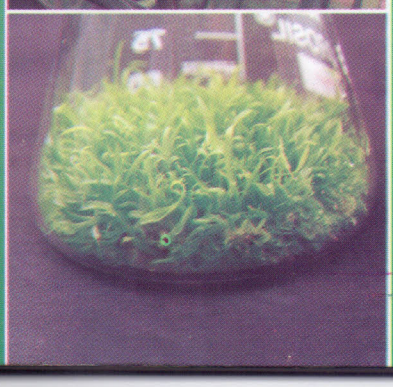

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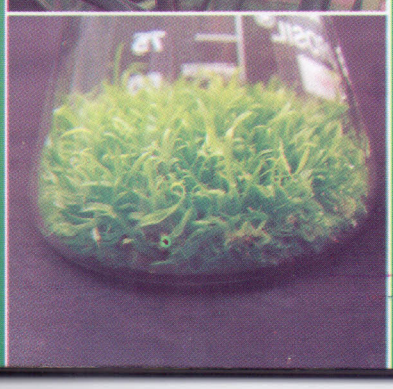

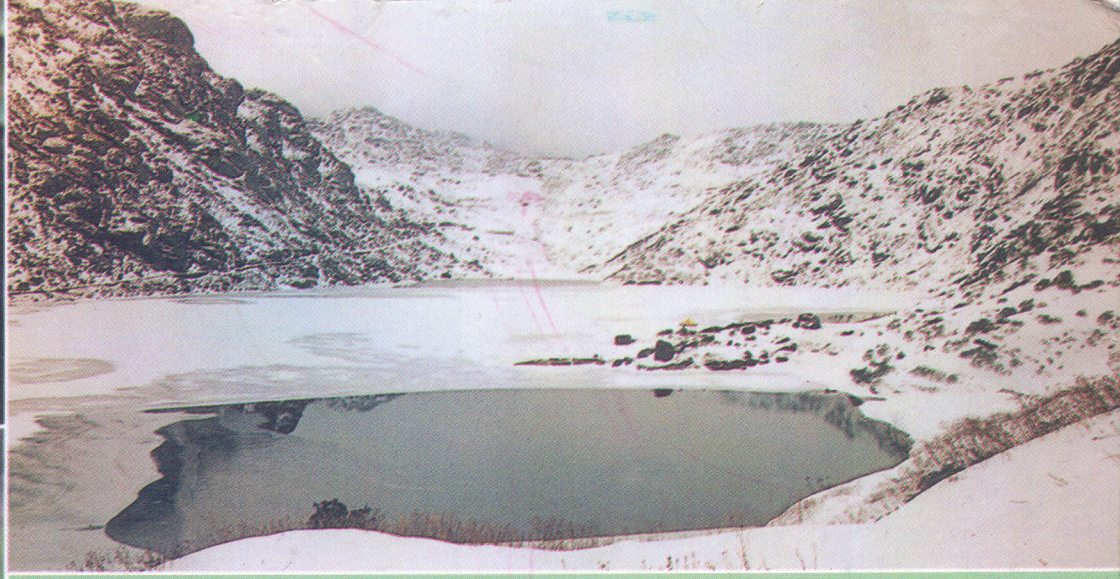

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वार्षिक प्रतिवेदन

ANNUAL REPORT
2000 - 2001

राष्ट्रीय आर्किडस अनुसंधान केन्द्र
भारतीय कृषि अनुसंधान परिषद,पांक्योंग
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Preface

Floriculture is reaping momentum on the domestic as well as world scenario. The production of flowers are now becoming an important viable agro business option. Today, floriculture has emerged as a lucrative business with a much higher potential for returns compared to field and other horticultural crops. With changing in life-styles and increased urban affluence, floriculture has assumed definite commercial status.

India stands on many frontiers like availability of natural resources, technology know-how, human resource, cheap laborers, diverse agro climatic conditions which permit production of most flowers in comparatively low cost almost throughout the year in one part or other parts of the country, even though her share in the world floriculture is less than half percent. The recent developments in the Indian floriculture have shown signs of playing role in the world floriculture market. The liberalized economic policies of the government and the developmental initiative have encouraged entrepreneurs to some extent. Considering the potential and possibilities for exploitation, Government of India has identified this sector as extreme focus area for generating income and employment opportunities, promoting greater involvement of women and enhancement of export. National Research Centre for Orchids was set up to strengthen the research on orchids and bulbous flowers.

Cultivation of orchids and bulbous flowers is highly specialized technique and in order to learn this art one should have basic background of the plant process going on within and outside the plant in the environment. It needs through knowledge of both the theoretical and practical aspects of flower production. These flowers are highly sensitive to climatic conditions and soil and respond well to the supplementation of manures, fertilizers, growth regulators, hormones etc. Slight variation in the application of their doses and time may wreak the quality of produce. Right from nursery to post harvest handling of flowers various steps are needed to achieve quality flowers. Their improvement, production, protection, management and later care during post harvest handling need to be addressed scientifically. Different methods of propagation techniques of seeds and their care in the field and in greenhouses are another aspects to be taken into mind. Since India is now a signatory member of WTO, it require its produce and products to be competitive both in domestic and export market. This called for use of improved varieties/hybrids, recommended agro techniques and plant protection measures, hi-tech interventions and scientific post harvest management.

I am hopeful that this centre will fulfill its mandate and achieve its goal with the dedicated team of scientist's and other staff in spite of mounted difficulties. I am happy to see the overall development of this upcoming centre in retrospect. It will be a failure on my part if I am not placing due credit to the scientists and editorial board for their taking pain to present this annual report in presentable form.

I hope the Centre will bloom with orchids and bulbous ornamentals in years to come.

(R. C. Upadhyaya)
Director

CONTENTS

EXECUTIVE SUMMARY

The long lasting beautiful flowers of orcids with vaied colours, shapes and sizes are greatest admiration throughout the world and contributed significantly of international trade in cut flowers and pot plants in earning foreign exchange. Though India possesses unpaalleled natural wealth and export potential of orchids, yet the India's share in the international trade is almost negligible because of lack of research support. Other bulbous flowers like gladiolus, lilies, freesia etc. and anthurium have also great demand in national and international market. The centre is in process of synthesizing, standardizing various technologies in orcids and bulbous flowers. The progress made during the period is as follows:

About 260 species and over 2,000 live specimens of orchids were collected from different parts of North Eastern Himalayas. Morphological observations of orchid germplasm on about 46 characters are being recorded on regular basis. In addition, 25 varieties of gladiolus, 31 varieties of gerbera and 46 varieties of chrysanthemum from different sources were collected.

Fifteen species of orchids from *Cymbidium, Coelogyne* and *Dendrobium* were characterized using RAPD analysis. A total of 227 distinct major RAPD bands of which 97% were polymorphic were generated from 15 randomly selected primers. Several cross combinations were made. Embryos from green pods of selected crosses were cultured *in vitro* for germination and progeny rising. The progeny of crosses made are in protocorm to plantlet stage.

Observations like crossability, days for column swelling, flower withering, pod swelling, pod maturity or pod abortion (physical) are being taken on te crosses made.

A breeding programme to find out the most suitable breeding methodology in developing superior cultivars in gladiolus is in progress.

Crosses were made in all possible combinations among six different groups of freesia. Harvested seeds weresown to raise the next progeny.

Among 14 growing media tested, media-containing sand as one of the components helps in quick germination but at later stage the mediawith FYM as one of the component showed better growth.

Immature embryos of 22 speies from 11 genera of epiphytic and terrestrial orchid species and hybrids were germinated in *in vitro*. The time taken for swelling among the species varied from 4 days in *Epidendron* hybrid (*E. zanthem* × *E. radicum*) to 115 days in *Renanthera inschootina*.

Protocorms of orchids obtained *in vitro* were cultured in MS and Nitsch media with BAP (0.5 mg/l) and with or without activated charcoal (AC). Supplementation of BAP in the medium resulted in proliferation of protocorms.

Root, leaf and protocorm (PLBs) segments of *Cymbidium* Lunavian Atlas cultured in Murashige & Skoog and Nitsch media supplemented with 1.0 mg/1 BAP and NAA (2.5, 5.0, 7.5 and 10.0 mg/l) gainmaximum culture weight, PLB weight and PLB size in Nitsch, where as more number of PLBs were obtained in MS. Among the various concentrations of NAA tested, maximum culture weight, PLBs weight and PLBs size was obtained at 5.0 mg/l NAA and 1.0 mg/l BAP.

Maximum shoot weight, shoot length, root number, root weight and root diameter were also recorded in Nitsh as basal media. Activated charcoal on various morphological characters indicated significant difference for shoot length and root diameter.

Protocorms from *in vitro* grown culturues of *Cymbidium* hybrid H × B cultured in MS, Nitsh and KC media supplemented with or without AC (3 g/l) and BAP (0.5, 1.0 and 1.5 g/l) showed maximum culture weight PLB size and more number of PLBs were in MS medium. However, shoot number, shoot length and leaf lengthh was maximum in Nitsch.

Plantlets from *in vitro* grown cultures of *Dendrobium nohile* × *D. nobile* var Alba cultured in Murashige and Skoog and Nitsch media supplemented with BAP and Activated charcoal (0 and 3 g.l), maximum root diameter (1.26 mm) was recorded in Nitsch. Presence of AC in the medium resulted in improved culture weight (55.7 mg), plant number, and shoot length and leaf as well as root growth.

In vitrro regenerated plantlets of Cymbidium hybrids Lunavian Atlas, Golden Girl, HXB, FXH, BXH, *Arundina bambusifolia, Bletilla hyacintha, Dendrobium* hybrids and *Epidendrum* spp. in thumb pots filled with white moss, leaf mould, FYM, charcoal, brick pieces, coco pith and wood ash. The plants grown in the ½ MS salts supplemented with paclobutrazol established better with very high rate of survival. Among the hybrdis, the establishment and growth was better in Golden Girl.

Foliar application of N20 : P5 : K5 on *Cymbidium* hybrid var. Cook's Bridge at 0.1% concentration produced maximum length of leaves and girth of pseudobulb.

