ANNUAL REPORT
1999 - 2000

भाकृअनुप
ICAR

National Research Centre for Orchids

Indian Council of Agricultural Research

Pakyong – 737 106, Sikkim

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National Research Centre for Orchids, Pakyong
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Front cover Page
Cymbidium hybrid

Inside cover
Arachnanthe cathcartii

Back Cover Page
Zygopetalum

Inside cover
Flower show view

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Contents

Preface

I am very happy to present the Annual Report of National Research Centre for Orchids for a very significant new millenium year 1999-2000 —significant because we are moving ahead into a 21st Century rejuvenated with the call of the paradigm shift that been considered necessary in the field of total agriculture in order to produce the desired quantities of food grains including aesthetic beauty. Orchids are undoubtedly some of the most exquisite and abundant members of the plant kingdom. A moderate estimate would suggest about 25,000 species in the plant family Orchidaceae. In the last century, fascinated by these beautiful and intriguing flowers wealthy and powerful spent fortunes to maintain them in their backyard. But thanks to the modern propagation and production technologies, today they are accessible to a much broader section of people. Horticulturists Worldwide today grow orchids not only because they are mysterious, but mainly due to the fact that they are highly priced and occupy 8% share of the Global floricultural trade.

Proper research support is imperative to save these beautiful members of plant kingdom, and also to harness the economic potential by scientific and judicious management. None other, but ICAR has taken the lead to fill this gap by establishing a National Research Centre for Orchids, at Pakyong , East Sikkim on 5th October,1996, and Darjeeling campus of National Research Centre for Orchids in October, 1997.

In its process of continuous and rapid development the centre is taking new initiatives one by one, based on priority. I hope our endeavour will bring closer all those who are concerned about orchids and other bulbous flowering plants of North Eastern Himalayas, generate effective technology for commercial scale cultivation of orchids and other important bulbous flowering crops, preserve our natural orchid flora and harvest economic benefit through judicious utilization of this unrestricted genetic diversity .

On the face of the multifarious activities of the institute right from NATP Projects, protect net project to Institute based activities and also problems unique to the State like land slides and frequent power cut, I have more than one reason to be happy when I see the overall development in the centre in retrospect. I congratulate the editorial board for the pain they have taken to accumulate the information and present it in this form.

I am extremely grateful to Padma Bhusan Dr. R. S. Paroda, Director General, ICAR and Secretary, DARE, Govt. of India for his constant support, guidance and constructive criticism with his scientific acumen and a very understanding approach towards us. I am also grateful to my Deputy Director General Dr. S.P. Ghosh, not only for his great concern scientific, technical and administrative advice but also for his visit to our centre.

I am extremely happy to present our **Annual Report** 1999-2000 to you all.

(R.C. Upadhyaya)
Director

2. Executive Summary

India is home to about 1300 species of orchids, of which about 800 are found in the North Eastern region of the country. North Eastern Himalayas are not only rich in terms of number of species, but more importantly many of them rank at the top of the list of ornamentally important ones. Sikkim Himalaya, comprising the hills of Sikkim and Darjeeling, harbors about 450 species and the centre of origin for important species like *Cymbidiums*. However, many of these once abundant species are threatened or might have already disappeared in the wild.

The Scientists and staff of the centre worked very hard to contribute their best. The scientist could not, however, be supported much with the technical and other supporting hands as the position in the man power front in the institute remains static. Inspite of these limitations the Centre could collect more than 300 species of orchids. Morphological and horticultural characterization of about 100 species has been taken up. Some of the collected species are rare, endangered or extinct. About 33 species of bulbous flowering plants were also collected and characterized. Standardization of agrotechniques for commercial cultivation of orchids is in progress. Breeding work for breeding superior hybrids of *Cymbidium* has been initiated. Tissue culture laboratory has started functioning and protocol for *in vitro* multiplication and rooting of *Cymbidium* hybrid and *Cattleya maxima* has been standardised. Green pod culture of embryos obtained from various crosses of *Cymbidium* and other species has been cultured and obtained protocorms. Work on molecular characterization of orchid species through DNA markers is initiated with technical and infra-structural help from NRCDNAFP, New Delhi, and fingerprinting profiles of 16 species of *Cymbidium*, *Dendrobium* and *Coelogyne* is being carried out. Basic facilities have been provided by renovating the old buildings and procurement of instruments and furniture on priority basis. The brief research findings of the centre during the period are:

- 300 orchid species of 80 genera are collected from North Eastern India and Darjeeling district of West Bengal and identified 250 species. Some are rare, endangered or already extinct in the wild.
- About 40 *Cymbidium* hybrids, 5 *Dendrobium* hybrids, 2 *Aranda* hybrids and 1 *Vanda* hybrid are also procured and maintained for further investigations. In addition to Orchids, the Centre had collected 33 species of bulbous flowering plants.

- Potting mixture comprised of equal proportion of leaf mould, FYM and saw dust found to be ideal for development of new shoots and growth from *Cymbidium* pseudobulb.
- Foliar application of organic manures at periodical interval influenced vegetative growth as well as flower bud initiation of orchids.
- To reduce the pre blooming period of *Cymbidium* hybrid, foliar application of organic manure neem cake 1:25 at fortnightly intervals influenced growth.
- Potting mixture consisting of equal proportion of FLY sand+FYM+ Leaf mould and FYM + Leaf mould enhanced root and shoot growth of *Cymbidium* pseudobulb.
- IBA at 250 PPM improved the root and shoot growth of pseudobulb.
- Under the ad-hoc project on "Protected cultivation of Ornamentals" GA_3 at 500 PPM among the growth regulators and inorganic nutrients NPK 15.10.10 at 0.2% improved the vegetative growth of *Cymbidium* hybrid.
- For production of quality planting material of gladiolus, planting of more than 3-cm diameter corm produced quality corm as well as more number of cormel.
- Harvesting of spike at emergence stage and application of 150 kg K_2O/ha also influenced corm and cormel production in gladiolus Cv. Summer Sunshine.
- Planting of cormel in equal mixture of soil, leaf mould & FYM produced marketable corm in one season.
- Eight Wonder and Jester are promising varieties of gladiolus for cut flower production in mid hill situations of Sikkim.
- Planting at 30 X 20 cm optimum for cut flower and corm production in gladiolus.
- Biotechnology laboratory with minimum facilities was set up.
- Supplementation of BAP and activated charcoal enhanced proliferation of protocorms and differentiation into plantlets.
- Four acres of farm forestland covered with various species of trees has been demarcated for *in situ* conservation of orchids.
- One fiber glass house and two polyhouses have been constructed under the Protect-net project.

3. Introduction

The Orchidaceae is one of the largest families of the flowering plants. Out of about 20000 species, about 750 genera known to occur in the warm humid parts of the world, nearly 1300 species are estimated to occur in India. A total of 475 species of about 100 genera of Orchids are from Sikkim alone. The unmatched ornamental value of orchid flowers accounts for multimillion-dollar cut-flower trade in International Market. They provide cut blooms which keep fresh for long, and add to the variety of floral arrangements. Though, there is often a preference of hybrids in commercial trade yet in beauty and other blossom characters many native species stand as competitors with best hybrids. Some of them even enjoy a national flower status and *Dendrobium nobile* is the Sikkim state flower. The economic importance of orchids lies mainly in their ornamental value, but many orchids are used in the traditional system of medicine for using a number of ailments. They are rich in alkaloids, flavinoids, glucosides, carbohydrates and other phyto-chemical contents. *Vanilla planifolia* and *V. fragrance* are the source of the essence vanillin.

Over the past two decades, there has been increase in awareness for conservation, cultivation and commercialization of orchids. Private or hobby growers have gained considerable scientific expertise to grow them on large scale. In view of the export potential of orchids and other cut flowers and limited research support available, and based on the recommendations of the Planning Commission, the Indian Council of Agricultural Research established a National Research Centre for Orchids. The NRC for Orchids, Darjeeling centre has undertaken research on temperate bulbous flowering plants and temperate orchids.

4. 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:

- Collection, characterization, evaluation, conservation and improvement of Orchids, anthurium and other bulbous flowering plants.
- Systematic breeding and production of commercial varieties and hybrids of superior quality of orchids, bulbous ornamentals and anthurium for national and international trade.
- Standardisation of agro-techniques for commercial cultivation and package of practices for post-harvest management for domestic and export markets of orchids, anthurium and other bulbous flowering plants.
- Production of quality planting materials of orchids, anthurium and other selected bulbous flowering plants.
- To act as a repository of information and as a centre for giving training on orchids and other floricultural crops.

OBJECTIVES

- To collect, conserve, characterize and evaluate germplasm and develop National repository of orchids and bulbous flowering plants.
- To standardize agro-techniques for cultivation of orchids, gladiolus, anthurium and lillium with specific emphasis on low cost technology.
- To evaluate locally adopted orchid species for their suitability as cut flower or potted plant for commercial purpose.

- To standardize micro propagation techniques for production of quality planting material at commercial scale.
- To develop export-worthy orchid lines through a systematic breeding programme.
- To carry out systematic work on disease and pest management of Orchids and other bulbous flowering plants.
- To standardize post harvest management practices of cut flowers for domestic and International markets.

5. Infrastructure Development

The centre is pushing hard to create the infra-structural facilities, necessary for attaining the objectives of the centre.

LABORATORY

Tissue culture laboratory with minimum facilities started functioning. 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 has been developed. However, the centre did not receive any journal till March end, though subscribed for two journals.

FIELD

The centre has 9.98 ha of terraced land. The whole farm has been fenced and broadening of the narrow terraces is in progress. One fibre glass house and two poly houses, with micro-irrigation and temperature control system, were constructed under Protect-net scheme. Another new net house was also constructed for the maintenance of ever increasing orchid germplasm, besides the two already existing net houses. Two low cost poly tunnels made up of bamboo were also constructed to study the suitability such low cost structures for commercial cultivation of orchids.

