Technical Bulletin No. 12

COMMERCIALIZATION OF CYMBIDIUMS IN SIKKIM

NRCO turning a dreams into reality

National Research Centre for Orchids
(Indian Council of Agricultural Research)
Pakyong – 737 106, Sikkim, India

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Commercialization of *Cymbidiums* in Sikkim

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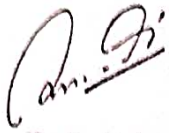
Foreword

India's second smallest and one of the most beautiful states, Sikkim is endowed with perfect climate and enormous biological diversity. The right type of climate provides an opportunity to grow a variety of flower crops, whereas the biological diversity gives an opportunity to engineer new products to satisfy the consumers. The importance of floriculture has been well recognized by the governments at centre as well as the state. Several programmes for promotion and expansion of floriculture business have been launched that have created a positive impact on rural unemployed youth. Perhaps, Sikkim is the only state whose policy is to promote organic floriculture and link it with the tourism industry by 2015. The favourable climatic conditions permit to cultivate almost all flower crops including orchids. However, a careful selection of crops needs to be made keeping in view the distance from production to consumption centre, cost of transportation and above all returns on investments. This dictates to grow high value and low volume flower crops, like orchids. Orchids have been gaining ground in Indian floriculture markets, but the most of the demand is met through the inferior quality dumped produce from South East Asian Nations. Sikkim has right climatic conditions to grow a variety of orchids requiring tropical to temperate climatic conditions. Cymbidium orchids fetch highest per unit price in the markets and also give the highest return per unit area to the farmers. These flowers get ready for marketing between Novembers to April when the

demand is high, but supplies are low. Though cultivation of cymbidium provides a big opportunity of earning for better livelihood but cultivating them requires technical expertise, which is lacking with the farmers. This bulletin is the outcome of demonstration programme undertaken by National Research Centre for Orchids under the DBT's Mission For Quality Planting Material Production and Utilization for the North –East. Under this programme, five demonstration units were set up at Kartok, Pakyong, Assam Lingzey in East Sikkim, Sombaria in West Sikkim, and Yangang in South Sikkim. There were 55 beneficiaries of the project who were given all most all the facilities and inputs except the labour for cultivation of cymbidium orchids on scientific lines. Cymbidium performed well in all the locations, but Yangang and Sombaria were tuned to be the best new production zones. I am sure the current publication 'Commercialization of Cymbidiums in Sikkim: NRCO turning a dream into reality' will be useful to the scientists interested in taking their technologies to the farmers' field, extension workers and entrepreneurs interested in commercialization of orchids in the country.



R.P. Medhi
Director

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INTRODUCTION

Sikkim is the second smallest state of India situated in Himalayan Mountains. It is bordered with Nepal in the west, China's Tibet Autonomous Region in the north and east and Bhutan in southeast. State of West Bengal lies to the south of this beautiful state. It is mountainous terrain with an elevation ranging between 280 meters to 8,586 meters. Here, most of the land is unfit for cultivation because of rocky and sloppy mountains. However, some slopes have been converted into terraced farms for cultivation of paddy, maize, zinger, cardamom, mandarins, etc. Only 12 percent of the total geographical area is under cultivation between the vertical gradient from 300 m (tropical) to 5000 m the (temperate). This region is highly significant in terms biological diversity as well as economic sustenance of sixty five percent population of the state. The state experiences subtropical to alpine climate and annual rainfall vary from 2,700 mm to 3,200 mm. The temperature is mild during summers (28^0C) but exceedingly cold (sub zero) during winters. The state is abundantly rich in biodiversity including orchids. The climatic conditions of the state are congenial for growing a variety of orchids. Among all orchids, the cymbidiums hold highest promise for the state. These orchids produce long-lasting, attractive, delicately colored, waxy cut flowers used for indoor decorations and for making corsages. Nowadays, they are also gaining popularity as high quality decorative pot plants. New Zealand, Australia, Netherlands, and United States of America (USA) are the world leader in the production of cymbidiums. The first hybrid of *Cymbidium* appeared in the later part of the nineteenth century

between *Cymbidium lowianum* Reichb.f and *Cymbidium eburneum* Lindl. in England. Further, the discovery of asymbiotic germination by Lewis Knudson in 1922 bypassed the mycorrhizal requirement in germination of orchid seeds. Using this method, seeds of orchids could be germinated aseptically on medium containing sugar and nutrient. There was a massive upsurge in development of orchid hybrids world over. The countries like Netherlands, United States of America, United Kingdom, New Zealand and Australia took a lead and have produced a large number of *Cymbidium* cultivars. The list of registered hybrids of cymbidium has crossed the figure of 14,000 and every year some 250 add to this pool. These hybrids are back bone of *Cymbidium* industry in the world. India is rich in orchid genetic resource including cymbidium. Twenty species of *Cymbidium* are known to occur within the political boundaries of India. Five of them have made a significant contribution in development of modern hybrids. Now, a few species of Chinese, Australian and Japanese origin have also become a choice of breeders for breeding the varieties for pot plant production as well as inducing warm/hot tolerance. Economically, cymbidiums have the potential to give the highest return per unit area than any other crops grown in hilly and socially and economically backward regions of the country. In export markets cymbidium fetch about 2-3 euro per stem whereas, in domestic markets, they fetch between Rs. 125-250 per stem. These flowers can be a boon for the farmers with small land holdings. They have the capacity to change the economic landscape of the state. A study conducted by NRCO revealed that availability of planting materials and its cost are major bottlenecks in commercializing the orchids in this region.

A programme on 'Quality Planting Material Production and Utilization for the North –East was initiated' under the financial help of Department of Biotechnology (DBT) to set up quality orchids farms where scientific cultivation and management practices were demonstrated in management of cymbidium farms. The major objectives of this programme were as under:

- Production of quality planting material and its utilization in the N-E Region
- Setting up of quality farms for the identified products in each NE state
- Strengthen of tissue culture infrastructure base and establishment of institutional linkages for effective implementation
- Establishing marketing linkages for value products
- Upliftment of socio- economic condition of the farmers through employment and income generation.

2. CONSTRAINTS IN COMMERCIALIZATION

Cymbidium is a new crop for the farmers in Sikkim. It also requires huge investments in construction of polyhouse, purchase of planting materials, plant protection chemicals and fertilizers. Traditionally, Sikkim farmers grow vegetables, ginger, cardamom, and other cereal crops. They have a very little exposure to cultivate this new crop. Thus, the risks involved in integrating cymbidiums in their farming system are very high. Further, cymbidiums have long juvenile phase ranging from 4-5 years means no income during this lean period. The planting materials of good quality cut flower

cultivars is either not available or it is very costly and beyond the reach of small and marginal farmers. Inherently, flower crops are perishable in nature and require a huge investment on development of post harvest infrastructure. Govt. of Sikkim is very serious about development floriculture and has launched several schemes for promotion of floriculture in the state.

3. SELECTION OF CULTIVARS

Twenty five cultivars of cymbidiums belonging to standard, intermediate and miniature were evaluated at National Research Centre for Orchids, Darjeeling Campus, Darjeeling for their floral characteristics. The 4 promising cultivars *viz.* Levis Duke 'Bella Vista', Burgundian 'Sydney', Margaret Thatcher 'Diplomat' and Vivacious 'Super White' were selected for standardization of mass propagation protocol. A brief description of varieties is given below.

3.1 *Cym* Levis Duke 'Bella Vista'

This cultivar was developed by developed by Dos Pueblos Company, USA in 1969. It is a cross of Etta Barlow and Blue Smoke. It has four species namely *C. lowianum, C. insigne, C. parishii* and *C. eburneum* in its ancestry. However, the cultivar is dominated by *C. lowianum*. It is an attractive green flowered late season cultivar. The flower

spikes are very long and straight. The bloom count ranges between 12 to16. It is very good cultivar for cut flower production.

3.2 *Cym* Margaret Thatcher 'Diplomat'

This cultivar was registered by Valley Orchids, Australia in 1991. It is a cross of Valley Angel and Caulpaulin. The eight species namely *C. insigne, C. grandiflorum, C. lowianum, C. tracyanum, C. erythrostylum, C. parishii* is in its ancestry. The flowers spikes require training during cultivation. It is a mid season cultivar. The flowers are apple green in colour and flower count ranges between 16 to19.

