

Good Agricultural Practices of Commercial Orchids

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ABSTRACT

Orchids are the second largest families of flowering plants and are distributed throughout the world. They may be epiphytic, terrestrial and lithophytic. In addition to global cut flower trades, orchids are also harvested, grown and traded for a variety of purposes, including as potted ornamental plants, medicinal products and food. Brazilian *Cattleya*, Mexican *Laelia* and Indian *Cymbidium*, *Vanda* and *Dendrobium* have played a major role in developing present day beautiful hybrid orchids which numbers more than 300000. The international trade is dominated by a small number of genera viz. *Cymbidium*, *Dendrobium*, *Phalaenopsis*, *Cattleya* and *Oncidium* with huge number of hybrids. In India, some of native genera like *Cymbidium*, *Paphiopedilum*, *Vanda*, *Arachnis* and *Dendrobium* are grown on a large scale with good agricultural practices for cut flower production.

INTRODUCTION

Orchids are the second largest families of flowering plants and are distributed throughout the world. The family orchidaceae is divided into five subfamilies (*Apostasioideae*, *Cypripedioideae*, *Vanilloideae*, *Orchidoideae*, *Epidendroideae*). Orchids account for c. 8% of angiosperm species diversity (Chase *et al.*, 2015). Till date, 29,199 species have been identified and accepted (Govaerts *et al.*, 2017), although several hundred new species are added each year. By the end of 2017, the IUCN Global Red

List included assessments for 948 orchid species, of which 56.5% are reported to be threatened. Orchids are monocot plants. They may be epiphytic, terrestrial and lithophytic. About 70% of the world's orchids are epiphytic and/or lithophytic, 25% are terrestrial and 5% of the world's orchids grow in mixed substrates (both lithophytic, epiphytic and terrestrial) (Arditti, 1992).

In addition to their geographical and taxonomic diversity, orchids are also widely used for a variety of reasons, both legally and illegally, sustainably, and unsustainably. One of the best-

known plant groups in the global horticultural and cut flower trades, orchids are also harvested, grown and traded for a variety of purposes, including as ornamental plants, medicinal products and food. Brazilian *Cattleya*, Mexican *Laelia* and Indian *Cymbidium*, *Vanda* and *Dendrobium* have played a major role in developing present day beautiful hybrid orchids which numbers more than 300000. In the international trade, among top ten cut flowers, orchids rank the sixth position and among orchids *Cymbidium* ranks the first position and in floricultural crops it accounts for 3% of the total cut flower production. In India, it comprises 158 genera and 1331 species which grow up to an elevation of 5000m. In India, some of native genera like *Cymbidium*, *Paphiopedilum*, *Vanda*, *Arachnis* and *Dendrobium* are cultivated on a large scale for cut flower production. The *Cymbidium* is mainly grown in Sikkim, Darjeeling hills, Arunachal Pradesh and Assam. Tropical orchids are cultivated in Kerala and some parts of Tamil Nadu, Karnataka and Maharashtra. We should prefer those species which flower during winter and spring months to export flowers to temperate regions from December to May.

Classification of Orchids

Based on temperature requirements, orchids are classified into three categories.

Cool climate or temperate orchids: These orchids require a day temperature between 18°C and 25°C and the night temperature range between 8°C and 16°C. E.g., *Cymbidium*, *Odontoglossum*, *Masdevallia*, *Disa*, *Cypripedium*, *Pleione* and *Zygopetalum*.

Intermediate climate or subtropical orchids: These orchids need a day temperature between 20°C and 24°C and a night temperature between 13°C and 16°C. E.g., warm tolerant *Cymbidium*, *Oncidium*, *Miltonia*, *Paphiopedilum*, *Lycaste* and *Bulbophyllum*.

Warm climate or tropical orchids: These orchids grow well in tropical and subtropical climate. They require a day temperature of 24°C and 30°C and night temperature of 18°C and 20°C. E.g., *Vanda*, *Mokara*, *Aranda*, *Cattleya*, *Ascocenda*, *Phalaenopsis* and *Calanthe*.

Importance and Uses (De et al., 2014)

Cymbidiums are highly valued for genetic resources, cut flowers, hanging baskets, potted plants and herbal medicines. *Cymbidium iridioides*, *C. eburneum*, *C. hookerianum*, *C. sanderae*, *C. lowianum*, *C. tracyanum*, *C. insigne*, *C. erythrostylum* are used for development of standard hybrids whereas *Cymbidium ensifolium*, *C. devonianum*, *C. tigrinum* are used for miniature hybrids. Both standard and novelty hybrids are used as cut flowers and species like *C. ensifolium*, *C. aloifolium*, *C. devonianum*, *C. eburneum*, *C. lancifolium*, *C. lowianum* and *C. mastersii* are used as potted orchids. Other miniature orchid hybrids can be used as potted plants are Autumn Beacon Geyserland, One Tree Hill Solstice Gold B/CSA, Wakakusu Delight, Minneken Khobai, Kusada Fantasy Carioca, Phar Lap, Gladys Whitesell, Summer Love. Cascading hybrids are ideal for hanging baskets, e.g., Sarah Jean Ice Cascade Ad/CSA, Nicoles Valentine Geyserland HCC/AOS, Dorothy Stockstill Forgotten Fruit. Rhizomes of *Cymbidium aloifolium* are used as salep, demulcent and emetic; pseudobulb of *Cymbidium longifolium* is used as emetic and demulcent whereas leaf juice of *Cym. giganteum* is used in blood clotting. *Dendrobiums* are popular for cut flowers and for interioscaping. They are also valuable as pot plants or hanging baskets. Some species are hanged on the walls or on tree branches to cover the bare walls and branches. The dried stems of *Dendrobium nobile* are used for making herbal medicines. *Dendrobium* enhances salivation and used for the treatment of dry mouth, dry coughs and severe thirst. Flowers could be used to cure eye ailments.