Application of mustard oil cake produced maximum plant height, length and number of pseudobulb as compared to other treatments.

Application of BA 100 ppm enhanced girth of pseudobulbs and width of leaves over other treatments. Maximum heighht of plants and length of leaves was recorded at GA 200 ppm and number of leaves at IAA 250 ppm.

Spraying of N30 : P10 : K10 at 0.1% concentration increased the lengt of leaves and number of leaves. However the length of pseudobulbs was found more in case of N30 : P30 : K10 at 0.1% concentration. Application of N10 : P20 : K10 at 0.1% concentration produced maximum number of pseudobulb.

Potting mixturre–leaf mold + FYM

+ Carcoal + Tree fern + Coconut husk influenced the overall the gorwth of plants followed by the media leaf mold + FYM + Charcoal + River Sand + Loam soil and media leaf mold + FYM + Charcoal in *Cymbidium* hybrid cv. Japanese 'YY'.

Planting of *Cymbidium* on raised bed (rotten wood pieces and moss 1 : 1) produced maximum plant height, number of leaves, length of leaves, number of pseudobulb, length of spike, diameter of flower and number of flower as compared to planting on the ground.

The whole and excised corms of Gladiolus cv. Jester planted at a spacing of 20 × 25 cm fertigated with N (200 kg/ha), P_2O_5(100 kg/ha) and K_2O (100 kg/ha) through urea, super phosphate and potash did not influence significantly on the corm and cormel production.

Stage of harvesting of spike and application of potassium significantly influenced plant height, number of corm per plant, diameter of corm, number of cormel per plant and weight of corms. Spike harvesting at emergence stage and application of 50 kg nitrogen increased size of corm, number of cormel per plant and weight of corms.

Planting of gladiolus corrmel on different media did not showed significant difference for the corm and cormel development. However, large size of corm and weight of corm were recorded by planting the cormel in leaf mould. Maximum number of cormel per plant was recorded in FYM + leaf mould.

Planting of corms at 20 × 15 cm spacing (33 corms/m^2) without application of potassium produced maximum height of plants, length of leaves, spike length, rachis length and number ofcorms. Ealy flowering was reported at the density of (50 corrms/m^2) and 100 kg K_2O/ha.

Planting of corms at 15 days interval and application of different doses of nitrogen significantly influenced the plant growth, flowering, corm and cormel production. Planting of corm on 15th March and application of 100 N kg/ha produced longest plant, spkke and rachis. However, number of flowrs per spike, individual weight of corms, weight of cormel were recorded at same date of planting but with 200 kg N/ha.

Different grades of corm significantly influenced plant height, length and width of leaves. An increasing trend was followed with increasing size of corm. Jumbo size corm (5–6 cm) produced maximum number of cormel.

Disease samples collected from Darjeeling, Mirik and Sukoo Pokhari of Darjeeling district (W.B.) and Pakyong. It was observed that Black rot of *Catteleya* caused by *Pythium* and *Colletotrichum*, whereas Leaf spot/Anthracnose of *Bulbophyllum* sp. by *Colletotrichum*, Leaf rust of *Phaius maculatus* by *Uredo*, flower spot of *Cymbidium* sp. by *Botrytis*, Black leaf spot of *Ione scariosa* and Stem anthracose of *Zeuxine* sp. by *Colletotrichum*. In winter annuals, Schizanthus wilt/stem rot caused by *Sclerotinia sclerotiorum* and *Crocosmia* wilt by *Fusarium* were also recorded.

Survey results depicted that mites (*Tetranychus utricae*), scales (*Diaspis biosduvali*), slugs (*Deroceras laeve*), mealy bugs (*Pseudococcus maritimus*), cabbage moth (*Hellula undalis*), grasshoppers

(*Hieroglyphus banian*), snail (*Achantina fullica*) and nematodes (*Aphelenchoides ritzemaboci*) were the pests of orchids in Sikkim. The pests associated with orchids in Sikim are not so serious and cause negligible damage. The pests observed by the survey could easily be managed with existing control methods or periodical interventions. In Sikkim, the damage due to pests was very less that might be due to tough physique of orchids accompanied with adverse climatic conditions like severe cold.

Out of more than 10,000 plants of 400 species maintained at centre, scale insects were reported only on 22 plants. *Cymbidium* sp. (16 plants), *Coelogyny barbata* (3 plants) and *Coelogyny barbatum* (3 plants) and the corresponding population was 3.34, 11.03 and 27.5 per sq. inch, respectively.

Thrips *Taeniotrips simplex* damage the spike by rasping tissues and sucking the sap. Affected spike develop silver streaks, turn brown and get deformed in case of severe damage.

Gerbera varieties 28-01, 59-01, 17-01, 50-35, 08-02 and 50-35 were found to be infested with whiteflies (*Trialeodes vaporarium*) and the average population per. sq inch was 34.83, 32.93, 23.27, 6.0 and 3.3 respectively during summer months.

Under NATP Biodiversity project twelve exploration programmes were carried out from parts of Sikkim, Arunachal Pradesh, Manipur, Mizoram, Meghalaya, West Bengal, Orissa and Andaman and NicobarIslands. Around 350 accessions of orchids and 11 Cymbidium hybrids from wild as well as from registered nurseries and hobby growers were collected/procured. Morphological characterization of various orchids for plant and flower characters for 18 characters were undertaken in those species that have flowered.

Available germplasm of indigenous bulbous plants collected and the morphological observations are being taken on the parameters like leaf number, leaf size, spike length, flower size as well as colour, period of flowering, etc. on regular interval.

Information was collected on the present scenario of the orchids cultivation in India. All the major commercial orchids farms, Orchids nurseries and hobby growers from major growing areas were covered under the survey.

At NRC for Orchids, Darjeeling Campus, 43 species of orchids from 21 genera have been collected from forest and added to the previous collection. All the species have been maintained in the orchidarium.

Artificial Habitat or Field Gene Bank created by fastening orchids like *Coelogyne cristata, Coelogyne nitida, Epigenium amplum, Otochilus albus, Otochilus fuscus* and *Vandopsis undulata* etc. on the available trees.

INTRODUCTION

Orchids are contemplated as one of the beautiful flowers in nature. The long lasting beautiful flowers with varied colours, shapes and sizes have created greatest admiration throughout the world and contributed significantly to international trade in cut flowers and pot plants in earning foreign exchange. Orchids provide cut blooms, which remain fresh for long and add to the variety of flower arrangements. Though there is often preference of hybrids in commercial trade yet in beauty and other blossom characters native species stand as competitors with best hybrids. India is considered as major habitat of orchids rich genetic diversity.However, this natural orchid wealth is yet to be utilized and manage properly in our country in spite of abundant natural genetic stock and varied climate suitable for its cultivation. There is a danger that unless proper conservation measures are taken, India will sure to loose most of the valuable orchid wealth that are of horticultural, medicinal and aesthetic values due to various developmental activities and exploitation.

Though India possesses unparalleled natural wealth and export potential of orchids, yet the share of India in the international trade is almost negligible because of lack of research support. In absence of comprehensive and systematic research support the abundant natural wealth of orchid is lying unexploited. In international trade mostly hybrids of orchids are accepted and at present India is lacking of export quality hybrid. Therefore, need arises to develop technologies for improvement of orchids, mass multiplication, production and protection and post harvest management. There is an urgent call for the implementation of mission oriented research progra-mmes to develop technology for making orchid production a viable commercial venture both for domestic as well as international trade.

Other bulbous flowers like gladiolus, lilies, freesia etc. also have great demand in national and international market. Similar research strategies are also needed for the production of quality flowers of these plants. Keeping in view the export potential of both orchids and bulbous flowering plants and limited research support available, National Research Centre for Orchids at Pakyong, Sikkim and sub-centre at Darjeeling will strengthen the research on orchids as well as bulbous flowers to cater the need of the hour.

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 bulbous flowering plants.
- To act as a national repository for scientific on mandate flower crops.
- To coordinate research with other scientific organizations and act as centre for training.

INFRASTRUCTURE DEVELOPMENT

The Centre is pushing hard to create the essential facilities to attain the mandate.

Laboratories

Tissue culture laboratory with minimum facilities started func-tioning. Other laboratories are also in process of establishment after renovating the old buildings.

Computer Cell

The computer cell of the Centre is equipped with Internet facility.

Library

Considering its limitation in terms of space a small library with about 250 books have been developed. However, the Centre did not receive any journal till March end.

Farm development

Terrace development

Total 8 terraces were developed combining small, irregular and unusually sloped terraces. Each of six terraces developed has the dimension of 80-85m (Length) × 4-6 m (breadth) × 2-3 m (height) and each of two terraces measured as 65-70 m (Length) × 7-9 m (breadth) × 3-4 m (height). In each developed terrace dry stonewall of average height of 2-3 m had erected to hold the soils. In combining 2–3 small terraces of irregular size, the soil cutting had been done along with filling the gap. About 100 to 110 boulders of average size of 6 × 7 × 8 cu. ft. had been broken into standard size for fitting into the wall of terrace developed. The approximate area of the developed terraces is 3.0 acres.

Rock Garden development

Selected two spots located above the director's office building and other above farm office -cum laboratory comprising 1.5 acres each covered with large boulders and slopes for rock gardens. These areas have been partially developed beautifying the boulders and slopes with perennial herbs/shrubs and ornamental flowers and climbers. Annual flower planting beds were also dug out with stones edging connected by approach stone footpath giving apparent aesthetic look. Further efforts will be made to beautify these two gardens to attract visitors.

RESEARCH ACTIVITIES

GENETICS

Project: Cytogenetical research on orchids

Syamali Chakrabarti

Characterization of orchids at morphological, biochemical, chromosomal and molecular level.

