

Smart solutions for harnessing orchid potential

Orchids as cut flowers and flowering pot plants are sold at a good price in flower markets world over. Orchids have a wide distribution in India, ranging from the lowlands up to an altitude of 4300 m. There are around 600-800 genera with 25,000-35,000 species and they are one of the largest families of flowering plants. Commercially valuable genera of orchids are *Cymbidium*, *Cattleya*, *Dendrobium*, *Phalaenopsis*, *Vanda*, *Aranda*, *Ascocenda*, *Mokara*, and *Paphiopedilum*. The rich biodiversity of the region is another advantage for the development of high quality varieties with high productivity and resistance to diseases and pests. Since the globalization of the Indian economy, the demand for orchids as cut flowers has increased manifold, which is mostly met with imported flowers from other countries.

ORCHIDS are highly valued in the ornamental and medicinal plant industry. They are among the most advanced flowering plants and are highly specialized in distinctive and incredible flower shapes, colours and beauty. There are around 600-800 genera with 25,000-35,000 species and they are one of the largest families of flowering plants. The variations in flower colour and shape are indeed fantastic and the flowers mimic bees, wasps, butterflies, moths, swans, pigeons and even human forms. This is the result of co-evolution with pollen vectors and insect-specific pollination, including pseudocopulation. In recent decades, scientific interventions in cultivation as well as genetic improvement have made orchid breeding a very profitable occupation. The development of new hybrids and the commercial production of cut flowers and potted flowering plants have expanded enormously in Europe, the USA, South America, Thailand, Singapore, Malaysia, Japan and Sri Lanka. India, with its large reservoir of genetic resources, is making inroads into the ever-growing domestic markets with a view to exporting these flowers.

Orchids have a wide distribution in India, ranging from the lowlands up to an altitude of 4300 m. There are ~1300 species of orchids distributed throughout

the country. The state of Arunachal Pradesh has the highest number of orchid species (558), followed by Sikkim (543), Meghalaya (532), West Bengal (467), Nagaland (396), Manipur (251), Uttarakhand (237), Kerala (186), Karnataka (175), Andaman and Nicobar Islands (143), Odisha (128), Maharashtra (122), Madhya Pradesh (89), Andhra Pradesh (89), Himachal Pradesh (76), Tamil Nadu (84), Tripura (66), Jharkhand (59), Jammu and Kashmir (61) and Telangana (17). Among them, eight north-eastern

states of India are the paradise of Indian orchids. These states harbour about 876 species of orchids in 151 genera and account for 70% of the country's orchid wealth. Of these, many species are endemic and rare species having a high ornamental value. *Anoetochilus sikkimensis*, *Cymbidium eburneum*, *Dendrobium hookerianum*, *D. densiflorum*, *D. devonianum*, *D. thrysiflorum*, *Paphiopedilum fairrieianum*, *P. insigne*, *P. villosum*, *P. spicerianum*, *P. hirsutissimum*, *P. venustum*, *Papilionanthe teres*, *Pleione humilis*, *P. maculata*, *P. praecox*, *Renanthera imschootiana*, and *Rhynchostylis retusa*, and *Vanda coerulea* are some of the promising orchids from these regions.

Cut flower and pot plant production

Orchids are the most important cut flowers and flowering pot plants sold in flower markets



Cymbidium lowianum



Dendrobium sonia

around the world. These flowers are known for their marvellous beauty and very good shelf-life. Some orchid flowers last one to three months if left on the plant, and as cut flowers, they stay fresh and perfect for two to six weeks. The present day orchid hybrids of *Cymbidium*, *Dendrobium*, *Oncidium*, *Vanda*, *Aranda*, and *Mokara* remain perfect for 7 days to 30 days and even longer if kept at a suitable room temperature. The flowers of *Cattleya* and *Phalaenopsis* stay fresh for 1 to 4 weeks; *Cypripedium* and *Paphiopedilum* last a month and *Cymbidium* spikes stay fresh for 3 to 4 weeks. Orchids for cut flower and pot plants are cultivated in climatically controlled greenhouses or net houses/naturally ventilated polyhouses where the climate is congenial for growing of orchids. The degree of control in greenhouses depends upon the crop requirement. Sanitary and phytosanitary measures are necessary to maintain the quality of the products. The product specific packages of practices for production of orchids have been standardized. These include artificial growing media, temperature and light requirement, fertigation requirement, protection from diseases and pests. The good agricultural practices (GAP), integrated pest management (IPM), integrated nutrient management (INM) should also be adopted in production of orchid cut flowers and pot plants. The promotion of organic fertilizers and biological control of pests would reduce the cost of cultivation. The production technology package should be such that enhances the confidence of growers and bring them good

returns from the market. The package of practices would differ for different cultivated products.