3.4 *Cym* Vivacious 'Superwhite'

The cultivar was registered by Valley Orchids, Australia in 1982. It is a cross of Valya Craig and Sleeping Nymph. The 8 species namely *C. insigne*, *C. lowianum*, *C. grandiflorum*, *C. eburneum*, *C. parishii*, *C. shroederi* and *C. tracyanum* are in its background. As the name indicates, it is a white flowering cultivar. The spikes

require a very little training and the bloom count ranges between 10 to 14

3.5 *Cym* Burgundian 'Sydney'

This cultivar was registered by H.W.B. Schroder in 1955. It is a cross between *Cym* Remus and *Cym* Babylon. The cultivar produces upright flower spikes. The flower count varies from 14-16. The cultivar has five species namely *C. lowianum*, *C. insigne*, *C. iansonii*, *C. eburneum* and *C. tracyanum* in its background. The lip of flower is very beautiful. It is very good for cut flower production.

4. MICROPROPAGATION OF CYMBIDIUM

Micropropagation is a technique of producing a large number of plants rapidly by aseptic culture of meristematic regions under controlled nutritional and environmental conditions. The meristem are either derived from a disease free plant or viruses are eliminated by using thermotherapy, chemotherapy or both. the resulting plantlets are disease free and healthy. Cymbidiums were the first orchids propagated through shoot tip culture. Since then, a number of micropropagation techniques for mass propagation of cymbidium cultivars have been standardized. The plants propagated through micropropagation are genetically identical and physiologically uniform and flower faster than seeded plantlets.

4.1. Meristem tip culture

In Cymbidium plant, meristem lies at the tip of the auxiliary shoot buds emerging from the previous year's growth, remains enclosed with emerging leaves and leaf sheaths. The shoot tips emerging from backbulbs also contain meristem. In general, backbulbs do not produce the shoots as long as they are attached to mother plants, but when the backbulbs are detached and planted separately often produce shoots. Shoot tips from the previous year's growth or the backbulbs are used for initiating meristem tip cultures. The shoot tips are sterilised in ethyl alcohol (75%) for few seconds and then sterilised in mercuric chloride solution (0.01%) for 10 min. The shoot tips are rinsed 3-4 times to remove the traces of mercuric chloride. Meristematic cells are stable and plants produced from them are similar to the parent plants, except for the incidental mutations.

4.2 Media

The researchers have demonstrated that various kinds of media can be used for initiation of cymbidium shoot tip cultures. However, commercial laboratories prefer Murashige and Skoog (MS) medium for initiation of cultures. The media can be modified by adding vitamins, hormones and sugars as per suitability of cultivars.

4.3 Methodology

For culture initiation, the shoots are collected from healthy plants free from bacterial, fungal as well as viral diseases known to infect cymbidiums. The mother plants are screened by using virus detection techniques like ELISA, RT-PCR for Cym MV and ORSV. The shoot tips are obtained either from the

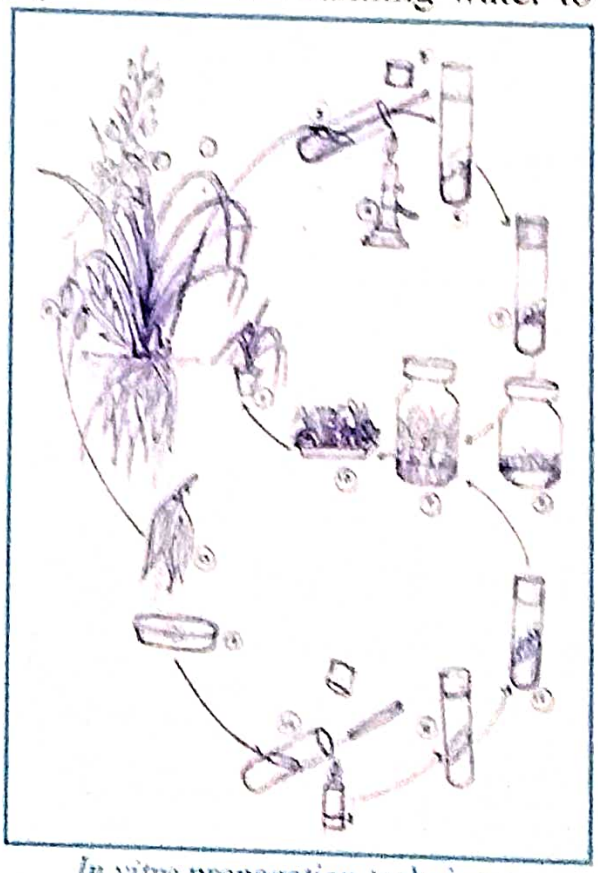
previous year's growth or shoots on backbulbs. The leaves covering the shoot tips are removed one by one until the white sheath is exposed. The distal and basal portion of the shoot is cut off at the two ends, locating the growing point somewhere in the middle of the shoot. The shoots are placed in a flask containing soap solution for 4-5 minutes and swirled occasionally. Thereafter, these are rinsed four to five times with distilled water until the soap solution washed out completely. A quick rinse is then given in 70 per cent ethyl alcohol. The shoot tips are again rinsed in sterile distilled water. Then the shoot tips are sterilised with 0.01 percent solution of mercuric chloride for 10 minute washed four to five times with sterile distilled water. The apex is excised with a sharp blade, and the explant is aseptically transferred to culture media. The inoculated tubes are kept in the culture room under light (2500 Lux) at 25°C. The excised tip turns green within 15 days and forms Plbs within 30 to 45 of culture.

The Plbs produced during the initiation of cultures are isolated and multiplied further on multiplication medium. The multiplication medium (MS/KC) is supplemented with plant growth regulator cytokinins and or auxins. 6-Benzyl aminopurine (BAP) and Naphthalene acetic acid (NAA) are commonly used in multiplication medium. The quantity of this plant hormone may vary with the cultivars and need to be worked out before applying on a commercial level because higher levels of plant growth hormone may cause somaclonal variations. The somaclonal variations are undesirable where the objective is to produce true-to-type plants.

Well-grown shoots are transferred to rooting medium. The

rooting media (MS/KC/NC) is generally supplemented with auxins for induction of roots. IBA and NAA are useful in inducing roots in cymbidiums. The dry leaves should be removed. While separating the plantlets from the clumps, care should be taken not to damage the basal portion of the shoots from where the roots emerge. The plantlets may be placed in culture bottles individually or in groups. Plantlets develop roots within 25-30 days after planting. Once the good root development has taken place, these may be moved for acclimatization.

The culture bottles are moved to acclimatization unit where the lids may be loosened and finally removed to reduce the relative humidity of the culture bottles. The plantlets are taken out of the culture bottles and thoroughly washed with running water to remove traces of the agar medium. The plantlets may also be washed in soapy water of mild detergent and rinsed 2-3 times with plain water to remove the soap. The plantlets are wetted off on paper towel or newspaper and finally dipped in fungicide. Hereafter, plantlets are planted in plug trays or perforated trays and placed in humidity chambers (for details see A manual for acclimatization of cymbidiums published NRC for Orchids)