Commercially Important Hybrids

Genera	Hybrids
Cymbidium	<p>White: Jungfrau ‘Snow Queen’, Jungfrau ‘Dos Pueblos’, Camalex, Showgirl ‘Cooksbridge’, Showgirl ‘Marion Miller’, Swallow var. ‘Takarazuki’</p> <p>Pink: Lilian Stewart ‘Coronation’, Lilian Stewart ‘Party Dress’, Orkney ‘Pink Heather’, Ensikhan, ‘Alpha Orient’, Pacific Rose ‘Swansea’, SoulhuntSeries, Valley Paradise ‘Shangriila’, Rievaulx ‘Cooksbridge’, Rincon Fairy ‘Pink Perfection’.</p> <p>Yellow: Angelica ‘December Gold’, Highland Sunset ‘Plumpton’, Mini Sarah ‘Artisan’,Hawtescens ,Gwen Sherman, ‘Arthur Fetzer’, San Francisco ‘Mona Lisa’, Valya Craig ‘Sutherland’, Luana ‘Imperial’, ‘Pine Clash Moon Venus’, ‘Valley Legend Steff’</p> <p>Green: Joyce Duncan ‘Susan Hughes’, ‘R.D. Hughes’,Miretta ‘Mcbean’, Lucense, Tricia Allen ‘The Globe’,Sparkle ‘Late Green’,Levis Duke ‘Belle Vista’ , Sparkle ‘Late Green’, Amsebury ‘Frank Slattery’, ‘Valley Zenith ‘Top Spot’, ‘Madrid Forest King’, ‘Winter Beach Sea Green’</p> <p>Red: Chief Joseph ‘Pathfinder’, Sensation ‘Chianti’ 4N, Terama ‘Robin,’Barushka ‘Dos Pueblos’, Khyber Pass ‘Rowes Red’, James Toya, ‘Fire Storm Ruby’, ‘Fire Storm Blaze’ ‘Bob Marlin Lucky’, ‘Red Beauty Evening Star’</p>
Dendrobium	<p>White: ‘Snow White’, ‘Pagoda White’, ‘Emma White’, ‘White Surprise’, ‘Jacquelyn Concert x Walter Oumae’, ‘Kasem White’, ‘Big White 4N’, ‘Big White Jumbo’, ‘White 5N’</p> <p>Blue: ‘Vorawit Blue’, ‘Lee Chong Blue’, ‘Kultana Blue’, ‘Kiyoshi Izumi’, ‘Blue Fairy’, ‘Lee Chong Blue’, ‘Bangkok Blue’</p> <p>Pink: ‘Chiengmai Pink’, ‘Ekapol Panda’, ‘Jisu’s Star’, ‘Juree Red’, ‘Kiilani Stripe’, ‘Long Champ’, ‘Penang Sugar’, ‘Sagura Pink’, ‘Miss Singapore’, ‘Madam Pink’, ‘Sonia -16’, ‘Ear Sakul’, ‘Candy Stripe Pink’, ‘Sonia-17’, ‘Sonia -28’, ‘Dr. A. Abraham’</p> <p>Yellow: ‘Sri Siam’, ‘Swan Lake’, ‘Thongchai Gold’, ‘Bonchoo Gold’, ‘Sarifa Fatima’</p> <p>Green: ‘Daangsaard’, ‘Kanjana Green’, ‘Green Mist’, ‘Little Green Apples’</p> <p>Red: ‘Meike Beauty’, ‘Pathum Red x Sabin’, ‘Little Lolita’, ‘Cleopatra’, ‘Diamond Star’, ‘Fireball’, ‘Little Lolita’, ‘Kating Daang’.</p>
Phalaenopsis	<p>Standard white: Elisabethe, Doris, Alice Gloria, Cast Iron Monarch, Dos Pueblos, Elinor Shaffer, Gladys Read, Grace Palm, Joseph Hampton, Juanita, Palm Beach, Ramona, Richard Shaffer, Sonja, Taisuco Bright, Taisuco Crane, Taisuco Snow, Cygnus, Brother Sister Windian</p> <p>Semi - alba Hybrids: Roselle, Ruby Lips, Sally Lowry, Judy Karleen, Sharon Karleen, Karleen’s Wendy, Bright Lights, Devon Michele, Spitfire, Mad Hatter, Rodco’s Lady, Lipstick, Career Girl, Show Girl, , Miki WataNabe, Memoria Francis Hunter, Dtps. Ox Prince Thunder, Dtps. ChianXen Magpie</p> <p>Striped Hybrids: Robert W. Miller, Peppermint, Samba, Barbara Freed Saltzman, Career Girl, Chorus Girl, Ella Freed, Marginata, Kaleidoscope</p> <p>Spotted White Hybrids: Elise de Valec, Rouserrole, Dame de Coeur, Snow Leopard, Marry Krull, Ann Krull, Cabrillo Star, Paifang’s Queen</p> <p>Pink Hybrids: Grand Conde, Versailles, Alger, Reve Rose, Zada, Barbara Bread, Ann Marie Beard, Lipperose, German Pinks, Danse, Ida Fukumura</p> <p>Standard Yellow : Bonnie Vasquez, Sogo Manager ‘Nina’, Brother Lawrence ‘Montclair’, Brother Oxford, Brother Passat, Brother Stage, Golden Gift, Goldiana, I- Hsin Sunflower, Misty Green, Sogo Lisa, Taida Lawrence, Taipei Gold, Hsin Yang Fortune, Shih Hua Long First Love, Detroit</p> <p>Standard Orange Desert Orange, Carnelian Queen, Orange Glow, Orange Beauty, Tangelo, Cinnamon Glow, Brother Sara Gold ‘Peach’, Zuma creek, Burnished Copper, lawless Red Peppers, Black Ball, Chen, Peachy, Amber, Ember, Bold Beauty</p> <p>Red and Purple Hybrids: Engine Red, Cardinal, Ewing, Red Galaxy, Liberty Hill, Imp’s Pride, Red Hot Imp, Venimp, Spirit House, Summer Morn, Red Buddha, Mahalo, Tapestry, Orchidland, Bloody Mary, Dixie Sunset, Peter Lin, Hwa Yuan, Sogo Grape, TaidaSalu, Katherine, Ruby Glow, Burgundy Beauty, Purple Gem, Carol, Garnet Beauty, Spotted Beauty, Strawberry, Plum Rose x Ox Black Jack</p> <p>Harlequins Hybrids: Golden Peoker ‘BL’, Golden Peoker ‘Nan - Cho’, Ever Spring King, Beautiful Dreamer, Ever Spring Prince, Ever Spring Light, Ever Spring Pioneer, Carolina Bronze Meteor Montclair, Montclair, Brother Jungle Cat, Nobby, Peacock, Celebration</p>

