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Floriculture prospects in Arunachal Pradesh with special reference to orchids

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Abstract

Floriculture is commercial production, marketing and retail sale of cut flowers and potted plants as well as home gardening and flower arrangement. Arunachal Pradesh has started to promote floriculture, especially orchids for export oriented cut-flower industries. The diverse agro-climatic condition provides an ideal opportunity for growth of agro-based industries. Floriculture is one of such industry having great potential in the state. In this paper an attempt has been made to analyze the problems and prospects of floriculture in Arunachal Pradesh with a focus on orchids. A comprehensive survey and interview was conducted for the existing orchid research and development centers to derive suitable conclusions. The study reveals about 550 species of orchids in the state, out of which about 100 species are ornamental belonging to genera Aerides, Ascocentrum, Calanthe, Cymbidium, Dendrobium, Epidendrum, Paphiopedilum Phaius, Renanthera, Rhynchostylis, Vanda, etc. So far five hybrid genus - *Renades "Arunodaya" Arachnocentron "Tipi Jubilee star", Esmeranda "Millennium Dawn", Cymbidium Sessa "Green Beauty"* and *Ascocenda "Tipi Blue Boy"* were successfully introduced in the state.

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Introduction

Floriculture is emerging as a fast growing sector in recent years and it is one of the most rapidly expanding and dynamic global enterprise in today's world. More than 140 countries are involved in the production of floriculture crops with increasing trends. The transformation of the floriculture industry from being merely domestic to global has opened up opportunities for multinational collaborations in developing countries of the third world. Hence, there is a significant increase in competition for floriculture products in the international markets. Orchids are the second largest group of flowering plants comprising about 788 genera and 18,500 species (Mabberley, 1997). In India, they are represented by 186 genera and 1,141 species (Kumar and Manilal, 1994). Orchids have three main habits; terrestrial - soil dwelling, epiphytic – on other plants and lithophytic – on rock surfaces (Dearnaley, 2007). Orchids are highly susceptible to slight changes in the environmental conditions. The seeds are very small and light that are easily dispersed by wind (Kumar *et. al.*, 2007). Lindley (1857, 1858) started the studies on orchids in India. Then, Hooker (1888-1890) prepared the Flora of British India, which included information on the Orchidaceae of India, and later published a book exclusively on Indian orchids (Hooker, 1895). The orchids of Sikkim Himalayas (King and Pantling, 1898) and orchids of NW Himalayas (Duthie, 1906) added more information on the orchids of India. The recent decades witnessed number of works on various states and regions of India. Some of the significant works are on the orchids of Meghalaya (Kataki, 1986), NW Himalayas (Deva and Naithani, 1986), Nilgiris (Joseph, 1987), Kerala (Kumar and Sashidharan, 1987), Manipur (Ghatak and Devi, 1986), Mizoram (Singh *et. al.*, 1990), Sikkim (Bruhl, 1993), Arunachal Pradesh (Chowdhery, 1998; Hegde, 2001; Rao, 2006), Nagaland (Hynniewta, *et. al.*, 2000) and Orissa (Mishra, 2003).

The area under floriculture at all India level had increased from 53,000 hectares in 1993-94 to 88,609 hectares in 1999 (National Horticulture Board, 2001). Flowers are used in occasions of joy and sorrow, worships, adornment of hair by women and home decorations in India and other parts of the world. The highly prized aesthetic appeal of flowers makes gardening rewarding pursuit all over the globe. The Government of India has set a target of achieving more than Rs. 100 crores for export in floricultural products by the end of century. Major states involved in floricultural activities spread over 73, 579 hectares of area in the states of Tamil Nadu, Karnataka, West Bengal, Andhra Pradesh, Rajasthan, Maharasthra, etc. About 500 hectares of land have climatically controlled green houses for growing quality flowers for export purposes. The total investment in this sector is approximately Rs.1000 million. Such export-oriented units with green house production have been set up in clusters around Pune (Maharashtra), Bangalore, Delhi, Kerela, Hyderabad, etc. Ornamental foliage plants of decorative values are also being exported in sizeable quantity. Dried flowers trade is comparatively new venture in India and is gradually gaining popularity. Presently, most of the dried products are exported to Germany, USA, Netherlands, UK, Italy and Japan that constitutes nearly 60% of the country's export of floriculture products. Floral extracts are likely to emerge as an important item in future. This sector has considerable potential both for domestic as well as export-oriented market. Some commercial units for production of value added products, collages and flower pictures, flower balls, cards and cover pomanders, festive decoration, sweet smelling, potpourri, etc. have been established in eastern and southern parts of India.

