

MINI MISSION 1, BULLETIN No. 1

**SUCCESSFUL ORCHID
GROWING IN NORTH
EAST INDIA:
UNDERSTANDING THE CRITICAL
FACTORS**



**NATIONAL RESEARCH CENTRE FOR ORCHIDS
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
PAKYONG – 737 106, EAST SIKKIM**



Zygopetalum Intermedium



Cymbidiums under simple bamboo structure

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Preface

Orchids occupy a special place in the cut flower trade. *Cymbidiums*, *Dendrobiums*, *Paphiopedilums*, *Phalaenopsis*, *Vandas*, *Cattleyas* and *Oncidiums* are the types especially used for cut flower production. Among orchids, *Cymbidiums* are the most suited for large scale cut flower production in the hills of north eastern region. As the result of its long lasting quality, several florets on a spray and availability in a various size, shape, colours make it an ideal for commercial production. A *Cymbidium* spray will last for over 50 to 60 days on a plant and have a vase life of over 2-3 weeks, making it ideally suited for the cutflower trade. There is also very much advantage in flowering time in north eastern region, being in the Northern hemisphere can do so from November to April with the appropriate choice of varieties. While Australia, New Zealand etc supplies *Cymbidium* cut flowers from June to November. Since most of the hybrids used for cut flower production have been raised from species that originate in the hills of Eastern Himalayas, they adopt well under minimum protected conditions using low cost polyhouses and produce quality flowers. Besides cool growing *Cymbidiums* this region can also grow tropical and subtropical orchids like *Dendrobiums*, *Paphiopedilums*, *Phalaenopsis*, *Vandas*, *Cattleya*, *Oncidiums* etc. at lower elevations. Thus offering an wider scope in terms of number of orchid genera that can be grown in this small geographical area. The orchid industry in this region would provide opportunities for employment to youth and opportunities in ancillary industries like plastics, packaging, transportation, cold storage etc.

With little bit of modification of the climatic conditions by means

of protected structures, proper scientific know-how to the orchid growers, proper post harvest management and above all strong marketing support and network, this region can become one of the leading exporter of orchid cut flowers. Question is: are we ready to exploit this opportunity.

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Introduction

A number of plant species has always been important to humankind as the source of food, fiber, medicine, building material and in totality for supporting the life itself in ecological sense. However, no other plant probably has acquired the status as orchids. They have always been considered as mysterious. They were the coveted possessions of connoisseurs even till very recently. Only after the cloning techniques *in vitro* were standardized and practiced on large scale, these precious plants become available to a broader section of people. The bulletin intends to provide an overall understanding of the basic as well as critical factors that make orchids grow vigorously and flower to their full potential, so that readers can get a good understanding of the different factors and make best utilization of the growing conditions available at their hand or modify them effectively according to their requirements for happy orchid growing.

Before one starts orchid growing he should ask if he is aware of the following:

- What orchid is it?
- What is its correct name?
- Is it a monopodial or sympodial?
- Species or hybrid?
- Where does it come from?
- What is the climatic regime where it grows in nature?
- What altitude does it grow at?
- What is its growth pattern? Does it go through any resting/dormant phase during its growth?

If one is attempting to grow hybrids then he should also take care to collect information on growing requirements of the hybrid while buying it from the nurserymen. Satisfactory answers to these questions will help greatly in providing correct growing conditions for the plants. To become a successful orchid grower, in fact, knowing the correct answer to the above questions is must.

Orchids grow from sea level to altitudes up to 3500m. Considering this wide distribution around the globe it is understandable that different orchids from different parts of the world experience numerous sets of macro and micro climate. In fact this is true for large number of species, which are very specific to their growing environment. Replicating the growing conditions, to their exact requirements, for several orchid species or hybrids at a given place is a difficult task. However, from years of experience, the orchid growers through out the world approximated the growing conditions into three regimes – warm or hot, intermediate and cool. Orchid species or hybrids are roughly grouped into any of these three and grown accordingly.

Experiences have shown that most of the orchids can be grown successfully under any of these three growing conditions.

Hot or Warm: Under warm or hot conditions night temperature should not fall below 18°C roughly and day temperature should not be lesser than 25°C roughly. *Dendrobium, Aranda, Mokara, Arachnis and Vanda, Phalaenopsis* hybrids are few examples which can be grown very successfully under this regime.

Intermediate: Under intermediate conditions the night temperature



***Dendrobium* hybrid: ideal for tropical climate**

should not fall below 15°C and day temperature should not rise beyond 30°C desirably. *Cattleya*, *Oncidium*, Mottled leaf *Paphiopedilums* from north eastern region of India, several *Dendrobium* species and



***Cattleya* hybrid: Ideal for intermediate condition**

Coelogyne are some examples which can be grown successfully under this condition.

Cool: Under cool regime the night temperature should be around 10°C or even may fall below and there should not be a lift of more than 10-12°C during daytime. All thin leafed *Cymbidium*, *Odontoglossum*, *Calanthe*, *Pleione* and several other orchids from higher altitudes can be grown successfully under this regime.

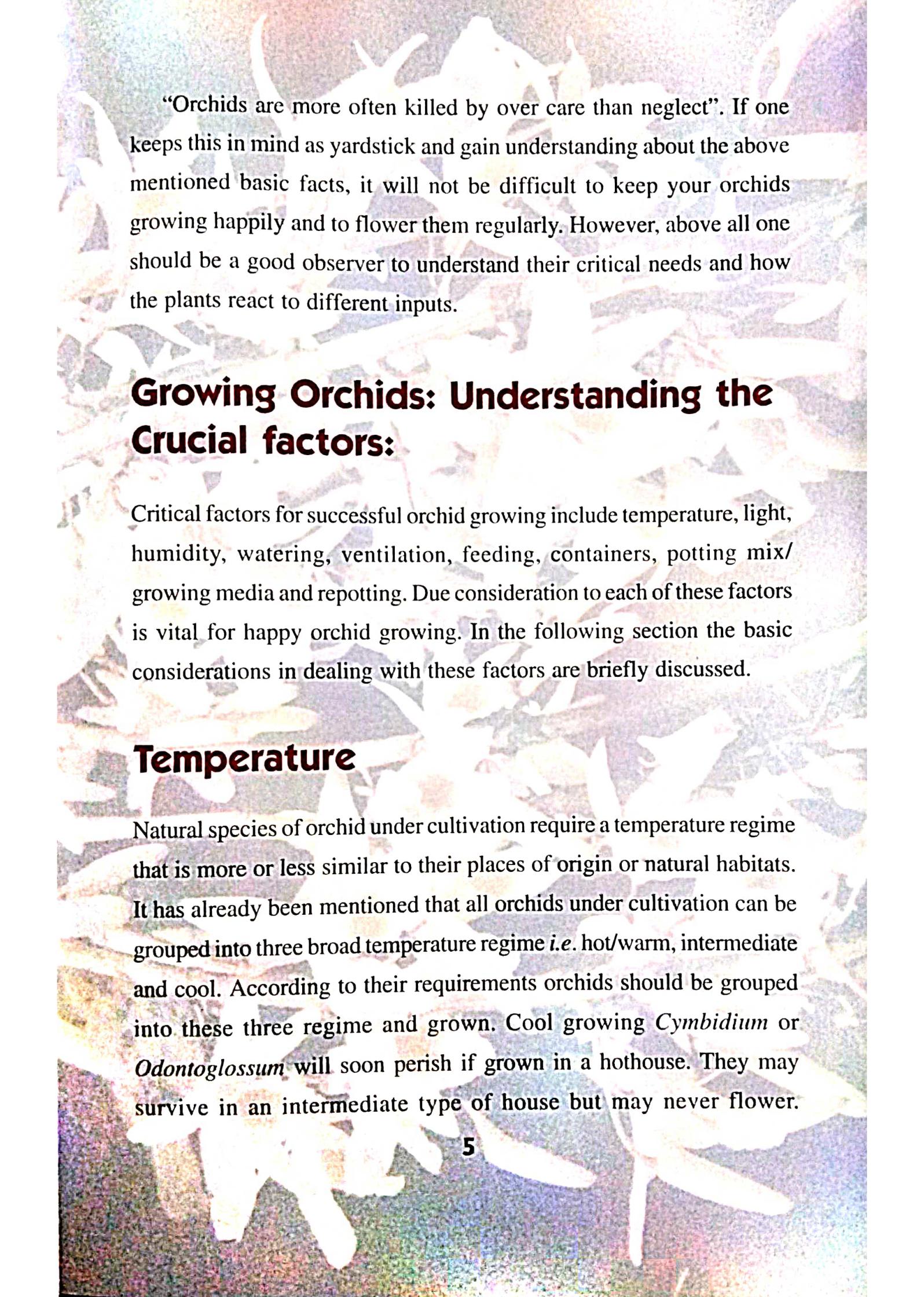
Most of the horticulturally important orchids are from the tropics and sub-tropics, growing at low to middle elevations. In nature they grow under conditions where nutrient availability is not in excess.