ANY OTHER ITEM

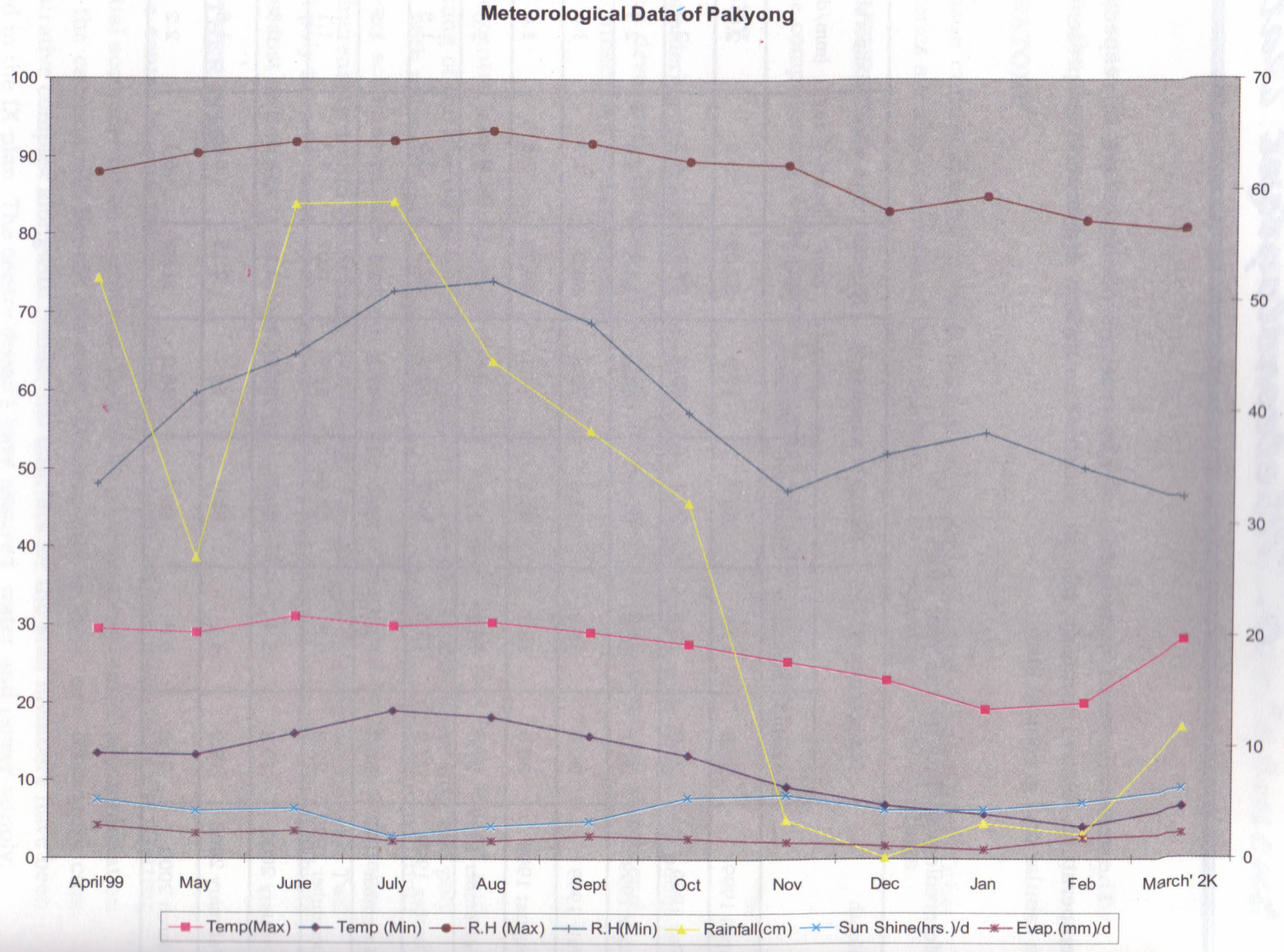
This centre is situated in a remote area, about 33 km from Gangtok. Getting residential accommodation is problem. Therefore, providing residential accommodation with in the campus will benefit the staff. Keeping this in view, new laboratory cum administrative complex alongwith residential quarters for the staff members have been proposed in the IX plan. The centre doesn't have assured water and power supply.

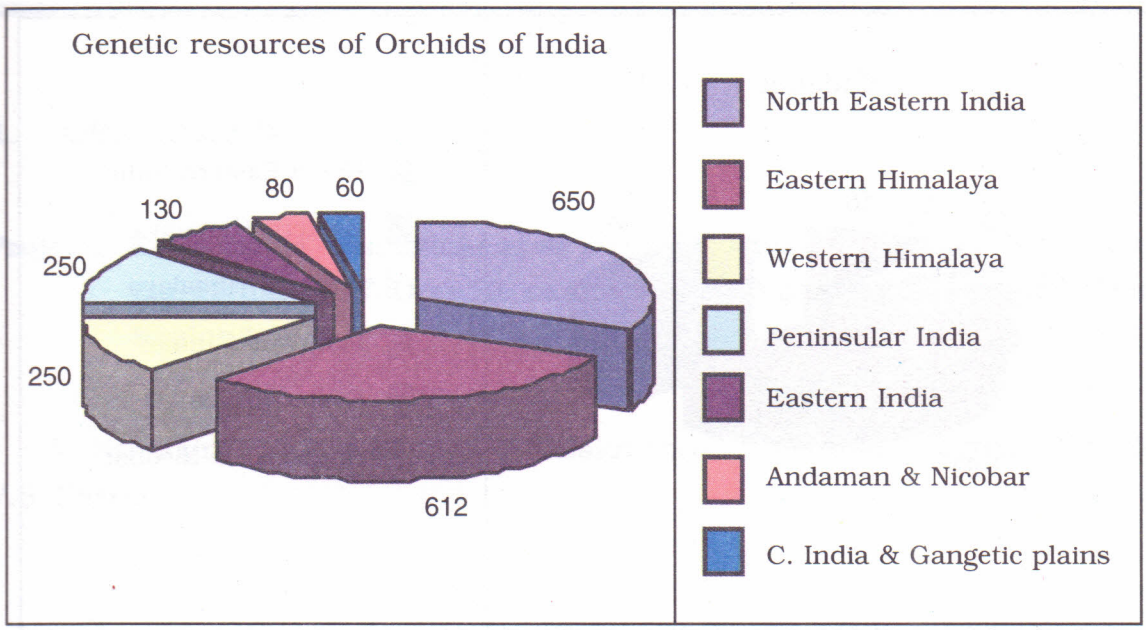
6. Meteorological Data

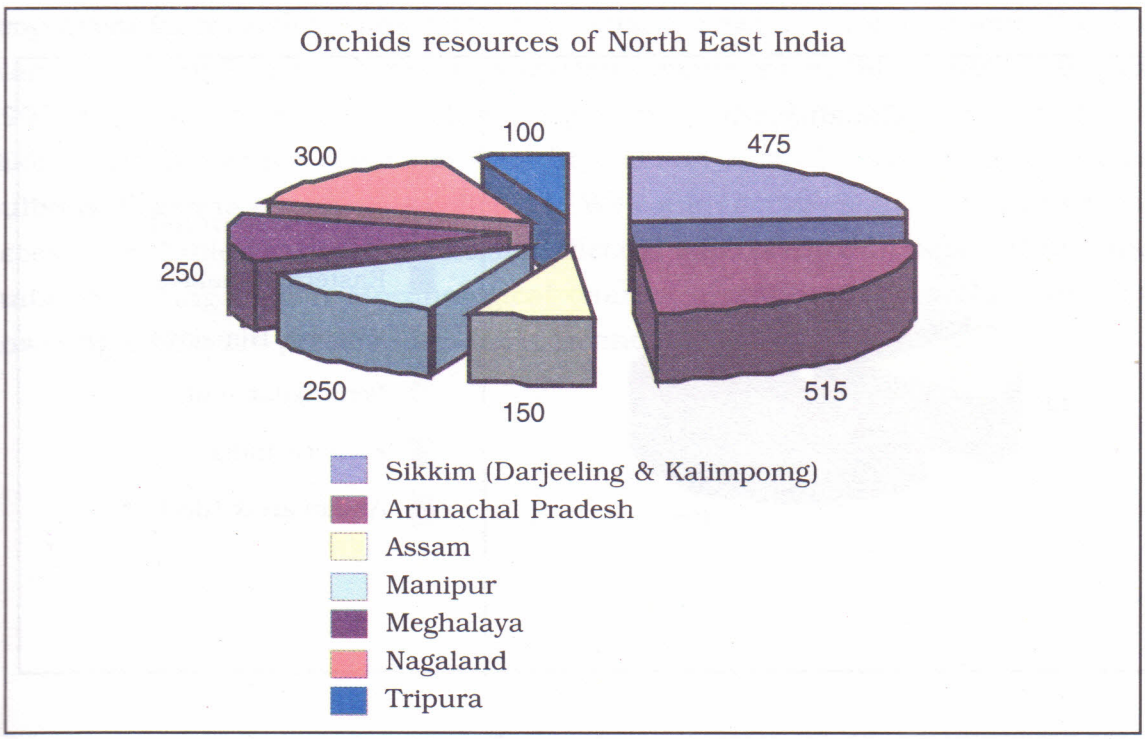
The monthly mean meteorological observations of the centre in respect of temperature, relative humidity, rainfall, sunshine hours and evaporation are presented in tabular and graphical form.

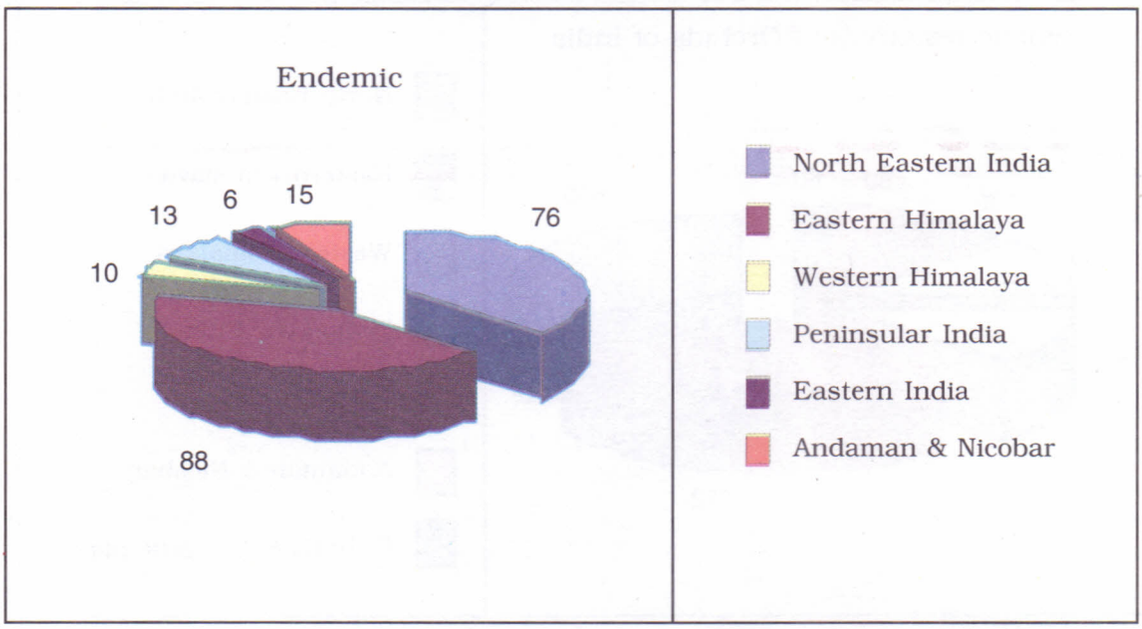
Metereological data for the year 1999-2000