North-east India possesses rich plant diversity. Majority of Indian orchids are mainly confined to this part of the country. The region has great potential to emerge as the major supplier of floricultural products especially orchids and cut-flowers. This potential, however, largely remains untapped for want of private initiative and it is developing only in few pockets of Sikkim, Meghalaya,

Assam, Nagaland and Arunachal Pradesh (Planning Commission, GOI, 2001). Currently, only 0.1% of the total area is used for flower production in the entire region. Arunachal Pradesh has diverse agro-climatic conditions for growing variety of floriculture crops, especially orchids round the year. About 23.52% of the flowering plants of India are found in Arunachal Pradesh. The Government of Arunachal Pradesh has initiated promotional programmes to develop orchids because they are the sustainable alternative crops to augment the local economy based on sound research and development. Coordinated efforts have been made under the departments of Forestry, Horticulture and Industrial sector to develop orchid as a cottage industry. Proper policy and investments are required for quality production and marketing of floriculture products with good returns in the state, nation and abroad. Arunachal Pradesh is an orchid paradise. Out of about 1300 species of orchids reported so far from India, about 870 species are from N. E. India and about 560 species are from Arunachal Pradesh. The concentration of orchids may be attributed to the congenial climatic conditions like high rainfall, high relative humidity, maximum forest cover with dense vegetation at different altitudinal zones ranging from tropical to alpine regions (Rao, 2006). The diverse climatic conditions ranging from humid tropical, sub-tropical, temperate and alpine zones influenced by high rainfall, varying temperature, humidity and wide ranging soil and phytogeographical situations have made this state as one of the "Biodiversity Hot-spots" in the world. Such a diverse agro-climatic situation provides an ideal opportunity for the growth of agro-based industry. Floriculture is one of such industry having great potential in this state (Hegde, 2001). Orchids have a great importance in the field of floriculture because of their multi-coloured curious shaped flowers with long lasting quality. Some of the species exhibit lots of variation in the wild population which are very much useful for the breeding programmes to develop hybrids of commercial value in the international market (Rao, 2006).

A determined effort is required to promote floriculture industry in Arunachal Pradesh in a more commercialized way and to expand its trade domain within the country as well as outside the country. Continuous support is needed from the central and state governments, financial institutions, non-governmental organizations, universities, other institutes, individuals and the development of cost-efficient indigenous technologies suitable to boost up the floriculture industry and economic development of the state. The basic objectives of the research are:

1. To analyze the role of geographical environment on the existing variety of floriculture.
2. To examine the role of floriculture on enhancement of household income of the farmers and variety of problems faced by the entrepreneurs engaged in the floriculture industry.
3. To study and analyze the prospects of orchid cultivation as floriculture crop in Arunachal Pradesh.

Materials and methods

The study is mainly based on the primary source of information collected from the various centers like State Forest Research Institute (SFRI), Itanagar, Orchid Research and Development Centre (ORDC), Tipi (Bhalukpong), Field Research Station, Chessa (Banderdewa), Nana-Koo Agro Pvt. Ltd, Ziro, Regional Research Laboratory (RRL), Jorhat Branch, Naharlagun. The various information on floriculture and orchids have been collected through personal interview with the Director in charge, Scientists, Foresters, Forest guards, Malis, etc. Suitable questionnaires were prepared and used for collecting required information to know about the research centers. The geographical location of various research centers have been collected with the help of Global Positioning System (GPS). The available literatures on floriculture and orchids in various books and journals were consulted for in depth knowledge. Cameras were also used for collecting photographs of the Research centers at different places and various plant species especially orchids.

Finally, the collected information are analyzed and tabulated to derive reasonable conclusions.

Study area

Arunachal Pradesh is the easternmost state of the country. In comparison to the other North-Eastern states, Arunachal Pradesh has the largest land mass of 83,743 sq. km with 16 different districts. The particular areas undertaken for the study are Tipi and Sessa area of Bhalukpong circle in West Kameng district, Hapoli of Ziro circle in Lower Subansiri district, Chessa under Banderdewa circle, Naharlagun and Itanagar area of Papumpare district (Fig. 1).

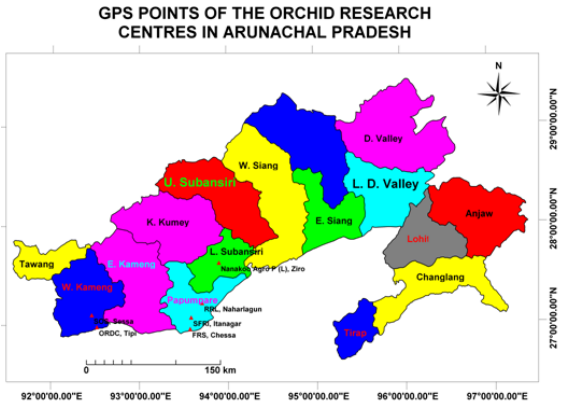

Fig. 1. Study area.

Tipi is situated at a distance of 6 km from Bhalukpong and Sessa about 24 km from Tipi. The area is mostly inhabited by the Aka (Hrusso) tribes of Arunachal Pradesh. However, the community participation in the floricultural activities is very meager. Ziro circle is situated in Lower Subansiri district. It lies in between 27º 30' N to 27º 36' N latitudes and 93º 47 'E to 93º 55' E longitudes. Ziro valley is mostly inhabited by the Apatani tribes of Arunachal Pradesh. The local farmers here have more interests in floriculture activities. A private floriculture centre had come up in this small town which reflects people's interest in floriculture. Naharlagun and Itanagar towns are situated in Papumpare district. Itanagar is the capital city of the state and Naharlagun is considered as twin capital of the state. Being the headquarters of the state, these two towns are access to facilities required for the development of floriculture industry. Though a particular centre for floriculture industry is yet to be set up in these towns, the various centres of research on forest and its products has been well established. Chessa is also situated in Papumpare district under Banderdewa circle. It is situated in the border area of Assam and Arunachal Pradesh and located about 22 km away from Naharlagun. Nyishi tribe inhibits the above mentioned places.