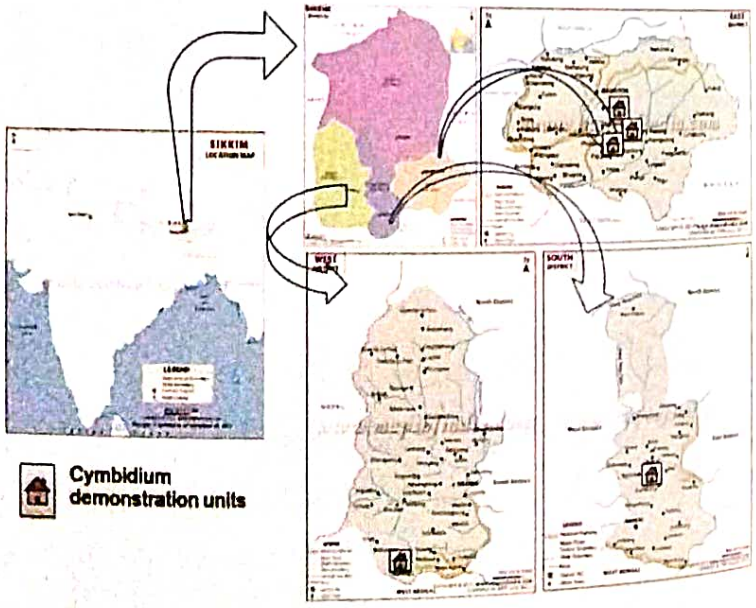


In vitro propagation techniques for *Cymbidiums*

5. INFRASTRUCTURE AND HUMAN RESOURCE DEVELOPMENT

5.1 Location of demonstration farms

Selection of the site is the most important decision that decides yield and profitability of crop under cultivation. A committee consisting of officials from Department of Horticulture and Cash Crops, Govt. of Sikkim and experts from National Research Centre for Orchids visited several places in Sikkim and suggested that Karthok, Pakyong, Assam Lingzey in East Sikkim, Sombaria in West Sikkim, and Yangang in South Sikkim would be ideal sites for setting up of cymbidium demonstration units. The sites were selected keeping in mind the suitability of climate for cymbidium cultivation, availability of good quality irrigation water, connectivity with the roads and interest of the farmers in cultivation of cymbidiums. The selected sites have been shown in the map. The demonstration units in Karthok, Assam Lingley and Pakyong (East Sikkim) were situated at an elevation of 1650, 1350 and 1250 MSL respectively whereas in Sombaria (West Sikkim) and Yangang (South Sikkim) were situated at 1200 and 1300 respectively.



Maps of three districts of Sikkim showing sites for cymbidium demonstration units

5.2 Assessment and selection of farmers

Cymbidium is a crop with long juvenile phase, generally a period of 4-5 years is required to obtain commercial yield. The cultivation of cymbidium requires technical expertise and involves heavy expenditure on development of infrastructure, procurement of planting material, potting media components, plant protection chemicals and fertilisers. Initially the farmers were reluctant to participate in cymbidium demonstration programme as the crop has long juvenile phase and requires heavy expenditure on care and maintenance of plants. An awareness workshop was organised to motivate the farmers,

Members of 5 SHG a. Green Zone Society, Karthok, b.Sayapatri Self Help Group, Assam Lingzey, C. Lotus Self Help Group, Pakyong D. Smriti Sangh, Sombaria and e. Bhavi Safalta Group, Yangang

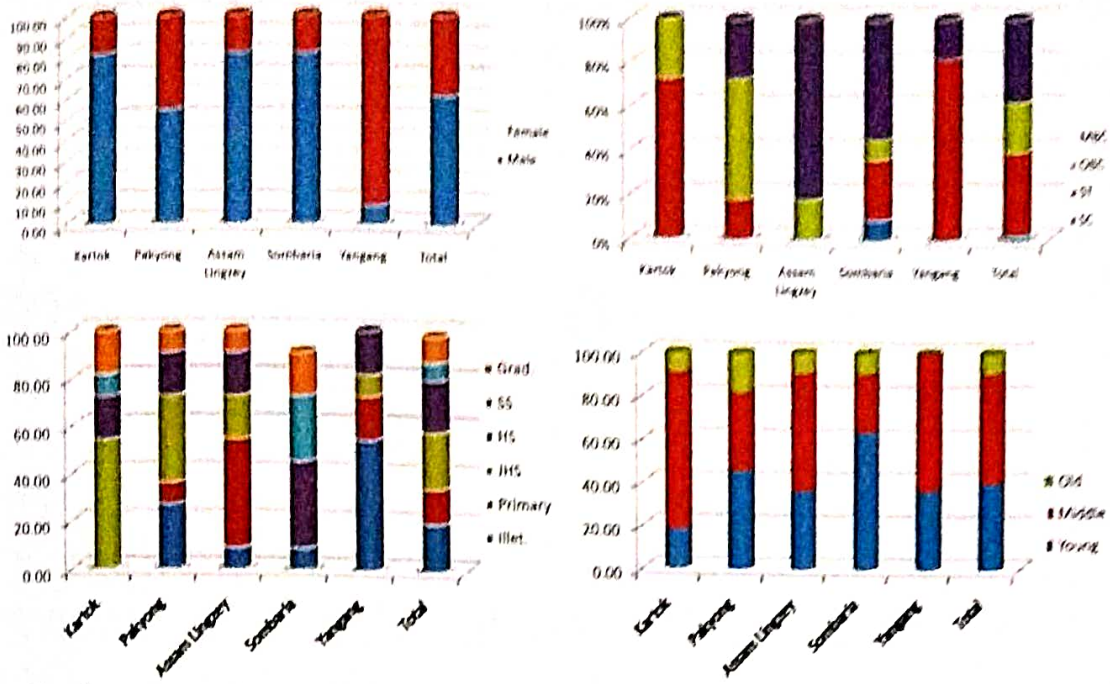
and they were told the benefits of cymbidium cultivation. Finally, the selection of farmers was done in a participatory manner by holding meetings in the village by explaining the

objectives of the demonstration and the role and responsibilities including expectations from the participating farmer. During the assessment exercise, Senior Technical Assistant (STA) collected detailed information about the farmers through interviews. Data collected were analysed and reviewed by the PI and COPIs of the project. All the 55 farmers, 11 from each location were encouraged to form Self Help Group (SHG). On behalf of individual SHG, the group leader signed a Memorandum of Understanding (MoU) stating their contribution to the project and what NRCO will provide in return for their support. Each group provided land for construction of polyhouse and free labour for management of demonstration units.

5.3 Ecational and social status of beneficiaries

Gender, age, social, economic and educational background of the selected farmers varied with the SHG. Women constituted 32 percent of all the farmers beneficiaries and were highest (90.1%) in Yangang. The SHG of Kartok, Assam Lingzey, and Sombaria had only 18.1 percent beneficiaries. Nearly 91 percent women beneficiary were either young (<35 years) or in their middle age (35-55 years). Only 9% beneficiaries were old (> 55 years.) The SHG of Sombaria had maximum young beneficiaries. Socially, the beneficiaries belonged to scheduled caste (SC), scheduled tribes (ST), most backward classes (MBC) and other backward classes (OBC). The SHG of Yanang had the highest number of ST beneficiaries (81.8 %) beneficiaries. There was only one SC beneficiary from Sombaria. Educationally, the beneficiaries were illiterate to graduate but the maximum were of Junior High School and

High School educational background. The graduate constituted about 11% of the total beneficiaries.

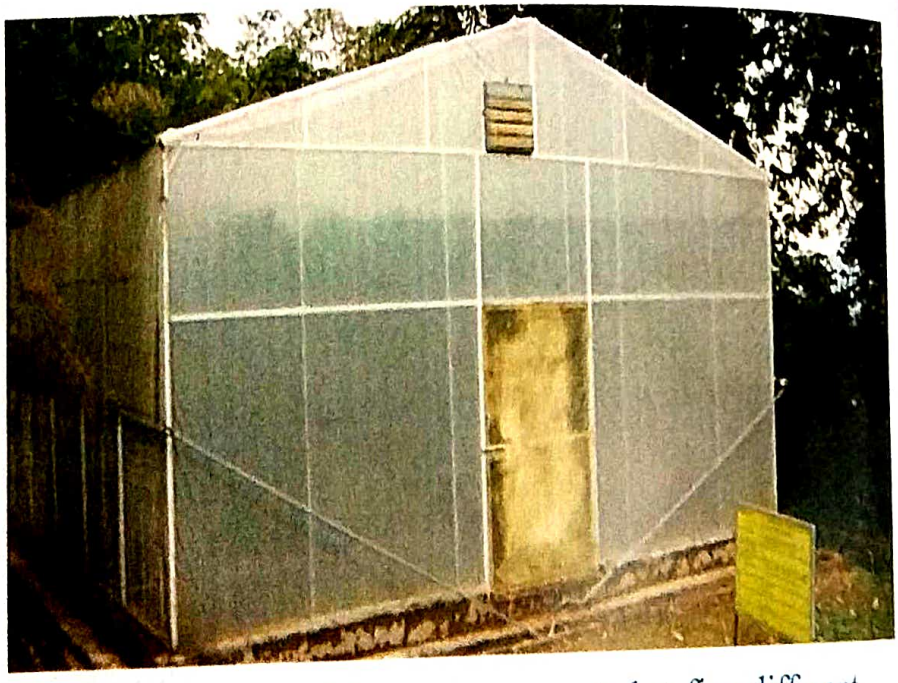


Socio-economic and educational profile of the farmers of five self help group selected for the cymbidium demonstration project.