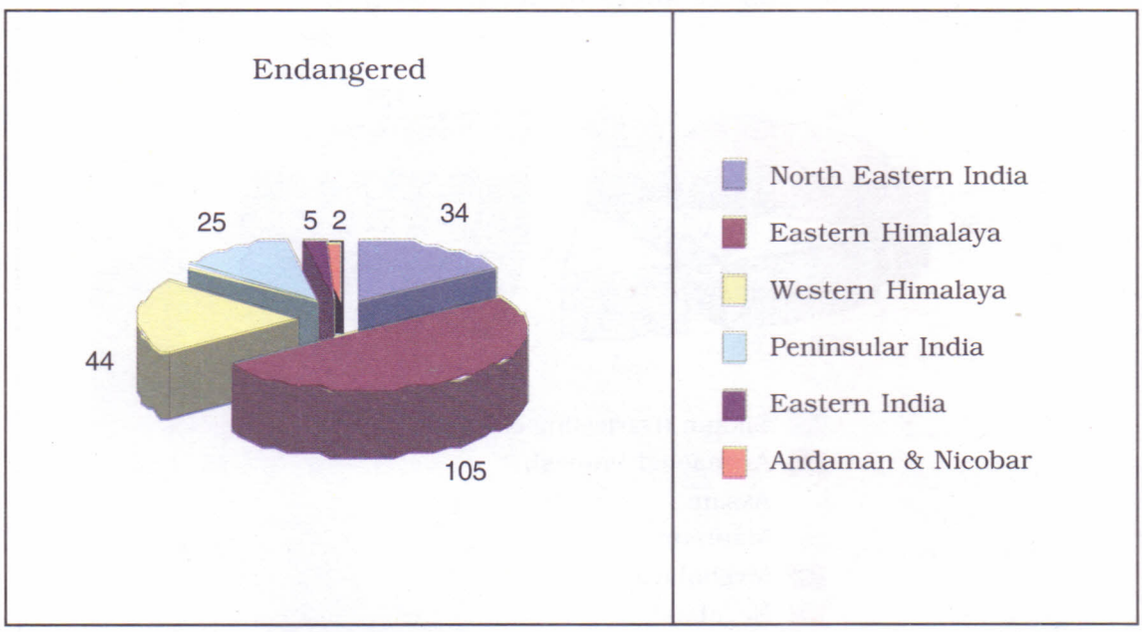
Month	Temperature °C		Relativ7e humidity %		Rainfall (cm)	Sun shine (hours / day)	Evaporation (mm/day)
	Maximum	Minimum	Maximum	Minimum			
April 1999	29.5	13.5	88.0	47.9	52.02	5.2	2.9
May 1999	29.0	13.3	90.4	59.7	27.0	4.2	2.3
June 1999	31.1	16.0	91.9	64.6	58.8	4.4	2.5
July 1999	29.8	18.9	92.0	72.8	59.0	1.9	1.6
August 1999	30.3	18.1	93.3	74.1	44.73	2.8	1.6
September 1999	29.0	15.7	91.8	68.7	38.5	3.3	2.0
October 1999	27.6	13.3	89.4	57.2	32.0	5.5	1.8
November 1999	25.3	9.2	89.0	47.2	3.5	5.7	1.5
December 1999	22.8	6.8	83.0	51.9	0.07	4.3	1.1
January 2000	19.2	5.7	84.9	54.7	3.16	4.3	0.8
February 2000	19.9	4.1	81.8	50.1	2.15	5.0	1.8
March 2000	27.9	6.5	80.7	46.2	11.68	6.1	2.2


Meteorological Data of Pakyong
100
90
80
70
60
50
40
30
20
10
0
70
60
50
40
30
20
10
0
April'99
May
June
July
Aug
Sept
Oct
Nov
Dec
Jan
Feb
March' 2K
Temp(Max)
Temp (Min)
R.H (Max)
R.H(Min)
Rainfall(cm)
Sun Shine(hrs.)/d
Evap.(mm)/d


Genetic resources of Orchids of India
80
60
130
650
250
250
612
North Eastern India
Eastern Himalaya
Western Himalaya
Peninsular India
Eastern India
Andaman & Nicobar
C. India & Gangetic plains


Orchids resources of North East India
100
300
475
250
250
150
515
Sikkim (Darjeeling & Kalimpomg)
Arunachal Pradesh
Assam
Manipur
Meghalaya
Nagaland
Tripura


Endemic
13
6
15
76
10
88
North Eastern India
Eastern Himalaya
Western Himalaya
Peninsular India
Eastern India
Andaman & Nicobar


Endangered
25
5
2
34
44
105
North Eastern India
Eastern Himalaya
Western Himalaya
Peninsular India
Eastern India
Andaman & Nicobar

7. Research Activities

1. GERMPLASM

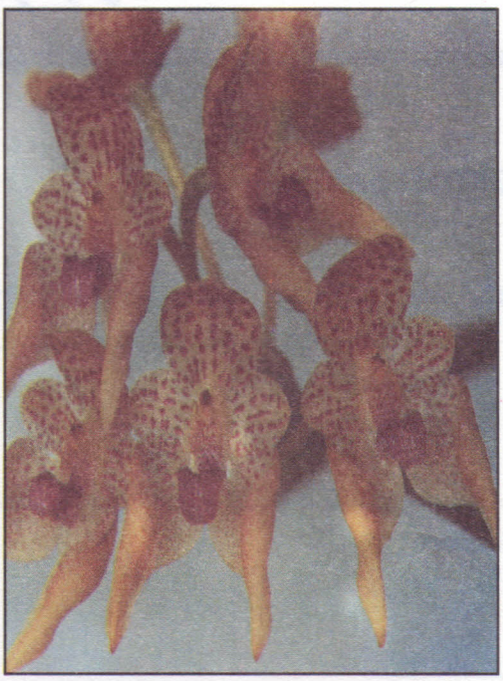
Project. Sustainable management of plant bio-diversity "Collection, evaluation, maintenance of Orchids and ornamental plants germplasm From NEH Region".

V. Nagaraju, R.C. Upadhyaya, S. Chakraborti, D. Burman, Rampal, S.P. Das and V.S. Nagrare

The National Agricultural Technology Project on Plant Biodiversity, a mission mode programme for collection, conservation and characterization of orchids and other flowering plants of North Eastern Region was started functioning at this Centre from November 1999. Eight short term exploration programmes were under taken from the parts of Sikkim and Darjeeling district of West Bengal and about 80 accessions of orchids and bulbous flowering plants were collected. We could identify some of the newly collected accessions (Table 1). All the materials collected were planted in pots / beds containing suitable potting media. Morphological characterization of the orchids and bulbous flowering plants are presented in table 1a and 1b.

ORCHID SPECIES

Bulbophyllum ornatissimum



Bulbophyllum guttulatum

Cryptochilus sanguina

Dendrobium Chrysotoxum

Paphiopedilum villosum

Thunia venosa

Vanda coerulea

Vanda tessalata

Table 1. Orchid germplasm collected during the year from various parts of India

Aerides vandarum
Agrostophyllum sp.
Anoectochilus lanceolatus
Anoectochilus sikkimensis
Anoectochilus tortus
Anoectochitus roxburgii
Anthogonium gracile
Bulbophyllum affine
Bulbophyllum cauliflorum
Bulbophyllum cylindraceum
Bulbophyllum hirtum
Bulbophyllum parviflorum
Bulbophyllum protractum
Bulbophyllum sikkimensis
Calanthe brevicornu
Calanthe chloroleuca
Coelogyne cristata
Coelogyne flavida
Coelogyne fuscescens
Coelogyne graminifolia
Coelogyne longipes
Coelogyne nitida
Coelogyne ochracea
Coelogyne ovalis
Coelogyne sp.
Coelogyne theserria
Coelogyne uniflora
Cymbidium cochleare
Cymbidium sp.
Cymbidium whiteae
D.porphyrochilum
Dendrobium devonianum
Dendrobium falconeri
Dendrobium nobile
Dendrobium amoenum
Dendrobium chrysanthum
Dendrobium draconis
Dendrobium gratissimum
Dendrobium jenkensii
Dendrobium pendulum
Dendrobium kingiannum
Dendrobium moschatum
Dendrobium pairardii
Dendrobium sp.
Eria confusa
Eria coroneria
Eria excavata
Eria rufinula
Eria sp.
Gastrochilus dasypogon
Goodyera hispeda
Goodyera procera
Goodyera secundiflora
Goodyera.grandis
Ione andersonii
Ione bicolor
Ione scariosa
Liparis bituberculata
Liparis nepalensis
Liparis sp.
Monomeria barbata
N. grandiflorum
N. pulchrum
Nephelaphyllum cordiflorum
Oberonia sp.
Ornithochilus fuscus
Paphiopedilum spicerianum
Phaius sp.
Phajus densiflora
Phajus maculata
Phajus mishmensis
Pleione hookeriana
Pleione humilis
Pleione sp.
Pogonia plicata
Pseudopitalum sp.
Rhynchostylis sp.
Staouropsis undulata
Thelasis longifolia
Thunia bensonii
Thunia sp.
Tylostylis discolor
Vanda sp.

Morphological characterization of 53 species of orchids and 29 species of bulbous flowering plants are presented in Table 1a and Table 1b respectively.

Table 1a. Morphological characterization of orchid germplasm.