Most of the popular orchids are epiphytes, that grow high on the

trees to take advantage of more nutrient availability due to trapping of detritus, more suitable light conditions, increased air circulation and less water retentive substrates. If these basic facts about the natural habitats of orchids are kept in mind while dealing with them under cultivation, orchids can be grown successfully like any other house plants.



***Cymbidium* hybrid:
Most suitable for cool condition**



“Orchids are more often killed by over care than neglect”. If one keeps this in mind as yardstick and gain understanding about the above mentioned basic facts, it will not be difficult to keep your orchids growing happily and to flower them regularly. However, above all one should be a good observer to understand their critical needs and how the plants react to different inputs.

Growing Orchids: Understanding the Crucial factors:

Critical factors for successful orchid growing include temperature, light, humidity, watering, ventilation, feeding, containers, potting mix/ growing media and repotting. Due consideration to each of these factors is vital for happy orchid growing. In the following section the basic considerations in dealing with these factors are briefly discussed.

Temperature

Natural species of orchid under cultivation require a temperature regime that is more or less similar to their places of origin or natural habitats. It has already been mentioned that all orchids under cultivation can be grouped into three broad temperature regime *i.e.* hot/warm, intermediate and cool. According to their requirements orchids should be grouped into these three regime and grown. Cool growing *Cymbidium* or *Odontoglossum* will soon perish if grown in a hothouse. They may survive in an intermediate type of house but may never flower.

Temperature may not be so crucial for survival but for flowering. *Cymbidium*, to mention as an example, though can tolerate up to 30°C during summer months, but there should be a sharp fall in night temperature during the period August to October. It must come down to below 15°C. They will not flower until they go through this cool down period. However, *Cymbidium*, like any other plants or orchids as such, will give its highest potential only in a specific temperature regime, which is 11°C to 25°C, with a temperature difference of about 10°C between day and night during flower bud emergence. Such specific requirements for different orchids should be kept in mind. Arrangements should be made to provide them with their favourite range. For example, in case of *Cymbidium* if the desired diurnal temperature differential is not there then cold water misting at the evening can be used to extend the difference between day and night temperature.

Small and young orchids will prefer about 5°C more temperature than mature plants. If plants going through a cooler temperature range than the optimum then keeping the plants on drier side will help. Reversibly, if the plants are going through hotter temperature range than the optimum, keeping humidity level high can help in avoiding injury.

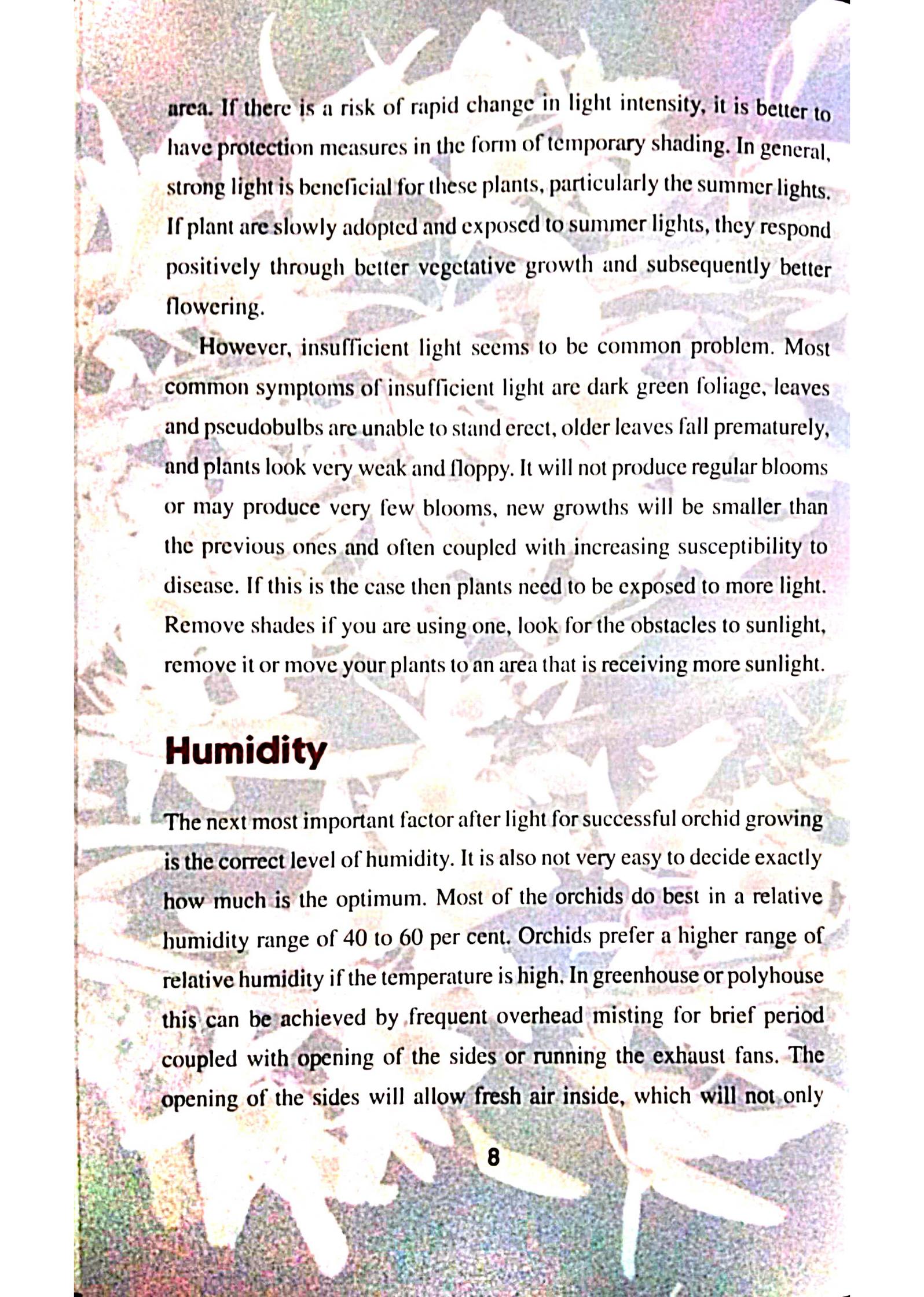
Light

Most important among all the factors. Quantity and more categorically the quality of light will determine whether orchids will bloom to its potential or bloom at all. If Orchid plants are looking healthy but not

producing flower than it is most likely that plants are not receiving enough light. Though actual requirement varies significantly from species to species, usually exposure from south side with moderate shading would be optimum for majority of them. More important is the quality of light than the quantity. Plenty of poor quality light will never make up for the quality light. Winter light is inferior than summer light, so the tilted light than overhead light. More a grower will be able to master the technique of maximizing the quality of light, more he will be able to grow wider range of orchids with success.