Several diseases and pests cause losses to their vigour, production capacity and affect the market value of the produce considerably. Orchids are known to be attacked by about 130 plant diseases affecting one or more orchid genera. These are caused by fungi, bacteria, nematodes and viruses. Not much attention was paid to study the diseases and pests of orchids in the past. The orchids are now emerging as major floriculture produce for export and the attention is being given to study diseases and pests of orchids and adopt sanitary and phytosanitary measures. Generally, orchids are less affected by pests in their natural habitat but can give a way to number of diseases and pests when grown under protected conditions. The important fungal diseases causing damage to orchids include black rot, anthracnose, orchid wilt and leaf spots. Bacterial soft rot and nematode also cause severe losses to orchids. The viral diseases particularly *Cymbidium* mosaic potexvirus (CymMV), *Odontoglossum* ringspot tobamovirus (ORSV), and *Orchid* fleck rhabdovirus (OFV) cause serious

problem in orchids. For commercial cultivation of orchids, the orchids are mass propagated in laboratories and planting material moves across international borders, and thus risk for introduction of exotic pathogens is severe. It requires strict vigil on imported material to avoid danger of introduction of exotic pathogens. Rapid and highly sensitive diagnostic tools are required to diagnose



Micropropagated plants



Micropropagated plants of *Cymbidium* orchid

pathogens. The biocontrol method in recent years has gained momentum in disease management of many fungal pathogens. Biocontrol with *Trichoderma viridae*, *T. harzianum* and *T. virens* have proved successful in controlling many important fungal pathogens. Bacterial antagonists like *Pseudomonas fluorescens*, *Bacillus subtilis* and *Streptomyces* spp. are also used against several important bacterial pathogens. In addition to diseases, there are number of pests such as mites, scales, aphids, mealy bugs, caterpillars, snails and slugs etc. that affect the overall growth of orchids and deteriorate the quality of flowers. Strict sanitation practices are essential for reducing losses caused by diseases and pests.

Post-harvest handling and marketing

Commercially valuable genera of orchids are *Cymbidium*, *Cattleya*, *Dendrobium*, *Phalaenopsis*, *Vanda*, *Aranda*, *Ascocenda*, *Mokara*, and *Paphiopedilum*. *Cymbidium*, *Dendrobium*, *Aranda*, *Mokara*, *Arachnis* and *Vandas* are grown for cut flower production, whereas *Phalaenopsis*, *Cattleya*, and *Paphiopedilums* are grown for potted flowering plant production. There are minimum prescribed quality standards for each type of orchid. Post-harvest life of orchid cut flowers is influenced by pre-harvest and post-harvest factors. The pre-harvest factors like genotype, light intensity, sugar level in cut stem, temperature, rate of water loss determine the life of cut orchids. However, harvest and post-harvest factors *viz.* time and harvesting stage, ethylene production, pre-cooling, pulsing, packaging material and storage temperature also affect the post-harvest life of cut orchids. The optimum harvesting stage varies with orchid genera however; cut flowers in most of the genera are harvested at full bloom stage except *Dendrobium*, *Oncidium* where the flower spikes area harvested at 75% bloom stage.

Production of quality planting material

Quality planting material refers to planting material free from diseases and pests, healthy, vigorous and takes minimum possible time to attain reproductive commercial stage. Orchids are propagated through division, cuttings, keikis, tubers, and backbulbs. However, the commercial

propagation of orchids is mericlone. The reliable protocols for mass propagation of selected commercial orchids with an emphasis on cost reduction are required for production of quality planting material. The orchids are infected by a number of viral diseases but *Cymbidium* Mosaic Virus (CymMV) and *Odontoglossum* ring spot virus (ORSV) are most serious. The productivity of plants is severely reduced if both these viruses are present together. The establishment clean laboratories producing disease free planting material needs to be promoted. There are techniques for detecting viruses from mother plants that have been standardized by various laboratories. These include indexing, enzyme-linked immunosorbent assay (ELISA) and molecular methods such as polymerase chain reaction (PCR). The virus from infected plants can be eliminated by techniques such as thermotherapy, meristem tissue culture, *in vitro* chemotherapy and cryotherapy of shoot tips followed by *in vitro* culture of shoot tips. These



Paphiopedilum fairrieianum



Paphiopedilum insigne

techniques not only eliminate viruses, but are also effective in eliminating viroids and phytoplasmas.