Fifteen species of orchids from 3 genera were used in RAPD analysis

1. *Cymbidium eburneum*
2. *Cymbidium grandiflorum*
3. *Cymbidium lowianum*
4. *Cymbidium munronianum*
5. *Cymbidium tracyanum*
6. *Cymbidium whiteae*
7. *Cymbidium pendulum*
8. *Cymbidium tigrinum*
9. *Cymbidium alofolium*
10. *Cymbidium goganteum*
11. *Coelogyne nitida*
12. *Coelogyne orchracea*
13. *Coelogyne cristata*
14. *Coelogyne flaccida*
15. *Dendrobium densiflorum*

DNA was extracted from fresh leaf tissue by the modified CTAB method. The polymerase chain reactions were carried out in a total volume of 20 µl consisting of plasmid DNA, sterile water, Taq buffer, dNTP and primer. The reaction cocktail was placed in the thermal cycler, which was programmed as Denaturation of DNA, Annealing of primer and Extension of primer. The DNA fragments produced were visualized in a 1.8% agarose gel. Replication of the RAPD reaction for every combination of template DNA and primer was carried out to ensure reproducibility. Only reproducible RAPD markers were included in the analysis. RAPD bands were discerned from the agarose gel and recorded as present and assembled in data matrix. The dendrogram following the NTSYS-UPGMA algorithm was generated with the Jaccard coefficient based on the markers generated. A total of 227 distinct major RAPD bands of which 97% were polymorphic were generated from 15 randomly selected primers.

PLANT BREEDING

Project: Breeding superior hybrids in *Cymbidium* and important orchids

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

Several cross combinations were made. Embryos from green pods of selected crosses were cultured *in vitro* for germination and progeny rising.

Status of crossed materials of Cymbidium and other Orchids species

S.P. Das and V. Nagaraju

Studies on breeding behavior of Orchids

Observations are being recorded on the different post fertilization phenomenon in orchids. Observations like crossability, days for column swelling, flower withering, pod swelling, pod

Cross Combination	Status
1 *C. lowianum* × C. Showgirl	Plantlet stage, Ready for hardening/ Shifted for hardening
2 C. Showgirl × *C. lowianum*	Plantlet stage, Ready for hardening
3 C. Bertha Pattershot × C. Showgirl	Plantlet stage, Globular stage
4 C. Showgirl (Selfed)	Plantlet stage, Protocorm & shoot stage
5 C. Pal Barkis × *C. lowianum* Reich 6.f.	Protocorms stage
C. Rivolux × C. Coral Sea	Protocorm stage
6 *Dendrobium nobile* Lindl. × *D. nobile* var. Varginalis	Plantlet stage
7 *Renanthera imschootiana* Rolfe. × *Vanda coerulea* Griff. Ex. Lindl.	2-3 leaf stage,
8 *Dendrobium nobile* Lindl. × *D. aureum* Lindl	Plantlet stage
9 *Vanda coerulescens* Griff. (Selfed)	2 leaf stage
10 *Cymbidium gammieanum* King & Pantl. (Selfed)	Embryo stage
11 *C. ensifolium* (L.)SW. × *C. Golden df.*	Embryo stage
12 *Epidendrum zanthum* × *E. radicams*	2 leaf stage, Protocorm stage
13 *D. chrysotosum* Lindl. (Selfed)	Plantlet stage
14 *Zygopetallum intermedium* Lindl. (selfed)	Embryo stage

maturity or pod abortion (physical) are being taken on the crosses made.

Studies on Pollen viability of orchids in storage

A study was initiated to study the viability of pollen in storage. Pollen from different selected orchid species stored at room temperature, at –40°C and at –50°C. Study is at preliminary stage.

Breeding in Gladiolus

A breeding programme with the objective to find out the most suitable breeding methodology in breeding superior cultivars in gladiolus is initiated. So far crosses were made in half diallel and line x tester fashion. Crossed seeds were sown to raise the cormels of the crosses. First generation cormels were sown to raise the second-generation cormels. The programme besides finding out the best methodology will also lead to development of superior cultivars and breeding lines.

Hybridization in Freesia

Considering the scope and potential of Freesia as cut flower owing to its highly scented flowers, a breeding programme has been initiated. Depending on the colour and the length of spikes, collected materials were grouped into six different groups. Crosses were made in all possible combinations among these groups. Crossed seeds are harvested. Seeds were sown to raise the progeny. Some lines from the seed grown progeny were selected and will be forwarded to the next generation.

Standardization of growing media for shoot initiation and growth from *Cymbidium* pseudobulbs

S. P Das

An experiment was conducted to standardize the growing media for shoot initiation and better growth from *Cymbidium* pseudobulbs. In total 14 growing medias were used. Results suggested significant differences among the media. The results indicated that media containing sand as one of the components helps in quick germination but at latter stage the media with FYM as one of the component showed better growth.

Collection, conservation, evaluation and characterization of Orchids and other germplasm

S. P. Das

About 260 species and over 2000 live specimens were collected from different parts of North Eastern Himalayas. Morphological observa-tions of orchid germplasm on about 46 characters are being recorded on regular basis. Spatial characteriza-tions of flowering habit of the orchid species are also being carried out. These sorts of observation are not available on orchids and will help in the better understanding of the flowering behavior of the orchid species. Also collected 25 varieties of gladiolus, 31 varieties of gerbera and 46 varieties of chrysanthemum from different sources.

BIOTECHNOLOGY

Project: Biotechnological intervention in Orchids and bulbous flowering plants

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

In vitro germination of embryos of orchid species and hybrids

V. Nagaraju and S.P. Das

Immature embryos of 22 species from 11 genera of epiphytic and terrestrial orchid species and hybrids were germinated in *in vitro*. The time taken for swelling among the species varied from 4 days in *Epidendron* hybrid (*E. zanthem* × *E. radicam*) to 115 days in *Renanthera imschootina*. Similarly, for globule formation it varied from 6 to 120 days. Germination was sporadic in most of the species. However, in *Epidendrum* and *Dendrobium* uniform germination was observed. Seeds of *C. tigrinum* and Herberaria sp., which still exhibited white embryos, were not germinated.

Variations were also recorded among the species for the develop-ment of protocorm. *Epidendrum* hybrid has taken 11 days as compared to 130 days in *R. imschootiana*. The time taken for swelling (35-92 days) and PLBs development (75-128 days) in *Cymbidium* hybrids were different when the explants of various developmental stages were used. Protocorm morphology and subse-quent development of PLBs was quite similar for all the species.

Protocorms of orchids obtained *in vitro* were cultured in MS and Nitsch media with BAP (0.5 mg/1) and with or without activated charcoal (AC). Supplementation of BAP in the medium resulted in proliferation of protocorms. Prolo-nged culture of PLBs in the same medium resulted in different-iation into plantlets. Addition of AC in the medium resulted in better differentia-tion of PLBs into plantlets. AC also stimulated shoot growth and produced healthy plantlets.

Morphogenetic response of root, leaf and protocorm explants of *Cymbidium* Lunavian Atlas to Media and plant growth substances

V. Nagaraju

Studies were carried out to induce PLBs and plantlets using various floral, leaf, shoot and root meristem of field as well as *in vitro* grown plantlets of *Cymbidium* hybrids. The preliminary investi-gations indicated that the steriliza-tion duration for ex- plants varied from 3 minutes to 15 minutes. Sterilization agents both mercuric chloride and sodium hypo-chloride showed similar response.

The response of root, leaf and PLB explants to media and growth substances varied from 10-100%. Among the various explants the response of PLBs sections was higher (66.7% to 100%) as compared to leaf sections (33.3% to 66.7%). With regard to differentiation of protocorms into plantlets, 16.7 to 91.7% of the explants differentiated in MS medium supp-lemented with various growth substance as compared to 29.2-87.5% in Nitsch.

Root, Leaf and protocorm (PLB) segments of *Cymbidium* Lunavian Atlas cultured in Murashige & Skoog and Nitsch media supplemented with 1.0 mg/l BAP and NAA (2.5, 5.0, 7.5 and 10.0 mg/l). Maximum culture weight, PLB weight and PLB size was recorded in Nitsch where as more number of PLBs were obtained in MS. However, it was statistically at par. Among the various concentra-tions of NAA tested, maximum culture weight,

PLBs weight and PLBs size was obtained at 5.0 mg/1 NAA and 1.0 mg/1 BAP.

Among the explants, maximum culture weight as well as PLBs weight was recorded from PLB explants, while, least culture weight was recorded from leaf explants. The interaction between media and NAA indicated that supplementation of NAA along with 1.0 mg/1 BAP gave better growth in both the media but maximum culture weight and bigger sized PLBs were obtained from Nitsch media.

Morphogenetic response of PLBs of Lunavian Atlas to basal media and Activated charcoal

V. Nagaraju

The effect of basal media and activated charcoal on morphogenetic response of PLB indicated significant. The total culture weight among the media varied from 173.2 mg in Knudson's C to 128.6 mg in Nitsch. Maximum shoot weight, shoot length, root number, root weight and root diameter were also recorded in Nitsch. Though greater number of leaves was recorded in MS, however, it was on par with Nitsch and KC. With regard to root characters, there was no variation among the media for root number, root length and root diameter among the media. The influence of activated charcoal on various morphological characters indicated significant for shoot length and root diameter. Presence of 3 g/1 AC improved, the culture weight, root length and root weight, however statically, it was non significant.

Effect of media, BAP and AC on PLBs of *Cymbidium* hybrid

V. Nagaraju and S.P. Das

Protocorms from *in vitro* grown cultures of *Cymbidium* hybrid H X B cultured in MS, Nitsch and KC media supplemented with or without AC (3 g/1) and BAP (0.5, 1.0 and 1.5 g/1). The results indicated significant variations among the media for most of the morphological characters except for PLBs size and root character. Among the media maximum culture weight (57.7 mg), PLB size (1.9 mm) and more number of PLBs (6.5) were obtained in MS medium. However, shoot number, shoot length and leaf length was maximum in Nitsch. The performance in respect of all other morphological characters was poor in KC media. The addition of activated charcoal indicated significant improvement with regard to PLB number and PLBs weight.

Protocorms (1-2 mm) of *Cymbidium* hybrid (Show Girl X *C. lowianum*) was cultured in MS, Nitsch and KC media supplemented with or without 3 g/l AC for further differentiation and growth of the plantlets. Significant variations for various morphological characters except for protocorm size, root length and root weight were recorded. Among the media, MS medium found to be superior with regard to culture weight (57.712 mg), protocorm number and shoot as well as root growth.