As orchids require dark periods to complete their metabolism, very long day length can be in fact detrimental rather than beneficial. Orchids normally should never be exposed more than 16-hour daylight. The best clue about the light requirement of orchid can be obtained from the knowledge of where it grows and under what situation. *Calanthe* normally grow on the floors of dense forest and therefore are covered/shaded heavily by the thick canopy. *Calanthes* thus will perish very soon if left out in direct sunlight. The same is true for *Phalaenopsis* and *Paphiopedilums*. On the contrary, *Arundina*, which grow under full sun, will never do well in shaded condition. *Cymbidiums* originated in Asia, where nights are sufficiently cool and days are bright; therefore, high light condition is essential for their successful growing.

More light is not a problem in most of the case, except the accidental or sudden exposure to higher intensity of light. Sudden or rapid change from lower to higher light intensity can lead to sunburn symptoms. Sunburns can be recognized as appearance of lighter colored patch, usually on the flat part of the leaf, followed by rapid blackening of the



area. If there is a risk of rapid change in light intensity, it is better to have protection measures in the form of temporary shading. In general, strong light is beneficial for these plants, particularly the summer lights. If plants are slowly adapted and exposed to summer lights, they respond positively through better vegetative growth and subsequently better flowering.

However, insufficient light seems to be a common problem. Most common symptoms of insufficient light are dark green foliage, leaves and pseudobulbs are unable to stand erect, older leaves fall prematurely, and plants look very weak and floppy. It will not produce regular blooms or may produce very few blooms, new growths will be smaller than the previous ones and often coupled with increasing susceptibility to disease. If this is the case then plants need to be exposed to more light. Remove shades if you are using one, look for the obstacles to sunlight, remove it or move your plants to an area that is receiving more sunlight.

Humidity

The next most important factor after light for successful orchid growing is the correct level of humidity. It is also not very easy to decide exactly how much is the optimum. Most of the orchids do best in a relative humidity range of 40 to 60 per cent. Orchids prefer a higher range of relative humidity if the temperature is high. In a greenhouse or polyhouse this can be achieved by frequent overhead misting for brief periods coupled with opening of the sides or running the exhaust fans. The opening of the sides will allow fresh air inside, which will not only

help to lower the foliar temperature but at the same time is an effective mechanism for protecting the plants from many common fungal and bacterial ailments that may attack orchids under a suffocated high temperature and high humidity condition. Under bench misting is also useful when used in combination with mesh bench and fan blowing air through the mist. Plume spray nozzles with high-pressure pump that will produce fine fog are another option. Adding a burst timer to the humidistat circuit can enhance the efficiency of spraying system. Burst timer works by giving a waiting period between two bursts of sprays. Another recent advancement is the centrifugal foggers. In this system water is supplied to a reservoir from mains, and then the water is pumped on to a high speed-spinning disk, which atomizes it to produce dry fog. Water droplets produced by this method are so fine that plants virtually do not become wet at all. Fluctuation in humidity level is, however, desirable as it gives the plants a chance to dry up.

Ventilation

Constant air movement around orchids is a must to keep the plants in good health. Irrespective of what type of orchid it is, a stale surrounding is very harmful. Ventilation helps the plants to cool down. Ventilation becomes much more important under low temperature condition. Fall in temperature increases the level of relative humidity; and in the absence of proper air circulation low temperature coupled with high relative humidity greatly encourage the infection by *Botrytis cinerea*. Air circulation alone keeps many of the disease problems away. Easiest

way to increase air circulation is by opening the sides. Exhaust fans will also come handy in increasing the air circulation in the green houses.

Watering

A large number of growers fail with orchids mainly because they either underwater or over water their plants. How much or how often to water? Though answer will vary according to the species but a basic understanding will help. Exchange of gases in the root zone of orchids is vital for their growth and survival. Orchid media are designed to hold both water and air. In fact there is a competition between these two. Thus if a media dries up beyond a point then air occupies the place that was supposed to be filled with water. At this stage it becomes a difficult task to rewet the media. Even if plants are watered at this stage, it just runs through the media without getting absorbed into it. Thus orchid plants should never be allowed to dry up to this extent. Moreover, as the water level starts declining in the media, salt concentration starts raising and at a point becomes toxic to the roots. Interestingly, dehydration can be caused by under watering as well as over watering. The symptoms of dehydration are leathery leaves, dull and wrinkled texture. Under watering can be diagnosed by a very light weight when the pot is held up, roots will look healthy and the media will also be in fine consistency. Whereas, if the problem is associated with over watering then the pot will be heavy, media as well as roots will have marshy appearance, in severe condition roots will be rotten and the media will deteriorate very rapidly. It is very important to

understand whether the problem is over watering or under watering. It is not so easy as it may look, because symptoms produced by both the conditions are apparently same. A wrong decision on this problem will simply aggravate the crisis further.

Symptoms of over watering: An over watered plant will normally show the following symptoms.

1. Yellowing of older leaves in a manner that is faster than the usual. Leaves will drop.
2. Pseudobulbs become shriveled and develop furrows lengthwise.
3. Development of blackened area, particularly under the bottom of the plant.
4. Plants start wilting.
5. On lifting the plant from the pot, roots will be dark and marshy.

As soon as it is understood the plants are suffering from over watering, repot the plant after removing all dead and rotten roots. Watering should be withheld for 4-6 weeks. Once it is evident that plants have given new roots, normal watering can be resumed. Frequency of watering should be reduced. A coarser grade media can be used. If plants have already reached a stage that it had lost all its roots, an alternative of root initiation can be followed. Plants, removing all dead roots and treating with a broad based fungicide may be kept inside a transparent polythene bag. The bags should be kept at shaded place that does not receive direct sunlight. Plants can be repotted in their normal media after they have produced new roots.

Symptoms of under watering: though not as common as over watering, some growers tend to give very little water to their orchids.

Probably this is due to the fact that they hear the words, "do not over pot them, do not over water them", so frequently. Common symptoms on under watered plant will show are:

1. Plant will become weak, leaves will not be able to stand erect and will become limp.
2. plants will start to wilt.
3. Once it is determined that plants are suffering from under watering then entering should be increased.

Water requirements by the epiphytes and terrestrial are also very different and therefore be kept in mind while watering schedule is designed. Condensation of fog on the plant surface may provide adequate moisture to the epiphytes, but same may not be of any use to the terrestrial plants, which are dependent on soil water recharge. On the other hand heavy rainfall followed by long dry spell can make the life difficult for epiphytes; whereas, such a condition may be fine for terrestrial as absorbed soil will maintain the water supply to the plants during dry spell.