Sl. No.	Species	Plant height	Leaf			Spike		Flowering Time		Flower Colour
			No.	Length	Width	No.	Length		No.	
1.	*Acampe pappilosa* Lindl.	27	13	9.5	2.1	2	0.5	Oct./Nov.	6	Parrot green
2.	*Aerides fieldingii* Williams (Jennings)	35	12	13.7	2.7	1	31.3	May	50	Whitish pink
3.	*Aerides odoratum* Lour., Fl. Cochinch	40	19	13.3	2.6	3	4.1	May	20	White with large purple blotches
4.	*Aerides williamsii* Warn., Sel.	25	8	18	3	1	22	May	30	White flushed and pink
5.	*Ascocentrum miniatum* (Lindl.) Schltr.	12	5	11.7	1.4	1	6.5	May	-	Red
6.	*Bulbophyllum careyanum* (Hook) Spreng., Syst.	22.5	2	19.5	3.6	2	10.8	November	50	Coppery brown
7.	*Bulbophyllum hirtum* (Smith.) Lindl.	17.5	2	15.5	3.6	6	38.3	November	75	Greenish white
8.	*Bulbophyllum leopardinum* (Wall) Lindl.	12	-	20.4	5.4	-	-	May	5	White with purple mix
9.	*Bulbophyllum ornatissimum*	8.6	11	6.5	3	1	8.5	Late October	1	Yellowish with prominent brown lines
10.	*Calanthe masuca* D. Don (Lindl.)	19	4	13.5	3.9	2	22.5	July	-	White with purple mix
11.	*Calanthe triplicata* (Willemet) Ames.	24	5	28.2	8.8	1	32.1	March - May	5	Pure white
12.	*Coelogyne alba*	-	2	22.5	2.6	2	15.5	April	-	Pure white
13.	*Coelogyne elata* Hook.	-	-	41.5	4.6	2	29.3	May	-	White
14.	*Coelogyne graminifolia*	24.5	2	23.5	2.7	1	23.6	May	24.5	-
15.	*Coelogyne punctulata* Lindl.	24.5	2	18.1	3.2	1	19.5	Early Nov.	3	White
16.	*Cryptochilus sanguina* Wall.	-	21	14.0	2.5	1	16.7	June	-	Red
17.	*Cymbidium devonianum* Paxt.	30	4	2.5	0.8	2	31	April	-	Purplish brown with green lines
18.	*Cymbidium gamiennum*	60	14	54	1.6	1	39.5	Oct./Nov.	10	Greenish yellow
19.	*Cymbidium munronianum* King & Pantl.	74	4	74	2.1	1	47	September	10	Brownish green
20.	*Dendrobium densiflorum* Lindl.	35	5	16	5.5	1	24.8	April	-	Yellow
21.	*Dendrobium falconeri* Hook.	35	8	3.5	0.2	2	-	May	-	White flushed with pale rose and tip dark purple
22.	*Dendrobium jenkensi* Wall. ex Lindl.	3	1	2.6	1.2	1	51	April	-	-
23.	*Dendrobium lituiflorum* Lindl.	30	8	11	2.5	2	44.8	April	-	White flushed with purple
24.	*Dendrobium parishii* Reichb. F.	-	-	-	-	1	39.5	May	-	White with purple (pink)
25.	*Dendrobium sp.*	24	11	49	1.4	-	-	November	1	Light purple
26.	*Eria coronaria* (Lindl.) Rchb.F.	32.5	2	16.5	4.6	9	9.1	December	25	Off-white
27.	*Eria stricata* Lindl.	18	2	9.1	1.7	1	9.2	February	17	Pubescent white
28.	*Goodyera procera* (Wall. Ex Ker. Gawl.) Hook.	25.5	13	13.5	3.3	1	32.2	April	26	Greenish white

Contd....

29. *Liparis longipes* Lindl.	37.5	2	24.8	2.5	-	28	September	Many	Greenish white
30. *Liparis plantaginea* Lindl.	17.2	2	18	2	2	17.9	July	13	Green
31. *Lusia filiformis* Hook.	30	12.5	10	-	1	10.5	August	12.5	Apple green mixed with brownish lines
32. *Lycaste schunbrunensis* Vindob.	74	2	66	8.5	1	11	December	1	Pinkish
33. *M. mismensia*	89.5	10	37	6.4	-	31.8	September	35	Pink
34. *Malaxis auraulea*	33.7	5	24.5	7.6	2	62.8	July	134	Perish green
35. *Mycrostylis wallichi* Lindl.	35	5	12.3	4.3	1	14.8	May	-	Light green with purple earlobes
36. *Neogyne gardneria* Rchb.F.	10.3	2	51	10.3	1	3.0	December	12	White
37. *Ornithochilus fufcus* Wall.	8	4	8.2	2.5	1	7	July	5	Brown
38. *Panisea uniflora*	-	2	2.1	0.4	1	1.7	May	-	Lemon green
39. *Paphiopedilum hirsutissimum* (Lindl.) Pfitz.	38	6	21.5	2	1	6.7	-	-	-
40. *Paphiopedilum venustum* (Wall.) Pfitz.	12	-	11	4.8	-	6.4	-	-	-
41. *Phaius flavus* Lindl.	50	8	50	10	2	25	-	-	-
42. *Renanthera imschootiana* (Lindl.) Rolfe.	35	8	11.2	2.2	2	43	March-June	-	Red
43. *Robiquetia spathulata* (Blume) Smith.	-	7	9.8	2.1	1	6.9	April	-	Pinkish white
44. *Saccolobium intermedium* Griff.	3.5	11	10.5	0.7	1	3.5	July	11	Yellow
45. *Sarcanthus pallidus* Lindl.	48.5	12	26	4.2	1	41.1	-	-	Brownish
46. *Thelasis longifolia* Hook. F.	4.2	2	14	2	3	22.7	August	1.0	Light green
47. *Thunnia hensonii*	57.5	19	11.9	2.1	2	43	July	18.5	White
48. *Vanda coerulescens*	25	-	13	1.9	-	26	-	-	Blue
49. *Vanda cristata*	-	13	14.3	1.6	3	2	April	-	Apple green
50. *Vanda parashii* Veitch & Riechb. F.	-	4	10.3	3.9	1	10.6	May	-	Light apple green with spots
51. *Vanda paruflora*	-	6	10.3	1.5	2	12.3	April	-	-
52. *Vanda stangeana* Rchb.F.	-	14	20	2.4	2	15.2	May-June	7	-
53. *Vanda teres var. candida.* Rchb.F.	53	7.5	17.5	-	1	6.5	-	5	Glossy white

Table 1b. Morphological characterization of bulbous flowering plants (size in cm.)

Sl. No.	Species	Leaf			Spike		Flowering time	Flower		Sepal	
		No.	Length	Width	No.	Length		Colour	Size	Length	Width
1	Hemerocallis	13	49.0	1.7	1	50.5	May	Red	9.9	8.4	2.2
2	Hemerocallis	8	41.5	1.1	1	58.7	May	Light red	7.6	9.7	2.3
3	Hemerocallis	9	37.3	1.2	1	50.4	May	Light red	9.9	8.2	2.3
4	Hemerocallis	16	49.7	2.1	1	58.5	May	Light red	11.6	9.5	2.8
5	Hemerocallis	12	50.8	1.7	1	61.7	May	Light red	11.0	9.2	2.4
6	Hemerocallis	9	49.4	1.8	1	68.5	May	Red	8.6	10.9	2.8
7	Hemerocallis	12	46.9	1.4	1	71.5	May	Red	6.6	10.3	2.5
8	Hemerocallis	10	44.7	1.5	1	58.2	May	Red	10.8	11.4	2.6
9	Hemerocallis	10	48.9	1.2	1	48.9	May	Red	6.2	11.1	2.8
10	Hemerocallis	11	59.4	1.9	1	64.2	May	Red	8.9	11.6	2.7
11	Hemerocallis	12	46.5	1.3	1	68.1	May	Light pink	11.2	8.9	2.2
12	Hemerocallis	12	56.9	1.9	1	69.2	May	Light pink	6.8	9.3	2.5
13	Aster lily	52	10.12	1.8	1	35.0	May	-	10.4	18.8	3.3
14	Aster lily	85	9.3	1.9	1	-	May	-	10.5	-	-
15	Aster lily	49	8.3	1.9	1	32.0	May	-	5.4	15.7	3.2
16	Zephyranthes	2	18.7	0.4	1	22.0	May	Pink	4.7	7.1	2.0
17	Agapanthus	19	58.2	3.1	1	91.5	May	*Blue*	18.46	4.7	0.8
18	Haemanthus	19	28.2	10.9	1	31.6	May	Light red	11.33	2.8	0.13
19	Asiatic lily	15	6.5	2.4	1	36.1	June	Whitish	7.3	11.5	3.3
20	Lillum	18	31.2	0.3	1	29.1	July	Pink	13.5	5.5	1.9
21	Oriental lily	8	4.2	1.5	1	34.2	June	Orange	14.2	8.1	3.0
22	Crinum	9	21.3	5.8	1	58.0	June	White	12.0	10.8	0.7
23	Crinum	8	35.0	4.8	1	51.5	June	White	-	11.0	0.6
24	Crinum	8	30.2	4.2	1	55.9	June	White	12.3	11.3	0.6
25	Asiatic lily	-	50.1	4.8	1	63.8	June	Pink	11.53	9.2	2.8
26	Asiatic lily	12	44.1	25.0	1	63.0	June	Pink	11.7	9.8	2.6
27	White lily	8	32.2	4.8	1	44.2	June	White	2.25	6.9	1.7
28	Lillium (white light)	18	16.2	0.6	1	16.2	June	Light white	4.6	3.03	1.1
29	Lillium (white light)	18	18.2	0.3	1	13.2	June	Light white	4.7	4.2	1.4

2. BREEDING

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

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

Breeding in *Cymbidium* :Crosses made during the year

	Female parent	Male Parent
1.	C. Hawtescence	C. Showgirl
2.	C. Showgirl	C. Hawtescence
3.	C. Hawtescence	C. Bertha Pattershot
4.	C. Bertha Pattershot	C. Hawtescence
5.	C. Hawtescence	C. Pal Barkis
6.	C. Pal Barkis	C. Hawtescence
7.	C. Hawtescence	C. Jung Frau Snow Queen
8.	C. Showgirl	C. Bertha Pattershot
9.	C. Showgirl	C. Pal Barkis
10.	C. Pal Barkis	C. Showgirl
11.	C. Showgirl	C. Redstar
12.	C. Showgirl	C. Emsebury
13.	C. Showgirl	C. *lowanium*
14.	C. *lowanium*	C. Showgirl
15.	C. Bertha Pattershot	C. Pal Barkis
16.	C. Pal Barkis	C. Bertha Pattershot
17.	C. Pal Barkis	C. *lowanium*
18.	C. Pal Barkis	C. Jung Frau Snow Queen
19.	C. Jung Frau Snow Queen	C. *lowanium*
20.	C. Redstar	C. Jung Frau Snow Queen
21.	C. Jung Frau Snow Queen	C. Redstar
22.	C. Redstar	C. *lowanium*
23.	C. *tigrinum*	C. devonianum
24.	C. *devonianum*	C. *tigrinum*
25.	C. *tigrinum*	C. *pendulum*
26.	C. *pendulum*	C. *tigrinum*
27.	C. *pendulum*	C. *devonianum*
28.	C. *devonianum*	C. *pendulum*
29.	C. *devonianum*	C. Red Sea
30.	C. Red Sea	C. *devonianum*
31.	C. *devonianum*	C. Hybrid(unknown)
32.	C. Hybrid(unknown)	C. *devonianum*
33.	C. Hybrid(unknown)	C. Red Sea