Development of new hybrids

Orchids comprise one of the largest families of flowering plants with 25,000 to 35,000 species belonging to 600-800 genera. At present, the cultivation of orchids in the country is based on the hybrids developed outside the country like New Zealand, Australia, the Netherlands, Thailand, and Japan. India is very rich in orchid genetic resource and nearly 1,300 species of orchids reported to occur in various parts of the country ranging from Himalaya to sea-shore of Kerala. The *ex situ* conservation of orchids have resulted in collection of large number of species in various government. institutions like, Orchid Research and Development Centre of State Forest Research Institute (SFRI), Arunachal Pradesh; NRC for Orchids, Sikkim and Darjeeling; IHBT, Palampur (HP); Orchid Laboratory, Chandigarh; Orchidaria under BSI Shillong and Ooty; and TBGRI, Trivandrum. The collected species needs to be utilized for production of hybrids, which suits to national and international market. A little progress has been made by SFRI, Arunachal Pradesh, private growers in Sikkim and Darjeeling and NRC for Orchids, Sikkim. Therefore, efforts need to be expedited and pragmatic breeding programme predicting the trends for next 10 years needs to be initiated.

Flower colour and long shelf-life are the most important attributes that adds to the aesthetic appeal of orchids. Manipulating plant pigment compositions either via conventional breeding can change flower colour or via biotechnological tools such as genetic engineering. Traditional breeding methods have been used for decades to evolve new varieties of orchids with improved colour combinations. The colour outcomes of such hybridization work are,

however limited, and depend on the combinations of the original colours in the parental lines. Furthermore, the long juvenile phase of orchids, lasting approximately four to six years per generation, makes the traditional breeding process a very lengthy proposition. In view of these limitations, the biotechnological approaches for directly manipulating orchid flower colour at the molecular level appear very attractive and promising. The tagging of the genes responsible for colour formation coupled with knowledge on genetic transformation procedures has enabled the development of transgenic plants with altered or enhanced

flower pigments. Using gamma irradiation, many plant mutant varieties including a number of *Dendrobium* sonia mutants have been created.

Production of orchids for food

The importance of orchids is recognised in many parts of the world in traditional cuisine as a garnish or supplement. There are many wild orchid species used as food by the tribal people of north-east India. The plant parts such as pseudobulb, root and rhizome of many of the orchid species are consumed as food. *Habenaria acuminata*, *H. susannae*, *Orchis latifolia*, *Pholidota articulate* and *Satyrium* species are used as food items which play an important role in the diet of the people of Nagaland region. Many tribes of Nagaland state use the leaves of *Cymbidium* species as food. The new shoots of cymbidiums are made into a gravy along with grains, as are the pseudobulbs of their orchids in combination with common vegetables like potatoes, tapioca, etc. The popular drink called *Faham* or *Madagascar tea* on the islands of Mauritius and Madagascar is made from the orchid *Jumellea fragrans*. Commercially, the vanilla flavouring or vanillin is extracted from *Vanilla planifolia*. The leaves of *Anoectochilus* are used as a vegetable in Indonesia and Malaysia. The pseudobulbs of *Cymbidium madidum* and *Dendrobium speciosum* as well as the tubers of *Microtis uniflora* and *Caladenia carnea* are eaten. The tubers of orchid genera such as *Acianthus*, *Dipodium*, *Glossodia*, *Lyperanthus*, *Prasophyllum* and *Thelymitra* were used as food by the inhabitants of Australia. In Africa, the tubers of *Cynorchis*, *Eulophia*, *Disa*, *Habenaria* and *Satyrium* are used as food or juice is extracted from them. The roots, tubers or rhizomes of *Eulophia*, *Gastrodia*, *Habenaria*, *Orchis*, *Pholidota*, *Platanthera* and *Spiranthes* are used as food in Asia. The tubers of *Disa engleriana*, *D. robusta*, *D. zambica*, *Habenaria clavata*, *Satyrium ambylosacco*, *S. buechananii* and *S. carsonii* are used as food in Malaysia. In Bhutan, the inflorescence or flowers and pseudobulbs of *Cymbidium* species are eaten.