Cattleya	<p>Cattleya: <i>Cattleya Alcmeda, Cattleya Bobby Howarth, Cattleya Intertexta, Cattleya Mrs. Myra Peters, Cattleya Veriflora, Cattleya 'Queen Sirikhit'</i></p> <p>Laeliocattleya: 'Hidden Agenda', 'Magic Road', 'Samba Crown', 'Tropical Fashion', 'Higher Ground', 'Mini Case', 'Nobiles General', 'Spring Parade', 'Upstrart', 'Harmony Show', 'Julie Anne', 'Beautiful Park', 'Orange Sunset', 'Carbon Lines', 'Good Friend', 'Pat's Golden Dream', 'Sunlight Kiss', 'Sweet Cream', 'Penny Love', 'Big Lucy', 'Blue Boy', 'Gatton Park'.</p> <p>Epilaeliocattleya: 'Chocolate Kisses', 'Kopaa', 'Rainbow Sherbet', 'Pixford', 'TinyMagic', 'Highland Canary', 'Pseudogold', 'Jackie Bright'</p> <p>Epicattleya: 'CathyMeincer', 'Painted Hill Star', 'Calandria', 'Erin Routon', 'Burdekin Honey', 'Peles Flame'</p>
Oncidium	<p>Golden Shower type: Aloha IwangaDogasima, Goldiana, Gower Ramsey, Golden Shower, Sum Lai Who Jungle Queen, Taka H & R, Sharry Baby Sweet Fragrance AM/AOS, Sweet Sugar</p> <p>Red coloured: Popki Red, Irine Gleason Red, Vision Brownish Red, Catherine Wilson x New Calidonia Brownish Red, J.R. Orange Red</p> <p>Colmanara hybrids: Colm. 'Jungle Monarch', Colm. 'Wildcat', Colm. Wildcat 'Bobcat', Colm. Wildcat 'Cheetah', Colm. Wildcat 'Rainbow', Colm. Wildcat 'Red Star', Colm. Wildcat 'Tiger'</p>
Paphiopedilum	<p>Multi-floral or strap leafed Paphiopedilums: Prince Edward of York', Paph. 'Michel Koopwitz', Paph 'Saint Swithin', Paph 'Mount Toro'</p> <p>Fragrant Slipper Orchids: Paph. 'Joyce Hasegawa', 'Paph. 'Lynleigh Koopwitz', 'Paph. 'Magic Lantern', Paph. 'Harold Koopwitz',</p> <p>Hybrid Phragmipediums: Phrag. 'Sorcerer's Apprentice', Phrag. 'Grande', Phrag. 'Don Wimber', Phrag. 'Elizabeth March', Phrag. 'Hanne Popow', Phrag. 'Jason Fischer', Phrag. 'Living Fire'</p>
Vanda Alliances	<p>Vanda hybrids: 'Roberts Delight', 'Dr. Anek', 'Pakchong Blue', 'Miss Joaquim', 'Fuch's Delight', 'Lumpini Red', 'Motes Indogo Blue', 'Pat Delight', 'Rasri Gold', 'Samsai Blue', 'AdisakSmile', 'Robert Sorenson', 'Kasems Delight', 'Richard Brandon', Kultana Delight', 'Brigton'sPride', 'Hope', 'Mark Lewis', 'Dr. Mahathis', 'Kultana Miami White', 'Kultana Violet', 'Grand Lady', 'Fuch's Midnight', 'Motes Nut Brown', Prayoon Delight'</p> <p>Aranda hybrids: 'City of Singapore', 'Hilda Galistan', 'UrmilaNandey', 'Christine', 'Thailand Sunspot', 'Millenium Dawn', 'Broga Giant', 'Salaya Red', 'Propine White', 'Propin Spot', 'Lueng Cholburi', 'Ishbel Manisaki', 'Baytown', 'Chao Praya Blue', Chao Praya Dot Com', 'Chao Praya Beauty', 'Ethan Pride', 'Taksari Chandrabir'</p> <p>Ascocenda hybrids: 'Carol Belk', 'RenukaAngle', 'Joyce Bevins', 'Adisak Blue', 'Renu Gold', 'Tipi Blue Boy', 'BobsFortune', 'Rubychai', ShahRukhKhan', Yang Sophia Firuz', 'Abdul Ghani Othman', 'Chunika', 'Fuch's Star', 'Kultana White', 'Golden Peace', 'LaniBeauty', 'MahoganyGem', 'CopperPure', 'Pokey Dot'</p> <p>Mokara hybrids: 'MadamPanne', 'Bangkok Gold', 'Chao Praya Gold', 'Chark Kuan Orange', 'Chark Kuan Pink', 'Kelvin Red', 'Kelvin Orange', 'Walter Ouame', 'Jitti Orange', 'Happy Beauty', 'Margaret Thatcher', 'Sarita Gold', 'Laura Bush', 'Winnie Burang', 'Gladys Oumae', 'Denis Child', 'Ratchaburi Blue', 'Lion's Gold', 'Chao Praya Sunrise', 'Pak-Kred', 'Golden Rooster', 'Jasso's Pride', 'Chao Praya Classic', 'Chao Praya Spots', 'Calypso', 'Bota Gold'</p> <p>Kagawara hybrids: 'Red Lava Orange', 'Mist', 'Christie LowRedland', 'Broga Cemerlang', 'Chao Praya Fantasy', 'Curtis Lutchman', 'Emily Kavita Rajah', 'Diinesh Gold', 'Lion's Flame', 'Irene Hew', 'Bukit Timah', 'Sandy Gold'</p> <p>Vascostylis hybrids: 'IquePink', 'Kruewan', 'Banjong Jasmine', 'Mishima Lime', 'Vanity Fair', 'Firuz', 'Pine Rivers', 'Banjong Elite', 'Pichtawit Gold', 'Chao Praya Lime', 'Lanna Rosy', 'Jeans Delight', 'Bay Sapphire', 'Spring Hill'</p> <p>Aeridovanda hybrids: 'Bensiri', 'Noreen', 'EarlyBird', 'ShivSidhu', 'New Dawn', 'Harrison Luke Somsri Sunlight'</p>