These basic principles should come into a play while making a water schedule for the orchids. A *Dendrobium* growing on a wooden block or a block of *Osmunda* fiber will prefer daily watering in the form of spray, whereas, a *Cymbidium* in a fine grade compost will prefer through watering but after certain gaps. Young or small plants in small pots will require more water than a mature plant in big size pot. *Cymbidium* plants with older leaves are less effected by moisture stress than those with young leaves. *Cattleya* plants grow best when watered 5-7 times a week, *Phalenopsis* had longer plants when watered 3 times

a week. Quality of water is also of great importance for good growth of orchid. Orchids have very low tolerance to excess salt content in irrigation water. Too much CaCO_3 in water can lead to excess calcium in the substrate and increase in pH. This could be balanced by appropriate nitrogenous fertilizers and in acute cases diluted minerals acids were suggested. A capillary watering and fertilizing through fiberglass netting in wicks for pot grown orchids was suggested recently, which will provide continuous and constant water to the plants without any salt deposition.

General guidelines for watering orchids

1. Orchids should never be watered with very cold waters, always water with warm but not hot water.
2. Morning is the best time for watering, so that the water droplets on the plant can dry up before evening, it will reduce the risk of rotting.
3. Orchids in a earthen pot will require more water than those are plastic pots, plastic pots will retain more moisture in comparison to the clay pots.
4. Plants in a smaller pot also require more water than those in bigger pots.
5. Plants receiving full sunlight or when temperature is higher will require more water.
6. If relative humidity is less, particularly lesser than 40% then plants will require more water.
7. Heavy airflow around the plants will also dry up the plans faster

- making them thirsty quicker.
8. If relative humidity is more than 70% and the weather is cloudy the Orchids will require lesser amount of water.
 9. If air movement around the plant is very little or absent, it is safer to keep the plants on drier side.
 10. If possible, it is better to water the orchids with rainwater.

Potting mixture

A number of potting media can successfully be used. However, the composition of the media has to be dependant on the considerations like their availability, how easily they are available, quality of the components, cost involved and a proven combination. Thermal mass of the media should be high in hot and dry places. Reverse is true for cooler regions. Thumb rule is that an orchid media should be free draining, free from water logging.

Potting material

Several potting materials have been used world wide with good results. Potting material that can be used for growing orchids include tree bark, osmunda fiber, tree charcoal, brick or stone chips, sphagnum moss, polystyrene granules, coconut husk, rock wool, perlite, pumice, vermiculite, peanut shells, poultry or horse or cowdung manure, styrofoam, leaf mould, top soil, sand, river singles, loam, beech or oak or *Schima wallichii* leaves, compost, absorba stone, absorbalite and many other.

Properties of the commonly used potting material are described in brief.

1. **Tree bark:** Shredded firbark from *Abies concolor* is widely used in Western Countries. If bark alone is to be used then external supplementation with fertilizer rich in nitrogen is essential as bark is deficient in nitrogen. However, bark is a most recommended potting material for several orchids as per the literature.
2. ***Osmunda* or tree fern fiber:** There was a time when it was thought that *Osmunda* or tree fern fiber was indispensable for orchid growing. The material is very good for those orchid whose roots do not prefer any disturbance. Most ideal substrate for the mounted orchids.
3. **Charcoal:** This is being used for many years worldwide; and is a most welcome component in majority, if not all, of combinations. Its water holding capacity is slightly more than the bark. Charcoal holds fertilizer and therefore regular flushing is essential to avoid the risk of salt deposition.
4. **Sphagnum moss:** Sphagnum is very good for encouraging new root growth; therefore, a good choice for seedling orchids. A layer of Sphagnum moss on the media of established plants in pot or around the root crown of mounted plants on tree fern block or cork as dressing helps in checking quick moisture loss.
5. **Perlite:** Good in most of the combination due to its ability to absorb water by capillary action, and yet maintain aeration.
6. **Brick or stone chips:** Used mainly to bulk up the media, absorb

- and drain out excess water from the media and to provide good aeration to the roots. As they are high in thermal mass, it is good to have them in a combination for hotter and drier climates.
7. **Rock wool:** This is an inert material and will need all nutrients supplied externally. Rock wool may become stale and/or contaminated and need to be repotted annually.
 8. **Coconut fiber:** Rapidly gaining in popularity as very good substrate for orchids. Coconut chunks are good for bulking up the media as well as very good in moisture retention. Coconut peat is a good choice for any finer grade media. Coconut husk chunks has particularly been proved as very good substrate for tropical *Dendrobiums*.
 9. **Manure:** Widely used are poultry and horse manure. Cow-dung manure is mostly used in Asian Countries. Inexpensive, rich in nutrients, including a dozen or so trace elements. Reports indicate that orchids with very low E.C. (electrical conductivity) like *Disa* do very well in horse manure.
 10. **Leaf Mould:** A good choice for terrestrial orchids, releases lot of nutrients as it decomposes, high in water retention capacity.
 11. **Absorba stone or Absorbalite:** These are very recently suggested substrate for orchid growing. Absorba stone is mined from ancient fossilized plants. It is claimed that it comes from the same material from which agar is made. This contains high amount of siliceous material. pH is highly alkaline (7.5 to 8). Absorbalite is principally composed of amorphous silicon dioxide. It's pH range is 6.5 to 7. Both these products are now

introduced by many growers in Australia. Utility of these products in orchids media is yet to be clearly established. However, one should be cautious as both the products contains more than 80% silicon dioxide and can lead to salt deposition.

A potting medium is just a way to secure the plants to the pot and at the same time provide the roots with necessary air and water. The major factors that should be kept in mind while selecting potting material are: what is its water retention capacity? How long it will take before it breaks down in the pot?. Organic matter will break down sooner than an inert potting material. The type of roots also is an important consideration while selecting the component. For fine rooted orchids a fine grade media is desirable; whereas orchids with thick and chunky roots will do well in coarse grade media. Properties of some of the most commonly used potting materials are given in Table.

Properties of some most commonly used potting material

Components	Molsture holding/retention capacity	Required watering frequency	Stability
Stone/brick chips	Very low	Very frequent	Very high
Perlite	Low	Frequent	High
Tree Fern	Medium	Medium to towards high	Medium
Coconut Husk	Towards high	Low to medium	Medium
Charcoal	Medium	Medium	Medium
Tree Bark	Towards high	Low to medium	Low to medium
Leaf mould	High	Low	Low

It is evident that several potting materials in several combinations can be used for growing orchids with equal success. More crucial is to master the watering and feeding according to the media in use. There are firms that use only stone chips for growing *Cymbidium* with very good success. Once a basic understanding of the potting materials is there it is better to leave it to the grower to decide his own combination according to the need of his orchids.

Feeding

Plants, whether grown in field or in pot, take their nutrition from inorganic minerals. Plant nutrition, therefore, takes into account all interrelationships of mineral elements present in the soil or soilless media and their availability to the plant roots. Optimum nutrition involves a complex balance of essential elements and other beneficial elements required for optimum plant growth. This requirement varies according to plant species. Orchids are no exception. Orchids like any other plants require nitrogen, phosphorous, potash and trace elements for healthy growth. From experiences over the year it is recognized that, in general, orchids grow satisfactorily when fed with a balanced fertilizer for about 10 months a year except the period when plants are in new growth. During the new growth period it is better to supply them with a nitrogen rich fertilizer. Some growers also shift to blossom booster fertilizer during the period before flower initiation. It is recommended to stick to one formula. Constant changes cause dangerous imbalance that seldom gives satisfactory results. More

dangerous is over fertilization, which will lead to salt deposition in the pot. Salt deposition can be identified in the form of white crusts on the media and around the pot. Dying of leaf tips is also an indication of salt deposition. Roots also turn black when they come into contact with the salt deposition in pot. Orchids have very low tolerance to excess salt.