Protected cultivation of *Cymbidium* orchid

Production of raw material for herbal and cosmetic industry

Orchids have been used in various systems of medicine since Vedic period. The medicinal value of orchids is mentioned as early as 250–300 BC by Susruta and Vagbhata in the ancient Sanskrit scriptures. Numerous orchids have been used since ancient times in traditional medical treatment as a remedy for various ailments. The orchid genera used in conventional medicine are *Calanthe*, *Coelogyne*, *Cymbidium*, *Cypripedium*, *Dendrobium*, *Ephemerantha*, *Eria*, *Galeola*, *Gastrodia*, *Gymnadenia*, *Habenaria*, *Ludisia*, *Luisia*, *Nevilia* and *Thunia*. In India, some orchids such as *Eulophia campestris*, *Orchis latifolia* and *Vanda roxburghii* have attracted the attention of the scientific community due to their medicinal properties. In Ayurveda, a revitalising herbal formulation ‘*Astavarga*’ (Chyavanprash) is derived from a group of eight herbs, four of which are orchids, namely Jivak (*Malaxis muscifera*), Rishbhaka (*Malaxis acuminata*), Riddhi (*H. intermedia*) and Vriddhi (*H. edgeworthii*). *Dendrobium macraei* and *D. nobile* are other important orchids from an Ayurvedic point of view, as they are said to be a source of jivanti.

Production of orchids for socio-cultural and religious functions

In Nagaland, *Dendrobium hookerianum* and *Dendrobium nobile* symbolise purity and holiness. The headhunting community wears *Dendrobium acinaforme* in the belief that it brings courage and good luck in the hunt. The beautiful foxtail orchid (*Rhynchostylis retusa*), which is called ‘Kopou Phul’ in Assam, is worn by ladies as jewellery on their heads at various festivals, especially at the ‘Bihu’ festival in Assam. It symbolises youthfulness in spring and is a symbol of love for the youth of the Ahom community. In Manipur (formerly Kangleipak), orchids are used in many historical ceremonies. The flowers of orchids like *Vanda tessellata* and *Coelogyne nitida* are used in local festivals in Assam and Arunachal Pradesh, and the flowers of *Papilionanthe teres* are used by the Tai ethnic groups in Assam and Arunachal Pradesh for offerings to Lord Buddha and spirits. The dried leaves of *Cymbidium* are used to make various attractive, eco-friendly products such as lepcha hats, fruit and vegetable baskets, tea trays, containers, seat mats, hanging pots, dustbins, plant growing

pots, etc. In the state of Sikkim, the locals collect the raw material of dried *Cymbidium* leaves from their orchards and backyards, and use it to make some traditional artefacts that are used in both traditional and religious rituals as modern lifestyle accessories. These artefacts have a unique intricate style, design and durability for which people have valued them since ancient period. It has become a tradition to use certain *Cymbidium* artefacts in certain socio-religious rituals performed in the respective region. This has indirectly contributed to the survival of this craft, as the traditional knowledge of how to make these artefacts has been preserved.

CONCLUSION

Orchids have been admired since time immemorial and are regarded as one of God’s most beautiful creations. They have not only astonished biologists, but now also amaze consumers worldwide with their fantastic colours and long-lasting flowers. The commercial cultivation of orchids in countries such as Australia, New Zealand, Hawaii, Thailand and Malaysia has become part of the multi-million dollar global orchid industry. The climatic conditions of the country are very favourable for the cultivation of all types of commercial orchids, namely *Dendrobium*, *Cymbidium*, *Vanda*, *Aranda*, *Mokara*, *Phalaenopsis*, *Paphiopedilum*, *Cattleya* etc. The rich biodiversity of the region is another advantage for the development of high quality varieties with high productivity and resistance to diseases and pests. Since the globalization of the Indian economy, the demand for orchids as cut flowers has increased manifold, which is mostly met with imported flowers from other countries. Almost everything is God-given, only man has to endeavour to make these plants a source of prosperity in the country. Sporadic attempts to commercialize orchids have already started in several states. However, a well planned strategy and smart solutions are needed to realise the potential of orchids.

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