and biotechnology will be included under crop improvement, giving focus on *Cymbidium* orchids. Other orchids, which have commercial value, are also to be taken into consideration.

5.2 Breeding programme should be initially confined on *Cymbidium* to achieve hybrids. The parental lines for breeding should be obtained from domestic as well as international sources including private sources.

5.3 For germplasm conservation under protected cultivation the existing polyhouse are to be partially modified/changed to provide the specific requirements of different orchid species groups.

5.4 One Scientist should be trained thoroughly in orchid taxonomy, initially at a leading national institute and subsequently at Royal Botanical Gardens, Kew, England.

#### 6. Crop Production

6.1 In the Crop production, the NRC should





concentrate on development of protected cultivation technology of orchids and other selected flowering plants (e.g. *Lilium*, *Gladiolus* etc.).

6.2 Experiments should be set for standardization water, light, relative humidity and temperature requirement of *Cymbidium* and other selected orchids.

6.3 Efficient low cost protective cultivation structures suited to *Cymbidium* for growing under Sikkim conditions.

6.4 The NRC should also attempt to develop a model orchid based floriculture unit covering *Cymbidium*, short gestation orchids and other flowers of commercial importance for year round flow of income.

## 7. Plant Protection

7.1 Virus diseases are posing serious threat to *Cymbidium* orchids. Special attention is to be given to cleaning the genetic stock / commercial hybrids for which technology has to be perfected at the NRC. For mass multiplication of elite varieties/hybrids, virus cleaning through tissue culture technique is essential.

7.2 The existing virologist/ plant pathologist should be attached to the micro propagation activities.

7.3 In case of insect pests, shoot borer, yellow mites and scale insect should receive more attention. In case of diseases, black rot, anthracnose and *Cymbidium* mosaic virus are important. To reduce the damage due to pests and diseases, sanitation and prophylactic measures should be preferred.

7.4 Attempts should be made to develop bio-control technology (in consultation with the PHYTONET programme, IISR, Calicut) for the control of *Phytophthora* black rot.

## 8. Post harvest management

8.1 NRC should take survey on pre- and post harvest storage, packaging and marketing of orchids in domestic market. Consumer preference and the problem faced by growers are to be determined through PRA exercises. Low cost storage of cut flowers, pre-cooling of different kinds of flower and packaging for long distance transport need investigation.

8.2 Social scientist (Economist) may be posted and the scientist (Horticulture) presently posted at Darjeeling Centre may be involved in investigations on post harvest management and marketing.

□





## Participation of Scientists in Conferences, Meetings, Workshops, Symposia etc in India and abroad

Name of Scientist	Period	Particulars	Venue
D. Barman	April 5–6, 2003	Workshop on Protected cultivation of vegetables and flowers in plains and hills (NATP).	IIHR, Bangalore
R.C. Upadhyaya, V. Nagaraju, S. Chakrabarti, T. K. Bag and Ram Pal	May 14–15, 2003	Seminar cum Workshop on Entrepreneurship development for the promotion of floriculture including Orchids in Meghalaya	ICAR Res. Complex, Barapani
V. Nagaraju	Aug 1, 2003	Brainstorming session on improvement of orchids through biotechnological approaches	DBT, New Delhi
R. C. Upadhyaya	Oct 27 - Nov 4, 2003	Training on Management	NAARM, Hyderabad
S. K. Naik	Oct 28, 2003- Feb 28, 2004	77th FOCARS	NAARM, Hyderabad
V. S. Nagrare	Nov 5–7, 2003	National Symposium on Frontier areas of entomological research	New Delhi
T. K. Bag	Nov, 8–28	Winter school on Detection of Plant viruses by PCR and Nucleic Acid Probes	TNAU, Coimbatore
V. Nagaraju and S. P. Das	Nov 12–14, 2003	National Symposium on Recent advances in Indian floriculture	KAU, Trichur
S. Chakrabarti	Nov 17–29 2003	Technologies in gene cloning, sequencing and plant transformation	IIHR, Bangalore
V. Nagaraju	Dec 8–12, 2003	Short course on Data analysis using SPSS	CPCRI, Kasaragod
S. P. Das	Dec 19–28, 2003	Training on Molecular marker assisted breeding in orchids under the biennium agreement between ICAR and RAAS	Academy of Agricultural Science, Moscow, Russia
V. Nagaraju	Feb 14–16, 2004	International conference on Organic food	ICAR Res Complex Barapani, NASC, New Delhi
S. Chakrabarti	Mar 9–10, 2004	National conference on Development of transgenic in agriculture	NASC, New Delhi
V. Nagaraju	Mar 17–18, 2004	5th National Workshop of NATP project on Sustainable management of plant biodiversity	NBPGR, New Delhi.