Inter- specific and inter-generic crosses

Sl. No.	Female parent	Male Parent
1.	*Phaius flavus*	*Dendrobium nobile (Alba)*
2.	*Dendrobium nobile (Alba)*	*Phaius flavus*
3.	*Strauropsis undulata*	*Vanda christata*
4.	*Vanda christata*	*Strauropsis undulata*
5.	*Vanda christata*	*Scoarpion orchids*
6.	*Vanda christata*	*Unknown(Makara type)*
7.	*Dendrobium nobile (Alba)*	*Dendrobium nobile*
8.	*Dendrobium nobile (Alba)*	*Dendrobium primulinum*
9.	*Dendrobium primulinum*	*Dendrobium nobile*
10.	*Dendrobium nobile*	*Dendrobium primulinum*
11.	*Epidendrum zanthum*	*Vanda cross*
12.	*Renanthera imschootiana*	*Stauropsis undulata*
13.	*Stauropsis undulata*	*Renanthera imschootiana*
14.	*Calanthe triplicata*	*Renanthera imschootiana*
15.	*Renanthera imschootiana*	*Calanthe triplicata*
16.	*Calanthe triplicata*	*Eria radiata*
17.	*Epidendrum zanthum*	*Calanthe triplicata*
18.	*Dendrobium nobile*	*Dendrobium ueterocarpum*
19.	*Dendrobium ueterocarpum*	*Dendrobium nobile*
20.	*Dendrobium* nobile	*Dendrobium densiflorum*
21.	*Dendrobium densiflorum*	*Dendrobium nobile*
22.	*Dendrobium nobile (Alba)*	*Dendrobium densiflorum*
23.	*Dendrobium nobile (Alba)*	*Dendrobium crepidatum*
24.	*Dendrobium nobile*	*Dendrobium crepidatum*
25.	*Dendrobium crepidatum*	*Dendrobium nobile*
26.	*Dendrobium nobile*	*Dendrobium pairardii*
27.	*Dendrobium pairardii*	*Dendrobium nobile*
28.	*Calanthe triplicata*	*Epidendrum zanthum*
29.	*Phaius flavus*	*Calanthe triplicata*
30.	*Dendrobium nobile*	*Phaius flavus*
31.	*Stauropsis undulata*	*Phaius flavus*
32.	*Phaius flavus*	*Stauropsis undulata*
33.	*Vanda stangeana*	*Dendrobium nobile*
34.	*Dendrobium nobile*	*Vanda stangeana*
35.	*Dendrobium pairardii*	*Renanthera imschootiana*
36.	*Renanthera imschootiana*	*Renanthera imschootiana*
37.	*Dendrobium nobile*	*Dendrobium williamsonii*
38.	*Dendrobium williamsonii*	*Dendrobium pairardii*
39.	*Dendrobium pairardii*	*Dendrobium williamsonii*
40.	*C. tigrinum*	*Dendrobium williamsonii*
41.	*Vanda stangeana*	*Dendrobium williamsonii*
42.	*P. hirsutissimum*	*Vanda stangeana*
43.	*Vanda stangeana*	*P. hirsutissimum*
44.	*Arundina grandiflora*	*Arundina alba*

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 in this crop. Depending on the colour and the length of spikes collected materials were grouped into six different groups. Crosses were made in all possible combination among these groups. Crossed seeds are harvested. Progeny grown from them will be tested in coming year.

3. GENETICS

Project: Studies of Genetic Variability of some Commercially important Himalayan orchids using Polymerase chain Reaction (PCR) based Random Amplification of Polymorphic DNA (RAPD) techniques.

Genetic variability was investigated using random amplified polymorphic DNA (RAPD) of three morphologically distinct groups of orchids belonging to the sub family Epidendrobieae and tribe Dendrobieae and Cymbidieae. 16 species of 3 genera of *Cymbidium, Coelogyne* and *Dendrobium* were used for analysis and a total of 227 distinct major RAPD bands of which 97% were polymorphic were generated from 15 primers. Relationship between these 3 genera and 15 species were estimated based on band sharing and cluster analysis.

Study of Floral biology of some Himalayan Orchids

Intraspecific morphological variations are very common in Indian Orchids which are correlated with environmental or genetic factors. To study the floral biology of some important orchids such as *Cymbidium, Dendrobium, Coelogyne* etc. flowers of different species were collected and preserved in herbarium to study the morphological variations.

4. BIOTECHNOLOGY

Project: Biotechnological interventions in orchids and bulbous plants

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

Green Pod Culture

Majority of commercially important orchids are raised from seeds and meristem. The orchid seeds although produced in a very large number per capsule, lack endosperm with the result only 1-3 % of seeds germinate in nature. Exogenous supply of food mainly carbon source enhanced germination and growth of many orchids.

In vitro germination of green pod embryos of hybrids

Embryos from green pods of crosses of *Cymbidium lowianum* X Show Girl, Show Girl X Show Girl, Show Girl X *C. lowianum*, Dos Pablos X *C. lowianum*, Bertha Petershot X Show Girl were cultured in MS, Nitsch and Knudsons'C media supplemented with or without Activated Charcoal (AC) and BAP and incubated in culture room. Swelling of seeds varies from 30 to 106 days among the crosses. Embryos of hybrid Show Girl X *C. lowianum* has taken least number of days (30) for swelling in KC supplemented with 0.5 mg/l BAP, while absence of BAP resulted in more number of days for swelling. Presence of AC also favored early swelling. The days taken for swelling in Bertha Petershot X Show Girl varies from 61 to 79 days in same medium, while in of *Cymbidium lowianum* X Show Girl it was 47 to 60 days. Variation recorded among the cross combinations for swelling of embryos might be due to the variation among the material. From swelling of embryos to protocorm like bodies formation, it has taken 11 to 94 days among the embryos from various crosses.

Embryos of *Arundina graminifolia, Blitella hyacintha, Dendrobium chrysotosum, Dendrobium nobile X D. nobile* var *Alba, D. nobile X D. heterocarpum Epidendrum zantheum X E. radiacum* were also cultured in various basal media with or without AC and harmones.

Seeds from green, mature but unopened capsules of *Epidendron radiacum* were cultured in Murashige and Skoog and Knudson's C media supplemented with or without BAP. One set of cultures was incubated in complete dark and other set was exposed to photoperiodic regime of 16 hours at the intensity of 3000 lux. The activity of embryos were observed with in 7-10 days from culture and formation of globular structures was noticed after one week followed by formation of protocorm like bodies (PLBs) in another two weeks period. Among the media maximum germination and large sized protocorms were recorded in MS medium supplemented with 3 g/l AC followed by MS basal medium. Incubation of cultures in light enhanced early swelling and formation of PLB's. Absence of AC in the medium resulted in slight browning of media and formation of smaller protocorms.

Effect of media and growth substances on *in vitro* multiplication of orchids

Protocorms from *in vitro* grown cultures of *Cymbidium* were cultured in Murashige and Skoog's, Nitsch and Knudson's C medium supplemented with BAP. The cultures were incubated at 25±1°C for 16 hour photoperiod. Observations indicated 6 weeks after

culture initiation resulted in production of protocorm like bodies (PLB's) in all the three media. Supplementation of 0.5 mg/l BAP to the medium resulted in rapid proliferation of PLB's. However, in Nitsch medium supplemented with 0.5 mg/l BAP recorded maximum number of PLB's. The size of the protocorm produced were bigger in MS compared to other two media. Absence of hormone in the medium resulted in development of plantlets.

Effect of basal media and growth regulator on protocorms of *Cymbidium*

Protocorms from *in vitro* obtained cultures of *Cymbidium* were cultured in 4 basal media *viz.*, Murashige and Skoog, Nitsch, Street and White. MS medium has resulted in maximum culture weight and more number of protocorms followed by Nitsch. Nitsch has resulted in increased protocorm size with more weight and was also responsible for more shoot number, better shoot and leaf size. Performance of other two media viz., Street and White interms of all the morphological characters were inferior. Addition of BAP to the media improved rate of proliferation as well as protocorm size. To develop complete plantlets, protocorms were transferred to MS and Nitsch media supplemented with or without activated charcoal (3 g/l). Better sized plantlets were obtained in Nitsch compared to MS. Presence of activated charcoal enhanced shoot and root development. Activated charcoal also helped in the development of roots with root hairs in both the media, however, Nitsch was found to be better than MS.

In vitro proliferation of *Cattleya maxima*

Shoots and protocorms from *in vitro* grown cultures were inoculated in Murashige and Skoog's and Knudson's C medium supplemented with and without BAP. Observations indicated 6 weeks after culture initiation resulted in increased number of shoots and production of profuse protocorm like bodies (PLB's) in both the medium supplemented with 0.5 mg/l BAP. Presence of higher concentration of BAP (1 mg/l) resulted in formation of profuse PLB's. Absence of hormone in the medium resulted in development of roots and elongation of shoots. MS supplemented with 0.5 mg/l BAP found to be better for rapid proliferation of PLB's and multiplication of shoots.

In vitro multiplication of bulbous flowering plants

Bulb scales, nodal and floral segments of Asiatic lilies and cormel of Freesia were cultured in MS media supplemented with BAP. Formation of buds and shoots were recorded in bulb scales and nodal explants. Swelling of floral explants were also observed, followed by embryogenesis and shoot initiation from anthers, ovules, petal and style of lilium.

5. 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, Ram Pal, & S.P.Das

Effect of growth regulators on germination and growth of *Cymbidium* pseudobulb.

Application of growth regulators significantly influenced number of roots and root length but not root diameter. Among the different concentration of growth regulators, IBA 250 PPM produced more number of roots (8.3) and maximum root length (6.75) (Table 2). Length of leaves were also found to be significantly enhanced by application of growth regulators. However, width of leaves, length and girth of pseudobulb did not respond significantly to the growth.

Table 2: Morphogenetic response of pseudobulbs of *Cymbidium* to growth regulators.

Growth regulator (PPM)	Leaf size		Root			Pseudobulb	
	Length (cm)	Width (cm)	No.	Length (cm)	Diameter (cm)	Length (cm)	Girth (cm)
IAA							
25	8.78	0.95	2.66	2.32	0.76	6.50	4.06
50	10.32	1.25	4.25	3.42	0.89	7.00	4.31
75	14.01	1.31	6.35	4.50	0.92	7.51	4.96
100	20.58	1.35	6.40	4.65	0.99	8.10	4.91
200	27.98	1.45	6.40	5.86	1.10	8.20	4.46
IBA							
50	15.92	1.07	3.00	4.52	0.68	7.21	4.03
100	15.99	1.20	4.18	4.47	0.79	7.61	4.21
150	21.86	1.61	4.82	5.28	0.82	7.85	4.25
200	23.35	1.72	5.35	5.92	1.20	7.76	4.20
250	25.79	1.92	8.30	6.75	1.25	6.95	4.33
NAA							
25	10.25	1.05	2.25	2.50	0.40	6.83	4.31
50	11.05	1.10	2.50	3.21	0.42	7.63	4.36
75	15.7	1.10	3.5	4.75	0.42	7.96	4.51
100	15.90	1.15	2.4	4.80	0.43	7.76	3.75
200	18.20	11.52	2.0	5.23	0.50	6.56	3.40
CONTROL	16.62	0.60	2.25	2.10	0.33	5.80	3.30
Sem	3.15	0.80	1.02	1.15	0.46	2.20	1.35
CD (0.05)	5.90	NS	2.10	2.45	NS	NS	NS

Effect of nutrient spray on pre-blooming period of *Cymbidium* hybrids.