The response of PLBs to KC medium was inferior with regard to total culture weight, protocorm weight and shoot length. Besides the root, leaf development was also completely inhibited.

Effect of media, BAP and activated charcoal on *Dendrobium* hybrid

V. Nagaraju and S.P. Das

Plantlets from *in vitro* grown cultures of *Dendrobium nobile* X *D. nobile* var. Alba cultured in Murashige and Skoog and Nitsch media supplemented with BAP (0, 0.5, 1.0 and 2.0 mg/1) and Activated charcoal (0 and 3 g/1). The data pertaining to morphological characters in different media indicated significant difference. Higher culture weight and more number of plantlets obtained in MS.

Significant difference was not observed among the media for culture weight and number of plantlets. Maximum root diameter (1.26 mm) was recorded in Nitsch. Presence of AC in the medium resulted in improved culture weight (55.7 mg), plant number, shoot length and leaf as well as root growth. Supplementation of BAP to the media improved the growth and multiplication. While at higher concentrations, the culture weight and shoot size was reduced. Further, discoloration of medium was also observed in the presence of BAP, might be due to leaching of phenols from the explants. However, supplementation of AC to the medium completely overcome the discoloration of media and further improved the leaf as well as shoot growth.

One cm long plantlets of *D. nobile* X *D. nobile* var. Alba from *in vitro* grown culture was again cultured in MS and Nitsch supplemented with triaquontinol (0.2, 2 and 3 mg/1). The results indicated significant variations among the media for culture weight shoot length as well as leaf size. The response with regard to various morphological characters was better in MS while maximum root length was recorded in Nitsch, however it was non significant. The interaction between media and triaqontinol indicated significant for culture weight, plantlet number and leaf as well as root length. Addition of triaqontinol to Nitsch medium increased the culture weight, plant weight, leaf length and root length as compared to control.

Acclimatization of *in vitro* regenerated orchids

V. Nagaraju

Studies were carried out using the *in vitro* regenerated plantlets of *Cymbidium* hybrids Lunavian Atlas, Golden Girl, HXB, FXH, BXH, *Arundina bamboosifolia, Bletilla hyacintha, Dendrobium* hybrids and *Epidendrum* spp. in thumb pots filled with white moss, leaf mould, FYM, charcoal, brick pieces, coco pith and wood ash. Prior to

transfer to pots, the plants grown in the ½ MS salts supplemented with paclobutrazol established better with very high rate of survival. Among the hybrids, the establishment and growth was better in Golden Girl. Establishment was very poor when the plantlets were planted in the potting mixture containing wood ash and FYM. Further studies are in progress.

HORTICULTURE

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

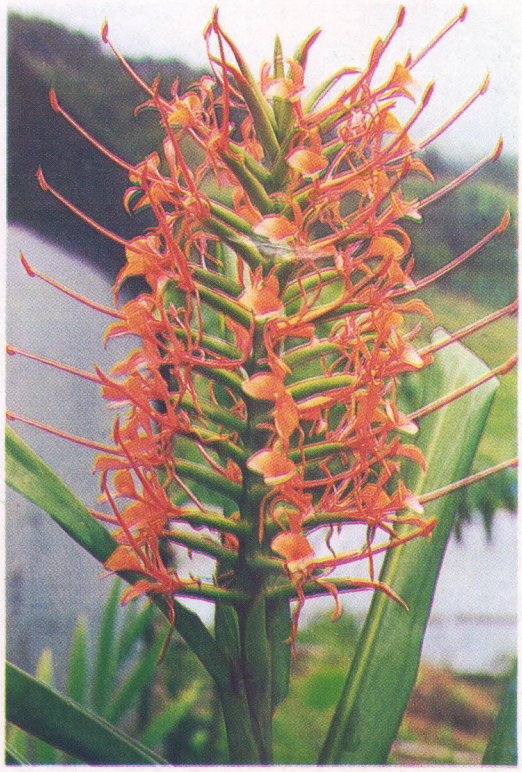
D. Barman, R. C. Upadhyaya and Rampal.

Effect of nutrient spray on growth and pre-blooming period of *Cymbidium* hybrid

An experiment was planned to study the influence of foliar application of N P K on pre blooming period of *Cymbidium* hybrid var. Cooks Bridge. The different nutrient combinations are being sprayed at fortnightly intervals and observations are being recorded accordingly. The results revealed that spraying of N20:P5:K5 at 0.1% concentration produced maximum length of leaves (51.7 cm), number of leaves (7.62) and girth of pseu-dobulb (2.33 cm) as compared to other treatments. However, maximum number of pseu-dobulbs (3.75) were recorded at N15:P5:K5 (0.2%).

Effect of organic manure on growth and flower quality of *Cymbidium* hybrid

Nutrients are being supplied fortnightly to the plant through Poultry manure, Goat



manure, Mustard oil cake, Fishmeal and Neem cake to see the effect on growth, flower production and quality of flower of *Cymbidium* hybrid. Observations are being recorded regularly. Application of mustard oil cake produced maximum plant height (67.38 Cm) length (3.80 Cm) and number of pseudobulb as compared to other treatments

Ad-hoc Project

Effect of growth regulators on pre blooming period and growth of *Cymbidium* hybrid

D. Barman

An experiment was laid out using various concentrations of BA (T1-100, T2-200, T3-300 PPM), GA3 (T4-100, T5-200, T6 -300 PPM) and IAA (T7-250, T8 -500, T9 -750 PPM) to study their effect on growth of *Cymbidium* hybrid. Plant growth regulators were sprayed at monthly intervals. Each treatment was replicated five times in a completely randomized block design. Observations such as plant growth, number of pseudobulbs, length and girth of pseudobulbs; number of leaves and shoot length are being taken regularly. The preliminary results indicated that the application of BA 100 ppm enhanced girth of pseudobulbs (2.78 cm) and width of leaves (1.65cm) over other treatments. Maximum height of plants (68.50cm) and length of leaves (53.31) was recorded at GA 200 ppm and number of leaves (6.67) at IAA 250 ppm.

Effect of N, P, K on growth of *Cymbidium* hybrid

Investigations were undertaken to study the influenced of foliar spray of macro nutrients at various concentrations (N -10, 20, 30, P -10, 20,30, and combination (18) at weekly intervals. Various growth parameters like number and length of shoot etc were recorded at monthly intervals. The preliminary result indicated that spraying of N30: P10: K10 at 0.1% concentration increased the length of leaves (60.35cm) and number of leaves (7.92). However the length of pseudobulb (5.85 cm) was found more in case of N30:P30:K10 at 0.1% concentration as compared to other treatments. The application of N10:P30:K10 at 0.1% concentration produced maximum number of pseudobulb (4.35).

Studies on the growing media on the growth of *Cymbidium* hybrid

An experiment was initiated with a objective to standardized potting media taking Cymbidium hybrid cv. Japanese 'YY'. The experiment consists of 10 treatment combinations replicated five times. The preliminary experimental results revealed that potting mixture - leafmould +FYM +Charcoal +Tree fern +Coconut husk influenced the overall growth of plants followed by the media leafmould + FYM + Charcoal + River Sand + Loam soil and media leafmould + FYM + Charcoal.

Reducing pre blooming period of *Cymbidium* hybrid

The experiment was initiated in 2000 with a view to reduce the pre blooming period of *Cymbidium* hybrid. There are 42 treatment combinations of NPK and growth regulators replicated five times. The nutrients and growth regulators are being sprayed at weekly and fortnightly interval respectively.

Effect of media and planting system of *Cymbidium*

Investigations were carried out to study the planting system and growing media on *Cymbidium* in low cost poly house. The experiment consisted of 11 treatment combinations with two replications each. The results revealed that planting of *Cymbidium* in raised bed (rotten wood pieces and moss 1:1) produced maximum plant height (108 cm), number of leaves (18.5), length of leaves (78.97 cm), number of pseudobulb (10.5), length of spike (98.65 cm), diameter of flower (11.35 cm) and number of flower (17.5) as compared to planting on the ground.

Improvement of flower yield of *Cymbidium* hybrids

An experiment was initiated into 2000 with a view to improve flower yield. There are 42 treatment combinations of NPK and growth regulators and replicated five times .The nutrients and growth regulators are being sprayed at weekly and fortnightly interval respectively .The experiment is under observations.

Project: Quality planting material production of orchids and bulbous flowering plants

R.C. Upadhyaya, D. Barman and Rampal

Effect of Whole & excised corm on corm and cormel production of Gladiolus cv. Jester

The whole and excised corms of Gladiolus cv. Jester planted at a spacing of 20 × 25 cm. The fertilizer dose-N (200kg/ha), P_2O_5 (100 kg/ha) and K_2O (100 kg/ha) was applied through urea, super phosphate and potash, respectively. It was observed that the whole and excised corm did not influence significantly on the corm and cormel production.

Effect of potassium and spike removal on corm production in *Gladiolus* cv. Jester

An experiment was conducted with an objective of producing high quality gladiolus corm and cormel. The corms were planted at a distance of 10X25cm.The experimental plots were fertigated with 1.25 ton/ha FYM, 200 kg N and 100 kg P_2O5.The treatments were spike removal- at emergence stage, opening of two flower bud, opening at five flower buds and complete opening. Potassium doses were- 50kg/ha, 100kg/ha and 150kg/ha. The results revealed that the stage of harvesting of spike and application of potassium significantly influenced plant height, number of corm per plant, diameter of corm, no. of cormel per plant and weight of corms. Spike harvesting at emergence stage and application of 50 kg nitrogen increased size of corm, number of cormel per plant and weight of corms.