5.4 Construction of polyhouse and supply of other farm inputs

Polyhouse is a frame of inflated structure covered with a transparent material in which crops are grown under partially controlled environment. These are protective structures erected to protect the crop from extreme sunshine, heavy rains and winds and also to exclude pests from the growing environment. Since, Sikkim lies under high rainfall region of country, polyhouses are indispensable for cultivation of cymbidiums in this region. Five medium cost even span, naturally ventilated polyhouses measuring 16.6 x 6 m, were constructed in each selected location for secondary hardening of tissue cultured plants. These were constructed using galvanized iron (G.I) pipes. The whole structure was firmly fixed in the ground. The insect nets were fixed at the sides of polyhouse to prevent the

entry of insects. The rolling curtains were provided to maintain the temperature during winters. In each polyhouse, misting units were also installed for overhead irrigation and to maintain desirable humidity inside the polyhouse. The design of polyhouses constructed for secondary hardening of tissue cultured plants given below. The iron benches (20 in each polyhouse) were placed for keeping of tissue cultured plants. Apart from polyhouse and benches, the farmers were also given other inputs like pots and potting media components, fertilizers, plant protection chemicals, etc. Initially, the saplings were cultivated in polyhouses, but as the saplings grew up they were moved to low cost polyhouses made by using bamboo as framing material for which the cladding material, UV stabilized polyethylene sheet was provided to the farmers.



Design of the polyhouse constructed at five different locations of Sikkim for secondary hardening of tissue cultured plants

5.5 Imparting technical know how

The selected farmers were imparted three-days training on

various aspects of cymbidium orchid cultivation. Under this training, programme farmers learnt about the basics of orchid cultivation and also received practical knowledge and guidance from the specialist. The objective of bringing the farmers to the research institute for training was to familiarize them with cymbidium growing structures and various operations carried out in cultivation of cymbidiums. Apart from training them at the institute, 'On Farm Trainings' were conducted so that the farmers could redress their problem without hampering their daily routine. Senior Technical Assistant (STA) recruited under the project acted in a close liaison with the farmers at one hand and with the experts at the research centre on the other. Thus, she worked as a bridge between the user of knowledge (farmers) and the source of knowledge (experts).

Farmers interacting with PI and experts during 'On Farm Training'

6. ESTABLISHMENT AND MANAGEMENT OF CYMBIDIUM FARMS

6.1 Transferring micropropagated plantlets to demonstration sites

The selected cultivars were tissue cultured and hardened at National Research Centre for Orchids, Darjeeling Campus

located at A.J.C. Bose Road, Darjeeling. The hardened plantlets were transferred to respective demonstration sites when they attained 15 cm height (nearly one year old). Over sixty thousand plantlets of cymbidium orchids were propagated and transferred to Sikkim and Meghalaya for setting orchid demonstration units.

Sending of micropropagated cymbidiums to demonstration sites

6.2 Preparing and sterilizing potting mixture

Preparation and sterilization of potting mixture is one of the most important steps in cultivation of orchids. Unlike other crops, roots of orchids require a proper balance of moisture, optimum nutrient content and physical support for anchoring the plant in potting media. The farmers were called and demonstrated how to choose media components, mix them in right proportion and sterilize them. They were cautioned that

leaf mould collected from the forest floors may carry the fungal spores so it must be sterilized, failure to do this pathogen present in leaf mould may cause black rot in cymbidiums.

6.3 Transplanting

After transfer of plantlets, farmers were demonstrated planting of tissue cultured plantlets. Usually, one year old seedlings are approximately 15 cm in height. These were planted in 5 cm diameter polybags. A 5 cm thick layer of broken bricks was spread at the bottom. The plant was established by holding it over the potting mix in one hand and filling the potting mix with the other. The potting mixture consisted leaf mould, cocopeat, farmyard manure (FYM) and perlite in equal proportion. Every year the seedlings were transferred to a larger polybag. In the third year, plants were transferred to a 15 cm diameter polythene bags. The first transplanting activity in each demonstration site was carried out in the presence and guidance of STA.

6.4 Fertilizing and watering of plantlets

Cymbidiums are heavy feeder and like fertilizer to grow and bloom well. Hence, the plants were fertilized with high nitrogenous fertilizer (30N:10P:10K) at weekly interval during summers and fortnightly interval during winters. The fertilizers were given with irrigation water @ 1 g per liter once a week in summers and once in two weeks during winters.

6.5 Training of flowers spikes

The flower spikes of cymbidiums were trained to keep them straight. As soon as the flower spikes appeared they were

protected by suitable stakes. This helped to ensure that they are not accidentally broken off during the handling of the plants. The training of spikes was carried out in the evening hours because spikes contain low moisture during evening hours. They are pliable and bend easily. There is a close relation between the amount of light received by the plant and development of flower colour. High light usually improves the colour of yellow, pinks, brown and red cymbidiums whereas white, green, pastel coloured flowers require low light for development of good colour.

6.6 Managing insects and pests

Microclimatic conditions of the glasshouse are favourable for building up of harmful insect and pest population. If they are not managed properly, may cause severe losses to plants growing in the greenhouse. Greenhouse floors, walls, benches or any other hiding places should be kept clean. The clean cultivation discourages building up of insect and pest population. The major insects causing damage to plantlets during cultivation are given as below:

Red spider mites

Mites are a serious problem in cymbidium orchids. They suck the cell sap from the underside of the newly emerged leaves giving rise silvery appearance. Hot and dry weather favours build up red spider mite population. The incidence of insects can be discouraged by providing humidity around the plants. At the initial stage, these can be controlled by spraying neem oil (Azadirachitin) @ 5 ml/lit of water. In severe cases spraying with Imidacloprid (Confidor) @ 0.05 % at 10-15, days interval

is useful in controlling mites.

Scales

The scales stick on the lower surface of the leaves and suck the sap from the cells causing loss of vigour and deformation in infested plantlets. The plants infested with scale insects should not be introduced in hardening house. Scales can be removed by rubbing the scurf encrustation with a soft tooth brush dipped in 70 % methylated spirit or by spraying with Malathion 0.05 percent.

Aphids

These are sucking insects accumulate on flowers and flower buds. They secrete honeydew on which sooty mould develops. The affected flower buds either fail to open or open in deformed shape. The sooty mould on flowers renders them unfit for market. Aphids can be controlled by spraying Imidochloprid or Azadirachitin.

Snails

These nocturnal creatures, they remain hiding in debris under the benches or even in potting media during the day and cause damage to plants by feeding on tender parts of the plants like buds, flowers and tender leaves during nights. They can be hand picked or trapped. The application of baits containing metaldehyde (1%) on the greenhouse floor, benches effectively controls this pest. Clean cultivation discourages build up snail population.

5.7 Managing diseases of cymbidium

High humidity and optimum temperature favour development of many fungal and bacterial diseases in greenhouse grown plants. The major diseases encountered during cultivation of cymbidiums are described as below:

Tip burn

The leaves of cymbidium first turn to light brown in colour and later dark brown. The exact reason of tip burn is not known, but it is believed that accumulation of salts causes tip burn. Flush out the pots to remove the accumulated salts. The cultivars having *Cymbidium devonianum* in their back ground are susceptible to this disorder.

Anthracnose

It is a fungal disease caused by Collectotrichum gloeosporioides. Oblong to oval, sunken, reddish brown to grey coloured spots appear on the leaf tips of infected plants. The affected part of the leaves should be removed with sterilised cutting tools. The pots and benches should be sprayed with 2 percent Formalin. Clean cultivation prevents spread of this disease. Spraying with Mancozeb and Carbendazim @ 1 g/l at weekly interval controls this disease.