The tonic made from *Dendrobium* nourishes stomach, lungs and kidneys. The plant is effective in treating pulmonary tuberculosis, impotence and anorexia. The pulp of pseudobulb is applied to boils and pimples. Juice of the plant is used to relieve fever. *Phalaenopsis* commonly used as pot plants and cut flowers and are suitable in hotel arrangements, hanging arrangements, households, boutique stores, weddings, funerals, birthdays, etc. The purity and brightness of the *Phalaenopsis* make an especial appeal for weddings and corsages. In addition to cut flowers and pot plants, *Cattleya* orchids are ideal components for flower decorations including bouquets and flower arrangements. Besides, this orchid is used for making clay flowers. *Oncidium* species, their hybrids and inter-generic hybrids are suited to intermediate and warmer climates. The plants are epiphytic using hosts such as cactus plant and trees for support. Hybridization of *Oncidium* orchids with *Brassia* orchids, *Miltonia* orchids and *Odontoglossum* orchids resulting in an *Oncidium* orchid that has some warmth tolerance and beautiful flowers. Hybrids and some commercial species are used for cutting flowers, hanging baskets and potted plants. *Paphiopedilums* are most popular orchids because of their unique shape, colour and easy to cultivate. They are commonly called as ‘Slipper Orchids’ and can be grown windowsills, in basements, Wardian cases, small green houses, in large commercial green houses, lathhouses and shade houses and can be grown in different climates. There are more than 13,000 hybrids have been registered which are very attractive in colors, size and shapes. These are grown as pot plants or cut flowers. All orchids having the same characteristics as the *Vanda* genus is called as a vandaceous orchid and they grouped together to form the *Vanda* Alliance. Genera like *Vandas*, *Aerides*, *Ascocentrum*, *Renanthera*, *Rhyncostylis*, *Aranda*, *Mokara*, *Kagawara* are included in the *Vanda* Alliance. Many of orchids under this group are called as ‘Scorpion Orchids’ or ‘Spider Orchids’. They are ideal for hanging

baskets, pots or tree logs. Leaf juice of *Vanda coerulea* is used against diarrhea, dysentery and external application for skin diseases. Leaf paste of *Vanda teres* is applied to reduce temperature in fever. Leaves of *Vanda cristata* are used as tonic and expectorant. In *Vanda tessellata*, paste of leaves is effective against fever. It is ingredient of *Rasna Panchaka Quatha*. In Ayurvedic medicine, it is used in the treatment of arthritis and rheumatism. The leaf juice extract is used in the treatment of otitis media. The root is an effective against scorpion sting and bronchitis.