Effect of media on cormel to corm production of *Gladiolus* cv. Eight Wonder

An experiment consisted of 6 treatment combinations was replicated thrice in randomized block design. The fertilizer dose- N (200kg/ha), P_2O_5 (100kg/ha) and K_2O (100kg/ha) was applied through urea, phosphate and potash. The cormel (< 1cm) planted at a spacing of 20 × 25 cm. The treatments

were Soil, FYM, Leaf mould, Soil + FYM, FYM + Leaf mould and Soil + FYM + Leaf mould. Planting of gladiolus cormel on different media did not showed significant difference for the corm and cormel development. However, large size of corm (3.7 cm) and weight of corm (16.75gm) were recorded by planting the cormel in leaf mould. Further, maximum no of cormel per plant was recorded in FYM + leaf mould.

Studies on the high-density planting and potassium application on corms and cormel production of *Gladiolus* cv. Jester

An experiment consisted of 12 treatment combinations was replicated thrice in FRBD. The treatment combinations were planting density (D1-50 corms/M 2,, D2-33 corms/m2 and D3-25 corms /m2) and application of potassium (K1-0,K2-100,K3-200&K4-300KG/ha). It was observed that the application of different doses of potassium had little effect on most of the parameters. However, rachis length was significantly influenced by the interaction effect. Planting of corms at 20 × 15 cm spacing (33 corms/m^2) without application of potassium produced maximum height of plants, length of leaves, spike length , rachis length and no. of corms .Early flowering was reported at the density of (50 corms/m^2) and 100 kg K_2O/ha.

Studies on Nitrogen and planting date on corm and cormel production of *gladiolus* cv. Jester

An experiment consist of 10 different planting dates (D1-1st March, D2-15th March, D4-30th April, D6-15th May, D7-30th May, D8-15th June, D9-30th June and D10-15th July) and 2 doses of Nitrogen (N1-100kg, N2-200kg/ha) was conducted. The corms were planted at 20 × 25 cm spacing. Both FYM (25 tonnes/ha P_2O_5 (100kg/ha) and K_2O (100kg/ha) were applied before planting. The data revealed that planting of corms at 15 days interval and application of different doses of nitrogen significantly influenced the plant growth, flowering, corm and cormel production .It was observed that planting of corm on 15th March and application of 100 kg N/ha produced longest plant, spike and rachis. However, number of flowers per spike, individual weight of corms, weight of cormel were recorded at same date of planting but with 200 Kg Nitrogen/ha.

Effect of size of corms on cormel production of Gladiolus cv. Jester

To optimize the size of mother corm for the production of cormel, corms of seven different sizes were planted. The corms were fertigated with 25tonnes FYM, 200 Kg N, 100 kg P_2O_5 and 100 kg K_2O per hectare at spacing of 20 × 25 cm. The data indicated that different grades of corm significantly influenced plant height, length and width of leaves. An increasing trend was followed with increasing size of corm. Jumbo size corm (5-6cm) produced maximum number of cormel.

PLANT PATHOLOGY

Project: Investigations on the fungal diseases of orchids

T. K. Bag

During survey and collection, disease samples were collected from Darjeeling, Mirik and Sukio Pokhari of

Darjeeling District (W.B.) and Pakyong. From the collected disease samples, fungi were isolated, purified and identified upto the genus level with the help of existing laboratory facilities.

These fungal cultures were sent to the Indian Type Culture Collection (ITCC), Division of Plant Pathology, IARI, New Delhi for further identification.

Beside orchids, some fungi causing serious disease to winter annuals were also recorded. Fungi were also isolated and purified. These diseases might be new report. These are:

1. *Schizanthus* wilt / stem rot - *Sclerotinia sclerotiorum*
2. *Crocosmia* wilt - *Fusarium*

Sl. No	Orchid host	Disease	Fungal genus identified
1.	*Cattleya* sp.	Black rot	*Pythium*
2.	*Cattleya* sp.	Black rot	*Pythium* and *Colletotrichum*
3.	*Bulbophyllum* sp.	Leaf spot/ Anthracnose	*Colletotrichum*
4.	*Phaius maculatus*	Leaf rust	*Uredo*
5.	*Cymbidium* sp.	Flower spot	*Botrytis*
6.	*Ione scariosa*	Black leaf spot	*Colletotrichum*
7.	*Zeuxine* sp.	Stem anthracnose	*Colletotrichum*

ENTOMOLOGY

Project: Pest management in orchids and bulbous flowering plants

V. S. Nagrare

A survey on pests associated with orchids and bulbous flowering plants and their management in Sikkim was carried out to understand the real problems faced by the growers and current methodologies used by them to get rid off the pests. The outcomes from the survey are as follow.

Orchids

Survey results depicted that mites (*Tetranychus utricae*), scales (*Diaspis boisduvali*), slugs (*Deroceras laeve*), mealy bugs (*Pseudococcus maritimus*), cabbage moth (*Hellula undalis*), grasshoppers (*Hieroglyphus banian*), snail (*Achatina fullica*) and nematodes (*Aphelenchoides ritzemaboci*) were the pests of orchids in Sikkim. Mites and scales were the serious pest of Cymbidiums according to the growers' perception. Mealy bugs were recorded on *Cattleya* whereas slugs were the serious pest of both *Cattleya* as well as *Phalenopsis*. Mites feeding results in unsightly leaves and their presence were noticed during February to October of the year causing maximum 2.5 % damage. Scales were serious during rainy season attacked on young shoots. Slugs were nocturnal; cut the root tips and leaves

cause losses up to 5 %. While mealy bugs were more prevalent in rainy season, suck the cell sap from leaf sheath. In all, the damage due to pests was not exceeding 5%, which was negligible. Mites could be easily managed with kelthane 2.0- 2.5 % either when they noticed or periodical at 15-20 days interventions. Phosphamidon 0.02 % on monthly interval gave satisfactory control against scales as well as mealy bugs. Orchid growers were not satisfied with calendar-based application of, slugit 2.5- 4% as well as mechanical removal of slugs whenever they are seen. Cymbidiums grown in natural conditions with free ventilation without use of any fertilizer, fungicide, insecticide etc, were quiet healthy and free from any pests damage. The pests associated with orchids in Sikkim are not so serious and cause negligible damage. The pests observed by the survey could easily be managed with existing control methods or periodical interventions. In Sikkim, the damage due to pests was very less that might be due to tough physique of orchids accompanied with adverse climatic conditions like severe cold. The orchid growers could get rid off pest problems with cleanliness and enough ventilation.

Gladiolus

Hairy caterpillar and Semilooper were reported. Semilooper damages the buds during flowering time. No preventive and curative control measures are being carried

Lilies

The nurserymen of this region are least interested in growing lilies.

On Farm Observations

Orchids

Out of more than 10,000 plant of 400 species maintained at N.R. C. for orchids, Scale insects were reported only on 22 plants- *Cymbidium* spp. (16 plants), *Coelogyne barbata* (3 plants) and *Coelogyne barbatum* (3 plants) and the corresponding population was 3.34, 11.03 and 27.5 per sq. inch. Scale insects attached themselves to leaves and suck the sap from the tissue. They are considered as minor pests.

Gladiolus

Thrips *Taeniothrips simplex* were recorded on gladiolus. Yellow coloured nymphs and black coloured adults damage spike by rasping tissue and sucking the sap. Affected spike develop silver streaks, turn brown and get deformed in case of sever damage. The affected flower bud shrives, get discoloured and failed to open.

Gerbera

Gerbera varieties 28-01, 59-01, 17-01, 50-35, 08-02 and 50-35 were found to be infested with whiteflies (*Trialeodes vaporarium*) and the average population per sq. inch was 34.83, 32.93, 23.27 6.0 and 3.3, respectively, during summer months at 26°C. Yellowing of leaves and gradual drying of the plant, dispersal of small whiteflies on shaking of affected branch elucidated the presence of pest. Whiteflies nymphs were yellowish bodies measuring about 1.0 to 1.5 mm. Both nymph and adults suck the cell sap from lower surface of the leaves. The youngones secrets honey like substance, which attracts black fungal growth on affected leaves thus interferes photosynthesis.

AD-HOC PROJECTS

NATP Project on "Sustainable management of Plant Biodiversity"

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

Twelve exploration progra-mmes

were carried out from parts of Sikkim, Arunachal Pradesh, Mani-pur, Mizoram, Meghalaya, West Bengal and Orissa. Even from Andaman and Nicobar Islands also some of the materials were collected. Totally around 350 accessions of orchids and 11 *Cymbidium* hybrids from Wild as well as from registered nurseries and hobby growers were collected/procured. Fifty-three accessions of bulbous flowering plants are also collected from North Eastern Hill region. The material collected was conserved in field gene bank and some of them were conserved in natural forest cover of the centre. Efforts were also made to prepare herbarium. Morphological characterization of various orchids for plant and flower characters for 18 characters was undertaken in those species that have flowered.

Evaluation of Indigenous and exotic bulbous flowering plants of North-Eastern Himalayas

Available germplasm of indigenous bulbous plants is being collected and the morphological observations are being taken on the parameters like leaf number, leaf size, spike length, flower size as well as colour, period of flowering, etc., on regular interval. This sort of observations will be useful in the breeding as well as other improvement programme for the conservation and further economical use.

NATP Project " Survey on existing pre & post harvest handling, storage, packaging, transportation and marketing systems for orchids in domestic and global level"

R.C. Upadhyaya, S.P. Das and Rampal

Information was collected on the present scenario of the orchids cultivation in India. All the major commercial orchid farms, Orchids nurseries and hobby growers from major growing areas were covered under the survey. A status report is being prepared on the basis of the study. It will be utilized to plan further need based research initiations.

NRC ORCHIDS ANNUAL REPORT 2000-2001

DENROBIUM LOGICARNU

CHILOCHISTA LUNIFERA

VANDA-COERULEA(Blue vanda)

BULBO PHYLLU sp.

NRC ORCHIDS ANNUAL REPORT 2000–2001


SAYUNARA BLZING GOLD


PLATINUM BIRD


LAGOON


APRIL BUSH

NATIONAL RESEARCH CENTRE FOR ORCHIDS, DARJEELING CAMPUS

Infrastructure development:

Building: The renovation of building at Darjeeling was being taken up in phased manner. The first phase has already been completed.

Land Boundaries: The work for fencing of land boundaries of Campus was in progress but could not complete fully due to some unavoidable circumstances. Only half work has been finished so far and the rest is likely to be taken up during 10th plan period.