Black rot

A devastating disease of cymbidiums caused by a fungus which could get introduced through unsterilised potting ingredients especially leaf mould. The water soaked symptoms develop on the aerial parts of the plants that turn brown. The affected shoots can be pulled out with slight pressure, and rotting portion gives

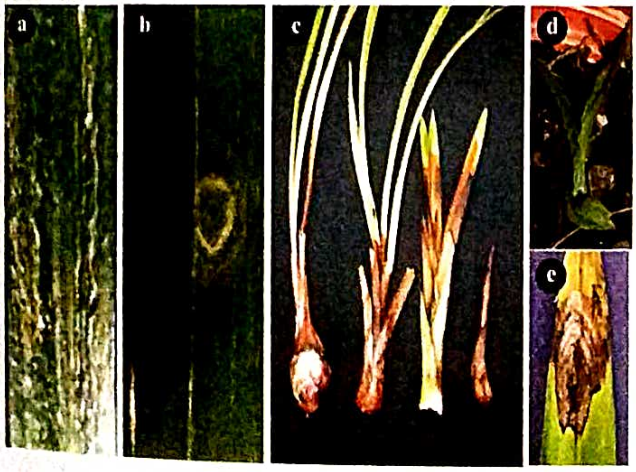
out a foul smell. The drenching of potting mixes with Metalyxyl @ 2.0 g /litre is useful.

Bacterial soft rot

This disease causes severe losses between transplantation to initiation of roots. High humidity coupled with high temperature favours development of this disease. The disease is caused by *Erwinia* sp. The affected plantlets show water soaked greyish-green lesions. The tissues of the infected area disintegrate and produce foul smell. The disease can be controlled by spraying tetracycline hydrochloride @ 1000 ppm.

Viral diseases

Cymbidiums in India are infected by three viruses namely Cymbidium mosaic virus (Cym MV), Odontoglossum ringspot virus (ORSV) and Orchid Fleck Rhabdovirus. Cym MV and ORSV are most common found in India. The affected plants show irregular or concentric yellow patches on the leaves. The viruses spread through cell sap during cutting of leaves, cleaning and handling of plantlets. Always use disease free planting material for commercial cultivation and prevent the spread of disease (read pamphlet 'prevention of virus transmission in cymbidium' published by NRC for Orchids).



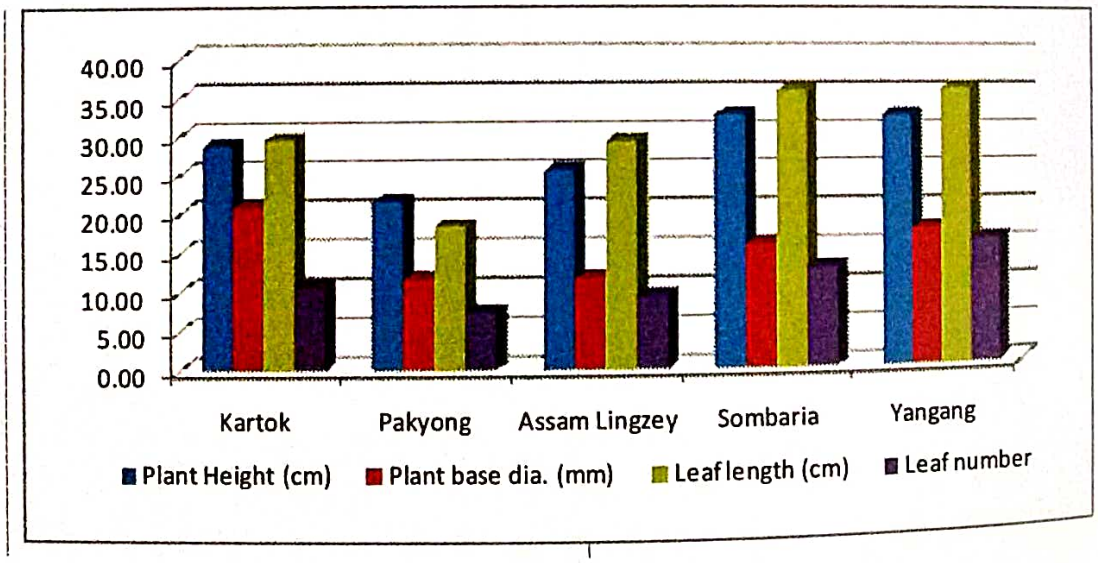
Cymbidiums plantlets affected with a. Cym MV b. ORSV c. black rot d. bacterial rot e. anthracnose

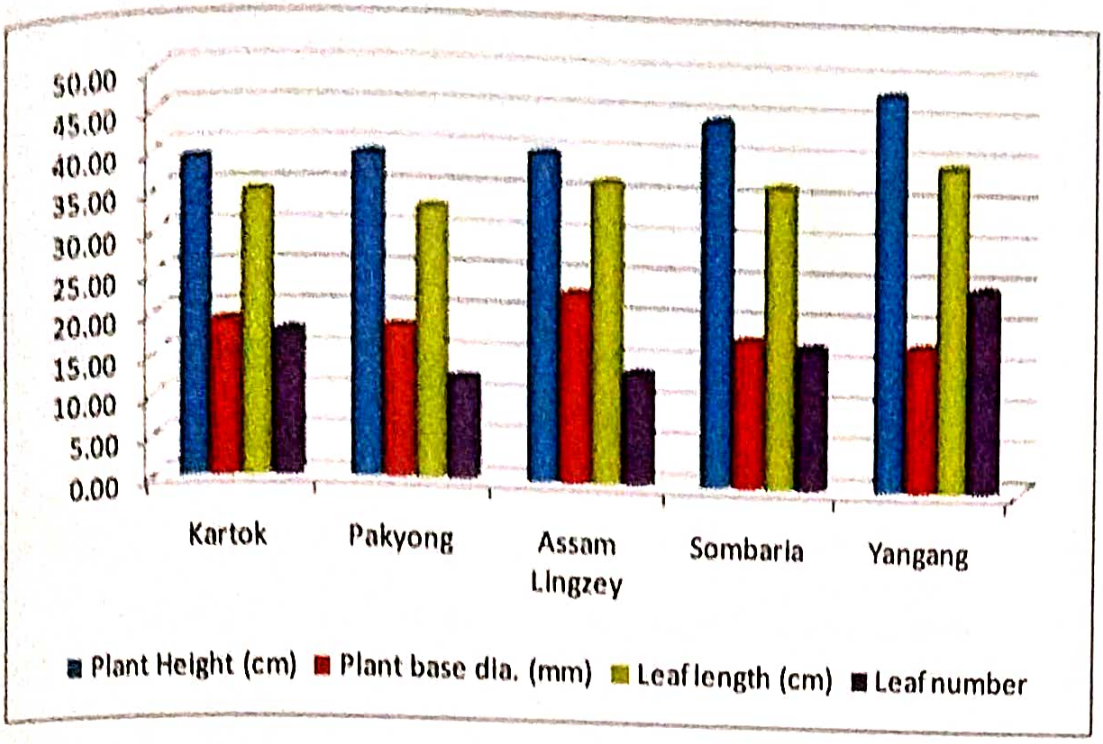
7. PERFORMANCE OF CYMBIDIUM CULTIVARS

Vegetative and reproductive characters of the plantlets grown in different locations were recorded and compared to assess the performance of cultivars. The recorded parameter include plant height, plant base diameter, leaf number and leaf length and reproductive charactors like % flowering plant, flowering time, duration etc.

7.1 *Cym* Levis Duke Bella Vista

The cultivar showed a significant difference among vegetative as well as reproductive characters recorded from the plants growing under different locations. The highest plant height, longest leaf length and maximum number of leaves were observed in Yangang followed by in Sombaria during two consecutive years. This cultivar performed very poorly under Pakyong conditions. The plants of this cultivar flowered early in Sombaria and Yagang. Nearly 20 percent plants flowered at the end of third year.