Effectiveness of foliar application of nutrients in orchids is a debatable issue. The rate of absorption by leaves was less than one eighth of that was observed for roots. Many types of organic manure including dilute liquid form of old cow or sheep or fowl manure, dilute urine, one part in ten parts of water, water extracts of finely shredded fresh fish, groundnut cake (one kg of cake dissolved in 10 gallons of water for rotting, the solution is sieved and used) were reported to be good for orchids.

Container

Most commonly used containers are earthen or plastic pots and wooden baskets. Tree fern rafts, cork, pieces of wood are also used for mounting orchids. Pots should be chosen according to the root growth habit of the orchids. *Cymbidium* with considerable bulk of long roots will prefer a fairly big pot, whereas *Vanda* or *Rhynchostylis*, whose roots prefer to remain exposed and hang freely in air will be best grown in a hanging wooden basket. Majority of the popular orchids are epiphytes and can be cultivated on support with the roots exposed and hanging, but in practice most orchids are grown in pots and only a few in hanging baskets, on tree fern rafts, on cork or in pieces of wood. Plastic pots are convenient for handling and lasts very long. Considering the longevity

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of the plastic pots they are economical too. Most important point that is to be kept in mind while dealing with pots is their ability to breathe air and moisture. An earthen pot is a better choice on this point, as it does lot of breathing; whereas, a plastic pot does not do that. This means that orchid roots in an earthen pot will have access to more air, which is vital for good growth of orchids. Plastic pots, therefore, should have extra holes along the sides to ensure sufficient air supply to the roots. On the other hand plastic pots will require less frequent watering as it retains more water. Baskets are generally made of hard wood so that they do not rot so quickly. If plants are mounted on cork or tree fern slabs or on wood piece then it is good to have some tufts of sphagnum moss around the root crown, which will help in retention of moisture for longer time. It is also good to replace the sphagnum moss once a year.

Repotting

Repotting of orchids is essential for at least two reasons, first is that media has decomposed and require a replacement and second is that plant has grown so big that the current pot size is no more enough to accommodate it. In general orchids respond positively if repotted every three years. Repotting also provide the best opportunity to check the health of the plants. Inspection of roots while repotting will tell a lot about the health of the plant and what is going wrong. Young plants respond more to frequent repotting. The best time to repot is just after flowering is over or when the plants resume new growth. This will allow the plants with maximum possible time for reestablishment so that their flowering in



An overgrown plant: needs repotting

subsequent year is not affected. While repotting the new pot size should just be enough to support growth for further 3 years. Over potting or repotting in too large a pot should be avoided.

Growing Structure

Large commercial farms in the tropical zone use mostly shade houses with imported shade nets placed horizontally at 10' height. Some farms in Kerala, which experience heavy rainfall during monsoon months, follow two-tier system of shading. In this method the inner layer is replaced with plastic film during the rainy season. In the North East, growers mainly use bamboo houses or low cost poly tunnels made from galvanized water pipe. Tops are covered with plastic film. These kind of low cost structures are suitable north eastern region. Separate packaging sheds should be available.



Cymbidiums under simple bamboo structure



Dendrobium growing in South India



A two tier structure in Kerala

Propagation of orchids

Orchids are inherently slow growers. Though they may produce millions of seed but only a negligible proportion of it germinates in nature. Today commercial orchid propagation is done mainly either through meristem culture or through seed culture. However, number of other vegetative propagation methods are also used extensively world wide. These methods do not require any special facility and offer effective ways to the growers to increase their stock. Different methods of orchid propagation are briefly discussed.

Division

This method is applicable to the sympodial orchids, in which new growth arises from several growing points on a rhizome. In fact often it becomes necessary to divide a large overgrown specimen to maintain

it in a manageable size. Best time for dividing an orchid is just before the onset of new growth or immediately after flowering is over. Division should be done by cutting the rhizome with a sharp, sterilized knife. Important factor to be kept in mind while attempting to divide a plant is that division should not effect the vigour and flower producing capacity of the plant. Size of the divisions will vary according to species. A *Paphiopedilum* may be divided to the extent of one mature growth in each section without affecting its subsequent growth and flowering. Whereas, dividing *Cymbidium* and *Cattleya* to that small size will definitely be detrimental for its subsequent growth and flowering. *Cymbidium* and *Cattleya* will not flower if there are less than 4 pseudobulbs in each clump. Normally the divisions should contain some back-bulbs along with new growth. Back-bulbs supply food to the new growths when required and help the divisions to establish without much shock.



Sympodials can be divided for propagation

Back bulb

Pseudobulbs in sympodial orchids those have completed flowering and shaded leaves after reaching maturity serve the purpose of further multiplication. The back bulbs upon separation from mother plant, produces new growth from certain growing points (called as eyes).



Multiplication through backbulb



Alternative method for multiplication through backbulb

Soaking in plain water, nutrient solution or growth regulator solution is beneficial for quick sprouting. An alternative to this method is placing the backbulbs in plastic bags. Either bags are sealed after blowing sufficient amount of air inside or kept loosely tied so that sufficient CO₂ supply is maintained. Our experience with *Cymbidium* and other orchid backbulbs has shown that this alternative method produced better results than that was obtained from placing them on sand bed. Moist sphagnum moss can be used for wrapping the backbulbs or can be kept at base to ensure minimum water loss from the bulbs.

Keikis

Keikis are produced from the nodal region of stem or inflorescence axis. These tiny plantlets are not desirable on an orchid, as keikis indicate that the orchid is becoming old or it is not healthy and many times formation of keikis suppress flower production. However, they can become effective means for multiplication. In some *Phalaenopsis*



Keikis ready for separation

species formation of keikis can be encouraged by tying the basal nodes with moist moss. It is better not to remove the keikis from the main plant and plant separately immediately after their formation ; rather they should be kept in such a fashion that their newly formed roots come in contact to the surface of a suitable media or substrate. The roots will grow into the compost and establish themselves within a short period. The roots if buried in compost, most likely they are going to die.

Cutting

This method is suitable for the species which produce long cane like stems. The pseudobulbous stems that have completed flowering are cut in several pieces. Each slice normally contain 2-3 nodal segments. The cuttings are placed on sand bed or on moss. The bed is kept moist by sprinkling water. New growth appears from the dormant buds of the nodal segments. Once the new shoots have grown sufficiently and produced substantial roots, they are separated and grown as independent plants. In some species flower stalk cuttings are also used for multiplication.

Pruning

This method of multiplication is applicable only to monopodial orchids. Monopodials due to their indeterminate growth habit can become very tall and unmanageable and therefore need to be pruned. Monopodials produce aerial roots along the stem. Thus cutting the apical region bearing 2-3 aerial roots gives a new plant, which can establish very easily when planted in the media. Removal of apical region

normally do not effect the basal portion, which subsequently produces new shoot.

Seed

Since the discovery by Knudson, *in vitro* culture of orchid seeds provided an effective mean for large scale multiplication.

Mericloneing

Orchids were the first plants to be propagated through tissue culture on commercial scale. Resident meristems (apical, axillary) are most frequently used as explant tissues for micropropagating orchids. From a single meristem up to 200 000 plants can be regenerated within a year. Use of meristematic tissues though poses no threat to the mother plant in sympodial orchids, however is detrimental for monopodial orchids that has only one growing point. With the advancement in technology it is now possible to establish culture from leaves, roots,



Multiplication of superior clone through tissue culture



Hardening of tissue cultured plant

stems, floral segments etc, of which leaf and root segments are particularly in use considering their year round availability and large number of plants that can be regenerated from them without causing any significant damage to the mother plant. Most recent development in this field is thin cell layer culture or thin section culture

Post Harvest Management

Orchid cut flowers, like any other flowers, require proper post harvest handling and care to reach the customers in best possible form. A quality cut flower stem produced under utmost care may lose all of its market value by the time it reaches the market due to faulty post harvest handling.