Land terracing: The terraces were small and uneven, hence it was understood that without proper terracing no field crops either in open or in shade/ poly house would be possible to grow. Hence work for broadening of terraces was initiated. However, a few terraces are yet to be developed.

Protected area: Nearly 400 sq.m. protected structure has been erected for protected cultivation of orchids and conservation of germplasm. The aforesaid area includes both perma-nent and temporary type of shade/poly houses.

Laboratory: A laboratory that was likely to set up at the campus with minimum common facilities could not be set up. However, a few instruments namely an incubator, distillation set and hot plate have been purchased.

Library: Meager facilities have been created in the library. A small library with about 30 books has been created.

Research Activities

Collection, Conservation, Characterization and Maintenance of High Altitude orchid germplasm

Collection: Fourty-three species of orchids have been added to the previous collection. All the species have been maintained in the orchidarium. The newly introduced species are as follows:

Acrochaene puncata Lindl.

Agrostophyllum callosum Reichb. F.

Arundina graminifolia (D. Don.) Hochr.

Bulbophyllum leopardinum (Wall) Lindl.

Bulbophyllum cylindraceum Lindl.

Bulbophyllum careyanum (W.J. Hook) spreng.

Calanthe brevicornu Lindl.

Calanthe herbacea Lindl.

Calanthe plantagenea Lindl.

Coelogyne barbata Griff.

Coelogyne corymbosa Lindl.

Coelogyne cristata Lindl.

Coelogyne elata Lindl.

Coelogyne fuscescens Lindl.

Coelogyne ovalis Lindl.

Cymbidium devonianum Paxt.

Cymbidium elegans Lindl.

Cymbidium erythriaeum Lindl.

Cymbidium gammieanum.

Cymbidium hookerianum Reichb. F.

Dendrobium denudens D. Don.

Epigenqium amplum (Lindl) summerh

Eria graminifolia Lindl.

Eria spicata (D. Don.)

Eria stricta Lindl.

Gastrochilus affinis (King & Pantl) Ktze

Goodyera hemsleyana King & Pantl.

Goodyera procera (wall. Ex ker - Gawl.) Hook

Habenaria pectinata D. Don.

Liparis cordifolia F. D. Hook.

Liparis longipes Lindl

Otochilus albus Lindl.

Otochilus sinensis Lindl.

Paphiopedilum insigne (wall ex. Lindl) Stein.

Paphiopedilum spicerianum Reichbf. Pfitz

Paphiopedilum villosum Lindl. Stein.

Phaius tancarvilleae

Pholidota imbricata W. J. Hook.

Pleione humilis (J. E. Sm)D. Don.

Pleione praecox (J. E. Sm) D. Don.

Satyrium nepalense D. Don.

Spiranthes spicalis (L.) Koch.

Vandopsis undulata (Lindl.) J. E. Sm.

Collection, Conservation, Characterization and Maintenance of bulbous ornamentals

No bulbous ornamental crop cultivar has been added this year to the previous collections. However, cultivars from previous collection are being multiplied.

Standardization of bulb production Technology for Lilium

The project could not be started due to non-availability of plant material.

Creation of Artificial Habitat or Field Gene Bank

In nature, the epiphytic orchids grow on trees and obtain their nutrition from leaches produced by decaying tree barks. Darjeeling Centre has large number of trees. To utilize these trees and zero down the cost on maintenance of orchids germplasm, a programme for creation of artificial habitat was started. Orchids like *Coelogyne cristata, Coelogyne nitida, Epigenium amplum, Otochilus albus, Otochilus fuscus* and *Vandopsis undulata* etc. were fastened on the trees and now these have established themselves on host trees and are growing well.

HUMAN RESOURCE DEVELOPMENT

Meetings/Seminars/Symposia Conferences/Workshops

1. Dr. V. Nagaraju, Sr. Scientist attended 2nd National Workshop on "NATP Project on Plant Biodiversity" at NBPGR, New Delhi from March 23-24, 2000.

2. Dr. R. C. Upadhyaya, Director, attended NATP Zonal level Workshop on Plant Genetic Resources at NBPGR Regional Station, Barapani, Shillong on July 15, 2000.

Trainings

1. Dr. Syamali Chakrabarti, Sr. Scientist (Genetics), Deputed for DNA Finger Printing of orchid species at NRC for DNA Finger Printing, NBPGR, New Delhi from June18 to July19, 2000.

2. Dr. V. S. Nagrare, Scientist (Entomology), attended 71st FOCARS from August 25 to Dec 22, 2000 at NAARM, Hyderabad.

PUBLICATIONS

R. C. Upadhyaya and S. P. Das. 2000." Cymbidium-Species and Hybrids available in North Eastern Himalayas". Technical bulletin No. 1. National Research Centre for Orchids, Pakyong 737 106, Sikkim.

MEETINGS

Institute Management Committee

Second IMC of the Centre was held on 4.10.2000, under the chairmanship of Dr. R. C. Upadhyaya. Dr. B.S. Dhankar, ADG (VC), ICAR, and Dr. V. Nagaraju, Dr. Syamali Chakrabarti, Dr. D. Barman, Shri Rampal and Dr. S. P. Das, all Scientists, NRC (O) were present. The issues discussed were: Action taken report on previous IMC; approval for foreign equipments; approval for replacing of equipments from EFC; approval for staff quarters; ongoing research projects; etc.

Research Advisory Committee

Second Research Advisory Committee meeting of the centre was held on 12.11.2000, under the chair-manship of Dr. P. Pushpangadan, Director, NBRI, Lucknow. Prof. S. P. Vij, Head, Botany Dept., Punjab university and Secretary TOSI, Dr. R. C. Upadhyaya, Director, NRC for Orchids, Dr. V. Nagaraju, Dr.Syamali Chakrabarti, Dr. D. Barman, senior scientists, Dr. T. K. Bag, Shri Rampal and Dr. S. P. Das, Scientists, NRC (O), were present. Dr. T. K. Bose, Dr. P. Das, Dr. Irulappan and Dr. D. Mukherjee were unable to attend the same. The RAC suggested to reformulate the research programmes under two broad groups: crop improvement and crop production. Every scientist made presentations on their ongoing/ proposed project(s). The projects were critically reviewed by RAC and suggestions for necessary modifica-tions were given.

Transfer of Technology

On 1st May 2000, a group of 20 progressive farmers lead by Shri. M.C. Acharya of Nagaland Environ-ment Protection & Economic Develop-ment (NEPED), Kohima visited the center. During their visit respective scientists

explained various research activities of the center. The farmers expressed their happiness about the activities of the centre especially about germplasm and tissue culture aspects of the orchids and also germplasm of gerbera.

Eighteen trainees from various parts of the Sikkim visited the centre on 11.9.2000 under the leadership of Shri K. B. Subba , Shri Hemant Basnet, Science and Technology Department, Government of Sikkim under the DBT sponsored training Programme. The trainees who were interested to take up the floriculture programmes felt happy to know about scientific cultivation of flowers, post harvest technology besides multiplication of planting material through tissue culture and conventional propagation.

STAFF NEWS

Appointments

Shri. Sunil Kumar Das, Assistant Finance and Account Officer joined on December 8, 2000

Transfers

Shri. Devis Joseph, Asstt. Administrative Officer (on depu-tation) was relieved from his duties on August 24, 2000 to join ICAR Research Complex for NEH Region, Sikkim Centre, Tadong.

Shri. Abhaya Kumar, Sr. Clerk (on deputation) was relieved from his duties on August 31, 2000 to join back at ICAR Research Complex for NEH Region, Sikkim Centre, Tadong.

Dr. T. K. Bag, Scientist (Plant Pathology) joined on November 6, 2000 consequent upon his transfer from ICAR Research Complex for NEH Region, A.P. Centre, Basar.

Promotions

Shri. S. K. Tamang, SSG IV was promoted to the post of SSG V w.e.f July 2000

Shri. T. B. Singh, SSG II was promoted to the post of SSG III w.e.f July 2000

Shri. Gopal Brahmin, SSG II was promoted to the post of SSG III w.e.f. July 2000

BUDGET EXPENDITURE

Budget and Expenditure statement for the year 2000-2001.

Sl. No	Head of Account	Budget allocation (In lakh)		Expenditure 2000-2001	
		Plan	Non Plan	Plan (Rs.)	Non Plan (Rs.)
1.	Establishment charges	27.50	37.90	67,265	35,65,777
2.	Traveling expense	5.00	0.70	2,93,999	1,03,676
3.	Other charge including equipment	62.50	8.40	34,79,316	4,00,284
4.	Work	205.00	3.00	-	-
	Total	300.00	50.00	38,40,580	40,69,737

PERSONALIA

		Designation
I. Scientific		
1.	Dr. R. C. Upadhyaya	Principal Scientist (Hort.) & Acting Director
2.	Dr. V. Nagaraju	Sr. Scientist (Biotechnology)
3.	Dr. Syamali Chakrabarti	Sr. Scientist (Genetics)
4.	Dr. D. Barman	Scientist (Hort.)
5.	Shri Rampal	Scientist (Hort.)
6.	Dr. T. K Bag	Scientist (Plant Pathalogy)
7.	Dr. S. P. Das	Scientist (Plant Breeding)
8.	Dr. Vishlesh S. Nagrare	Scientist (Entomology)
II. Administrative		
1.	Shri. Sunil Kumar Das	Assistant Finance and Accounts Officer
2.	Miss Lakit Lepcha	Assistant
3.	Shri Rajat Kr. Das	Sr. Clerk
4.	Mrs. Diki Bhutia	Jr. Clerk
5.	Mrs. Dilmaya Subba	Jr. Clerk
III. Technical		
1.	Shri. P. B. Subba	Tech. Asst. (T-II-3)
2.	Miss Pema Choden Bhutia	Tech. Asst. (T-II-3)
3.	Shri Sunil Kumar	Tech. Asst. (T-II-3)
4.	Shri G. B. Mukhiya	Farm Tech. (T-1)
5.	Shri D. Bhujel	Field Man (T-1)
6.	Shri R. C. Gurung	Technical Asst. (T-1)
IV. Supporting		
1.	Shri. S. K. Tamang	SSG - IV
2.	Shri T. B. Singh	SSG - II
3.	Shri Gopal Brahmin	SSG - II
4.	Shri Phigu Tshering Bhutia	SSG - I
5.	Shri Dawa Bhutia	SSG - I
6.	Shri Tularam Dulal	SSG - I
7.	Meena Kumari Chettri	SSG - I
8.	Trilok Singh Balmiki	SSG - I