Investigations were carried out to study the influence of foliar application of NPK on pre blooming period of *Cymbidium* hybrid var. Cooks Bridge. The experiment was laid out in CRD design with 12 treatments sprayed at fortnightly intervals, repeated thrice.

The result showed that spraying of NPK 15:5:5 at 0.2 % concentration improved the plant height (52.2 cm), length of leaves (43.85 cm), width of leaves (1.35 cm), no. of leaves (8.2), Shoot length (51.97 cm), length of pseudobulb (2.22 cm) and girth of pseudobulb (2.4 cm) in comparison with other treatments.

Effect of organic manure on flower quality of *Cymbidium* hybrids.

Spraying of neem cake solution at fortnightly interval enhanced the plant growth in terms of plant height, length of leaves, number of leaves, width of leaves, diameter of pseudobulb and number of pseudobulbs.

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

D. Barman, R.C. Upadhyaya and Rampal

Studies on cormel to corm production

Planting of gladiolus cormel (less than 1 cm size) at a spacing of 20 ´ 25 cm in Soil + FYM + Leaf Mould +Oil cake remarkably increased germination percentage (95.73%), plant height (69.24 cm) and leaf length (49.49 cm) as compared to other media. Further, the different type of growing media significantly influenced corm weight and cormel production. The maximum corm weight (24.75 gm) with larger diameter (4.85 cm) and more number of cormel (34.13) per plant was recorded at Soil + FYM + Leaf mould media.

Studies on whole and excised corms and cormel production

The planting of whole and excised corm significantly influenced on number of leaves/ plant, spike length, rachis length, number of floret per spike and total weight of corms (Table 3). The whole sized corm produced maximum plant height (61.8 cm), more number of (8.73), elongated leaves (39.73), maximum spike length (92.8 cm), rachis length (65.53 cm) and more number of florets (15.4). However the whole and excised corm did not influence remarkably the corm and cormel production.

Table 3. Studies on whole and excised corms on corm and cormel production

Treatment	Germi-Nation %	Plant Height (Cm)	No of Leaves	Length of Leaves	Width of Leaves	Spike Length	No of Spikes	No. of Flowers (gm)	Wt of Corms Plant	No of Corms/
Whole corm	75.0	61.8	8.73	39.73	3.9	92.8	15.4	11.28	28.21	1.6
3/4[1] corm	72.2	55.9	7.86	39.33	3.58	83.6	12.46	10.13	16.74	1.13
1/2 corm	75.0	61.2	8.33	39.66	4.13	78.2	12.6	9.97	24.62	1.00
1/4 corm	63.8	41.6	4.11	33.86	2.40	40.16	7.66	8.72	10.07	1.00
Sem	16.8	15.3	1.62	4.04	1.02	21.73	3.25	0.63	11.48	0.5
CD (0.05)	NS	NS	2.16	NS	NS	44.38	6.63	NS	22.28	NS

Influence of mother corm size on flowering and corm development in Gladiolus *cv.* Jester

The different grade of mother corm significantly influenced on various morphological and floral characters. An increasing trend was followed with increased size of corm. Maximum daughter corm was recorded at extra jumbo size corm (7.6 cm). Further, planting different size of corm significantly influenced the corm weight and diameter. However, the size of mother corm did not respond significantly on cormel number and weight per plant (Table 4).

Table 4. Influence of mother corm size on flowering and corm development in gladiolus cv. Jester

Treatment	Plant height (cm)	Leaf No.	Flowering duration (days)	Spike length (cm)	No. of florets / spike	Weight of corm (gm)	Diameter of corm (cm)	No. of cormel /plant	Weight of cormel (gm)
T1	36.73	4.13	-	-	-	26.41	4.37	1.43	0.47
T2	37.93	4.93	7.60	65.33	11.46	25.71	4.13	1.21	0.39
T3	41.86	6.53	8.06	62.53	12.93	27.96	5.11	3.08	0.94
T4	56.33	6.86	11.4	85.86	17.73	36.10	5.18	9.60	3.24
T5	60.13	6.93	12.13	91.73	18.13	34.77	5.53	11.06	0.23
T6	60.66	7.6	14.73	97.66	19.53	59.51	6.57	13.0	0.97
T7	65.06	7.6	15.66	99.00	19.80	42.52	6.05	17.80	0.47
SEM	2.58	4.61	0.72	3.65	0.51	9.93	0.31	8.63	1.53
C.D. (0.05)	5.38	N.S	1.51	7.61	1.08	20.72	0.66	N.S	N.S

Effect of mulching on cut flower and corm production in gladiolus

The dry weed mulching had significant role on plant height, number of leaves, length of leaves, number of florets and weight of corms as compared to non-mulching. However, the variations were not statistically significant. Mulching with black polythene sheet enhanced spike length, rachis length and diameter of corm.

Influence of potash and spike removal on corm and cormel production in gladiolus cv. Summer Pearl.

The stage of harvesting of spike remarkably influenced the weight and size of corm and cormel number (Table 5). The additional increment of potassium significantly enhanced the plant height, corm weight and diameter as well as cormel number, while a decreasing trend was followed due to delayed harvesting of spike.

Table 5: Effect of K and spike removal on morphological characters, corm and cormel production.

Treatments	Plant height (cm)	Number of corm	Weight of corm (gm)	Mean weight (gm)	Diameter of corm (cm)	Number of cormel	Weight of cormel (gm)	Mean weight (gm)
S1	54.44	1.90	40.50	21.31	5.31	49.80	12.48	0.25
S2	61.68	1.55	32.38	20.89	5.08	36.20	8.76	0.24
S3	52.36	1.40	23.36	16.68	4.94	33.28	7.89	0.23
S4	51.72	1.15	18.91	16.47	4.46	31.43	6.26	0.20
SEm	1.80	0.05	2.15		0.50	2.66	1.53	
CD at 5%	4.43	0.12	9.61		1.23	6.57	3.77	
K1	45.92	1.09	25.62	23.55	4.39	35.66	7.59	0.21
K2	59.54	1.30	30.57	23.51	5.12	38.37	8.52	0.22
K3	59.70	1.65	41.58	25.21	5.33	38.95	8.96	0.23
SEm	1.55	0.02	1.95		0.39	1.19	0.92	
CD at 5%	4.29	0.05	5.40		1.08	3.20	NS	

6. AD-HOC PROJECT :

Project : Protected cultivation of Ornamentals

Effect of growth regulators on reducing of pre blooming period of *Cymbidium* hybrid.

The experiment was laid out using BA (100, 200, 300 PPM), GA 3 (100, 200, 300 PPM) and IAA (250, 500, 750 PPM) to study their influence on growth and flowering of *Cymbidium* hybrids. Each treatment sprayed on monthly intervals and replicated five times in a randomised block design.

The results revealed that IAA 250 PPM enhanced number of leaves (7.32), and girth of pseudobulb (3.60) however, GA_3 10 PPM produced longest leaves (46.63 cm). The maximum number of shoot (3.00) was recorded at the plants sprayed with 300 PPM of GA_3 .

Effect of N, P, & K on growth and flowering of *Cymbidium* hybrid.

Investigations were undertaken to study the influence of foliar spray of 3 macronutrients at various concentrations (N-10, 20, 30; P-10, 20, 30 and K-10) and combination (18) at weekly intervals. Various growth parameters like number and length of pseudobulb, girth of pseudobulb, number of leaves per shoot, length of shoot etc were recorded at monthly intervals.

The results indicated that spraying of N30: P10: K10 at 0.1 % concentration increased the length of leaves (50.00 cm) and number of leaves (7.30). However the length of bulb (5.50) and number of shoots (3.90) was found more in case of N20: P30: K10 at 0.1% concentration as compared to other treatments. The application of N10: P30 : K10 at 0.2 % concentration produced maximum number of pseudobulb (4.15).

8. National Research Centre for Orchids, Darjeeling Campus

INFRASTRUCTURE DEVELOPMENT :

Building : The building which was inherited from CPRS was in very dilapidated condition. The work for renovation of building is being taken up in phased manner. The first phase of renovation has been completed and for the second phase, the CPWD has been asked to frame the estimates.

Land Boundaries : The work for fencing of land boundaries of NRC (O), Darjeeling Campus is in progress.

Library : The Head office made available 18 (eighteen) more books related with Horticulture. The books have been included in the campus library.

9. Research Activities

Project 1. Collection, conservation, characterisation and maintenance of high altitude orchid germplasm.

Rampal

Collection: 25 more species of orchids have been added to the previous collection. All the species of Orchids have been maintained in the orchidarium.

The newly introduced species includes

Acanthepium striatum Lindl.
Anoectochilus crispus Lindl.
Anoectochilus lanceolatus Lindl.
Anthogonium gracile Lindl.
Bulbophyllum leopardinum (Wall) Lindl.
Calanthe alismaefolia Lindl.
Calanthe anthropophora Lindl.
Calanthe aungusta Lindl.
Calanthe alpina Lindl.
Calanthe biloba Lindl.
Calanthe brevicornu Lindl.
Calanthe ceciliae Reichb. F.
Cymbidinium devonianum Paxt.
Dendrobium longicornu Lindl.
Dortis pulcharima Lindl.
Eria coronaria (Lindl.) Reichb. F.
Liparis resupinata Reidl.
Liparis bootalensis Griff..
Liparis tigerhillensis A.P.Das & Chanda.
Nephalaphylum nudum J. D. Hook.
Nephalaphylum pulchrum var. Sikkimensis J. D. Hook.
Nephalaphylum cerdifolium (Lindl.) Lindl.
Papheopedilum ferrieanum
Phaleonopsis sp.
Otochilus albus Lindl.

Maintenance: Above mentioned species of orchids have been maintained in the Campus Orchidarium.

Characterisation: The species are further being evaluated for their horticultural traits.

Project 2. Collection, conservation, multiplication of bulbous ornamentals.