Major post harvest losses in orchids are as follows:

Major post harvest losses in orchids

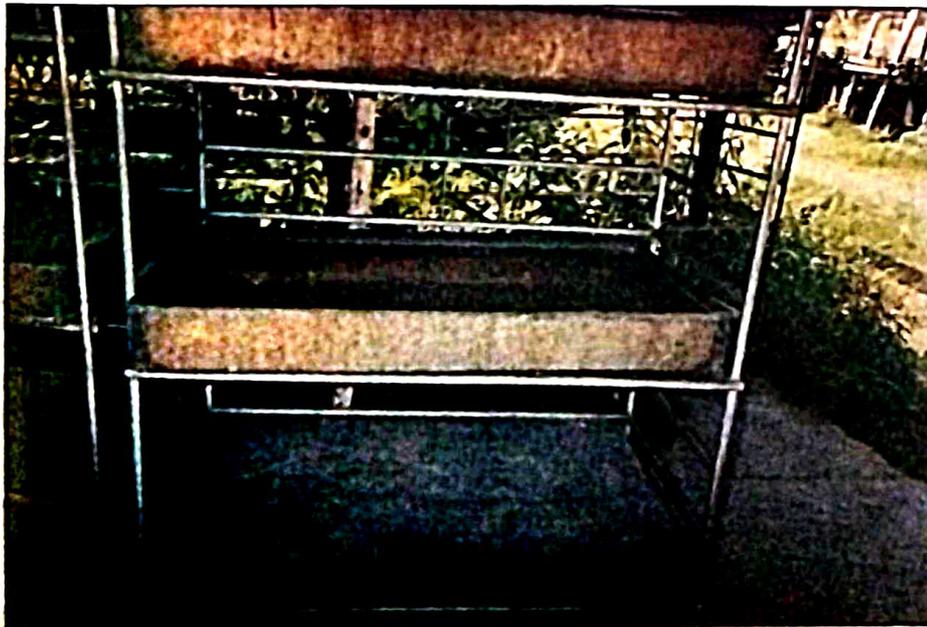
Causal agent	Detrimental Effects	Source
Ethylene	Accumulation of anthocyanin in lip and column	Wounding
	Wilting of perianth	Decapping
	Premature wilting Abscission	Pollination Dislodgement of pollinia
	Forced unfolding of flower buds and reduced vase life	Emasculation
Loss of water	Upward folding of perianth	Transpiration
	Wilting and shedding of flowers	Metabolic activities
Packaging material	Petal bruising	Faulty packaging technique
Low temperature in storage chamber	Darkening of column and labellum	

Post harvest operations

Orchid cut flowers should be harvested at proper stage to get the most of its quality and vase life. Flowers harvested before and after the right stage will be poor in quality and have reduced vase life. The right harvesting stage for majority of the commercially important orchids is fully opened and matured flowers. In *Dendrobium*, however, common practice is to harvest at 75 per cent bloom stage. In *Cattleya* flowers should be harvested 3-5 days after bud split. Harvesting of fully matured flowers as mature cut flowers require less support from moisture passing

the stem. Utmost care should be taken to ensure that pollinia is not removed. Dislodgement of pollinia will lead to withering of the flower and subsequently will affect the longevity of other flowers on the stem.

The spikes are dipped in a bucket containing water immediately after harvest. Spikes are cleaned in plain water to remove any dust or dirt on the flowers. These are then air-dried. Pulsing treatment should be performed at 20-27°C and about 20,000 Lux light intensity. Pulsing of *Dendrobium* cut flowers with 6% sucrose or BA 75 ppm was reported to improve the quality of flower spike and increase vase life. The cut flowers should be kept in holding solution. Holding solution with a mixture of AgNO₃ (25 ppm), HQ (400 ppm) and sucrose (5%) was reported to improve vase life bud opening. The spikes ready for packaging are made into bundles of 5 or 10. Only one colour spikes should be bundled in one bunch. A wet cotton swab wrapped in a small piece of plastic should be put around the base of the spikes. This will



Trays used for pulsing orchid spikes

ensure continuous water supply to the spikes during transport. Packaging should be done in cool atmosphere and under clean condition. The spikes are normally packed in cartoons. The size and dimension of the cartoons should be determined by the orchid genera and the number of spikes. The genera with sturdy spikes can be packed more closely than those with delicate flowers. Ethylene scrubbers with KMnO_4 / Purafil (activated alumina pellets) should be put in the packaging box. The box should have holes all around for proper ventilation during transport. Storage of cut flowers, if required, should be done at proper temperature. Although respiration rates of orchid cut flowers are greatly reduced at -5°C , but majority of orchids suffer from chilling injury below 5°C . This is particularly the case



Cymbidium spike sleeved in thin plastic



A two piece box for packaging orchid cut flowers

Stems for export market should meet the following standards:

- 1. Minimum eight standard blooms per stem.**
- 2. Flowers must be clean, unblemished and evenly coloured with broad and firm petals.**
- 3. Stem must have flowers evenly arranged along and around the stem.**
- 4. Two third of the stem should be covered with flowers.**
- 5. Flowers must have a firm texture and a luminescent sheen.**
- 6. Should have long vase life (at least 10 days for the consumers).**
- 7. The first flower should still be good when the last flower opens**
- 8. Stems must be firm when held up and not bend from the vertical.**
- 9. Market preferences are different according to the importing countries, just to mention Japanese prefer dwarf and small flowered spikes; whereas, in USA large and showy blooms are preferred.**

for the sub tropical and tropical orchids. The injury is mainly manifested in the form of break down of column tissue and subsequent darkening of column and labellum. Orchid cut flowers can be stored for 10-14 days at temperature range 5-7°C. Temperate orchids can tolerate lower temperature during storage.

To reduce the risk of ethylene release in orchid cut flowers and to ensure maximum potential vase life the cut flowers should be protected from mechanical injury, herbivorous damage, decapping, removal of pollinia, pollination, exposure to chilling temperature as well as higher temperature than the optimum and any other external sources that is ethylene producing or may induce ethylene production. Shelf life of orchid cut flowers can be increased by placing the stems in solutions of 250 p.p.m. boric acid or standard HQC solution.



Dendrobium spikes ready for harvest

Diseases of Orchids and their Control

Disease	Symptoms	Control measures
Anthracnose	<p>Pathogens normally infect orchid leaves through wound injury; any other part also can get infected. Symptoms appears as dark brown to black coloured oblong to circular oval, sunken spots. Severe infestations cause leaf blight or plant death. The upper leaves are reported to be more susceptible than lower leaves. The disease attacks <i>Cymbidium</i>, <i>Phalaenopsis</i>, <i>Cattleya</i>, <i>Oncidium</i>, <i>Paphiopedilum</i>, <i>Dendrobium</i>, and <i>Coelogyne</i>. <i>Aerides</i>, <i>Otochillus</i>, <i>Eria</i>, <i>Liparis</i>, <i>Calanthe</i> etc.</p>	<p>Removal and destruction of infected plant parts. If plants are exposed to full sunlight then shift them to moderate shade. Direct exposure to sunlight acts as precursor to the disease. Chemical control with Benomyl, Bitertanol, Captan, Bavistin. Spraying at 15 day's interval may be necessary if the infection is severe.</p>
Bacterial brown rot/ Bacterial soft rot	<p>The disease produce water soaked lesions and wet decay. Results from prolonged wetness and stagnant atmosphere. Pseudobulbs show progressive rot. Infected pseudobulbs become soft, dark and shriveled giving a burnt look.</p>	<p>Oxytetracycline and chloramphenicol were found effective against <i>E.carotovora</i>. Dilute aqueous solution was also effective. <i>E. cyripedi</i> could be controlled by submerging infected plants in 1:2000 solutions of 8-quinolol or natriphene for 1 to 2.5 hours. Increase air circulation, a rinse with</p>