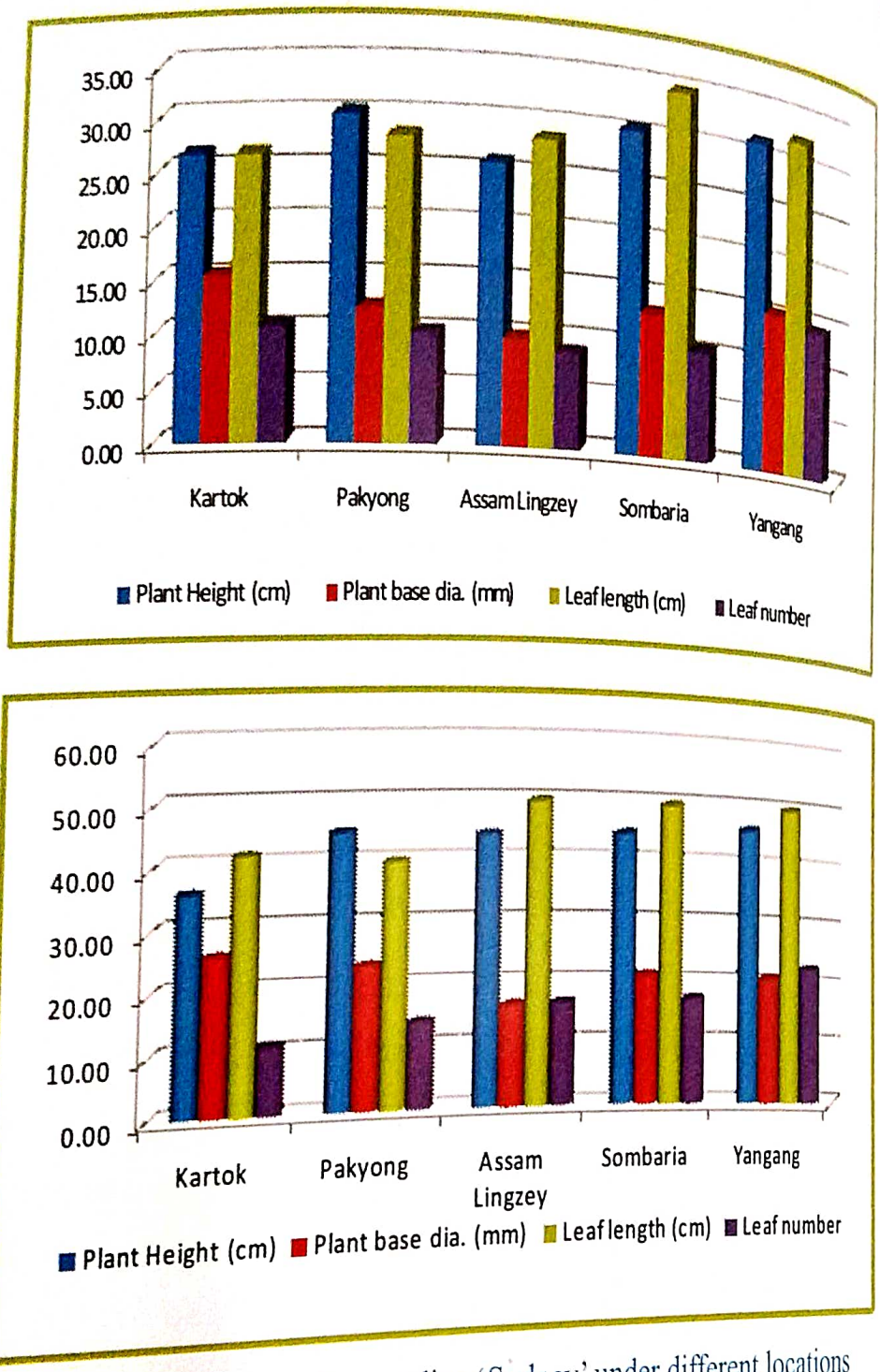




Performance of *Cym* Levis Duke 'Bella Vista ' under different locations top : first year and bottom : second year

7.2 *Cym* Burgundian 'Sydney'

Cym Burgundian Sydney also showed a significant difference in vegetative as well as reproductive characteristicss. The greatest plant height, longest leaf length and maximum leaf number were recorded from the plants grown in Yangang. However, the plant base diameter and length of leaves were found highest in the plants grown in Kartok and Sombaria. During the second year, no significant difference in height of the plants grown in Yangang, Sombaria, Assam Lingzey was observed. The plant base diameter was found maximum in Assam Lingzey followed by in Pakyong. The plants of this variety did not flower in any of the five locations and expected to flower in the next year (4^{th} year).

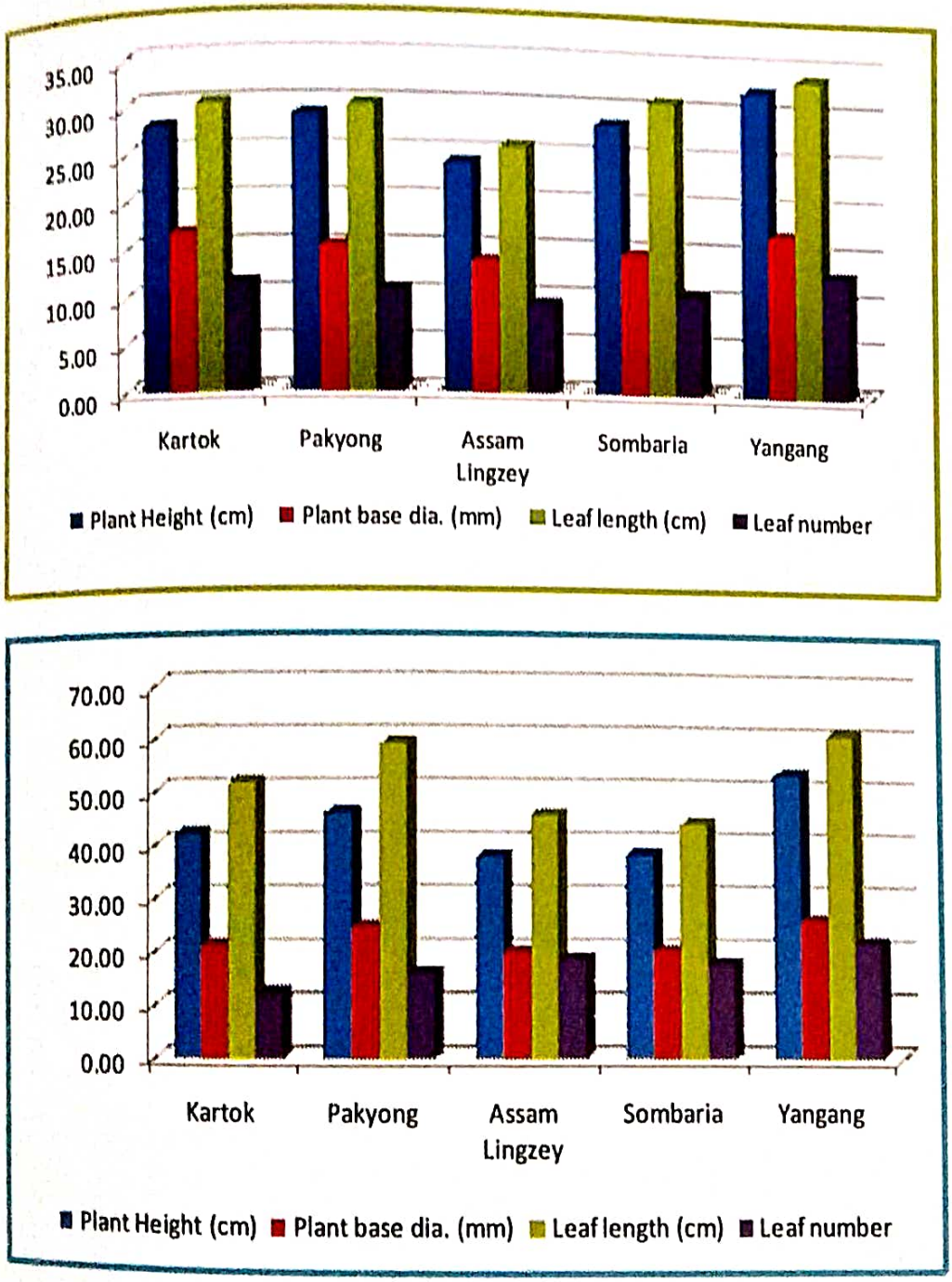


Performance of *Cym* Burgundian 'Sydney' under different locations top : first year and bottom : second year

7.3 *Cym* Margaret Thatcher 'Diplomat'

The best performance of this variety was observed in Yangang. All the vegetative characters, plant height, plant base diameter, leaf length and leaf numbers were recorded highest in this location as compared with other locations. During the second