Collection : Fairly large numbers of bulbous ornamental have been introduced in the campus. The introduced bulbous ornamental species include:-

Achemenes longiflora
Acidanthera bicolor
Agapanthus umbellatus
Amaryllis belladona
Arisaema flavum
Arisaema speciesum
Begonia sp.
Caladium sp.
Clivia miniata
Crinum asiaticum
Crinum sp.
Cyclamen sp.
Glaxonia sp.
Gloriosa carsonii
Gloriosa lutea
Gloriosa superba
Gloriosa rothschildiana
Haemanthus multiflorus
Hedychium flavum
Hippeastrum
Hyacinthus orientalis
Iris sp.
Lilium giganteum
Lilium longiflorum
Lilium tigrinum
Narcissus sp.
Orinthagalum umbellatum
Sinningia speciosa
Zantedeschia aethiopica
Zephyranthes candida
Zephyranthes robusta
Zephyranthes reesea
Zephyranthes sulphurea

Multiplication : The above mentioned bulbous ornamentals are being multiplied through conventional methods of propagation.

PARTICIPATED IN SEMINAR/ SYMPOSIA/ CONFERENCE/ WORKSHOP / MEETING

1. National Symposium on Emerging Scenario in Ornamental Horticulture in 2000 AD and beyond. July 21-22nd 1999. IARI New Delhi.	Dr. R.C. Upadhyaya & Dr. Shyamali Chakrabarti
2. International Conference on Green House technology for small scale farmers, 12th August 1999, Pune.	Dr. R.C.Upadhyaya
3. Jai Vigyan National Science and Technology mission on conservation of Agrobiodiversity (PGR) – First consultation cum orientation workshop on plant biodiversity, NBPGR, New Delhi, August 24-25th, 1999	Dr. V. Nagaraju
4. Directors conference at NBPGR, New Delhi, Sept., 8-9th 1999	Dr. R.C.Upadhyaya
5. Regional Committee meeting of region III at Shillong, Nov., 9-12th 1999	Dr. R.C.Upadhyaya
6. International Symposium on citriculture, Nov., 23-27th, 1999 at NRC for Citrus, Nagpur.	Dr. R.C.Upadhyaya
7. National Symposium on Commercial Floriculture In India, 22-24th January 2000, at BCKVV, Calcutta.	Dr. D. Barman
8. National Conference on Gladiolus from January, 24-25th, at NBRI, Lucknow.	Dr. D. Barman
9. National Seminar on Plant Biology, 3-5th Feb., 2000, CPCRI, Kasaragod.	Dr. V. Nagaraju
10. International Conference on Managing Natural Resources, New Delhi, 14-18th Feb., 2000	Dr. V. Nagaraju
11. NATP Zonal level Workshop on Plant genetic resources at NBPGR Regional Station, Barapani, Shillong on 26th Feb., 2000	Dr. V. Nagaraju

HUMAN RESOURCE DEVELOPMENT

- Dr. S.P.Das, Scientist (Plant Breeding), 67th FOCARS Training at NAARM, Hyderabad June 1st - Sept 28th, 1999.
- Dr. Shyamali Chakrabarti, Sr. Scientist (Genetics), Deputed for learning techniques of DNA Finger printing at NRC for DNA finger printing, NBPGR, New Delhi,July23rd-Aug28th1999.
- Dr. S.P. Das, Scientist (Plant Breeding) attended a training programme on Advanced Statistical Techniques in Research for Crop and Animal Improvement (ASTRCAI), from 3rd January to 17th January, 2000, at Centre for Advanced Studies in Agricultural Statistics and Computer Application, IASRI, New Delhi.

PUBLICATIONS

Papers presented in seminars/symposia/conference

1. Barman, D., Upadhyaya, R.C and Rampal. 1999 Aromatic Orchids of Eastern Himalaya. Natl. Symposium on Emerging Scenario in Ornamental Horticulture in 2000 AD and beyond, 21-22nd July 1999., IARI New Delhi.

2. Upadhyaya, R.C and Nagaraju, V. 1999. Status and future prospect of floriculture in India with particular reference to Orchids. Intl. Conf. Green House Tech. for small scale farmers held at Yashada, Pune. 12th Aug., 1999.

3. Barman, D., Das, S.P., Nagaraju, V and Upadhyaya, R.C. 2000. Influence of mother corm size on flowering and corm development in Gladiolus. Natl. Conf. Gladiolus, Jan, 24-25, NBRI, Lucknow, Abst. 22.

4. Barman, D., Nagaraju, V and Upadhyaya, R.C. 2000. Effect of potash and spike removal for corm and cormel production in gladiolus. Natl. Symp. Comm. Floric. In India, 22-24th Jan. 2000, BCKVV. Calcutta.

5. Nagaraju, V and Upadhyaya, R.C. 2000. Effect of media and growth substances on *in vitro* multiplication of *Cymbidium*. Natl. Sem. Pl. Biol., 3-5th Feb. 2000, CPCRI, Kasaragod. p. 120.

6. Nagaraju, V and Upadhyaya, R.C. 2000. *In vitro* proliferation of *Cattleya maxima*. Natl. Seminar. Pl. Biol., 3-5th Feb. 2000, CPCRI, Kasaragod. p.127.

7. Upadhyaya, R.C., Burman, D., Nagaraju, V., Das, S.P and Bhutia, P.C. 2000. Orchid Resources of Hindu Kush Himalayas. Intl. Conf. Managing Natural Resources, New Delhi, 14th-18th Feb, 2000, p.1138.

10. Personalia

SCIENTIFIC

Sl. No.	Name	Designation
1.	Dr. R.C. Upadhyaya	Principal Scientist (Hort.) and Director
2.	Dr. V. Nagaraju	Sr. Scientist (Biotechnology)
3.	Dr. (Miss) Shyamali Chakraborti	Sr. Scientist (Genetics)
4.	Dr. D. Barman	Scientist (Hort.)
5.	Shri Ram Pal	Scientist (Hort.)
6.	Dr. S.P. Das	Scientist (Plant Breeding)
7.	Dr. Vishlesh S. Nagrare	Scientist (Entomology)

TECHNICAL

1.	Shri. P.B. Subha	Tech. Asst. (T-II-3)
2.	Miss Pema Choden Bhutia	Tech. Asst.(T-II-3) Horticulture
3.	Shri Sunil Kumar	Tech. Asst. (T-II-3) Computer
4.	Shri G.B. Mukhiya	Field Farm Tech. (T-1)
5.	Shri D. Bhujel	Field Man (T-1)
6.	Shri R.C. Gurung	Technical Asst. (T-1) Driver

ADMINISTRATION

1.	Shri Davis Joseph	Asst. Admn. Officer (On deputation)
2.	Miss Lakit Lepcha	Assistant
3.	Shri Rajat Kr. Das	Sr. Clerk
4.	Shri Abhaya Kumar	Sr. Clerk (On deputation)
5.	Mrs. Diki Bhutia	Jr. Clerk
6.	Mrs. Dilmaya Subha	Jr. Clerk

SUPPORTING

1.	Shri. S.K. Tamang	S.S.G – IV
2.	Shri T.B. Singh	S.S.G – II
3.	Shri Gopal Brahmin	S.S.G – II
4.	Shri Phigu Tshering Bhutia	S.S.G – I
5.	Shri Dawa Butia	S.S.G – I
6.	Shri Tularam Dulal	S.S.G – I
7.	Miss. Meena Kumari Chettri	S.S.G – I
8.	Sri. Trilok Singh Balmiki	S.S.G – I

APPOINTMENTS

- Dr. R.C. Upadhyaya, Principal Scientist and Director i/c joined on 9th April 1999.
- Dr. Shyamali Chakrabarti, Sr. Scientist (Genetics) joined on 8th May 1999.
- Dr. Vishlesh S. Nagrare, Scientist (Entomology) joined on 18th November 1999.

11. Budget Expenditure

Statement of expenditure for the year 1999-2000 (Rs. in lakhs)

Sl. No.	Head of Account	Expenditure 1999-2000
1.	Establishment charges	1.5
2.	Travelling allowance	3.5
3.	Other charges including equipments	25.0
4.	Works	90.0
	Total	**120.0**

Management Committee

1.	Dr. R.C. Upadhyaya, Director, NRC for Orchids, Pakyong	Chairman
2.	Dr. B. S. Dhankar, Asst. Director General (VC), I.C.A.R, New Delhi	Member
3.	Dr. V. Nagaraju, Sr. Scientist (Biotechnology) , NRC for Orchids, Pakyong	Member
4.	Dr. D. Barman, Scientist (Hort.) NRC for Orchids, Pakyong	Member
5.	Mr. Rampal, Scientist (Hort.), NRC for Orchids, Darjeeling Campus	Member
6.	Dr. S. P. Das, Scientist(Plant Breeding), NRC for Orchids, Pakyong	Member
7.	Mr. Davis Joseph, Asst. Admn. Officer, NRC for Orchids, Pakyong	Member Secretary

Research Advisory Committee

Dr. P. Pushpangadan, Director, NBRI, Lucknow	Chairman
Prof. T.K. Bose, Calcutta	Member
Dr. I. Irullapan, Director, NSL Ltd., Chennai	Member
Prof. P. Das, Director, RPRC, Bhubaneswar	Member
Prof. S.P. Vij, Botany Dept., Punjab University, Chandigarh	Member
Dr. R.C. Upadhyaya, Director, NRC for Orchids, Pakyong	Member
Dr. V. Nagaraju, Sr. Scientist (Biotechnology), NRC for Orchids	Member
Dr. Shyamali Chakraborti, Sr. Scientist (Genetics)	Member Secretary

Brainstorming Session

The first Brain storming session of the Institute was held on 14th October 1999 to formulate the research strategies and research based developmental programmes on orchids and bulbous ornamentals. Dr. S.P. Ghosh, DDG (Hort.) inaugurated the programme. About 25 eminent scientists of different Institutes and high level officials of state Agriculture and Horticulture Dept., Govt. of Sikkim and also progressive farmers were participated in the session. The stalwarts of Orchids research in India like Prof. Pushpangadhan, Prof. S.P. Vij, Dr. I. Irullappan, Dr. Seeni, Dr. Satish Mohan, participated in the session. The important issues were discussed in two separate technical sessions. In session I crop Improvement aspects of orchids was discussed which was chaired by Dr. Pushpangadhan, Director, National Botanical Research Institiute, Lucknow. In session II, Crop production was discussed, which was chaired by Dr.Irulappan, Director, NSL Ltd. Chennai.