Results and discussion

Floriculture in Arunachal Pradesh

Floriculture industry has great potential in this state. At present, the state has made some progress in cultivating orchids promoted by the SFRI (State Forest Research Institute) and the Orchid Society Arunachal. The Department of Horticulture has also made efforts through the Chief Minister's Floriculture Mission by introducing ornamental plants in home gardens and public places in addition to distribution of seeds and bulbs in various districts. However, a serious attempt and effort is needed in augmenting development of this sector by involving the local entrepreneurs, farmers and by mobilizing the governments, financial institutions and private investments. Field studies have been conducted in four research centers namely - Orchid Research and Development Centre, Tipi, State Forest Research Institute, Itanagar, Field Research Station, Chessa, Regional Research Laboratory (RRL), Naharlagun and Nana-Koo Agro. Pvt. Ltd., Ziro. RRL, Jorhat is run by the central government under the Department of Environment and Forest.

Orchid research and development centre (ORDC), Tipi

ORDC is located at Tipi in Bhalukpong circle of West Kameng District of Arunachal Pradesh. It is situated on the west bank of Kameng River also known as *Jia – bhorali* in Assam. The area is surrounded by high hills covered with semi evergreen tropical rain forest vegetation. It stretches over an area of 10 hectares of flat land comprising of office buildings, orchidaria, tissue culture lab, museum, herbarium and gardens.

Fig. 2. Some of the important orchids of Arunachal Pradesh. (a) *Rhynchostylis retusa* (b) *Cymbdium walu* (c) *Vanda coerulea* (d) *Dendrobium thyrsiflorum* (e) *Bulbophyllum crassipes* (f) *Dendrobium ochreatu*.

Realizing the natural occurrence of varieties of orchids in the state on the one hand and its importance as a foreign exchange earner on the other, an orchid station was established in the year 1972 at Tipi, by the then Governor of NEFA with an objective of collection, utilization and commercialization of orchids. However, with the realization of rarity and endangered status of orchid species, the objectives and programmes of development of orchids have been revised and reoriented in the year 1978 to promote development of orchid trade in a sustainable manner adopting bio–technological means and also by involving the local tribal farmers and entrepreneurs.

Sessa Orchid Sanctuary and Nursery, a branch of ORDC is located at Sessa which is about 24 km away from Tipi on the way to Bomdila. It was declared as Sessa Orchid Sanctuary in 1984 under the provision of the Wild Life Conservation Act. The Sanctuary stretches over an area of 100 km² in Doimara Forest Division, West Kameng District. The sanctuary harbours about 200 species of orchids of sub-tropical types. The sanctuary is unique in the country in having 6 new species of orchids and 7 species of saprophytic orchids. The nursery comprises representative specimen of various orchid species of the sanctuary and a demonstration farm of cymbidium hybrids for cut-flower production. Over the last fifteen years it has been possible to produce 15 inter and intra specific hybrids and 2 hybrid genera. So far five hybrid genus - *Renades "Arunodaya" Arachnocentron "Tipi Jubilee star", Esmeranda "Millennium Dawn", Cymbidium Sessa "Green Beauty", Ascocenda "Tipi Blue Boy"* has been registered in the Royal Horticulture Society, London which is produced from the Orchid Centre, Tipi.

State forest research institute (SFRI), Itanagar

The SFRI is established by the Department of Environment and Forests, Arunachal Pradesh. It is located at Van Vihar, Itanagar that is surrounded by hills and enjoys favorable climate with moderate warm summers and cool winters. The Department of Environment and Forests has established the SFRI in 1993 at Itanagar by amalgamating the already existing research facilities. The institute has 7 divisions at present pursuing research in various disciplines viz. Orchidology, Soil Science, Forest Genetics, Silviculture, Systematic Botany, Forest Zoology and Ecology. The division of Orchidology was instituted to develop the orchid resources of the state in a sustainable manner. The division is responsible for documentation, scientific studies and extension activities of orchid farming and floriculture through community participation. The division of Orchidology has made many significant achievements, such as largest collection of orchid species in India (over 550 species), establishment of Sessa Orchid Sanctuary for *in situ* conservation, establishment of Orchidaria in 8 different zones for *ex situ* conservation, cultivation and propagation of over 2 lakhs orchids, establishment of tissue culture laboratories at Tipi and Itanagar, breeding and development of 15 hybrids, extension and development of 6 Cymbidium farms involving local entrepreneurs and women, introducing capsule course in tissue culture of orchids, organizing Festival of Flowers five times during the last one

decade, publications of two books, several booklets, 140 research papers, several folders, stickers, publicity materials and Arunachal Forest News and number of research projects.