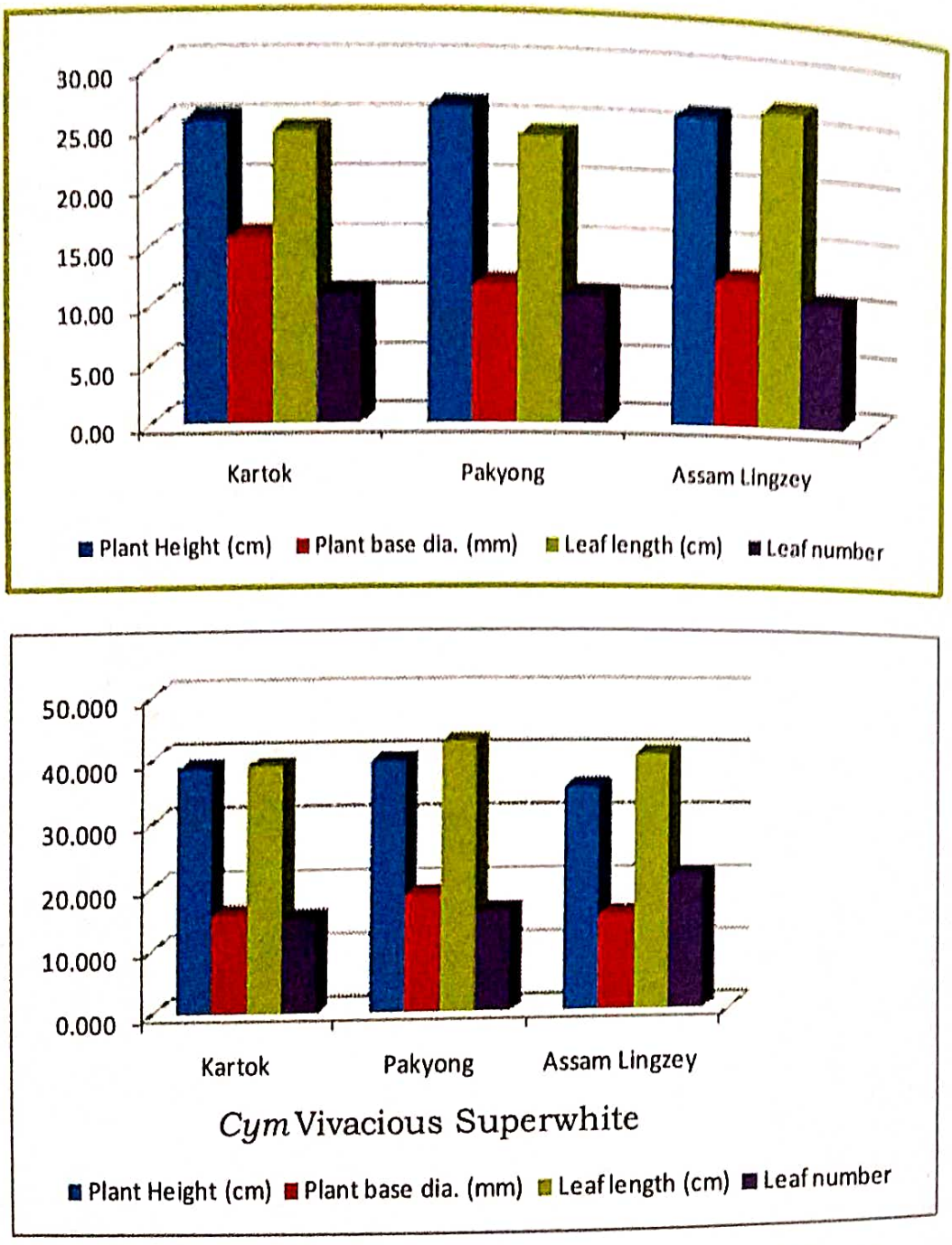
year, this variety performed well in Pakyong and Kartok. The performance of this variety in other two locations Assam Lingzey and Sombaria was not very satisfactory. In Yangang, this variety flowered at the end of the third year. Nearly 30% plant flowered, and the remaining are expected to flower in the next year.



Performance of *Cym* Margaret Thather 'Diplomat' under different locations top : first year and bottom : second year

7.4 *Cym* Vivacious 'Super white'

This variety was grown in three locations. The plants grown in Pakyong had maximum numbers of leaves, largest plant base diameter, and plant height as compared to other locations. The plants this variety did not flower in any of the five locations, expected to flower during the next year.



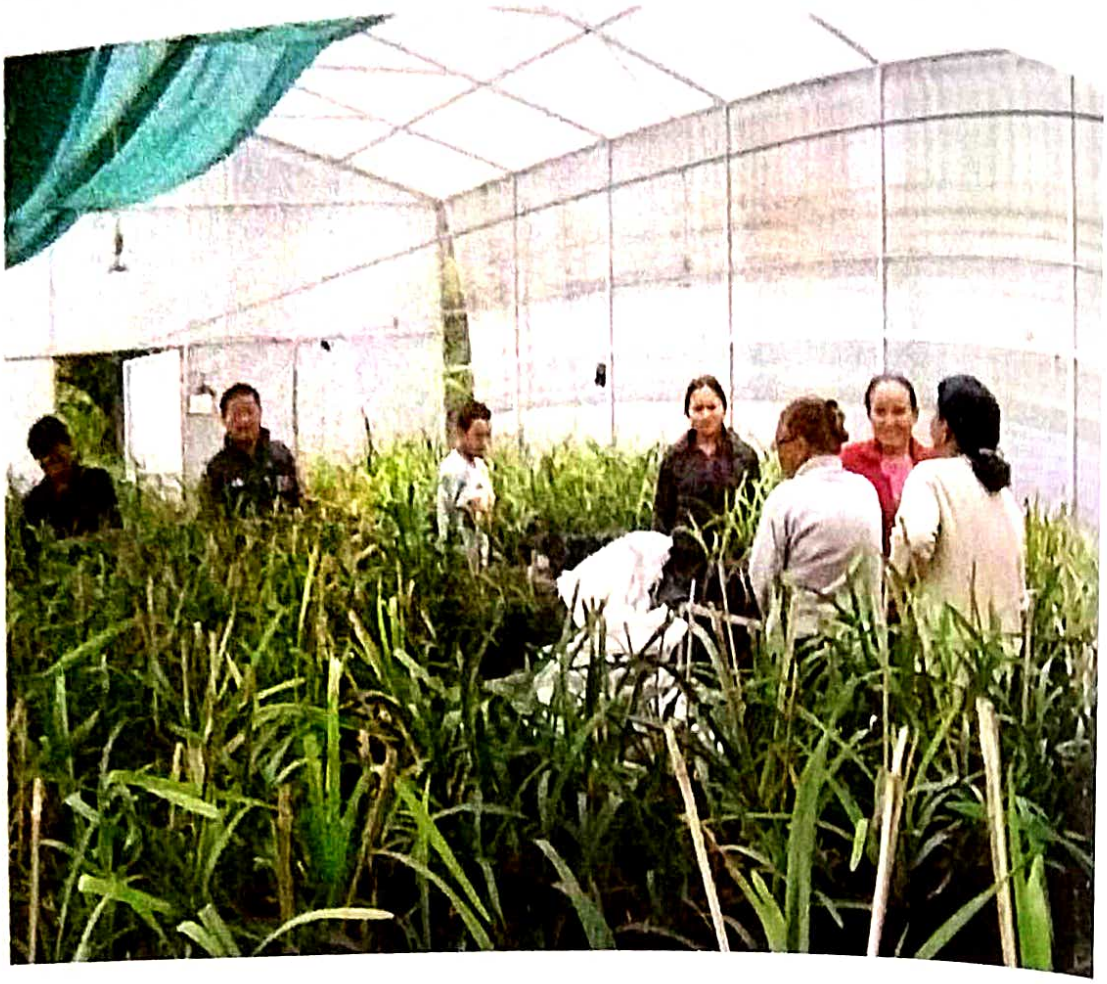
Performance of *Cym* Vivacious 'Super white' under different locations top : first year and bottom : second year