विशिष्ट सारांश

भारतभर में आर्किडों की लगभग 1300 प्रजातियां पाई जाती हैं, जिनमें से लगभग 800 प्रजातियां देश के उत्तर पूर्वी क्षेत्र में मौजूद हैं। उत्तर-पूर्वी हिमालय, प्रजातियों की संख्या में ही सम्पन्न नहीं है, अपितु यहां की सबसे महत्वपूर्ण बात यह है कि इस क्षेत्र में पाई जाने वाली अनेक प्रजातियां महत्वपूर्ण सजावटी पौधों की सूची में सबसे ऊपर के स्थान पर हैं। सिक्किम हिमालय, के सिक्किम और दार्जलिंग क्षेत्र में लगभग 450 प्रजातियां मौजूद हैं और इतना ही नहीं यह क्षेत्र सिम्बिडियम जैसी महत्वपूर्ण प्रजातियों के उद्‌भव का केन्द्र स्थल भी है।

केन्द्र के वैज्ञानिकों और कर्मचारियों ने अपना बहुमूल्य योगदान देने के लिए बड़ा ही कड़ा परिश्रम किया है। तथापि यहां कार्य कर रहे वैज्ञानिकों को, कोई बहुत अच्छी तकनीकी और कोई दूसरी सहायता नहीं मिल रही है, क्योंकि संस्थान में मानवशक्ति की स्थिति स्थिर बनी हुई है। इन सीमाओं के बावजूद केन्द्र आर्किडों की 300 से अधिक प्रजातियां एकत्रित कर पाया है। लगभग 100 प्रजातियों के आकारकीय एवं आर्किड अभिलक्षणन का काम शुरू किया गया है। संकलित की गई प्रजातियों मे से कुछ दुर्लभ हैं, कुछ संकटापन्न हैं अथवा कुछ विलुप्त होने के कगार पर हैं। बलबस पुष्प वाले पौधों की 33 प्रजातियां एकत्रित की गईं और उनका अभिलक्षणन का काम किया गया। आर्किडों को व्यावसायिक रूप से लगाने के लिए कृषि तकनीकों के मानकी करण का काम चल रहा है। सिम्बिडियम की श्रेष्ठ संकर तैयार करने के लिए प्रजनन का काम आरंभ किया गया है। ऊतक संवर्धन प्रयोगशाला ने काम करना शुरू कर दिया है और सिम्बिडियम संकार एवं कैटलिया मैक्सीमा के परखनली बहुगुणनतथा मूलोत्पत्ति के लिए प्रोटोकोल को मानकीकृत कर दिया गया है। सिम्बिडियम एवं अन्य प्रजातियों के विभिन्न संकरों से प्राप्त भ्रूणों के हरे शिम्बों को संवर्धित कर प्राटोकॉर्म प्राप्त किए गए। एन.आर.सी.डी.एन.ए.एफ.पी., नई दिल्ली से मिल रही तकनीकी एवं बुनियादी-ढ़ांचागत मदद से डी.एन.ए. चिन्हकों के माध्यम से आर्किडों की प्रजातियों के आण्विक अभिलक्षणन का काम शुरू हुआ और सिम्बिडियम, डेण्ड्रोबियम और कोइलोज़ाइन की 16 प्रजातियों की फिंगर प्रिटिंग रूपरेखा तैयार की गई। पुराने भवन का नवीनीकरण कर मूलभूत सुविधाएं मुहैया कराई गई हैं और उपकरण व फर्नीचर प्राथमिकता के आधार पर खरीदा गया। इस अवधि के दौरान केन्द्र में किए गए अनुसंधान कार्यों से निकाले गए निष्कर्ष संक्षिप्त रूप से निम्नानुसार हैं :

- उत्तर पूर्वी भारत और पश्चिम बंगाल के दार्जलिंग जिले से 80 वंशों की 300 आर्किड प्रजातियों को एकत्रित कर 250 प्रजातियों की पहचान की गई। इनमें से कुछ दुर्लभ हैं, कुछ संकटापन्न हैं अथवा जंगलों से पहले ही विलुप्त हो चुकी हैं।

- लगभग 40 सिम्बिडियम संकर, 5 डेण्ड्रोबियम संकर, 2 अरण्ड संकर और 1 वैण्डा संकर भी प्राप्त किए गए और उन्हें भावी आन्वेषणों के लिए रखा गया। आर्किडों के अलावा केन्द्र द्वारा बलबस पुष्प पौधों की 33 प्रजातियां भी एकत्रित की गईं।

- गमलों में डाला जाने वाला पूर्ण फंफूदी (लीफ माऊल्ड) एफ.वाई.एम. और बुरादे का समानुपातिक मिश्रण, नए तनों के विकास एवं सिम्बिडियम के सूडोबल्ब की बढ़वार के लिए एक आदर्श मिश्रण है।

- सावधिक अन्तराल पर कार्बनिक खाद के पत्रीय उपयोग से ना सिर्फ वनस्पितिक बढ़वार होती है अपितु बागों में पुष्प कालिकाएं फूटती हैं।

- सिम्बिडियम संकर के खिलने से पूर्व की अवधि को कम करने के लिए एक पखवाड़े के अन्तराल पर नीम की खली 1:25 के अनुपात में कार्बनिक खाद पत्रक के रूप में डालने से इसकी बढ़वार प्रभावित होती है।

- गमलों में एफ.एल.वाई. सैण्ड + एफ.वाई.एम. + पर्ण फफूंदी और एफ.वाई.एम. + पर्ण फफूंदी के समानुपातिक मिश्रण से सिम्बिडियम सूडो बल्ब की जड़ एवं तने में वृद्धि होती है।

- 250 पी.एम. पर आई.बी.ए. से सूडो बल्ब की जड़ एवं तने की बढ़वार में सुधार होता है।

- 'सजावटी पौधों की संरक्षित खेती' नामक तदर्थ परियोजना के तहत 2 प्रतिशत की दर से बढ़वार नियामकों और कार्बनिक पोषक तत्त्वों अर्थात् NPK 15.10.10 में 500 पी.पी.एम., पर GA_3 से सिम्बिडियम संकर की वनस्पतिक बढ़वार में सुधार होता है।

- ग्लैडिओलस की बेहतर गुणवत्ता वाली रोपण सामग्री का उत्पादन करने के लिए 3 से.मी. से अधिक के व्यास वाला घनकंद (कॉर्म) रोपित करने से अच्छी गुणवत्ता वाले घनकंद तो मिले ही साथ ही घनकंदक भी अधिक संख्या में पैदा हुए।

- आविर्भाव की अवस्था में ही कणिश (स्पाइक) को काट देने तथा 150 कि.ग्रा. K_2O / डालने से भी ग्लैडिओलस Cv समर शाइन में घनकंद और घनकंदकों का उत्पादन प्रभावित हुआ।

- मिट्टी पर्ण फफूंद और एफ.वाई.एम. के समान मिश्रण में घनकंदकों का रोपण करने पर एक मौसम में बाजार योग्य घनकंदों का उत्पादन हुआ।

- सिक्किम के मध्यवर्ती पहाड़ी क्षेत्र में कट फ्लॉवर का उत्पादन करने के लिए ग्लैडिओलस की एट वण्डर और जेस्टर आशाजनक किस्में हैं।

- ग्लैडिओलस के कट फ्लॉवर और घनकंद के उत्पादन के लिए 30x20 से.मी. की दूरी पर रोपा जाना अनुकूलतम हैं।

- कम से कम सुविधाओं वाली एक जैवप्रोद्योगिकी प्रयोगशाला स्थापित की गई।

- पूरक रूप में BAP और सक्रियित काष्ठकोयला डालने से प्रोटोकॉर्मों का प्रचुरोद्भवन बढ़ता है और पादपकों में भिन्नता आती है।

- विभिन्न प्रजातियों के पेड़ों से आच्छादित 5 एकड़ फार्म वन भूमि को आर्किडों के स्वस्थाने संरक्षण के लिए चिन्हित किया गया।

- प्रोजेक्ट-नैट-प्रोजेक्ट के तहत फाईबर ग्लास का एक और दो पॉलीहाऊसों का निर्माण किया गया।

13. Distinguished Visitors

Visitor	Organization	Date
Dr. H.P. Singh	Horticulture Commissioner, DAC, Krishi Bhawan, New Delhi	3.4.99
Mr. Arvind Risbud	P. S. to Minister, Civil Aviation & Tourism, Govt. Of India	6.4.99
Dr. I. Irulappan	Director (ops), NSL Ltd, Chennai.	6.4.99
Mr. Vinod Kr. Kaul	Assistant Direcotr, APEDA, Calcutta	6.4.99
D.K. Saikia	Flora Exotica, Guwahati	6.4.99
Dr. K.V. Peter	Director, Indian Institute of spices research, Calicut	10.4.99
Dr. Dipak Sarkar	Head, NBSS & LUP, Regional Centre, (ICAR), Calcutta	20.5.99
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Dr. A.A.Sofi	Director, Central Institute of Temperate Horticulture, Srinagar	20.11.99

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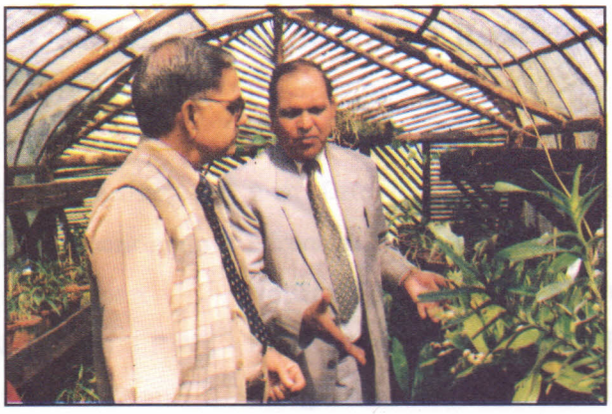
Mr. Khorlo Bhutia	Joint Director, Horticulture(E)	3.11.99
Dr. G.B. Rathuri	Head, C.H.E.S. I.I.H.R., Godhra	21.12.99
Dr.K.M. Bujarbaruah	Director, NRC for Mithun , Nagaland	30.12.99
Mr. H.Y. Mohan Ram	Department of Environment Biology, University of Delhi	22.2.2000
Dr. S.K. Bhattacharjee	Project Coordinator, AICFIP, ICAR, New Delhi-12	23.2.2000
Mr. M.C. Khati	Additional Director, Deptt. of Agriculture, Gangtok	14.3.2000
Mr. P. Das	Director, Regional Plant Research Centre, Bhubaneswar.	14.3.2000
Dr. Mathura Rai	Head, Central Horticultural Experimental Station, Ranchi	15.3.2000
Dr. B.P. Tripathy	Sr. Scientist (Soil Sci.), Agricultural Research Station, Lumlke, Nepal.	17.3.2000
Mr. R.C. Munankarmy	Sr. Scientist (Soil Sci.), Agricultural Research Station, Nepal	17.3.2000
Mr. K.N. Mishra	Senior Scientist (Soil Science) Nepal	17.3.2000

Visitors



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