Disease	Symptoms	Control measures
Bacterial brown spot	<p>The disease produced symptoms as brown spots with water soaked halo on the leaves, symptoms predominantly occur on the underside of the leaves, sometime lead to dieback of the affected leaf or peduncle or occasionally the whole plant.</p>	<p>quaternary ammonium compound such as Physan was also suggested for quick drying of leaves after watering.</p> <p>The disease can be controlled by removing infected leaves, avoidance of overhead misting.</p>
Basal rot /Orchid wilt	<p>Can be very devastating. Plants turn yellow, rot and die. Rotting of roots pseudobulb and rapid collapse are common. Mycelial webs along with small brownish black sclerotias can be seen on the infected portions. The disease can take epidemic form through the spreading of sclerotia. <i>Cymbidium</i>, <i>Paphiopedilum Phaius</i>, <i>Dendrobium</i>, <i>Coelogyne</i>. <i>Aerides</i>, <i>Eria</i>, <i>Cattleya</i> is observed to be infected.</p>	<p>Spread of pathogen was observed to be through leaf mould or potting medium. Heat sterilization of potting media was found effective to kill the sclerotia. Infected plants should be destroyed. Contaminated pots, benches in the house and potting mix should be sterilized with 2% formalin.</p>

Disease	Symptoms	Control measures
Black rot/ Crown rot/ Heart rot	<p>Can become a serious problem, particularly under high humidity condition. <i>Phytophthora</i> spp. mainly attack pseudo stems and young buds to cause yellowing, wilting and death of affected plants. All affected plants initially produce water soaked spots on the infected portions. Later on these spots become black and dry at later stage and may lead to complete defoliation of the plant. Reported to infect <i>Cymbidium</i>, <i>Phalaenopsis</i>, <i>Cattleya</i>, <i>Oncidium</i>, <i>Paphiopedilum</i>, <i>Dendrobium</i>, <i>Vanda</i>, and <i>Phaius</i>.</p>	<p>Remove and destroy infected plant parts. Repot in sterilized fresh pot and media. Most effective chemical control is spraying of Ridomil and Ridomil MZ. Ridomil (Metalaxyl) at 0.05% a.i. or Ridomil MZ (Metalaxyl + Mancozeb) at 0.15% a.i. or Difolatan (Captafol) 0.2% a.i. or Zineb at 2g/l of water or Captan 2g/l.</p>
Blossom blight/ Petal blight	<p>Infection is characterized by numerous, sunken, watery, ark brown to black spots on petals, particularly on the older leaves. Severe infection in the buds may cause yellowing and drooping. Sometimes shot hole symptom is also visible. Reported to occur on <i>Cymbidium</i>, <i>Cattleya</i>, and <i>Phalaenopsis Spathoglottis</i> etc.</p>	<p>The disease predominantly occurs in cool, damp and stagnant atmosphere. Good air circulation around the plants on bloom is key to keep them free of the disease. Removal of infected flowers is important as sprinkling of water can very easily disperse the spores. Periodic spray with Dithane M-45 is also reported to be useful.</p>

Disease	Symptoms	Control measures
Cercospora leaf spot	<p>Infects leaves only, causing indefinite yellow lesions, which coalesced and produce spores in dark grey spots on the lower surface. Severe infection can cause leaf fall.</p>	<p>Removal and destruction of diseased leaves. Chemical control with Chlorothalonil WP 75% and 56% Carbandazim plus Dithianon WP are reported to be effective.</p>
Collar rot	<p>Leaf and stem base loose chlorophyll, become light yellow or brown in colour and eventually rot and collapse.</p>	<p>Dip the plants in Natriphene or carboxin. Repot in sterilized media.</p>
Cymbidium Tip burn	<p>Infected leaf tips become spotted which subsequently coalesce leading to death of entire leaf tip. Dead leaf tips usually get coated by mass of powdery spores.</p>	<p>Remove dead leaf tips. Drench the tips with fungicides like Bavistin or Dithane M-45.</p>
Damping off	<p>Seedlings are affected. Roots collapse and eventually the plant die back.</p>	<p>Strict sanitation. Drenching with copper sulphate at 1p.p.m. concentration.</p>
Fusarium leaf spot	<p>Symptoms usually occur around wound on leaves as small lesions.</p>	<p>Removal of infected leaves. Chemical control with Ferbam, Maneb or Zineb is reported.</p>

Disease	Symptoms	Control measures
Leaf spot	<p>Symptoms appear as buff coloured areas with dark mousy grey margins. Initial sporadic spots later on merge to form irregular elongated areas.</p>	Not known
Root rot	<p>Disease initially occurs as brown rot of the roots, which subsequently spreads to rhizomes. Plants wither gradually due to root loss.</p>	<p>Remove infected roots. Dip the plants in Natriphene or Thiram and replot in fresh medium.</p>
Rusts	<p>Disease mostly appear on the abaxial surface of young leaves as small raised blister like pustules of yellow or rust colour, initially appear as small dots and acquire larger dimension at later stage, several pustules coalesced together and ultimately turn black.</p>	<p>Removal and destruction of infested leaves. Spraying copper fungicide is effective.</p>
Slimy rot/ Stem rot	<p>Symptoms appear as slimy rot of entire shoot, advancing lesions at leaf bases and brown lesions on pseudobulbs.</p>	Not known.

Disease

Viruses

Symptoms

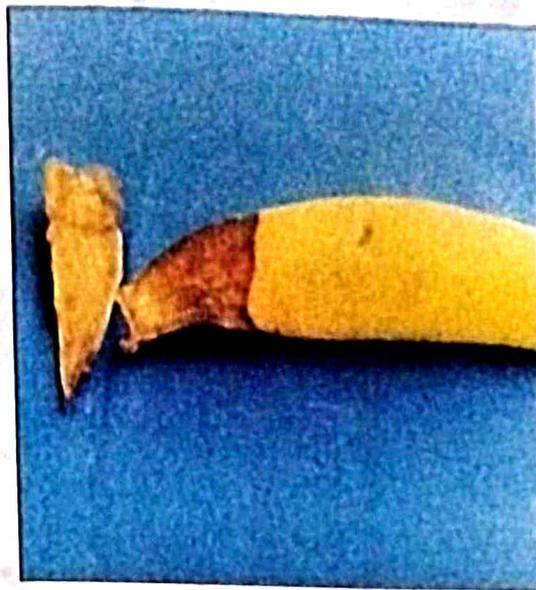
Leaves show yellow or white distinct mottling.

Control measures

Best way to deal with viruses is to burn all the infected plants and acquire a clean stock. Eradication of aphids, disinfection of cutting tools on every single use.



Sclerotium rolfsii* on *Phaius



Anthracnose on *Cattleya*



Sclerotium* wilt on *Paphiopedilum venustum



Black rot on *Cattleya*



Black rot on *Cymbidium*

Black rot on *Cymbidium*





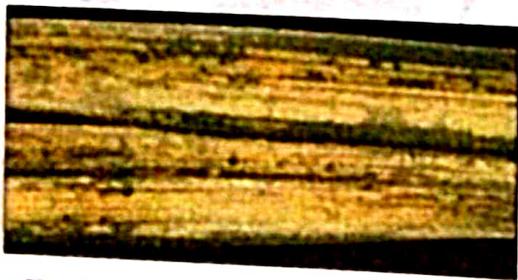
Orchid wilt on *Dendrobium* sp.