Nursery structures

Nurseries include a variety of structures used for specific or multiple purposes. These include buildings to store farm equipments and materials, potting operations etc., green houses, shade houses, nursery beds, cold frames, mist chamber, hot beds, lath houses etc, to propagate, grow and rear of nursery plants.

Greenhouses are classified into two broad groups depending upon the cost of installation namely,

- Low cost greenhouse
- Medium to high cost greenhouse

The low-cost greenhouses are made of a frame of steel, aluminum, bamboo or wood covered with plastic films or net. In these types, ultimately rains, insects and diseases are prevented to save the plant materials. Adequate natural ventilation is kept through doors, windows or collapsible sides when the entire frame is covered with plastic films. A 30-mesh net is preferred to keep the aphids away. In some cases, roofs are made impervious and sides are covered with net to get rid of heavy rains and closed atmosphere. Irrigation is given through micro-sprayers only to maintain proper humidity level. Such types of greenhouses may be of single span, multi-span, gothic arch, gable, Quonset and saw tooth with area ranging from 20 m² to several hectares.

The medium cost greenhouses are constructed to control significantly environmental factors depending upon the type of crops and agro-climatic zones. In these types of greenhouses, a well-designed cooling system and photoperiodic control and active heating systems are employed, for example, Conservation greenhouse, Dome-shaped greenhouse, Alpine house and Polygonal greenhouse. Similarly, greenhouses can be classified into two groups based on the type of framework and environmental control, namely (a) Conventional greenhouse (b) Special greenhouses. Conventional greenhouses have an aluminium or timber framework and either all glass or part solid walls. Conventional greenhouses have wide range of accessories like staging and shelves, for example, Traditional span, Three-quarter span etc. Special types of greenhouses are designed for incorporation of highly decorative garden features and high value crops for example, Poly-tunnels, Ground-to-Ground greenhouse, Gable type greenhouse, Quonset greenhouse, Conservation greenhouse, Dome shaped greenhouse, Alpine greenhouse. Orchids are naturally grown by the shades of trees which protect from direct sun and under controlled conditions, they are grown in specially designed orchidaria or orchid houses running North-South. A central tank filled with water or by using artificial fogging nozzles aid to increase humidity.

Under moderate climatic conditions tropical orchids are grown in open fields whereas moderate protection is required for large scale cultivation. They are grown in fibre-house or orchid house or simple shadenet house or polyhouse. Temperate orchid should be grown in cool houses. A 75% shade net house with 70-80% humidity, day temperature of 21 - 29°C and night temperature of 18 to 21°C is ideal for growing this tropical orchid. In high rainfall zones, the shade net house should be provided with a rain shelter.

Climatic Management

Light: In *Cymbidium*, a full morning sun or bright dappled afternoon shade during summer and full sun in winter is ideal. Mature plants need 50-55% shade during hot weather. During growing season, they require up to 5000-6000 f.c. light whereas in flowering season upto 2000-3000 f.c. light. Foliages should be yellowish green in colour. All types of *Dendrobium* orchids require warm bright light (2500-3000-foot candles). They should get at least 12-14 hours of light each day year-round. *Phalaenopsis* can be grown indoors in windowsills, sunroom, and shaded greenhouses and under artificial lights in most temperate climates. The requirement of light is 1000-1500-foot candles for winter and 800-1200-foot candles in summer. *Phalaenopsis* can be grown under artificial light. *Phalaenopsis* can be grown 9-12 inches under fluorescent lights or 4 to 6 feet under 400 watts high intensity discharge lights or high-pressure sodium lights. *Cattleya* orchids need medium to bright light to the exposure with 2000 to 3000-foot candles. They thrive well under a 40% shade cloth. Most *Oncidium* orchids will thrive with one to several hours of sun a day and a light intensity of 2500 foot candles. Generally, thicker-leaved plants, such as *Tolumnias* also known as "mule-ear" and "equitant" *Oncidium* orchids, can tolerate more light. *Oncidium* orchids in a greenhouse are best advised to make use of a shade cloth which can be anywhere from 30 to 50 percent shade, depending on the orchid plants. *Paphiopedilum* readily adapt indoor conditions and can be grown successfully in artificial light. The optimum light for the growth of *Paphiopedilum* is between 6000 - 15000 lux (800-1200-foot candles). Direct sunlight is not ideal for slipper orchids. All *Vanda* orchids require high light levels. Strap leaf Vandaceous orchids require 60-65% shade whereas terete or semi-terete vandas need more light and require 50% shade. On an average they require a light intensity of 4000-foot candles.