## Distinguished Visitors

# 12

Shri Hukmdev Narayan Yadav, Union Agriculture Minister for State	21.06.2003	Dr. S.P. Ghosh, Ex-DDG (Hort), ICAR	21.02.2004
His Excellency, Shri V. Rama Rao, Governor of Sikkim	05.07.2003	Dr. P.K. Rajeevan, Head, Div. of Pomology & Floriculture, KAU, Trissur, Kerala	21.02.2004
Dr. G. L. Kaul, Vice- Chancellor, AAU, Jorhat	24.09.2003	Dr. S. Chaudhuri, Ex- Director Research and Prof. of Plant Pathology, BCKV, Mohanpur	21.02.2004
Dr. Manmohan Attawar, CMD, Indo American Hybrid Seeds, Bangalore	24.09.2003	Mr. Udai C. Pradhan, Chair ISROSG/IUCN /SSC, Kalimpong	16.03.2004
Dr. P. K. Hajra, Ex- Director, BSI, Dehradun	24.09.2003	Dr. R. P. Tewari, Director, NRC for Mushroom, Solan, Himachal Pradesh	24.03.2004
Dr. S. N. Hegde, Director, SFRI, Itanagar	24.09.2003		
Dr. B. N. Chaudhary, Ex- ADG, ICAR	24.09.2003		



Shri. Hukmdev Narayan Yadav, Union Minister of Agriculture for State



His Excellency, Shri V. Rama Rao, Governor of Sikkim (Fourth from right)





## Personnel (As on March 31, 2004)

# 13

### I. Scientific

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

### II. Administration

- |                          |   |
|--------------------------|---|
| 1. Shri. Sunil Kumar Das | Assistant Finance and<br>Accounts Officer |
| 2. Miss Lakit Lepcha     | Assistant                                 |
| 3. Shri Rajat Kumar Das  | Sr. Clerk                                 |
| 4. Mrs. Diki Bhutia      | Jr. Clerk                                 |
| 5. Mrs. Dilmaya Subba    | Jr. Clerk                                 |

### III. Technical

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

### IV. Supporting

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

### Promotion

1. Shri Sunil Kumar, promoted to Sr. Tech. Asst. (T-4)
2. Shri G.B. Mukhiya, promoted to Farm Tech. (T-2)
3. Shri R.C. Gurung, promoted to Technical Asst.,  
Driver (T-2)
4. Shri Phigu Tshering Bhutia, promoted to SSG - II
5. Ms. Meena Kumari Chettri, promoted to SSG - II

### Retirement

1. Shri P. B. Subba, T4 retired on 29.02.2004.

### Resignation

1. Shri Dikendra Bhujel, Field Technician (T-1)  
resigned on 29.05.03.





## Any other relevant information

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# 14

### Library

Under the NATP project “Strengthening of Library Information System” CD-ROM data base/online database was purchased. Foreign journals viz. Orchids, The Orchid Review, The Australian Orchid Review, Orchid Digest, CSA Journal, Hort Science, Journal of Genetics and Breeding, Journal of Economic Entomology, Phytopathology, Horticulture Abstracts, Journal of The American Society of Horticulture, Plant Cell, Tissue and Organ Culture, Plant Disease and Nature were subscribed for enrichment of library facilities. Hort CD subscribed for the period 2003–04. Library information systems was kept upto date by continuing the subscription of several National journals of Crop Improvement, Crop Production and Crop Protection of Horticultural importance viz. India Journal of Agricultural Sciences, Indian Journal of Horticulture, Indian Journal of Ornamental horticulture and landscaping, Indian Journal of Plant Physiology, Indian Journal of Genetics and Plant Breeding, Indian Phytopathology, Indian Horticulture, Indian Farming, Current Science were subscribed for enrichment of library facilities. Books on orchids viz. Miniature orchids, CITES I and II, Rare Orchids and Orchids: The complete growers Guide were procured from American Orchid Society as reference books.

### Seminar cum Workshop

“Entrepreneurship development for floriculture in Meghalaya” was organized during 14 – 15th May

2003 in collaboration with the ICAR Research complex for NEH Region, Barapani, Meghalaya. The participants were mainly from all the states of North Eastern region. Flower show was also arranged on the occasion and diversity of orchids was displayed to create awareness among the people.

### Exhibition

During International conference on Organic food, the diversity of orchids was displayed in the exhibition at ICAR Research complex for NEH Region, Barapani from 14–16th February 2004.

### NSS Camp

The National Service Scheme camp of 200 students of St. Xavier’s School, Pakyong, Sikkim held for four days during September 14–17, 2003. During camp students were made acquainted with the cultivation of flowers. They paid labor and learnt skill on flower cultivation.



A group of students of NSS Camp





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