Uredo rust on *Phaius maculatus*



Orchid wilt on *Coelogyne corymbosa*



Typical virus symptom (CYMV)



ORSV on *Dendrobium*



Tip blight of *Aerides* inflorescence caused by *Fusarium* sp.

Insect Pests of Orchids and their Control

Insect	Characteristics/Damage	Control measures
Ants	<p>Transport and transfer aphids and scale insects</p>	<p>Spraying with any common insecticide.</p>
Aphids	<p>Transmit viruses. Both nymph and adult suck sap from tender shoots, flower buds. Honey dew secreted by them attracts ants and fungus.</p>	<p>Minor infestation can be hand removed. Serious infestation can be controlled with spraying of Dimethoate or Malathion.</p>
Black twig borer	<p>Feed on the plant twigs</p>	<p>Chemical control with Chloropyrifos at preliminary stage.</p>
Grasshoppers	<p>Eat on foliage and flowers. Can cause severe damage if present in large number.</p>	<p>Surroundings should be weed free. Spraying with chemicals Carbamate or Organophosphate will keep them away.</p>
Mealy bugs	<p>Normally appears as a cotton wool ball around leaf axils, or inside the sheaths of new shoots.</p>	<p>Wiping with methylated spirit on cotton is effective against localized infection. Chemical controls with Acephate or Dimethoate are also effective.</p>

Insect	Characteristics/Damage	Control measures
Mites	<p>Suck sap from leaves, produce fine webs on the underside of the leaves, and cause flower damage. Characterized by silvery marks left on the abaxial surface of the leaves, which subsequently turn into brown or black. Flowers develop purple brown spots, reduce in size, sometimes petals get twisted. Stunted growth and loss of foliage are also common.</p>	<p>Use of predator <i>Phytoseiulus persimilis</i>. Acaricides like Cyhexatin, Propargite, Dicofol, Bromopropylate, Azocyclotin, Ethion and Fluvalinate, can be used as chemical control.</p>
Nematode	<p>Produce greasy leaf blotch symptom</p>	<p>Drenching the potting mix with Oxamyl and Fenamiphos</p>
Orchid beetle	<p>Adults feed on leaves and flowers causing hole like damage. Sometime also feed on pedicels and cut the flowers from the peduncle.</p>	<p>Control of adult can be done by spraying Bendiocarb at 0.4g/litre, carbaryl 1.0g/litre, methidathion at 0.5g/litre and methiocarb at 1.5g/litre. Bendiocarb, Carbaryl, Diazinon, Fluvalinate and Methidathion applied to eggs prevent maturation of larvae.</p>

Insect	Characteristics/Damage	Control measures
Orchid weevil	<p>Weevils lay eggs in the cavities formed by adult feeding, larvae mines pseudobulb and complete pupation inside the mine. Punctures flower buds, cause white streaking on flower.</p>	<p>Acephate on Bendiocarb at 120 g per 100 liters of water or Chloropyrifos or microencapsulated methyl parathion at 60 g/100 liters of water.</p>
Rats	<p>Can cause serious damage to ground planted orchids. Eat on foliage and rhizomes.</p>	<p>Use of poison baits.</p>
Scale	<p>Can normally be noticed as brown, small, elevated spot like thing on the foliage. Suck sap from leaves, stem or roots. Induce toxicants into the plants. Infected plants lose vigour slowly.</p>	<p>Initial minor infestations can be removed mechanically by scrubbing the infestations with soft brush or by wiping the infestations with cotton swab soaked in methylated spirit. Regular watching and cleaning are the keys for effective control. Organophosphates are recommended as chemical control.</p>

Insect**Characteristics/Damage****Control measures****Snail Slug**

Feed on the tender parts. Eat root tips. Presence can be identified by silvery trails created by their movement. Create holes in stem, leaves and flower spike. Attacks mainly during night time.

Mechanical picking during night and killing. Chemical control with Slugit, Methiocarb, Aluminium sulphate. Spreading of methylated pellets, barriers to prevent them from climbing the racks.

Thrips

Nymphs and adults live and feed on flower parts in unopened buds by remaining hidden in the buds. Flower buds stop developing, flowers wither and collapse. White streaking and subsequent browning of the petals and sepals are also visible.

Spraying with metasystox, carbaryl, Aldicarb, Abamectin 0.15 EC, carbofusan, dimethoate is recommended.



Aphids on *Oncidium* flower



Mite infestation on young seedlings of *Cymbidium*



Mealy bugs on orchid leaf



Aphids on *Cymbidium* bud

Different scale insects on orchid hosts



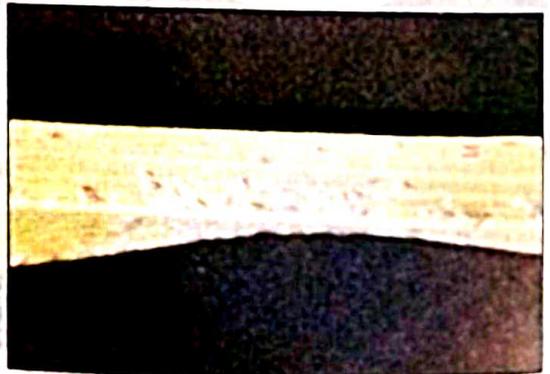
Flower damaged by grasshopper feeding



Phaius flavus



Pahlopedillum hirsuttissimum



Cymbidium hybrid



Cymbidium devonianum



Cymbidium sp.



Renanthera imscootiana

Easy Reference Culture Table

CYMBIDIUMS

Season	Spring	Summer	Autumn	Winter	
Ideal Day Temp.	20-21	24-25	18-22	16-18	Degree C
Ideal Night Temp.	12-15	15-16	11-13	10-11	Degree C
Watering	L/F L/F F F F F	F F F F F F	L/F L/F F L/F L/F	L L L L L L	F - frequency L - less freq.
Feeding	N N N N N N	N N N N N N	G G G G G G	G G G G G G	N - high nitrogen G - General Feed K - Potassium
Shading	L L L L L L	H H H H H H	L L L L L L	N N N N N N	N - no shading L - light shading H - heavy shading
Ventilation	L M M M M M	M M M M M M	L L L L L L	L L L L L L	M - more L - less
Humidity	L H/L H H H H	H H H H H H	H/L H/L L L L L	L L L L L L	H - high L - low
Reportting	Y Y Y Y Y Y	N N N N N N	N N N N N N	N N N N N N	Y - yes N - no

Easy Reference Culture Table

PHALAENOPSIS

	Spring		Summer		Autumn		Winter		Degree C	Degree C
Season										
Ideal Day Temp.	22-24		26-28		22-24		22-24			
Ideal Night Temp.	16-18		18-20		16-18		16-18			
Watering	L/F	L/F	F	F	L/F	L/F	L	L	L	F - frequently L - less frequently
Feeding	N	N	N	N	K	N	G	G	G	N - high nitrogen G - General Feed K - Potassium
Shading	L/H	L/H	H	H	H	L/H	L	N	L	N - no shading L - light shading H - heavy shading
Ventilation	L	L/M	M	M	M	L/M	L	L	L	M - more L - less
Humidity	H/L	H/L	H	H	H/L	H/L	L	L	L	H - high L - low
Reporting	Y	Y	N	N	N	N	N	N	Y	Y - yes N - no