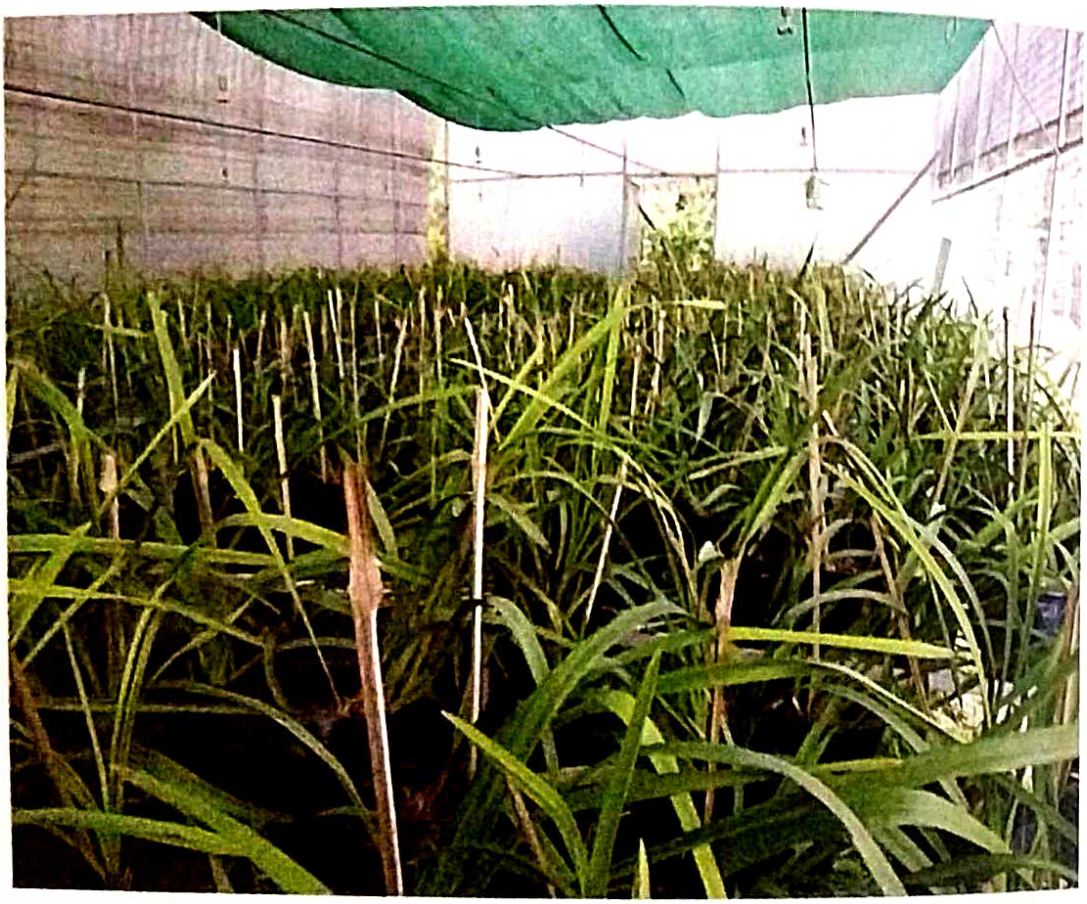
Performance of cymbidiums at Yangang

Performance of cymbidiums at Sombaria

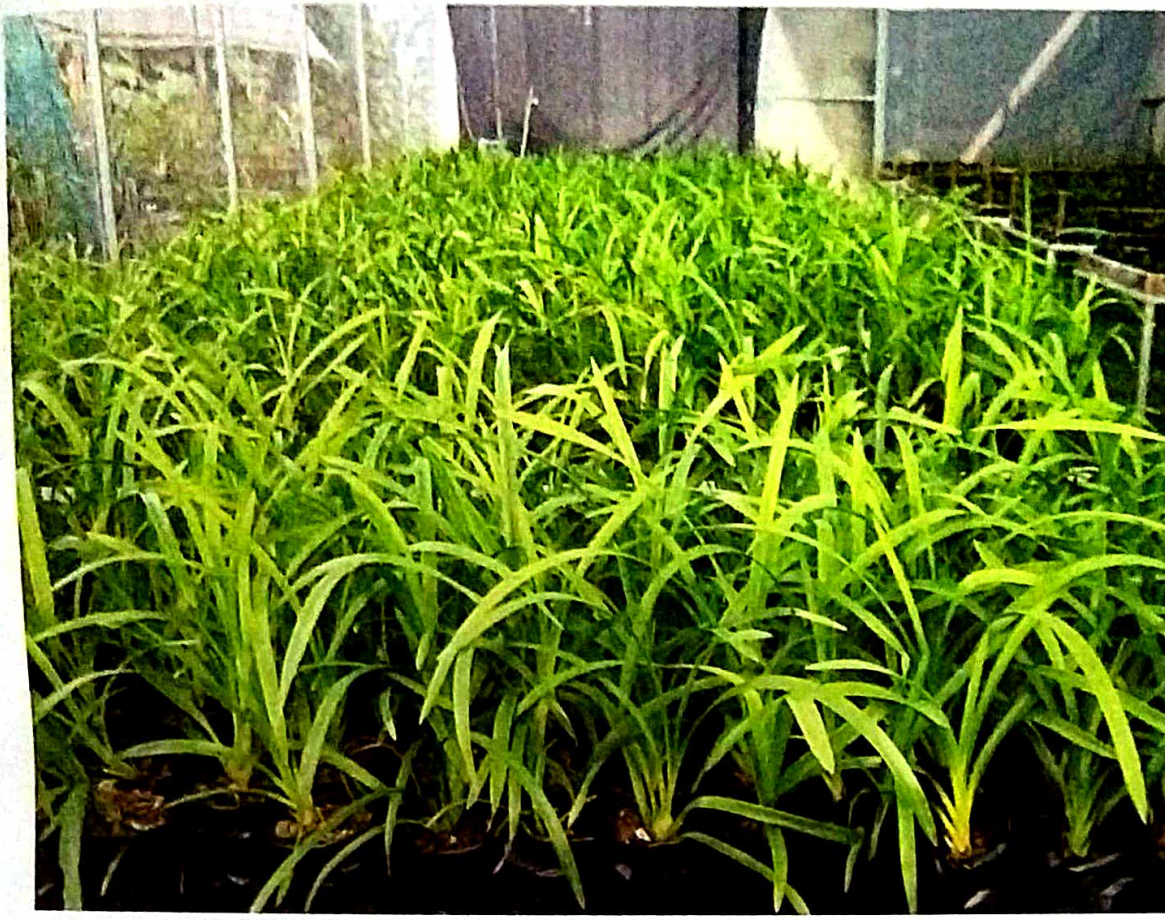
Dr. S.P. Ghosh, Project Chairman and Dr. Vibha Dhawan, Principal Investigator visit Assam Lingzey to assess the performance

Performance of cymbidiums at Assam Lingzey





Performance of cymbidiums at Pakyong



Performance of cymbidiums at Kartok

Performance of cymbidiums at Kartok

8. LINKING FARMERS TO EXPERTS

The idea of linking farmers was to the experts conceived because the farmers were living far off places in hilly terrain, and it was difficult for them to move for seeking advice from the experts at NRCO. Hence, it was planned to link the experts with the farmers. In the process, the experts benefitted by getting first hand information to plan their research programme and the farmers benefitted by getting their complaints redressed. The experts routinely visited the farmers field. The problems redressed by the experts are mentioned under the heading 6.

Farmers receiving tips on management of cymbidiums directly from the experts

9. ESTABLISHING MARKETING LINKAGES

The farmers would be linked with Sikkim State Cooperative Supply and Marketing Federation Limited for marketing of their produce. The supplied plants have not come to the commercial bearing stage. Till then, the farmers would market their produce themselves. The group leader of the SHG has been assigned the job to collect and market the produce locally.

10. CONCLUSION

It is generally conceived that that climatic conditions of Sikkim are suitable for growing of cymbidium orchids. However, the microclimatic conditions of hilly regions vary with altitude and facings of the slope. These microclimatic conditions determine the performance of a particular variety. In our experiments, we found that Yangang is the best place for growing Levis Duke 'Bella Vista' and Margaret Thatcher 'Diplomat'. In this area, cymbidiums were introduced first time for the cultivation. We lack competent technical manpower for cultivation of cymbidiums which need to be developed. The microclimatic conditions suitable for promising cultivars should be identified, and product specific production zones should be identified to harness the benefits of microclimate.

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