Temperature: In general, *Cymbidium* can tolerate as low as temperature of 7°C. In vegetative stage, plantlets grow best at temperature of 18°C at night and 24-30°C during the day. A temperature of 10-15°C is required for initiation of flower spikes. During the winter season (Late October to late February) a temperature of 7-12°C at night and 18-24°C during the day is maintained. Miniature hybrids can withstand 5°C higher temperature than standard cymbidiums. The cool growing *Dendrobium* orchid group thrives well temperatures ranging between 10 and 24°C. The intermediate *Dendrobium* orchid prefers a temperature range of 14-26°C whereas the warm growing *Dendrobium* orchids prefer 16 to 30°C. The warmer group species like *Dendrobium phalaenopsis*, *Den. gouldii*, *Den. biggibum*, *Den. Antennatum* and *Den. discolor* bloom at night temperatures above 16°C and the cool growing species such as *Den. lindleyi*, *Den. aggregatum*, *Den. parishii*, *Den. pierardii*, *Den. densiflorum*, *Den. chrysotoxum* and *Den. anosmum* perform well at night temperature of 10°C. Low temperature and short days could change the concentration of endogenous growth regulators leading to the induction of flowering in sympodial orchids. The *Phalaenopsis* is a tropical plant, and consequently temperatures lower than 15°C and 32°C and above should be avoided. For an appropriate growth endeavors should be made to maintain an average temperature of 26-27°C during the growing phase and 19-21°C during the phase of flowering. During winter, the temperature should be maintained between 18 to 20°C. A temperature of 18°C is particularly necessary in the event that the induction of buds needs to be enhanced in conditions of inadequate light or high daytime temperatures. Care should be taken to ensure a minimum nighttime temperature of 15°C - 20°C for the rest of winter. The ideal temperature range of *Cattleya* orchid species is between 15 and 30° Celsius. Depending upon the temperature, *Cattleya* orchids should be watered about once or twice a week. In winter, the *Cattleya* orchid plants will become stressed if the temperature

drops below 15°C. Majority of *Oncidium* species grow well in temperature between 25-30°C during daytime and 20°C during the night. Little bit hot are tolerated by the warmth tolerant *Oncidium* orchid hybrids if humidity and air movement are increased as the temperatures rise.

Paphiopedilum can survive in range of temperatures. The best temperature of polyhouse for the good growth is between 15°C to 26°C. However, some species may tolerate up to 36°C. Fall in night temperature is required for initiation of flowering particularly *P. rothschildianum* and its hybrids. *Paphiopedilums* will generally tolerate lower than ideal temperatures provided the medium should be dry. The *Vanda* orchid prefers warm temperature in summer and winter. They are highly susceptible to cold and frost. In cooler region, the orchid plants will go into a dormant state during winter. Cylindrical Vandas require a minimum temperature of 16-17°C at night during winter and a maximum of 30-32°C in the summer. Flat leaved vandas need a winter night temperature of 10-12°C and a summer daytime temperature of 22-25°C. They can tolerate higher and lower temperatures for short periods only.

Humidity & Watering: Most orchids are damaged by overwater rather than under watering. Over watering leads to root rot and many other diseases. Most orchids prefer water of pH 5.0-6.5 although rainwater is best. Watering with lower or higher pH or with high levels of dissolved minerals can hamper nutrient uptake. Frequent watering is essential under high sunlight and high temperature conditions. Plants in small containers dry out more quickly than in large containers. Plants in earthen pots require more watering than plants in plastic pots. A hanging plant, with better aeration than one in a pot needs more frequent watering. More frequent watering is necessary for fresh potting materials. Watering should be practiced either in the morning or in afternoon time. Monopodial orchids require higher humidity than sympodial ones. As rule of

thumb, in high temperature, humidity should be kept high. Provisions of misting units or foggers or even humidifiers will ensure adequate humidity. Standing water beneath the benches may be kept improving humidity. In *Cymbidium*, watering is required all the year round to keep the pseudobulbs green and smooth. The frequency of watering is given as: Summer: 2-3 times per week, Autumn: Once or twice per week, Winter: Once per week and Spring: As Autumn season. An optimum range of relative humidity is 50-80% and important for good growth and flowering. During hot weather, misting down the plants and the surrounding floors and benches maintain humidity. In *Dendrobium*, humidity is kept at 50-70%. *Phalaenopsis* can perform better with the humidity of 50-70%. To increase the humidity level, companion plants like ferns, bromeliads, and other foliage plants can be placed near the *Phalaenopsis* plant in the house. *Cattleya* orchids should be watered about once or twice a week. It should be watered more frequently during the hotter months of the year. *Cattleya* orchids may be allowed to dry out between applications of water. It is advised to always water the *Cattleya* orchids early in the day, so that the foliage will be dry by nightfall. They require 40-60% relative humidity. Generally, *Oncidium* orchid plants with large fleshy roots or leaves require less-frequent watering than thin-leaved or thin-rooted plants. Watering should be thorough, and the medium should be allowed to dry at least halfway through the pot before watering again. This may be every 2 to 10 days depending on weather, pot size and material, type of orchid and type of potting medium. Plants not actively growing should be watered less. Humidity ranges should be between 50 and 60 percent. Many *Oncidium* orchids require less humidity than other orchids. *Paphiopedilums* require high relative humidity particularly during summer months for the growth of leaves and roots and in minimizing bacterial and fungal infection to the plants. When the temperature goes down during winter season the humidity must be decreased gradually. The optimum humidity for the good

growth of *Paphiopedilums* ranges between 65-75%. Vandaceous plants love good quality water. Being a monopodial growth habit, the plants cannot retain water for any great length of time. It is always advisable to water these plants as early in the morning as possible, so that by noon the foliage of the plants dry up. Orchids do not appreciate being wet and cold, so water your plants in the wintertime only on bright and clear mornings, as necessary. Adult plants are watered once a week in the wintertime and every day during summer. Vandaceous orchids require humidity upto 70-75%.