Nana – Koo Agro Pvt Ltd., Ziro

Nana – Koo orchid Farm is a private owned farm situated in Hapoli area at Ziro. This Orchid farm is owned by Shri Tilling Doley and it was set up in the year 1995 under the project "Micro propagation and Farming of *Cymbidium* Orchids as supplemental crop in *Jhum* and wasteland of Arunachal Pradesh", guided by the SFRI, Itanagar and sponsored and financially aided by World Wide Fund (WWF) and North – Eastern Development Finance Corporation Ltd. (NEDFI). It is also assisted by National Horticulture Board, New Delhi. A plot of waste land at Hapoli was developed into an orchid nursery where 4, 750 seedlings of cymbidium hybrids supplied by the SFRI were planted. The flowers started blooming in the year 1996. About 3000 cut flowers were marketed that year. In the next year there were 17, 244 plants in the nursery. They yielded 10, 000 cut flowers. The number of plants trebled in three years and the yield of cut flowers more than doubled in the second year of the harvest. In addition to *Cymbidium* many other orchids were introduced such as *Paphiopedilums, Dendrobiums, Vandas,* etc. The commercial possibilities of cut flower trade are favorable in this center. The agro – climatic conditions of Hapoli (Ziro) has been found to be ideally suited for growing *Cymbidium* varieties which are known for their beauty and durability. All the flowers in the Nana – Koo Orchid Farm have been profitably marketed through the Orchid Society of Arunachal (OSA). The cut flowers are exported to places like Guwahati, Delhi, Kolkata and other places as per the demand.

Field Research Station, Chessa

The Field Research Station at Chessa is functioning under the SFRI, Itanagar. This center was established in the year 1980 covering about 100 hectares. It falls under the Drupong Reserved Forest, having evergreen to semi evergreen type of vegetation. These forest areas are highly resource laden with timber, fuel, fodder, medicinal plants, broom grass, bamboo and canes.

Regional research laboratory (RRL), Jorhat, branch laboratory, Naharlagun

RRL, branch laboratory, Naharlagun is a government aided laboratory. RRL Works under Council of Science and Industrial Research (CSIR), New Delhi. Its major thrust is research and development activities by developing indigenous technologies and utilizing the immense natural wealth of the state. Arunachal Pradesh is bestowed with abundance of plant resources, but the people of the state are ignorant about the richness of the plant resources and also not concerned for conservation of valuable medicinal and aromatic plants, medicinal plants are collected indiscriminately by the ignorant locals from hills and plains to sell to the traders without realizing their actual value. People were also unable to utilize the fallow land and wasteland due to poor infrastructure, difficult terrain and insufficient road communication. RRL worked initially to identify suitable locations, potential species of medicinal and aromatic plants appropriate to the location and develop agro-technology for large scale organized cultivation and multiplication of planting materials and extraction of oil and ingredients. It started extensive awareness programmes through workshops, exhibition, seminars, etc. on cultivation, processing and marketing of commercially important medicinal and aromatic plants in different parts of state. Projects were taken up on cultivation of *citronella* and production of its oil during 1997-2001. Under this project up to May 2002, 14,039 litres of citronella oil worth Rs 34.49 lakhs have been produced by the cooperative societies and marketed immediately. Similarly, this laboratory has introduced *Patchouli* for the first time in Arunachal Pradesh in the year 1986-87. Three nurseries cum demonstration centre have been established in association with local Non-Governmental Organizations at Roing, Ziro and New Bomdila for

introduction, acclimatization, multiplication and demonstration of commercially important medicinal plants.

Case study of selected floriculture Item: Orchids

Orchids belong to the family of Orchidaceae, the largest group of flowering plants in the world having innumerable varieties and hybrids, occurring mainly in the humid tropics, and sub-tropical regions and rarely in the temperate region. There are about 22, 000 species in some 700 to 800 genera of the family. In India, there are about 1150 species, out of which 550 species occur in Arunachal Pradesh. The phytogeographical situation with varying elevations and diverse climatic conditions having high percentage of humidity throughout the year favoured the growth and occurrence of orchids in rich diversity. The orchids are cosmopolitan in distribution but they live in a delicately balanced equilibrium with their ecosystem and are highly vulnerable to habitat destruction. Their great diversity occurs in the tropical and sub-tropical climates where positive factors for growth (thick vegetation and high humidity) prevail. They can grow in soil (terrestrial), on other plants, usually trees (epiphytic), on rocks (lithophytic / saxatilic) and even in semi-aquatic conditions (saprophytic). The terrestrial habit is basic but the epiphytic mode has been effectively utilized during species diversification in these plants, nearly 735 species are epiphytes. Nearly 80,000 hybrids are estimated to have been developed till 1979 and are being supplemented by more than 1800 new hybrids every year. In Arunachal Pradesh there are 142 genera and 600 species of orchids. Out of which 77 genera and 384 species belong to epiphytic, 58 genera and 192 species terrestrial and 1 genera and 24 species belong to saprophytic (Rao, 1998). As per the records the status of orchids in the state is common species (230), threatened species (31), vulnerable species (16) and endangered species (12). The district wise distribution of orchid species in the state is given in Table 1.

Table 1. District wise distribution of orchid species of Arunachal Pradesh**.**

Name of district	Number of species
Tawang	50
West Kameng	300
East Kameng	100
Papumpare	75
Lower Subansiri	150
Upper Subansiri	150
Upper Siang	200
West Siang	150
East Siang	150
Dibang Valley	200
Lohit	200
Changlang	250
Tirap	150

Source: Orchid Research and Development Center (ORDC), Tipi.