कार्यकारी सारांश

विभिन्न रंगों और आकारों में पाये जाने वाले टिकाऊ फूल आर्किड ने विश्व भर में अद्‌भुत तारीफ हासिल की है और अन्तर्राष्ट्रीय व्यापार में विदेशी मुद्रा कमाने में भी इसका महत्वपूर्ण योगदान है। आर्किड के लिए भारत में अपार प्राकृतिक संपदा और निर्यात की संभावनाएँ होते हुए भी अन्तर्राष्ट्रीय व्यापार में भारत का योगदान नगण्य है और इसका कारण अनुसंधान की कमी है। अन्य कंदीय पौधे जैसे ग्लैडिओलस, लिली, फ्रीसिअ और एन्थूरियम की भी राष्ट्रीय एवं अन्तर्राष्ट्रीय बाजार में बेहद मांग है। यह केन्द्र आर्किड और कंदीय फूलों की विभिन्न प्रौद्योगिकियों के संश्लेषण एवं मानकीकरणा की प्रक्रिया में है। इस अवधि के दौरान निम्न प्रगति हुई –

उत्तरी-पूर्वी हिमालय के विभिन्न क्षेत्रों से आर्किड की 260 प्रजातियां और 2,000 से अधिक सजीव नमूने एकत्र किये गये। नियमित आधार पर आर्किड जननद्रव्य के 46 अभिलक्षण रिकार्ड किये जाते हैं। इसके अतिरिक्त ग्लैडिओलस की 25 किस्में, जरबेरा की 31 किस्में और क्राइसेन्थमम (गुलमेंहदी) की 46 किस्में विभिन्न स्रोतों से एकत्र की गईं।

आर ए पी डी विश्लेषण के प्रयोग से आर्किड से सिम्बीडियम, कोलेजिन और डेन्ड्रोबियम 15 प्रजातियों का अभिलक्षणन किया गया।

विभिन्न संकर तालमेल बनाए गये। चयनित संकरों की हरी फलियों से भ्रूण लेकर प्रयोगशाला में संवर्द्धन किया गया। इन संकरों से प्राप्त संतति आदि घनकंद से नवाद्‌भिद् की अवस्था में हैं।

निर्मित संकरों में संकरण, कॉलम उभार की अवधि, फूलों का झड़ना, फली उभार, फली परिपक्वन या फली गिरना आदि का अध्ययन किया जा रहा है। ग्लैडिओलस में उत्तम किस्मों के विकास के लिए सर्वाधिक उपयुक्त प्रजनन विधि जानने के लिए एक प्रजनन कार्यक्रम प्रगति पर है।

फ्रीसिआ के 6 विभिन्न समूहों में सभी संभावित तालमेलों में संकरण किया गया। इससे प्राप्त बीजों को अगली संतति प्राप्त करने के लिए बो दिया गया है।

परीक्षित 14 पौधे उगाने योग्य माध्यमों में से, जल्दी अंकुरण पाने के लिए बालू और बाद की अवस्था में अच्छे विकास के लिए घूरे की खाद अच्छी पायी गयी।

आर्किड प्रजाति एपिफाइटिक और टैरेस्ट्रियल की 22 प्रजातियों की 11 पीढ़ियों के अपरिपक्व भ्रूणों और संकरणों का प्रयोगशला में अंकुरण किया गया। प्रजातियों में उभार अवधि एपिडेन्ड्रान संकर (*ई. जेन्थम* × *ई. रेडिकम*) में 4 दिन से लेकर ऐन्थेरा इमस्कूटिना में 115 दिन तक रही।

प्रयोगशाला से प्राप्त आर्किड का प्रोटोक्रोम (आदि घनकंद) को बी ए पी (05 मि.ग्रा./लि.) और सक्रिय चारकोल सहित या रहित एम एस माध्यम में संवर्द्धन किया गया। माध्यम में बी ए पी के पूरक से प्रोटोक्रोम की वृद्धि तेजी से हुई।

सीम्बीडियम लूनेविअन एटलस जिसे मुराशीज और स्कूग एवं नीत्श माध्यम (1.0

मिग्रा./ली वी ए पी और एन ए ए 2.5, 5.0, 7.5 और 10.0 मिग्रा./ली.) में उगाने से जड़, पत्ती और प्रोटोक्रोम (पी एल बी) को संवर्धित भार अधिकतम रहा। पी एल बी भार और पी एल बी आकार नीत्श और पी एल वी सर्वाधिक संख्या एम एस माध्यम में प्राप्त हुई। एन ए ए के विभिन्न परीक्षित सान्द्रों में, अधिकतम संवर्द्धन भार, पी एल बी भार और पी एल बी आकार 5.0 मिग्रा./ली. एन ए और 1.0 मिग्रा./ली. बी ए पी से प्राप्त हुआ।

नीत्श आधार माध्यम में अधिकतम टहनियों का भार, टहनियों की लंबाई, मूल संख्या, मूल भार और मूल व्यास रिकार्ड किये गये। विभिन्न कार्यिकी लक्षणों में टहनियों और लंबाई और मूल व्यास पर सक्रिय चारकोल का बेहद असर रहा।

सीम्बीडियम संकरण एच × बी के संवर्धन से प्रयोगशाला में प्राप्त प्रोटोकोर्म को जब एम एस, नीत्श और के सी माध्यम में सहित या रहित ए सी (3 ग्रा./ली.) और बी ए पी (0.5, 1.0 और 1.5 मिग्रा./ली.) से पी एल बी आकार में अधिकतम संवर्द्धन भार प्राप्त किया गया और एम एस माध्यम में पी एल बी की संख्या अधिकतम रही। हालांकि नीत्श में टहनियों की संख्या, टहनियों की लंबाई और पत्तियों की लंबाई अधिकतम रही।

डेन्ड्रोबियम नोहिले × *डी. मोबाइल* किस्म एल्बा के प्रयोगशाला प्राप्त नवोद्भिदों के मुराशीज़ और स्कूल एवं नीत्श माध्यम, पी ए पी और सक्रिया चारकोल (0 और 3 मिग्रा./ली.) पूरक सहित संवद्धर्न में अधिकतम मूल व्यास (1.26 मि.मी.) नीत्श में रिकार्ड किया गया। माध्यम में ए सी की उपस्थिति से संवर्द्धन भार (55.7 मि. ग्रा.), पादप संख्या, और टहनी की लंबाई एवं पत्ती और मूल विकास बढ़ गया।

सीम्बीडियम संकर लूनाविअन एटलस, गोल्डन गर्ल, एच एक्स बी, एफ एक्स एच, बी एक्स एच, अरूणदीन बेम्बूसिफोलिआ, बलेटिला हायसिन्था, डेन्ड्रोविअम संकर और एपिडेन्ड्रम प्रजाति को छोटे-छोटे गमलों में सफेद माँस, पत्तियों की खाद, घूरे की खाद, चारकोल, ईंटों के टुकड़े, नारियल जटा और लकड़ी की राख भरकर उगाया गया। ½ एम एस लवण संपूरक पैक्लोब्यूट्राजॉल में उगाये पौधों ने उच्च जीवितता दर्शायी। संकरों में गोल्डन गर्ल में स्थापना एवं विकास अच्छा रहा।

सीम्बीडियम संकर किस्म कुक्स ब्रिज में एन20 : पी5 : के 0.1% सान्द्र के पर्णिल छिड़काव से पत्तियों और कूटबल्बों की संख्या में अधिकतम वृद्धि हुई।

सरसों की खली के प्रयोग से अन्य उपचारों की तुलना में पौधे की लंबाई, ऊंचाई और कूटबल्बों की संख्या में अत्यधिक वृद्धि हुई।

बी ए 100 पी पी एम के प्रयोग से अन्य उपचारों की तुलना में कूटबल्बों और पत्तियों की चौड़ाई में वृद्धि हुई। हालांकि कूटबल्बों की लंबाई एन30 : पी30 : के 10 के 0.1% सान्द्र से अधिक पाई गई। एन30 : पी30 : के 10 के 0.1% सान्द्रसे कूटबल्बों की संख्या बहुत बढ़ गई।

सीम्बीडियम संकर किस्म जापानी वाई वाई के लिए मिट्टी का मिश्रण-पत्तियों की खाद + घूरे की खाद + चारकोल, फर्न, नारियल की जटाओं से वृद्धि तीव्र गति से हुई। इसके पश्चात् पत्तियों की खाद + घूरे की खाद + चारकोल + बालू + बलुई मिट्टी और इससे कम पत्तियों की खाद + घूरे की खाद + चारकोल रही।

सिम्बीडियम की ऊंची क्यारियों (गली-सड़ी लकड़ी और मांस 1:1) में रोपण से समतल भूमि की अपेक्षा अधिकतम पौधे की ऊंचाई, पत्तियों की संख्या, पत्तियों की लंबाई,

कूट-बल्बों की संख्या, शूकिका की लंबाई, फलों का व्या और फूलों की संख्या में वृद्धि पायी गयी।

ग्लैडिओलस किस्म जैस्टर के घनकंदों को 20 × 25 सें.मी. के अंतराल पर लगाकर नाइट्रोजन (200 कि.ग्रा./है.), फॉस्फोरस (100 कि.ग्रा./है.) और पोटाश (100 कि.ग्रा. /है.) यूरिया, सुपर फास्फेट और पोटाश के माध्यम से देने पर घनकंदों और घनकंदों के उत्पादन पर उल्लेखनीय प्रभाव नहीं मिला।