Aeration and ventilation: Fresh air and good circulation are essential for orchid production. Full of continual light breezes make a good source carbon dioxide for photosynthesis. Leaves should move gently in a light breeze. Air movement in growing environment ensures good growth and less infestation of diseases and pests. Ceiling and oscillating fans are effective for providing gentle air flow in hobby greenhouse or indoor growing area. Both can cover large areas with a constantly changing air flow pattern without excessive drying the plants. *Paphiopedilums* require good ventilation and high relative humidity particularly during summer months for the growth of leaves and roots and in minimizing bacterial and fungal infection to the plants. The air movement helps to evaporate excessive water in the compost or potting medium. In warm climates, evaporative coolers are essential for the commercial glasshouses.

Planting

Earthen pots, plastic pots, baskets, tree fern block, wooden trays and whole husk of coconut are common containers used for planting orchids. Sufficient drainage is very essential for orchids. Therefore, holes of appropriate size are made in containers both at the bottom and on the sides. The size of the container should be proportionate to the size of the plant and its growth habit. Orchids can be planted on the ground too, in shallow trenches filled with

media. Terrestrial and semi-terrestrial plants like *Paphiopedilum* and *Cymbidium* perform better in deep pots. Orchid plants as a rule grow to be near one another to aid a microclimate higher in humidity. Basket culture is useful for those orchids like *Vanda*, *Rhyncostylis*, *Arachnis* with pendent flower spikes and long dangling roots. Orchids in hanging pot or baskets are grown with lighter media like charcoal, coconut husk and tree fern fibre. Clay pots are best suitable for terrestrial orchids. Plastic pots are used for epiphytes. Slabs or logs of tree fern are effective for cool growing orchids. A potting media of terrestrial orchids should have equal parts of leaf mould, soil and sand. Clay soil, bone meal, sawdust, charcoal dust, manure, wood savings etc. are also used in various proportions for satisfactory growth of terrestrial orchids. A potting medium consisting of charcoal, brick pieces and coconut fibre in equal proportions is ideal for vegetative growth and flowering of epiphytic orchids like *Aerides*, *Dendrobium* etc. Under low humid conditions (30%), plastic pots with a mixture of bark/perlite/sphagnum moss or osmunda are used. Under average humidity (35-50%), it is advisable to use plastic pots with a mixture of bark and sphagnum moss. Under high humidity (55% and above), clay pots are used with bark, stone culture, charcoal or tree fern. The medium used for growing orchids should allow good aeration and drainage. It should not absorb too much water and should not degenerate easily. The components are washed thoroughly before filling in pots.

For epiphytic orchids, the pots are filled with the media and the plants are placed over it, exposing the roots. In sympodials, the plant is placed near the edge of the pot, the growing point facing towards the centre. A monopodial orchid is placed in the centre of the container. If necessary, a stake may be used to keep the plant in position. When growing on tree fern rafts, the plant is tied with a soft copper wire. The whole plant with pot may be dipped in water after planting and thereafter watered judiciously. The plants can also be grown on raised

platforms over appropriate media directly or in pots.

Potting mixtures of some commercial orchids

Cymbidium: Cocochips + cocopeat + brick pieces + rice husk/ leaf moulds/ slow release fertilizer (3: 1: 1: 5g/pot),

Dendrobium: Coco peat + brick pieces + tree bark (1: 1: 1),

Vanda: Cocochips + brick pieces + leaf fern (1:1:1),

Oncidium: Cocochips + brick pieces + leaf moulds (1:1:1),

Phalaenopsis: Cocochips + brickpieces + leafmoulds + green moss (1:1:1:1)

Cattleya: Cocochips + brick piece + leaf mould/ leaf fern (1:1:1)

In *Cymbidium*, the pots should be placed at spacing of 60 cm x 60 cm, which will accommodate about 3 pots / m² (gross). The total number of plants will be about 30,000 / ha. In *Dendrobium*, the planting density should be 100,000-1,50,000 plants/ha. Other sympodial orchids, in general, prefer a very close planting and crowded growth.

Manuring and Fertilization

Orchids are light feeders and they require nitrogen from beginning to two-third of their life cycle. During rest period, they do not need any fertilizers. During flower initiation and inflorescence development plant are fed with less nitrogen, more phosphorus and potassium. During the blooming time, a small level of nitrogen and phosphorus and high levels of potassium are maintained. In orchids, foliar feeding is found to be ideal. Frequent application of fertilizers in low concentrations is the best way of feeding orchids. A concentration of 0.2 to 0.3 % of 30:10:10 (N: P: K) at vegetative stage and 10:20:20 (N: P: K) at

blooming stage are applied for quality flower production. Readymade fertilizer formulations are available in the market to satisfy these requirements. Spraying 2-5 times a week is generally ideal. In flowering plants, care should be taken to see that the plants are kept free from fertilizer application at least 3 days prior to harvest of flowers. Otherwise the keeping quality of flowers may be affected. Micronutrients aid to improve the quality. These are applied once a month. The chemical fertilizers are to be perfectly balanced with organic manures-cowdung, cows' urine, groundnut cake, fish emulsion and neem oil cake. They are to be diluted before application. Since urine contains high level of salts, a dilution of 1: 25 is necessary. For others, 1:10 dilution and subsequent storing for 4-5 days before application is ideal. One spray a week with organic manure is enough.