Agro-climatic conditions

The natural habitats of orchids are found in the high elevation region of tropical, sub-tropical and temperate regions of the country. The orchids grow best in areas of high humidity but direct rainfall is harmful for the plants. A minimum of 65% humidity is required throughout the year for the healthy growth of orchids. Direct sunlight is also harmful for the orchid plants. About 50% sunlight is necessary for the growth of orchids. Shade is essential for the plants which can be provided by using netlons and polyhouse. Shade of about 50% is sufficient for the plants to grow. Temperature requirement varies from plant to plant. Orchids of tropical and sub-tropical regions require high temperature of about 22° C - 36° C and temperate orchids like *Cymbidium* require lower temperature of about 10° C - 25° C. A temperature difference of 10° C between day and night is desirable. Orchids grow well in black top soil with rich humus content. While potting the plants, pieces of bricks, charcoals, wooden chips (rotten), cow dung, etc. are mixed with the soil. Heavy rainfall, hail, snow and frost are harmful for the orchids.

Importance and utility of orchids

The rich diversity of Indian orchids has many proven values such as ornamental, therapeutic, aesthetic, horticultural, etc. Many species also find frequent mention in ancient Indian literature for their curative

and aphrodisiac properties, and also as symbols of sanctity. More than 30% of the species are source of incalculable aesthetic pleasure because of their exceptionally beautiful and long-lasting flowers of myriad shapes, sizes, and colours. A majority of the flowers bloom during March - May and September - November, but there is hardly any time when one or the other species do not bloom. Ironically, the orchids are also fed to the milch cattle in the north eastern region, with a belief that *Dendrobiums* enhances milk yield and *Cymbidiums* improve their health.

Cultivation of Cymbidium

The genus *Cymbidium* is represented by about 90 species distributed in Asia, India, Japan, Australia, etc. and about 20 species are known to occur in India. Out of them, Arunachal alone is represented by 16 species viz. *Cymbidium aloifolium, C. cochleare, C. cypeifolium, C. devonianum, C. dayanum, C. hookerianum, C. iridoides, C. longifilium hook, C. lowianum C. mackinnonii duttie, C.macrorhizon and C. mastersii*. Among all the orchids grown, *Cymbidiums* are most suited for large scale cut-flower productions in the hills of Arunachal Pradesh. *Cymbidiums* are temperate flowers and are grown in the higher altitudes of Arunachal Pradesh. They are grown in pots and beds with neither too shady nor too sunny conditions. Temperature and light are the two important factors for producing quality flower spikes. *Cymbidiums* grows best at places of temperature in between 16° - 21° C day and 7 - 10° C night temperatures which is ideal for most of the species. They cannot stand frost and thus needs necessary protection from frost. *Cymbidiums* can be grown outdoors if some kind of shade is provided. They are grown in medium containing loamy soil, fine bark and leaf mould one part each and river sand ½ parts with a little charcoal powder. As *Cymbidiums* need plenty of watering, the compost must provide adequate drainage and for this purpose, pots are filled with crocks unto $^2/_3$ before filling the compost. During the growing season, the plants should be watered frequently and heavily, while less amount of watering is required in winter. Watering in the form of fine spray on foliage is quite beneficial. Humidity should be 70 - 80% for better growth of the plants. Low humidity will stress the plant in summer and high humidity result in flower spotting. Good amount of light and pollution free air is required for healthy growth of plant. It is essential to ensure that neither pests nor diseases are developed in the plants throughout the growing season. Diseases like *botrytis cinerea* or grey mound in the flowers occur when the temperature drops below 13° C and the humidity is over 90%. The foliage and flowering spikes are also attacked by aphids and red spiders. Chemical sprays can also seriously damage the flowers. If sound horticultural principles are followed such as maintaining good air movement, keeping the sites and poly houses free from weeds and correct watering, most of the pests and disease can be contained. The plants should be inspected regularly for pests and diseases and should be treated immediately with a light dose of malathian or roger spray.

Propagation method

Cymbidium is propagated by the methods of tissue culture, producing plantlets by the division of older plants. This is highly specialized technique carried out in the laboratory in an artificial medium (agar) in a community flask. The flasks should be placed in well lit area away from direct sunlight at a temperature between 15° C and 25° C and kept for few weeks to acclimatize. The flask should be gently warmed and warm water added to the agar medium to assist removal of the plantlets. These plantlets should then be separated and washed free of any agar and the roots allowed drying. The young plants are then transplanted into community trays filled with the growing compost. During the weaning period the plants should be kept under humid conditions keeping the compost moist by damping over, rather than direct watering. It is essential to shade the plants during the first three weeks to one month and as new roots and growth develops the shading should

be gradually reduced. Large plants are usually propagated by division carried out after flowering. Harvesting and post-harvest activities are carried out with utmost care. The spikes are cut when all the flowers are open with 150 - 250 cm of stem below the lowest flower. The spikes are then taken to pack house and stood vertically in a preservative solution such as crystals. Spikes can be stored for up to two weeks at a temperature of 0° C to 4° C. While grading and packing of flowers it is ensured that the spikes are perfect. Packing should not be done in the green house, as it is too warm for the flowers and there is a risk of insect contamination in the boxes. A separate packing shed should be there which must be cool, ideally around 12° to 15° C with a good air flow. Market requirements differ from flower to flower. Each market has its own preferences for flower colour, shape and size. The main requirements are for straight spikes, all flowers fully open each flower clean and free from any blemish, clear colours, broad firm petals, preferably with each flower facing the same way. A minimum of 8 standard blooms must be there per stem. Few markets also use the individual flowers as well as spikes and they are also used for preparing corsages.