शूकिका (स्पाइक) तोड़ने की अवस्था और पोटेशियम का प्रयोग पौधे की ऊंचाई, प्रति पौधा घनकंदों की संख्या, घनकंद का व्यास और घनकंद भार आदि के लिए अधिक प्रभावकारी रहा। शुरुआती अवस्था में शूकिका तोड़ने और 50 कि.ग्रा. नाइट्रोजन के प्रयोग से घनकंद के आकार, घनकंदों की संख्या और घनकंदों के भार में वृद्धि हुई।

ग्लैडिओलस को विभिन्न माध्यमों में उगाने से घनकंदों और घनकंदकों के विकास पर कोई महत्वपूर्ण प्रभाव नहीं पड़ा। हालांकि पत्तियों की खाद डालने से घनकंदों के आकार और भार में वृद्धि रिकार्ड क गयी।

20 × 15 सें.मी. अन्तराल (33 घनकंद प्रति वर्ग मी.) पर रोपण एवं बिना पोटेशियम के प्रयोग से पौधों की ऊंचाई, पत्तियों की लंबाई, शूकिका की लंबाई और पिच्छाक्ष (रेकिस) की लंबाई और घनकंदों की संख्या में अधिकतम वृद्धि हुई। 50 घनकंद प्रति वर्ग मी. घनत्व पर रोपण एवं 100 कि.ग्रा. पोटाश/हैक्टर के प्रयोग से अगेती पुष्पन प्राप्त हुआ।

घनकंद रोपण में 15 दिन का अन्तराल और नाइट्रोजन की विभिन्न खुराकों से पौधे की वृद्धि, पुष्पन, घनकंद का उत्पादन प्रभावित हुआ। 15 मार्च को घनकंद रोपण और 100 कि.ग्रा. नाइट्रोजन/हैक्टर प्रयोग से पौधे, शूकिका और पिच्छाक्ष की लंबाई बढ़ गई। हालांकि प्रति शूकिका फूलों की संख्या, अकेले घनकंद का भार और घनकंदकों का भार इस तिथि पर रोपण करके 200 कि.ग्रा. नाईट्रोजन/हैक्टर देने से अधिक रहा।

घनकंदों की विभिन्न श्रेणियों ने पौधों की ऊंचाई, लंबाई और पत्तियों की चौड़ाई को विशेष प्रभावित किया। घनकंदों के आकार के बढ़ने से बढ़त में वृद्धि हुई। बृहद आकार (5–6 सें.मी.) के घनकंद से घनकंदकों की संख्या बढ़ी।

दार्जिलिंग और दार्जिलिंग जिले के मिरिक, सूकिओ, पोखरी और पेकयांग से रोग नमूने एकत्र किये गये। यह पाया गया कि पिथियम और कोलेटोट्रिकम से केटेलिया में काला रतुआ, जबकि बल्बोफाइलम प्रजाति में पत्ती धब्बा। एन्थ्राक्नोज़ कोलेटोट्रिकम से, फायस मेकुलेटस में पत्ती धब्बा यूरेडा से, सिम्बिडियम प्रजाति में पुष्प धब्बा बोट्रिटिस से, अयोन सेक्रिओसा में काला पत्ती धब्बा और जैक्सीन प्रजाति में तथा एन्थ्रेक्नोज़ कोलेटोट्रिकम के कारण होता है। शीतकालीन वार्षिक पौधों में स्काईजैन्थस मुरझान। तना गलन का कारण स्केलोरोटिनिया स्केलेरोटिओरम और क्रोकोसमिया मुरझान का कारण फ्यूजेरियम रिकार्ड किये गये।

सर्वेक्षण के नतीजों से पता चला कि सिक्किम में आर्किड के प्रमुख नाशीकीट इस प्रकार हैं :

कूटकी (*टैट्रांकस यूट्रीकि*), शल्क (*डिआसपिस बोइसदुवली*), घोंघा (*डेरोसेरस लावे*), मिली बग (*स्यूडोकोकस मैरीटाकूम्स*), पत्तागोभी शलभ (*हैलुला अन्डेलिस*), टिड्डा (*हाइरोग्लाइग्फस बनिअन*), शम्बूक (*एकिटीना फुलिका*). और सूत्रकृमि (*एफिलेनकोयड्स रिट्जेमाबोकी*) आदि। सिक्किम में आर्किड से

संबंधित कीटों से हानि लगभग नगण्य होती है। सर्वेक्षण में ज्ञात नाशीकीटों का उपलब्ध नियंत्रण विधियों या आवधिक छिड़काव इत्यादि से आसानी से नियंत्रण किया जा सकता है। सिक्किम में नाशीकीटों द्वारा हानि बहुत कम है इसका कारण आर्किड का मजबूत गठन और प्रतिकूल मौसम (बेहद सर्दी) है।

केन्द्र में लगे 400 प्रजातियों के 10,000 से अधिक पौधों में, शल्क कीट केवल 22 पौधों पर ही पाये गये – सिम्बिडिअम प्रजाति (16 पौधे), कोयलोगइनी बारबाटा (3 पौधे) और केयलोगाइनी बारबाटम (3 पौधे) और सदृश संख्या 3.34, 11.03 और 27.05 प्रति वर्ग इंच थी।

थ्रिप्य (*टेनिओथ्रिप्स सिम्पलैक्स*) शूकिका को काटकर और इसका रस पीकर पौधे को हानि पहुंचाता है। प्रभावित शूकिका में रजत धारियां बन जाती हैं और प्रबल प्रकोप की स्थिति में ये भूरी होकर विकृत हो जाती हैं।

जरबेरा किस्में 28-01, 59-01, 17-01, 50-35, 08-02, 50-35 श्वेत मक्खी (*ट्राइलोड्स वेपोरेरिअम*) से ग्रस्त पायी गयीं और गर्मियोां में इनकी औसत जनसंख्य प्रति वर्ग इंच क्रमशः 34.83, 32.93, 23.27, 6.0 और 3.3 रही।

एन ए टी पी जैवविविधता प्रायोजना के तहत 12 अन्वेषण कार्यक्रम सिक्किम, अरूणाचल प्रदेश, मणिपुर, मिजोरम, मेघालय, पश्चिम बंगाल, उड़ीसाा और अंडमान-निकोबार द्वीपसमूह में चलाये गये। आर्किड की लगभग 350 प्रविष्टियां और 11 सिम्बिडिअम संकर जंगलों/पंजीकृत नर्सरियों या शौकिया उगाने वाले लोगों से एकत्र/संरक्षित किये गये। विभिन्न आर्किडों के पौधों और फूलों के आकारिकी अभिलक्षणन के लिए पुष्पन वाली प्रजातियों के 18 अभिलक्षण लिये गये।

देशी कंदीय पौधों के उपलब्ध जर्मप्लाज्म (जननद्रव्य) एकत्र किये गये और उनका नियमित रूप से पत्तियों की संख्या/पत्तियों का आकार, शूकिका की लंबाई, फूलों का आकार, रंग, पुष्पन अवधिा आदि के लिए आकारिकी निरीक्षण किया गया।

भारत में आर्किड की खेती की वर्तमान स्थिति के बारे में सूचना एकत्र की गयी। इस सर्वेक्षण में प्रमुख क्षेत्रों के सभी प्रमुख व्यावसाायिक आर्किड फार्मों, आर्किड नर्सरियों और शैकिया उगाने वालों को शामिल किया गया।

राष्ट्रीय आर्किड अनुसंधान केन्द्र, दार्जलिंग कैम्पस में 21 पीढ़ियों की 43 प्रजातियों को जंगल से एकत्र करके पिछले एकत्रण में शामिल किया गया। सभी प्रजातियों की आर्किडेरियम में देखभाल की जा रही है।

आर्किड जैसे कोसलोजीन क्रिस्टटा, कोलोजीन निटिडा, एपिजेनियम एम्पलम, ओटोकाइलस एल्बस, आटोकाइलस फस्कस और वेन्डोप्सिस अन्डुलाटा आदि के लिए आर्टिफिशियल हैबिटेट (कृत्रिम आवास) या क्षेत्रीय जीन बैंक का निर्माण किया गया।

DISTINGUISHED VISITORS

Name of Visitor	Organization	Date
Dr. Ashok Mishra	Prof. & Head, Dept. of Plant Pathology, GAU, Gujurat	16.05.2000
Dr. Shyam Singh	Director, NRC for Citrus, Nagpur	20.06.2000
Dr. K. E. Lawande	Director, NRCOG, Rajguru nagar, Pune	20.06.2000
Dr. S. S. Baghel	Vice-Chancellor, CAU, Imphal	24.06.2000
Dr. (Mrs) Tej Verma	ADG (Education), ICAR, New Delhi	24.06.2000
P.C. Jonny Kutty	Deputy Director, Spices Board, Gangtok	14.09.2000
Dr.B.S. Dhankar	ADG (VC), ICAR, Krishi Bhawan, New Delhi	04.11.2000
Dr.P. Pushpangadan	Director, NBRI, Lucknow	12.11.2000
Prof. (Dr.) S. P. Vij	Head, Botany Department, Punjab University, Chandigarh	12.11.2000
Dr. A. Alam	DDG (Engg.), ICAR, Krishi Bhawan, New Delhi	19.11.2000
Dr. K. U. K. Nampoothiri	Director, CPCRI, Kasaragod	30.11.2000
P. K. Bhaumik,	Director General, Pushpa Gujral Science city, Kapurthala, Punjab.	14.12.2000
Dr. (Mrs) Lily Mitra	Deputy Director, NHB, Gurgaon	25.02.2001
Dr. I. Irulappan	Director, Natural Synergies Ltd., Chennai	0303.2001
Mr. K. Natarajan,	Natural Synergies Ltd., Chennai	03.03.2001
Schaefer N. Dr.	Schafer Orchids (Australia)	03.03.2001

Visit of Dr. S. S. Bhghhel, VC, AAU, Imphal and Dr. (Mrs.) Tej Verma, ADG, Education

Visit of Dr. B. S. Dhankar, ADG, (VC), ICAR, New Delhi

DARJEELING CAMPUS ORCHIDARIUM

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