Aftercare

Better post-planting attention is required to get healthy plants and quality flowers. Check the support given to plants, remove decayed and dried up parts, check water stagnation, provide good ventilation, remove weed growth on the media and exposing the roots are the main operations to be done. The monopodial types- *Vanda*, *Arachnis* and *Aranda*, prefer open conditions with plenty of sunlight. The dendrobiums, cymbidiums, cattleyas and oncidiums should be grown under partial shade. The thumb rule is to provide maximum light which they can withstand, without adversely affecting their health. Care should also be given to see that the shading materials should not hinder the air movement. The ultraviolet (UV) stabilized agro-shade nets are ideal for regulating shade, which are available at varying shade intensities. Green or black colour is usually preferred.

Orchid plants require repotting if there is no space left in the pots for new growths and if the substrate has decomposed or roots are rotting. Timing is the most important part of good repotting. The best time for repotting of an

orchid is when new growth and new roots are just beginning to form, before those new roots reach even 1 cm long. In most of the orchids, it occurs right after flowering. It shows that repotting should be done between February and June.

Harvest and Economics of Cultivation

In most of the genera, orchids take more than one year to come to flowering, after planting out of the flasks. Initial spike is very small, and these are preferably pinched off to improve the quality of spikes. In *Dendrobium*, the spikes of orchids are harvested when a few buds on the top remain unopen whereas in *Cymbidium* two buds open stage or 70% bloom stage. In *Phalaenopsis*, the 40-60 cm long spikes containing at least 8-10 flowers are harvested when all flowers are fully open. Average flower production is 6 to 7 stems / plant /year. In *Cattleya*, fully open flowers on a spike of 25-40cm length depending on the type are harvested. *Oncidiums* are harvested, when more than 80 per cent flowers on the spikes are fully open on a spike length of 60 cm with many florets. Inflorescences of *Paphiopedilum* become ready for harvest after 3-4 days opening of flower. Vandas are harvested when all flowers are already open, depending on types 10 to 16 flowers on a stem length of 50-60cm. Under tropical conditions, harvesting during early morning or evening is preferred. Leaving a small length of the stalk, the spikes are cut using a sharp knife. Application of fungicides to the open wounds of the plant prevents possible infection.

Yield of spikes varies from genus to genus and variety to variety. A healthy well grown *Cymbidium* orchid will produce flowers spikes every year and a plant 10 years old can produce from 10 to 20 flower spikes. On an average, 6-8 spikes are available from commercial varieties of *Dendrobium*. The harvested spikes, also known as stems, are immediately put in a bucket of water. The cut end is fully immersed. These are then taken to the packing house for grading and packing. The cut ends of the spikes

are wrapped with wet cotton and tied with a rubber band. Alternatively, the cut ends are inserted into a plastic tube containing water.

Number of buds to be retained on the spike and grading vary in different places. It is usually 25-50% of the total flowers in a spike. In standard *Cymbidium*, 12-15 flowers are kept per spike whereas in *Dendrobiums*, those having less than 5 flowers are not usually preferred.

Boxes used for packing different types and grades of orchids vary in their size. Use strong cartons of adequate size for better handling of flowers. About 50 flowers are packed in a single box. It is desirable to keep boxes in refrigerated trucks during transport. They are also be stored in refrigerated rooms. A storage temperature below 7°C causes chilling injury to the flowers.

After reaching the destination, the flower spikes are usually removed from cartons and placed in water. It is desirable to cut and remove a small portion of the base of the spike once every 2 or 3 days to help better absorption of water. In *Cymbidium*, 4% sucrose + 100 ppm $Al_2(SO_4)_3$ or 2% sucrose + 200 ppm 8-HQS (8-Hydroxy quinoline sulphate) whereas in *Dendrobium*, 2% sucrose + 200 ppm 8-HQC (8-Hydroxy quinolone citrate) is used as holding solutions.

Pricing of spikes depends upon the type of orchid and the grade of spikes. The cost of one *Dendrobium* spike ranges from Rs. 10 to Rs. 25 depending upon the grade. For *Oncidium* and *Vanda*, the usual pricing is between Rs. 10 and Rs. 20 and in *Cymbidium*, the cost of one spike ranges from Rs.100/- to Rs.200/-.

At present most of the flowers produced in the country are fed to internal markets. There are agencies like societies and traders who arrange for collection of spikes at a reasonable price. These societies and traders in turn take the flowers to bigger traders who are in certain major cities. The flowers are then passed on to wholesaler agents in metropolitan cities who then dispose the flowers to retailers or

consumers directly. Certain agencies also take up value addition by making floral arrangements and bouquets.

A *Cymbidium* grower can earn Rs. 40 lakhs in 10 years from an area of 500m² accommodating 1500 plants after investing 10 lakhs and saling of 55000-60,000 cut spikes. From an area of 500m² containing 3000 plants, a *Dendrobium* grower can earn 5 lakhs in three years after saling of 3000 number of cut spikes and 3000 mother plants.



Cym. 'Red Beauty Evening Star' Den. 'Bangkok Blue'



Vanda 'Motes Indigo Blue' Cattleya 'Queen Sirikit'



Aranda 'Thailand Sunspot' Mokara 'Happy Beauty'



Phalaenopsis 'Strawberry'



Oncidium 'Sweet Suagar' Paphiopedilum 'Harold Koopwitz'

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