Culture of Dendrobium

The genus *Dendrobium* consists of about 900 species in South East Asia, Australia, India and Thailand. About 110 species are known to occur in India and 68 species in North East India. Arunachal Pradesh has about 40 species distributed in various climatic conditions. It is the second largest genus of the family. The name "*Dendrobium*" has been derived from the Greek word '*dendron*' (a tree), '*bios*' (life) with reference to the aerial existence of the species (life on a tree). *Dendrobium* is a tropical flower and occurs throughout the state, excepting the snow - line peaks in varying concentrations. They are particularly abundant in tropical forest up to 900m above MSL and sub-tropical forest areas from 900 - 1800m above MSL in the state. There are hundreds of *Dendrobium* hybrids at present flowering 3-4 times a year which are particularly developed for the cut-flower industry. However, they can be grown under glass houses with controlled temperature conditions, because of the prevailing cold winters. *Dendrobiums* are tropical orchids, requiring warm, humid and shady conditions. It grows well in temperatures ranging in between 22° - 30° C during day time and 26° - 22° C at night. Exact temperature requirements however vary from species to species. Humidity for most of the *Dendrobiums* lies in between 50% - 79% but evergreen species require higher humidity level of about 65% - 80%. It requires bright light and sunshine especially the early morning light with good ventilation and humidity. Most of the evergreen *Dendrobiums* need to be kept moist during the growing season but need less water while budding. It is also very important to use good quality clean water with low dissolved salts and free from sodium and chloride. The pH value of water should be about 5.5 to 6.00 Rainwater is the finest source of water. The atmosphere has to be humid and regular spraying with a fine mist has to be carried out 2 to 3 times each day. *Dendrobiums* are best grown in pots, wooden blocks or hanging baskets depending upon whether the species is pendulous or erect type. However, the tropical hybrids which flowers 3 to 4 times in a single year can be grown in pots in glass houses, providing cultural requirements. Potting media for *Dendrobiums* must be well drained and can be potted in earthen or plastic pots with potting media consisting of burnt bricks, charcoal, fern fiber, wooden chips, and leaf mould in different combinations. Some *Dendrobium* species which have pendant type of habit should be potted in baskets in hanging conditions or may be attached on tree fern.

Propagation method

Dendrobiums are propagated by various methods such as bulb division which takes about 6-10 months to flower, by back bulb and offshoot method which takes about 12 months to flower, and by tissue culture method which requires high technical skill and modern tissue culture laboratory. It offers a rapid way of multiplying stock with the advantage that the young plants are disease and virus free. After

6 months in the community trays the young plants can be transplanted into the production pots in the green house and they will flower after 12 months. *Dendrobiums* are not a very high feeder except the evergreen types, commonly NPK fertilizers in dilute solution twice a month is sufficient for most of the species growing in pots. The most common disease of *Dendrobium* is yellowing of leaves which are due to lack of nitrogen or low temperature. Sometimes pseudo bulbs are shriveled, which can be removed by giving adequate supply of water. Fungicides like diethane M 45 (0.2%) in water should be sprayed once in a month to prevent fungal diseases. Insects can be kept away by spraying 0.002 % insecticide in every 45 days. But care should be taken when spraying flowering crops to avoid damage to the bloom. At the time of harvesting the flowers are cut early in the morning using a sharp knife or market requirements. The stage of cutting is when the bottom 8 flowers are fully open. They should be immediately taken to a cool packing house and stood upright in water. They are then selected for export quality, rejecting any damaged, stained or badly formed petals. After the selection they are graded into super long (more than 55 cm), long (45-54 cm), medium (35-44 cm) and short (unto 35 cm). After grading they are bundled and packed in a cardboard box. *Dendrobiums* being tropical in origin are susceptible to chilling, injury and should be placed in each export box before closing and then marketed with the minimum of delay to ensure a long shelf life at the point of final sale.

Ornamental orchids

Arunachal Pradesh has about 100 ornamental species especially belonging to the genera *Aerides, Ascocentrum, Calanthe, Cymbidium, Dendrobium, Epidendrum*, *Pephiopedilum phaius, Renathera, Rhynchostylis, Vanda, etc.* Some of them are epiphytic and others are terrestrial requiring different techniques for growing. *Rhynchostylis retusa*, an epiphytic herb is very common throughout the plains of Assam. It is known as *"kopou phul*" and is intimately linked with the culture of Assamese societies. The flower (inflorescence) is used by the girls to adorn their hair during the spring festival, known as "Rongali Bihu". It is regarded as symbol of love, fertility and merriment. Tai Khamti and other ethnic Tai girls of Arunachal Pradesh and Assam also use these flowers in spring festival '*Poi-Sangken*' for adornment of their hairs and for offering to Lord Buddha and other Gods or Spirits. These inflorescences are used as adornment by the young girls of Tai ethnic and other Tibeto-Burman tribes in Myanmar, China, Northern Thailand, Laos and Northern Vietnam. It is also used for medicinal and beautification purpose. *Rhynchostylis retusa* is the state flower of Arunachal Pradesh which is found in abundance in the foot-hills of the state.

Orchids with medicinal value

Besides ornamental value, orchids are also known for their medicinal usage especially in the traditional system of medicine by ethnic people world over. Different parts of the plants are used as medicine for various ailments. In fact, the name orchid designates the medicinal potential of plants and the word 'orchid' is derived from Greek word *'Orchis'* meaning testis used for describing testicular shaped bulbs of many orchids growing in that region believed to be useful in treating human virility. Some of the orchids are also rich in alkaloids, glycosides, carbohydrates and other phytochemical contents. They are utilized in local medicines for treating nervous disorders (*Cymbidium elegans, Cypripedium pubescens*), rheumatism (*Acampe papillosa*), dermal problems (*Dendrobium alpestre*), tuberculosis (*Eulophia flaccida*), bad dreams *(Ansellia humilis*), etc. Their additional uses are also indicated such as aphrodisiac and restorative drugs, as a source of food, gums, narcotics and poisons, etc. *Vanilla planifolia* and related species of orchids are cultivated as plantation crops to source 'Vanillin'. Even today, number of ethnic communities in India and other parts of the world use several species of orchids in their traditional system of medicines (Table 2).

Table 2. Orchids with medicinal values.

Botanical name	Parts used	Therapeutic use
Acampa anthropophora	Plant	Anti – malaria.
Acampa papillosa	Roots	Rheumatism.
Aerides odoratum	Plant	Anti – tuberculosis.
Cymbidium aloifolium	Plant, pod	Emetic (substance causing vomiting.
Cypripedium clegans	Plant	To cure nervous disorder.
Dendrobium nobile	Seeds	Wound healing and cure nervous system.
Goodyera pubesecus	Roots	Antidotes for smoke and mad dog bites.
Goodyera oblongifolia	Entire plant	To cure gout.
Ryncostylis retusa	Plants	As emollient for softening / soothing.
Vanda testacca	Leaves and flowers	Rheumatism, nervous disorder and scorpion bite.

Source: Orchid Research and Development Center (ORDC), Tipi.

Commercial possibilities

Trade in floriculture is developing rapidly and the trends are shifting fast in favour of orchids which command a high price and demands in trade. Arunachal Pradesh has good research and technical know-how available on orchid culture, cultivation and production at various research centres. There is good demand for orchid cut-flower in cosmopolitan cities like Delhi, Kolkata and Mumbai and once the cut-flower reach the dealers, they are distributed to the retailers spread over the cities. Today Cymbidium cut-flowers are sold by the retailers at a cost ranging from Rs 45/- to Rs120/- each depending upon the quality, colour, number and size of cut-flower spikes. Similarly, *Dendrobiums* and other tropical orchid cut-flowers are also sold at a price ranging between Rs 15/- to Rs 25/- per spike. However, there is no local market in Arunachal Pradesh at present which pose as a big drawback for the orchid traders. All the production is therefore transported by road up to the air port at Ziro, North Lakhimpur, Tezpur and Guwahati. Once the cut-flowers reach the market place, best quality cut-flowers are separated out and then exported to various countries like Europe, USA, Japan, Singapore and Thailand etc. New Zealand produces cut-flower in the summer months from May to August, whereas orchids of India are available from October to March. Hence, there is a good export market potential for Cymbidiums from India especially from Arunachal Pradesh and other hill states of North east India which possesses suitable climatic conditions for producing Cymbidium for cut-flowers. At present, hardly 10,000 to 20,000 cut-flowers are produced from these areas, whereas there is a huge export demand for cut – flowers within the country as well as outside the country. During the year 2003-2004, a total of Rs. 93,705/- only has been earned as revenue by selling the orchids products at Orchid Research and Development Centre, Tipi.

The floriculture trade is carried out in both cut-flower and plants in Arunachal Pradesh. But since orchids are considered as rare and endangered plant group, it has been regulated under the Convention on International Trade in Endangered Species of wild flora and fauna (CITES) and Wild Life Protection act of Government of India, it is mandatory to register the orchid farms under Wild Life Preservation offices. Any orchid to be traded must be nursery propagated in the nursery or in vitro cultured. Trade of orchids collected from the wild is totally prohibited. Noting the demand of orchid cut-flowers, the produces of the farmers have been marketed providing a market linkage through the Orchid Society of Arunachal, which is a significant step taken in the development and extension activities. With the consistent efforts of the Orchid unit of the Department of Environment and Forests, Government of Arunachal Pradesh, a sound Research and Development base has been created. However, further strides are to be taken in transferring the technology to the growers in an extensive manner. The Orchid Society of Arunachal has been mobilizing the farmers in taking up cultivation of orchids in their *jhum* agricultural lands. The orchid division of the State Forest Research Institute (SFRI), Itanagar is also involved in this venture to produce quality seedlings to distribute to the farmers, and to identify

agencies who can handle the cut-flower and plant production of Arunachal Pradesh to transport and sell off in the market with good returns to the growers. Noting the global importance and realizing the export potentials, Government of India has also initiated assistance schemes under various organizations like Agricultural and Processed Food Products Export Development Authority (APEDA), National Horticulture Board, National Agricultural Bank for Rural Development (NABARD), North Eastern Development Finance Corporation Ltd. (NEDFI), etc. Floriculture Insurance Schemes have also been introduced by four Insurance Companies like New India Assurance Co. Ltd, Oriental Insurance Co., United Indian Insurance Co. Ltd. and National Insurance Co.

Problems

As per the recent survey, lack of fund seems to be the major constraint that leads to other related problems of floriculture. The lack of sufficient labour force for running and maintenance of various floriculture centres and poor communication and transport system are other bottlenecks in the development of floriculture industry. The remoteness and isolation of the state from rest of the country makes it much more difficult to develop an orchid industry. Lack of infrastructural facilities also hampers the growth of this industry. Though research and developmental activities have been started long back, it is still confined to few centers only and is still not adequate to fulfill the present requirements. Therefore, adequate support should be given to research and development sector, and it should be backed-up by intensive breeding and plant improvement programmes. For development of floriculture, quality planting materials should be available. Though plants are found in plenty in wild conditions, quality planting materials are not available and often have to be exported from other states like Sikkim, Shillong, Kerela, etc. Even if one offers to take up orchid farming, one needs to invest heavily on planting materials of proven quality as cut flower and for the development of the nursery. Some of the planting materials are even exotic in nature and are exported from outside the country. There is also lack of mass propagation by using agro-technique means of planting flowers. Lack of post harvesting technology also prevails in the centers. Harvesting and packing processes are carried out in an unscientific manner. Proper packing materials are also not utilized. Poly bags are used for packing flowers instead of using hardboard boxes which tends to damage the flowers quickly. Lack of market information, linkage and marketing centre are other problems which hampers the growth of floriculture industry. Floriculture items have to be bought from the centers itself, except few private enterprises that sent outside as per the demands and requirement of the buyers. Though there is high demand of orchid cut-flowers, there is lack of institutional and financial support to the centers. Moreover there seems to be lack of proper coordination among the financial institutions. Though, the institutions like National Agriculture Bank for Rural Development (NABARD) is willing to support floricultural projects, other institutions like Arunachal Pradesh Co-operative Apex Bank and the State Bank of India (SBI) are apprehensive in supporting the entrepreneurs in such projects. Thus, it seems that it is due to the lack of unambiguous policies of the government, hence, clear cut guidelines are required. The centers also lacks in latest technology, trained manpower and extension programmes which are the main requisites for the development of floriculture industry. The endangered status of orchids requiring CITES and legal Procurement Certificates and permits from Wild Life authorities, makes it rather difficult for a common man to take up orchid cultivation. The fallow lands left after *jhum* cultivation can be utilized for growing floriculture items of economic and medicinal values which in turn will help in uplifting the household income. Lack of land holding system, difficult terrain, unavailability of data base, lack of awareness among the local public, etc are some of the additional problems which needs to be tackled for the proper development of floriculture industry in Arunachal Pradesh. Though there are many

problems and constraints on the path of development of floriculture industry in Arunachal Pradesh, but at the same time the state is also blessed with many advantages. Therefore, the need of the hour is determination and concerted effort by the people, leaders, scientists, and technologists to harness these natural assets into a viable commercial activity adopting the modern technologies. Increased production would certainly diffuse the difficulties and constraints and supplement the economy of the people and also reduce pressure on forests and environment to certain extent, thereby creating better future and prospects for the development of floriculture industry in Arunachal Pradesh.

Conclusion

The state of Arunachal Pradesh has a rich floristic diversity. It constitutes high endemism and comparatively higher incidence of rare and threatened taxa. An estimated number of 5000 flowering plants, 600 orchids, 400 ferns, 48 gymnosperms and an equally high number of unexplored algae, fungi, lichens and bryophytes inhabit the diverse habitats that occur in at least six broad forest types of Arunachal Pradesh. The eastern Himalayan state contains more than 33% of the total Indian flora, out of which about 30 % are endemic to the entire Indo-Malayan Region. Presence of numerous species of primitive plants and wild relatives of cultivated plant truly justifies the region to be recognized as "cradle of flowering plants". But the natural plant species is gradually depleting due to increasing population, Urbanization, Industrializations, deforestation, road construction and other developmental activities. Keeping these facts in mind, the need was felt for conservation of the plant species of the state and this work was entrusted to the SFRI, Itanagar, under the Department of Environment and Forest. Under this institute, a separate division of orchidology was developed in order to conserve and develop the orchid's flora of the state by the means of scientific study and application of bio-technology. It also aimed at technological development in orchid farming and floriculture with people's participation and contributes towards economy of the state and its local inhabitants. Orchid Society of Arunachal also has an important role to play in this venture. At present a few numbers of centers are working under this institute spread across different parts of the state. Orchid cut-flower commands a special position in the floricultural arena and efforts are being made to promote orchid as an important commercial floricultural item in our state. Many private entrepreneurs are also venturing into the orchid cut-flower trade. In fact orchid growing can be developed as a cottage industry in Arunachal Pradesh with proper marketing channels. Places like Dirang, Bomdila, Rupa, Ziro, Itanagar, Along, Pasighat, Tezu, Roing, Deomali, Khonsa, etc. can be adopted as agro-technology blocks for growing selected clones of varieties of different orchid species. The seedlings produced by the labs at the institute can be supplied through the Orchid Society of Arunachal (OSA) to the housewives, farmers and entrepreneurs in the blocks, thereby increasing production with lesser costs. In this venture orchid lovers, scientists, technicians, leaders of the state and the State Government should work determinedly to develop this industry as a viable commercial activity. Thus, floriculture industry has immense potential in Arunachal Pradesh and with concerted effort, this environmental friendly venture would also encourage tourism, create more opportunity for self employment, socio-economic upliftment of the poorer section of the society and overall development of the state.

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